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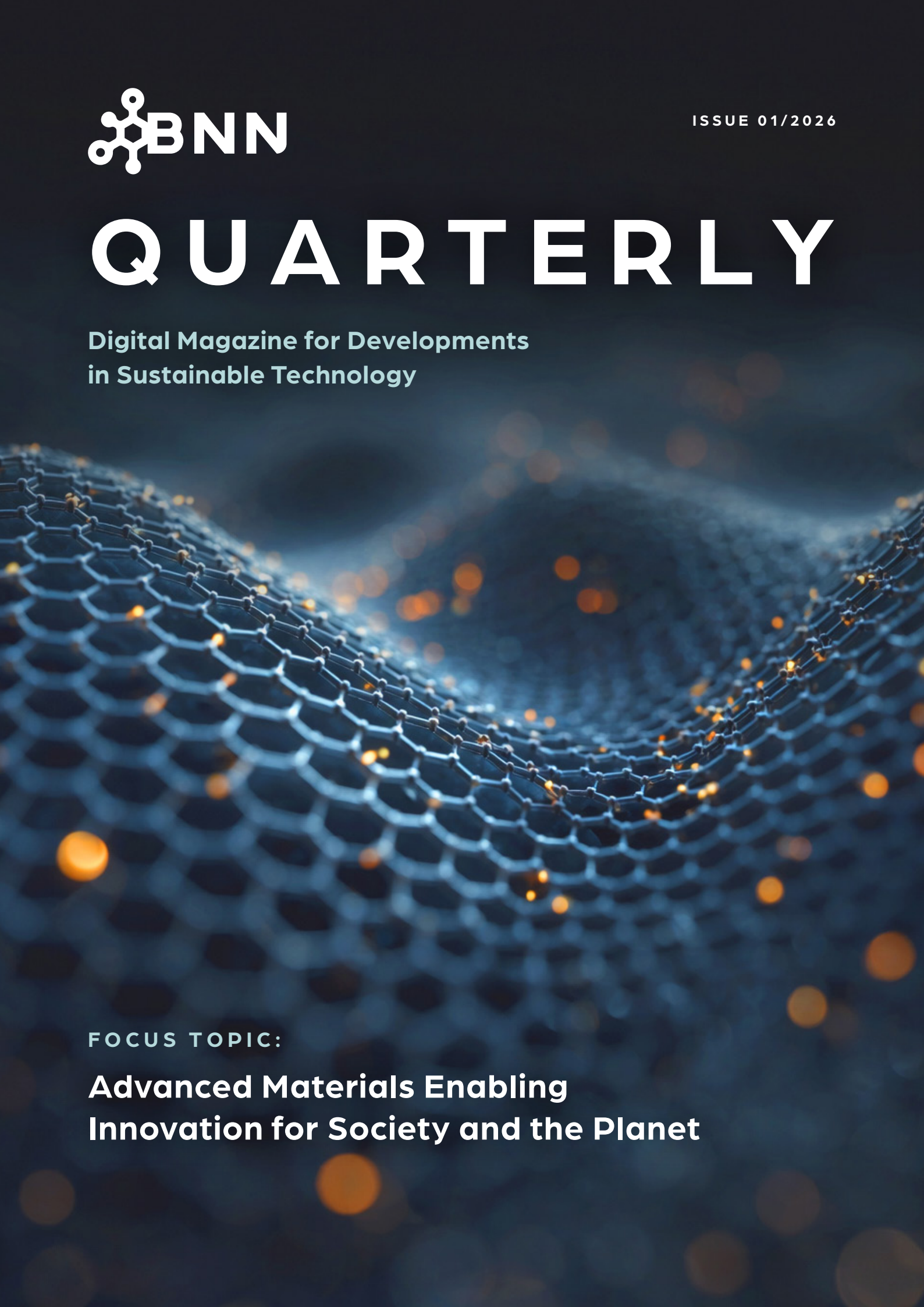
# BNN QUARTERLY

Digital Magazine for Developments in Sustainable Technology



FOCUS TOPIC:

## Advanced Materials Enabling Innovation for Society and the Planet

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**INNOVATION IS THE KEY.**

**SUSTAINABILITY LEADS THE WAY.**

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# Editorial

## "DO GOOD AND TALK ABOUT IT"

***"Do good and talk about it"*** – speaking about our achievements has been done too little in the past. This year, on 16th October 2026, we celebrate the 20th anniversary of the foundation of the BioNanoNet Forschungsgesellschaft mbH, well known now as **BNN**. This is a good moment and reason for searching archives and presenting our success story ***"From a small regional project towards a relevant non-profit RTO in Europe"***.

We are gratefully celebrating our achievements, almost impossible to count all the benefits we brought over the years to our members and the community. We have **initiated, developed, implemented, and are coordinating strategic assets** (e.g., technology platforms, communities, roadmaps, contributions to consultations, etc.), thus bringing prosperity to our partners and to the entire community. BNN goes all the way of **bringing real content forward**, we put immense efforts into "community-work" (e.g., NSC Community, SCC, INISS-nano, NanoInformationCommission, ISO/CEN-working groups, etc.). Our ANTHOS'26 conference is so far the biggest success stories of BNN in the AdMa-ecosystem.

We are **proud of the value we are bringing already for 20 years** to a large community by building up and leading several initiatives, creating content for **strategic directions to enable sustainable development**. Our visionary strategies have positively impacted the European ecosystem in the fields of safety and sustainability (e.g., creating the SSbD framework) as well as in the sphere of nano- and advanced materials.

**We collaborate globally** gaining benefits for the entire society. **Scientific collaboration** is a valuable tool for **making this world a better place**.

Let's go!

Sincerely,

Andreas & the BNN Team

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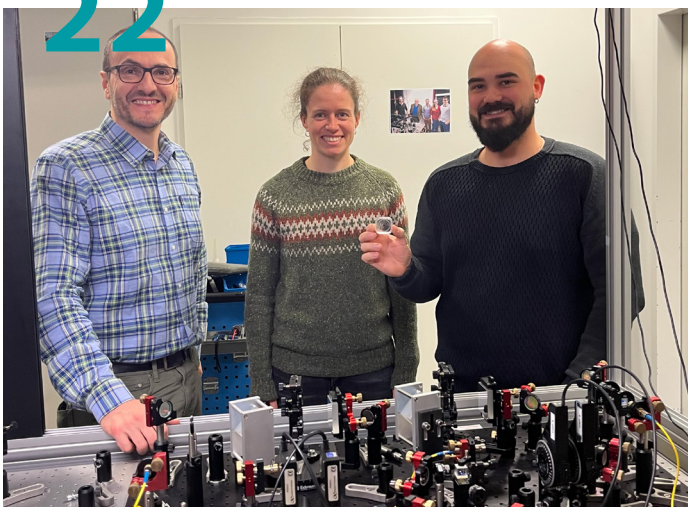

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# SustainableNano Seminar #11: SSbD in Pharma – Safe and Sustainable Nanomedicines

On 5th of February 2026, **BioNanoNet Forschungsgesellschaft mbH (BNN)**, in collaboration with the **SustainableNano – Spanish Network on Safe and Sustainable Nanotechnologies (SNSSN)**, successfully delivered **SustainableNano Seminar #11**, dedicated to "SSbD in Pharma – Safe and Sustainable Nanomedicines." The webinar, presented by **Johanna K. Scheper** and **Daniel García (BNN)**, focused on how the **Safe and Sustainable by Design (SSbD)** framework can be effectively implemented in pharmaceutical innovation.

The seminar began with a brief introduction to **Advanced Materials (AdMa)** and their increasing importance in nanomedicine: nanotechnology-based drug delivery systems like lipid nanoparticles and polymer-based carriers are reshaping therapeutic strategies. However, they also pose significant regulatory and environmental challenges. European regulatory pathways require compliance with pharmaceutical legislation, including safety assessments for benefit-risk evaluation prior to marketing authorization. Also, environmental risk assessment of the active substance is needed, a process that has recently become more stringent.

A central theme of the session was the **updated SSbD Framework**, developed by the **Joint Research Centre of the European Commission**. The framework promotes the early integration of safety, environmental sustainability, and socio-economic considerations throughout the life cycle of materials and products. In the pharmaceutical sector, this involves voluntarily embedding safety and sustainability criteria from the earliest research stages through manufacturing, use, and end-of-life management, a challenge that requires careful planning and innovation.

The collaboration between **BNN** and the Spanish network **SNSSN** reflects a shared commitment to advancing safe and sustainable nanotechnologies across Europe. SNSSN brings together leading Spanish research centres dedicated to nanoscale research and development, with the goal of generating nanosciences and nanotechnologies that are safe, sustainable, and societally beneficial. The network emphasizes integrating sustainability criteria across the entire value chain, from production and consumption to waste management and recycling.

By aligning expertise across Austria and Spain, the seminar demonstrated how transnational cooperation can accelerate the practical implementation of SSbD principles. An industrial pharmaceutical case study developed within the EC funding project Nabiheal illustrated how early hazard screening, greener design strategies, and life-cycle thinking can be systematically incorporated into R&D processes. The example showed that SSbD really is not only a regulatory response but can be used also as a strategic innovation tool.


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# Sweden Excellence Cluster Workshop on Bridging Advanced Materials

**At a workshop on 3rd of March in Gothenburg, stakeholders in advanced materials from Sweden and the EU gathered to discuss further initiatives in the field. The road ahead looks exciting, to say the least.**

The Swedish BAM-project ("Bridging Advanced Materials") held a workshop in Gothenburg in early March. Thirty people from industry, academia, innovation arenas and research institutes worked together to shape ideas for a future Swedish cluster of excellence in advanced materials. "It was a great day! We brought together the right people and had interesting discussions to continue the work on the direction forward for advanced materials", says project leader Johan Ek Weis.

The BAM-project is planning a project for a Swedish Cluster of Excellence in Advanced Materials, funded by the Swedish innovation agency Vinnova. The project partners are Chalmers Industriteknik, RISE Research Institutes of Sweden, KTH Ventures and THINGS, together with a large stakeholder group from industry and academia. Here, the goal is to create an AdMa-cluster that will build on research excellence, facilitate growth for small and medium-sized enterprises and scale-up companies, increase the uptake in larger companies, reduce the time frame for innovation and development cycles, and work with policies and regulations – plus increase the teamwork among Swedish and other European AdMa-initiatives. *"Advanced materials are building our future on so many levels. We believe in intensified collaboration going forward, where we build bridges between financiers, academia and industry"*, says Johan Ek Weis.

The workshop was attended by Eva Schillinger, who heads the European partnership IAM-I, Andreas Falk (ATIMA) from BNN leading the EU project InnoMatSyn, companies like Saab and Oxeon, universities (Chalmers University of Technology and Linköping University), and representatives from IVL Swedish Environmental Research Institute, Business Sweden and Sahlgrenska University Hospital, among others.

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# ANTHOS'26 Recap

**The second Summit on Advanced (Nano)Materials and Technologies: From Needs to Solutions.**

From the 9th to the 11th of March 2026 the ANTHOS'26 Summit took place at the TWELVE Conference Center in Vienna (Austria). The Summit was organized all around sessions and round tables with experts focusing on the goal of the conference - Understanding the needs of the SSbD stakeholders i.e., the initiators, the legislators, regulators and implementors, and the solutions SSbD provides. The summit counted with more than 120 participants from research organizations and academia (61%), SMEs and large industry (22%), national authorities (5%) and EU and policy institutions (3%), as well as other organizations (4%) active and interested in safety and sustainability and the Advanced Materials (AdMa) field, related processes and products.

ANTHOS'26 has been organized by BNN, supported by the NSC Community (The Network for Safety and Sustainability of Chemicals and Materials), and 12 EU and national-funded projects (AI-TranspWood, AIChemiSSts, ATIMA, BIOSAFIRE, CheMatSustain, InnoMatSyn, INTEGRANO, PINK, PLANETS, SSbD4CheM, SUNRISE, TOXBOX) – all of them part of the NSC community. Furthermore, the Austrian ministry of Agriculture and Forestry, Climate and Environmental Protection, Regions and Water Management (BMLUK) as well as the ministry of Innovation, Mobility and Infrastructure (BMIMI) supported the conference. The event brought together leading Safe and Sustainable by Design (SSbD) experts, including partners of EU-funded projects as well as other representatives of key organizations and international stakeholder groups, such as the European Commission (EC), the OECD, ECHA, and Austrian governmental representatives. All of them actively provided the ideal stage to disseminate results obtained in the different projects and exchanging state-of-the-art knowledge within the SSbD and AdMa communities.

The three days of the summit included activities such as a co-creation workshop organized by some of the EU-funded participating projects, the BNN Networking Event, a NSC Steering Group Meeting including an interactive workshop, and a number of sessions and round tables, tackling the needs that the different AdMa community stakeholders have and how EU-funded projects are actively contributing to providing specific solutions. In the next pages we provide you with a brief summary about the key goals of the different sessions and some of the highlights and outcomes.

# Day 1 – Monday, 9th March 2026

The first day of ANTHOS'26 started with a **Co-creation Workshop** organized by **the NSC-sister projects' collaboration "RESILIENCE-01-22" EU-funded projects SUNRISE, INTEGRANO and INSIGHT**, as well as the RESILIENCE-01-24 project **AIChemiSSts**. The projects presented different methodologies for assessing the safety and sustainability impact of products during early stages of development. More specifically SUNRISE and AIChemiSSts introduced a tiered-based approach tool featuring qualitative questionnaires to identify the risks when data is scarce, while INSIGHT project presented integrated models for the development and assessment of high impact chemicals and materials. The INTEGRANO project presented a quantitative approach, using key performance indicators and experimental data to support industrial decision-making.


The workshop concluded with a joint dialogue that highlighted the next challenges that still remain to be addressed in the field such as:

- **Lack of guidance and awareness**: specially SMEs sometimes do not know where to start with the SSbD implementation. There is a noted disconnection between the tools developed by the scientific community and the industry.
- **Limited resources and expertise to permit the SSbD implementation**: SMEs often lack the internal experts needed to perform complex assessments, making it difficult to decide and divide into go/no-go scenarios.
- **Data scarcity and uncertainty for AdMa**: these materials are often multicomponent and complex forcing companies to move to expensive experimental testing.
- **Methodological complexity and trade-offs**: SMEs struggle with trade-offs, such as balancing safety and sustainability against the material's functionality and cost.
- **Questionable commercial value of the SSbD approach for the SMEs**: Without strong regulatory incentives or a clear market pull, adoption of SSbD by SMEs or industry will remain low.
- **Inadequacy of digital tools alone**: the tools alone are not enough to solve the problem. Each material case is unique, thus human-centric support, guidance and expert knowledge is still required and in the center of the process.

The summit continued with the **BNN Networking Event** that included brief presentations of all the co-organizing projects and closed with the **NSC Steering Group meeting** and a networking slot for all the attendees in a nice and relaxed atmosphere.


# Day 2 – Tuesday, 10th March 2026

The second day of ANTHOS'26 included five different sessions, all providing insights about what are the needs of the different stakeholder groups (i.e., the initiators, the legislators, the regulators, and the implementors) of the AdMa field, and how the projects enable and provide (part of) the solutions.

The first slot – **The Needs session** – included presentations from i) the initiators side, represented by Hubert Rauscher from the EC-JRC, ii) the legislators, represented by Mar González from the OECD, and (iii) the regulators, represented by Virginia Rodriguez Unamuno from ECHA.


The presentations were followed by a round table focused on **"Needs of the implementors"**. The panel counted five industry-related experts, namely Gunther Van Kerckhove from OCSiAI, Pierre-Emmanuel Dufils from SYENSQO, Carlos Fito from ITENE, and Massimo Perucca from Project HUB-360. Irantzu Garmendia, from the EC-JRC, moderated the discussion by guiding and engaging the experts to share their experiences in the implementation of the SSbD concept in their innovative activities.

The interventions of the different speakers and the experts of the round table emphasized the following:

- Addressing the needs of the different stakeholder groups requires ***a fundamental shift in the innovator's mindset and the creation of harmonized testing guidelines.***
- From the initiators side, the implementation of the ***SSbD framework is and will remain to be a voluntary approach*** and guide for ***balancing safety and sustainability*** throughout a product/chemical/material life cycle, whereas ***regulators stressed the necessity for standardized data and legal clarity*** to make the concepts functional.
- ***Essential drivers*** for moving research knowledge and results into regulatory acceptance and industrial scale-up were identified, i.e., ***networking and data sharing***. However, while the AdMa community is notably more open than others, companies in this sector still face challenges regarding confidentiality and competitiveness when asked to share the required data for transparent SSbD assessments.
- The successful implementation of SSbD depends on the capacity, the community will have, to develop ***robust and transparent tools whilst remaining pragmatic*** for both industry and policy makers. Companies prize pragmatism vs. complexity: they will not use tools that are too expensive, or too time-consuming regardless of how scientifically excellent they are. They need pragmatic tools that help them to take decisions even when information is incomplete.
- Companies will realize the ***economic benefit of SSbD***, if this improves their ***innovation efficiency and capacity*** by e.g., using early-stage screening tools that prevent failure in late stages. Innovators are looking for clearer ways to see and realize the ***tangible advantages*** of adopting SSbD in their development processes.
- Companies explicitly asked for ***solutions, tools, or guidance that support economic sustainability*** within the SSbD approach.
- Innovators and companies require ***legal clarity*** and explicit ***links to existing regulations*** to ensure their assessments lead to consistent compliant decisions.
- The utilization of the ***Mutual Acceptance of Data (MAD) System from the OECD*** can help companies to use and generate data in one member country that is then accepted by all 38 OECD member countries and some others. This, ***allows companies to "test once" and submit results globally***, which saves a significant amount of money, it avoids redundant testing and reduces the use of animal testing.
- By ***adopting an iterative and tiered SSbD approach***, starting already at early stages of the innovation life cycle, companies will be able to screen and sort out hazardous or non-sustainable options before making heavy capital investments, helping to ***ensure*** they ***meet function, sustainability and safety criteria more efficiently***.

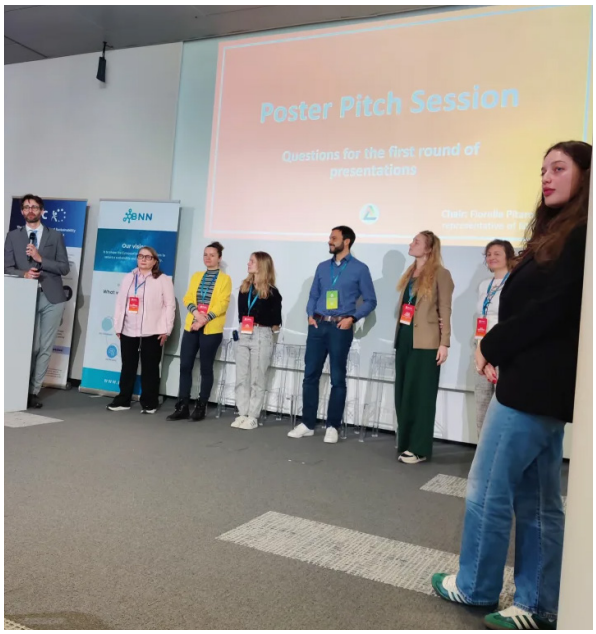
To provide answers to these and other needs, the summit gathered five Solutions Sessions, two of them held during the second day of the conference, focusing on how EU-funded projects contribute to provide solutions for the needs of the initiators and the legislators, and three dedicated sessions held during the third day of the conference focusing on the solutions provided by EU-funded projects to the needs of regulators, scientific and corporate implementors.

**The Solutions Session 1 - Project solutions to the needs of Initiators** was chaired by Hubert Rauscher (EC-JRC) and included six talks and panelists (Blanca Suárez Merino from TEMAS Solutions, Lya G. Soeteman-Hernández from RIVM, Stefania Truffa from Project Hub-360, Sébastien Artous from CEA, Mónica Martinez Junquera from AVANZARE and Katharina Lang-Hogrefe from BNN) presenting and discussing about practical solutions for implementing SSbD, emphasizing a critical shift in mindset, moving from late-stage regulatory compliance towards early-stage, purpose-driven innovation integrating safety and environmental as well as socio-economic impact.

Some of the take home messages of this session were:

- Companies can ***transform SSbD*** from a ***perceived regulatory burden into*** a ***strategic market advantage*** by shifting their mindset from late-stage compliance to early-stage innovation.
- Risk reduction and cost efficiency, as one of the most significant advantages is the ***"fail early, fail cheap"*** principle. By identifying safety or sustainability "bugs" early in the research and development phase, companies can ***prevent costly late-stage redesigns, regulatory delays***, or total ***market rejection***.
- ***Market differentiation and value creation*** by reframing their narrative towards ***purpose-driven innovations as unique selling point*** (e.g., increasing customer demand for environmental transparency, view SSbD as a “badge of honor”, or adding value since SSbD can improve durability, recyclability and supply chain resilience).
- ***Proactive regulatory readiness:*** Instead of reacting to new restrictions, companies can use SSbD to ***stay ahead of future regulations***.
- There is a necessity of ***transdisciplinary teams*** and ***digitalization*** to balance technical functionality with sustainability goals.
- ***Communicate success stories*** and educate early-stage researchers to ensure these practices become standard at all industrial levels. For SSbD to be a true strategic advantage, it must be integrated into the ***company governance*** and shall follow a ***top-down commitment*** because when sustainability and safety become part of the core corporate strategy—rather than just an accounting task—it coordinates all departments (R&D, regulatory, and finance) to ward a single goal.
- ***Reputation Management:*** In a market where a brand's reputation can be easily destroyed by safety failures, a commitment to SSbD builds a ***strong, resilient brand*** that consumers might trust easier.
- The ***SSbD ambassador role*** was introduced and defined as a dedicated contact point, that ensures that the complex, multi-layered SSbD framework is applied pragmatically within a company, helping to align sustainability goals with industrial realities by (i) connecting SSbD experts with the industrial partners, (ii) managing the data needs, (iii) facilitating transdisciplinary coordination, (iv) leading the innovation process, and (v) helping companies move from a reactive compliance mindset to a proactive, purpose-driven design approach.

The session ended **with all experts stating to remain optimistic about the rapid adoption of the SSbD framework and its ability to support a drive towards a greener and more resilient European economy.**



Day 2 of ANTHOS'26 ended with the **Solutions session 2 - Project solutions to the needs of Legislators**, chaired by Mar González from the OECD. The session included as speakers and panelists Lya G. Soeteman-Hernández from RIVM, Blanca Suárez Merino from TEMAS Solutions, Monique Groenewold from RIVM, Andreas Falk from BNN, Virginia Rodriguez Unamuno from ECHA, and Martin Himly from PLUS. The invited experts presented specific approaches such as ecosystem thinking, tools and frameworks developed in international initiatives and their relevance for policy makers, and discussed moving beyond voluntary industry adoption toward a Safe and Sustainable Innovation Approach (SSIA) that includes regulatory preparedness.

The speakers emphasized the necessity of "trusted environments" to facilitate early dialogue between innovators and regulators, ensuring that e.g. safety data aligns with policy needs. Key activities such as the development of digital tools, inventory platforms, and standardized data formats to harmonize international standards were highlighted. ***The session advocated for a collaborative ecosystem to bridge the gap between scientific research, industrial competitiveness, and global governance.***

Key take home messages of this session were:

- ***Research and innovation projects can function as regulatory intelligence providers***, not only technology developers.
- ***SSIA supports regulation indirectly*** by identifying regulatory gaps, gaps in test methods, and flagging emerging risks—***without replacing regulatory decision-making.***
- ***Early assessment initiatives,*** such as Early4AdMa, ***improve regulatory readiness*** by delivering actionable evidence before innovation reaches the market.
- ***Regulatory sandboxes and trusted environments are key enablers*** of preparedness but require clear governance, trust mechanisms, and mandates to succeed.
- ***Regulatory preparedness and trusted environments are essential*** for SSIA.
- Efficient legislation will be facilitated by improved cross-border collaborations amongst European countries (and beyond), based on ***ecosystem thinking.***
- ***Coordinated collaboration*** (e.g., NSC Community) ***maximizes the use of research outputs*** for legislative purpose.

A separate session on this day was dedicated especially to young researchers, as well as some experienced implementors. 20 highly motivated speakers gave a snapshot into their scientific work in the **Poster Pitch Session**. The session was organised and moderated by the representative of NSC's Early Career Researchers (ECR) Fiorella Pitaro from Empa, and gave some fascinating insights into different concepts of SSbD implementation and related methods. A detailed recap of the Poster Pitch Session can be found on the NSC webpage.


# Day 3 – Wednesday, 11th March 2026

The third day of ANTHOS'26 started with the **Solutions session 3 – Project solutions to the needs of Regulators**, chaired by Virginia Rodriguez Unamuno from ECHA, centered around practical solutions such as tools, methodologies and collaborative strategies that aim to transform regulatory challenges into enablers of safer and more sustainable innovation. By turning regulatory frameworks into catalysts for progress, SSbD approaches can reduce risks, accelerate market adoption, and **position Europe as a global leader in sustainable materials design**.

The session hosted inspirational talks from Barry Hardy from Edelweiss Connect, Massimo Perucca from Project Hub-360, and Peter Wick from Empa. The speakers evaluated how artificial intelligence (AI), machine learning, and New Approach Methodologies (NAMs) can generate the necessary evidence for safety assessments, while reducing reliance on animal testing. They highlighted in the talks the challenges of data quality, reproducibility, and the technical gaps in Life Cycle Assessment (LCA) for AdMas. They put **strong emphasis on the necessity of creating traceable evidence packages to bridge the gap between innovative scientific research and stringent regulatory requirements**. The talks were followed by a panel discussion about the need for European investments in transparent digital tools and the importance of collaborative science to ensure global competitiveness.

Some of the key takeaways from the session were:

- ***AI serves as a critical innovation motor for SSbD product development*** by ***accelerating the discovery of safer alternatives, managing complex data***, and ***providing robust evidence*** for regulatory compliance. Related to accelerating discovery and idea exploration, AI is particularly effective in the early phase of innovation (Tier 1 SSbD), where it can be used for massive screening and data science supporting substitution of hazardous substances while maintaining functionality. When referring to knowledge discovery, AI can help to identify innovative solutions that might not be obvious through traditional research and it also helps and guides experimental design and research.
- ***AI's most clear value proposition today is assisting with data curation and background rsearch***, which are essential to build a reliable knowledge base. It has the potential to orchestrate complex risk assessment workflows, document tasks, data and results to ensure that processes are structured and traceable.
- ***Europe should invest in a transparent, open European AI ecosystem to remain globally competitive*** while ensuring that the AI used for product innovation is trustworthy and aligned with societal sustainability goals.
- **Regulators** face a multifaceted set of ***challenges*** when dealing with SSbD approaches, ranging from technical data issues to deep-sea ted organizational and cultural hurdles such as,data integrity and technical reproducibility, ***transparency vs. intellectual property, lack-of agreed metrics*** (i.e., "when is good, good enough") to accept an *in vitro* or *in silico* model over a traditional animal testing, and finally ***regulators must find ways to test and include the new digital tools without losing their regulatory independence*** in the assessment process.
- A major hurdle is that ***many regulators and scientists simply do not trust black-boxes***, because they cannot see "how AI got the results at the end". For a regulator to feel confident that they have protected human health and the environment, they require a mechanistic understanding of the results, which black-box models often cannot provide. Therefore, the experts highlighted a strong preference for ***"white-box" approaches and explainable AI***, where algorithms and training sets are transparent, allowing for replicable and controllable results.

The summit continued with the **Solutions session 4 - Projects solutions to the needs of (scientific)** Implementors chaired by Martin Himly (PLUS, NSC WG ETC). The session included talks of Haralambos Sarimveis from NTUA, Nikolaj Zangenberg from DTI, Pamina Weber from LIST, Vincenç Pomar-Portillo from Empa, and, Neeraj Shandilya from TNO.

The session addressed means and current developments for SSbD workflows:

(i) FAIR *in silico* assessment tools and interoperable pipelines provided by the PINK project.

(ii) SSbD4CheM emphasized to bridge *in silico* with *in chemico* and *in vitro* assessments, aiming to replace animal testing with standardized NAMs.

(iii) Integration of real-time sensors and computer vision to monitor organ models and automation of data collection by the TOXBOX project.

(iv) The decision support system developed in PLANETS that uses multi-objective optimization to help industry stakeholders navigate complex trade-offs between functionality, safety, and environmental impact.

Overall, the **experts emphasized the necessity of data harmonization, regulatory readiness, and long-term infrastructure to ensure these innovative tools remain accessible to the scientific community**.

Some key messages from the sessions were:

- ***AI models allow for a tiered assessment strategy*** and approach where researchers apply quick methodologies that allows the ***"Fail fast, fail cheap" approach***.
- ***AI models can act as a bridge between different types of scientific data***, integrating results from *in silico*, *in vitro*, and *in vivo* assessments. This ***allows for "emergent messages"*** to be extracted from diverse data sources, ***providing a more holistic view*** of a chemical's safety than any single test could offer.
- ***AI agents improve model accessibility for industrial users by shifting the interface*** from technical programming to natural language interaction. Instead of requiring specialized coding knowledge, it allows users to interact with complex scientific tools through common language prompts. For industrial partners, this approach addresses a critical barrier: the need for tools to be "easy" and "directly usable" without programming experience typically required for APIs or standalone applications. Thus, ***AI makes advanced safety and sustainability assessments more reachable for non-expert industrial users***.

**Solutions session 5 - Projects solutions to the needs of (corporate) Implementors**, chaired by Danail Hristozov from GreenDecision, included eight presentations about state-of-the-art solutions for SSbD assessment and decision making for both, chemicals and AdMas, in line with the revised SSbD framework recently published by the EC. Industrial implementations showcased success stories involving real use cases of plasticizers, lubricants, flame retardants, paint surfactants, plant protection products, and polymers representing activities by the EU funded projects AIChemiSSts, CROPSAFE, PLANETS, SUNRISE, and SURPASS.

Industrial leaders and researchers presented success stories to demonstrate that investing safety and sustainability provides a clear return on investment (RoI), especially for SMEs. The discussions detailed specific technical methodologies, such as scoping analysis, life cycle assessments, and social sustainability evaluations, to help innovators navigate regulatory hurdles. **The session underscored the importance of collaborative innovation and early-stage assessment to ensure that new materials are functional, non-toxic, and environmentally friendly.**

Key messages provided were:

- The ***SSbD*** approach ***drives innovation by shifting the focus from reactive regulatory compliance to proactive design-led solutions***. Innovations occur at distinct levels such as molecular (re)design, process (re)design and/or product (re)design.
- Innovation must be functionally equivalent or superior to existing benchmarks, thus ***balancing functionality and safety is a must.*** If a given AdMa is safe but lacks functionality it can not successfully reach the market.
- ***SSbD encourages life cycle thinking,*** requiring innovators to collaborate with different actors along the value chain—from chemical manufacturers to formulators and end-users—to create a "trusted environment" for innovation, and ensure that safety and sustainability are addressed at every stage.
- ***Modern SSbD also prioritizes social sustainability,*** driving innovation that addresses stakeholder concerns such as product responsibility, transparency, and worker health and safety.
- ***LCA enables a shift from "gate-to-gate" thinking*** (focusing only on an internal company process) ***to "cradle-to-grave" thinking***. It provides a broader view of safety and sustainability by ***considering upstream impacts*** (e.g., raw material extraction and feedstock treatment), ***manufacturing*** (e.g., energy and water consumpti on during production), ***use phase and End-of-Life*** predicting the impacts of recycling and disposal.


This completed the different solution sessions and a short **recap session** was conducted where the **conclusions** were shortly presented by the Chairs of the different sessions under the moderation of Andreas Falk (BNN).

The closing session of ANTHOS'26 was a round table focusing on the **"Future Outlook"**. The panel gathered seven experts with different perspectives on the future of AdMa and SSbD: Danail Hristozov (GreenDecision, NSC WG SSbD), Emma Stromberg (IVL, IRISS), Virginia Rodriguez Unamuno (ECHA), Alexander Pogany (BMIMI), Eva Valsami-Jones (University of Birmingham, NSC Coord. Team), Hubert Rauscher (EC-JRC), and Thomas Jakl (BMLUK) were engaged and challenged to provide their thoughts and views under the excellent moderation of Sean Kelly from NIA and also part of the AdMa Technology Council.

The panel discussed the implementation of SSbD and the necessity of real co-creation between policy makers, industry leaders, and the academic community to ensure research remains impactful. It was emphasized that for industry to adopt SSbD, there must be a clear return on investment or a strong regulatory driver. The dialogue also explored the topic of regulatory sandboxes and the challenges of involving small businesses that lack the resources for extensive testing. **Panelists advocated for standardized terminology and data sharing to unify different stakeholders under a common understanding as one of the biggest challenges and current needs**.

Some key messages from the experts looking forward to the future ahead were:

- ***Policy makers can incentivize the adoption of SSbD*** through a combination of ***financial rewards, regulatory streamlining, and strategic support*** (e.g., reduced fees/taxes and quicker procedures, public procurement, subsidies, etc.).
- To better quantify the return of investment of SSbD the experts suggested shifting from academic indicators to practical industry metrics ***focusing on profitability, risk prevention, and reduced uncertainty***.
- The upcoming ***Advanced Materials Act is expected to provide strategic guidance for research***, to ***improve the impact of research*** by combining national and EU funding, incentivize sustainability, to ***help on establishing SSbD knowledge*** within higher education curricula to ***ensure the next generation*** of scientists and innovators is ***trained and aligned with SSbD principles and thinking***.
- Regulatory sandboxes are envisioned as collaborative spaces where various stakeholders can work together to navigate the complexities of SSbD. While the concept is still under definition several key practical characteristics werehighlighted: (i) the ***sandbox shall serve as an environment for mutual support and open communication*** allowing industry and regulators to support each other along discussions on challenges and understanding on how to apply SSbD, (ii) ***a sand box should not be limited to large corporations***, but ensuring a place for SMEs in order to learn about the added value and the benefits of SSbD, (iii) ***a sandbox shall act as a mechanism to help industry move from early-stage innovation to regulatory preparedness***, and (iv) in these spaces, ***national and European authorities shall be able to work together to align their strategic developments***. Thus, the sandbox is a practical tool to establish dialogue, exchange experience and co-create a common understanding.

We are confident that ANTHOS'26 successfully presented cutting-edge research and advances in the field of Safe-and-Sustainable-by-Design (SSbD) and AdMa and also brought together a lively crowd of highly motivated experts, who are already eagerly planning their next steps, potentially with some newly found collaboration partners! If you are interested in attending the next edition of ANTHOS, just follow BNN's LinkedIn channel, and consider joining the BioNanoNet Association.

We are currently working on publishing the conference outcomes, as well as event materials upon

their approval by the contributing partners. Stay tuned for more information coming soon.

Some insight into the 3 days - Have a look at the pictures!

Stay tuned for more information coming soon.

Led by BNN Supported by NSC

Federal Ministry Innovation, Mobility and Infrastructure Republic of Austria

Federal Ministry Agriculture and Forestry, Climate and Environmental Protection, Regions and Water Management Republic of Austria

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#ANTHOS'26
Vienna - Austria
#AdMa
#SSbD
Where Innovation Thrives!
9th–11th March 2026
BNN
Our vision


Austrian interface of the European AdMa ecosystem
ATIMA
InnoMatSyn
Strong multiplier function through established platforms in strategically relevant sectors and promising technology areas.
Creation of a joint roadmap for Austria's future with innovative AdMa aligned with the EU priorities.
Addresses cross-sectoral needs, challenges and solutions.
It acts as an incubator for industrial transformation.
Improves European Materials Sovereignty
Enhances Austrias Visibility in European and Global AdMa Leadership

FOCUS TOPIC
OF THIS ISSUE:

# Advanced Materials Enabling Innovation for Society and the Planet

JOHANNES KEPLER UNIVERSITÄT LINZ

JOHANNES KEPLER UNIVERSITY LINZ

# Emergent Phenomena in Quantum Materials

Over the last decades, condensed matter physics has been the playground for the realization of physical systems, in which quantum effects persist over a wide range of energy and length scales. The resulting quantum materials include topological insulators, topological crystalline insulators, magnetically doped topological quantum materials, 2-dimensional van der Waals (2D vdW) materials, Kitaev materials, and spin-orbit-materials, and many more.

The Quantum Materials Group at Johannes Kepler University Linz has developed a comprehensive protocol of crystal growth and characterization methods, overarching conventional techniques and advanced synchrotron-based methods. These methods have allowed to establish the correlation between fabrication parameters and physical properties in a variety of relevant materials systems and heterostructures. Moreover, the researchers routinely contribute to test theoretical predictions on the behavior of quantum materials and structures, through the close collaboration with internationally recognized theoretical groups.

The current research focuses on emergent phenomena in quantum materials, with particular attention to topology, symmetry, and spin-orbit coupling. Among the most relevant recent achievements, three highlights are: the demonstration of Rashba spin-orbit coupling in wurtzite n-GaN:Si, the discovery of infra-red optically active centres in (Ga,Mn)N:Mg, the electronic characteristics that emerge in the Mn doped topological crystalline insulator SnTe and in the intrinsic ferromagnetic topological insulator $Mn(Sb,Bi)_2Te_4$. Moreover, the study of 2D topological semimetals has revealed both quantum chiral anomaly in flakes of the Weyl semimetal Td-$WTe_2$ up to a record temperature of 100 K, and Pt vacancy-induced Kondo effect in non-magnetic $PtSe_2$. The mentioned results have significantly contributed to the fundamental understanding of quantum systems and to their control in the perspective of applications in advanced information technology, quantum sensorics and related fields.

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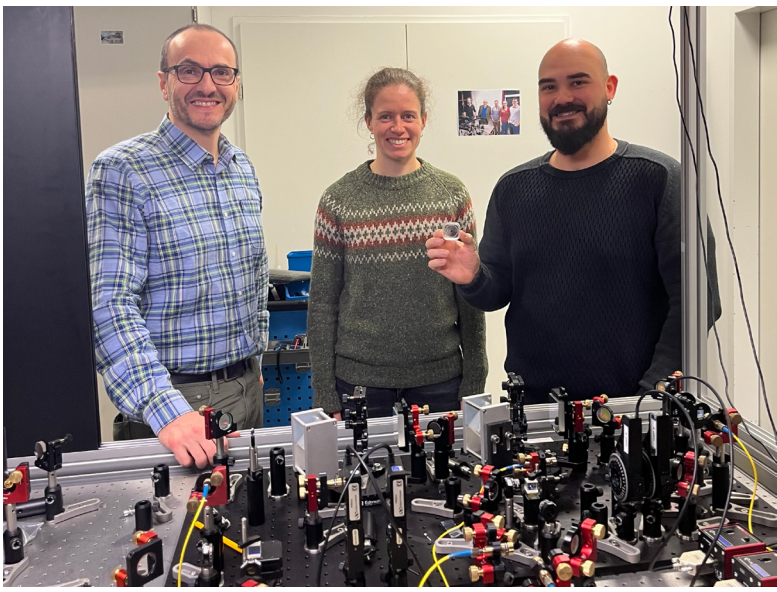
# Quantum Teleportation: A Major Step Toward the Quantum Internet

To build a future quantum internet, scientists must learn how to reliably use quantum effects in real networks. One of the most fascinating of these effects is quantum teleportation. During UNESCO's International Year of Quantum Science and Technology 2025, an international team with researchers from Johannes Kepler University (JKU) Linz has achieved a major breakthrough in this field.

Information travels fastest at the speed of light, so light particles—photons—are the natural carriers of data in a quantum internet. Such a network could link quantum computers, making them far more powerful, and enable communication that is fundamentally secure, protected by the laws of physics. The challenge is that single photons cannot be sent reliably over long distances: they are lost in optical fibers and, unlike classical signals, they cannot be amplified. Quantum teleportation offers an elegant solution. Instead of sending the photon itself, only its quantum state is transferred.

Although quantum teleportation was first demonstrated in 1997 by Nobel laureate Anton Zeilinger, it has so far been impractical. Previous methods were slow and required nearly identical photons from the same source. For real-world networks, however, photons must come from many different sources spread across large distances. This is where JKU researchers come into play. An international collaboration with scientists from Austria, Italy, Germany, the Netherlands, and Brazil developed techniques to generate photons on different semiconductor chips and precisely tune them so they become indistinguishable. Using highly efficient ring-shaped light extractors and external magnetic fields, the team ensured that photons from separate sources could interact and interfere—an essential requirement for teleportation.

In the experiment, the quantum state of one photon was successfully teleported to another photon from a different chip with a success rate of 82%.



From left to right: Professor Dr. Armando Rastelli, Dr. Eva Schöll, Dr. Tobias Maria Krieger.

In simple terms, the quantum information arrived almost perfectly in more than four out of five attempts—an exceptionally high value for such experiments.

"This result opens entirely new possibilities for scalable quantum networks," the researchers conclude. For the first time, quantum teleportation has been demonstrated using photons from different semiconductor quantum dots, marking an important step toward practical quantum technologies.

The full research article can be found online.

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JOHANNES KEPLER UNIVERSITY LINZ

# Polymers with Tailored Degradabilities

One of the most pressing issues worldwide is the growing global plastic waste crisis. The steadily increasing production of plastics reached 430 million tons in 2024 alone, with additional 36 million tons of polymers in liquid formulations. However, the fate of these materials is not clear. Some of the polymers are actually recycled, but the recycling rates of plastic materials are far too low. Europe-wide the plastics recycling rate reached only 26.9%, with 25% of the plastic waste ending up in landfills. But these are only the figures covering the collected waste.

What about the unaccounted plastic waste ending up in the environment? The indiscriminate use of synthetic polymers and their inertness in decomposition are leading to an alarming increase in soil and water pollution. It is expected that without drastic action the annual amount of plastic trash washed into the oceans will increase to 29 million metric tons per year in 2040, adding up to an estimated total amount of 600 million tons in the seas by 2040. It becomes quite clear that with millions of tons of non-degradable plastic waste and millions of tons of non-degradable polymers stemming from liquid formulations accumulating in rivers and oceans, new approaches are of urgent need, in order to reduce the environmental impact of plastics and polymers and to dramatically improve their circular economy.

In recent decades, research and development has focused on improving the mechanical and chemical stability of all types of polymers typically used as main components in plastics. Thus, they degrade slowly and potentially remain in the environment for a very long time. Far too many plastics end up in the environment, often as insoluble macroscopic and microscopic fragments, and cause damage, because their end-of-life options in connection with defined decomposition have not yet been sufficiently investigated. All polymers, biological as well as synthetic, are degraded in an undefined way and/or the nature and fate of their de-


Swelling and degradation of an APtA-PU foam in a buffered solution (PBS) at pH 7. Left – dry foam; middle – foam after 7 days in the buffered solution; right: foam after 36 days (dried).

gradation products is often unclear. Here, further research and development in the direction of polymers that show tailored degradation behavior are urgently demanded.

A major objective in the research at the Institute of Polymer Chemistry at the JKU is to develop polymers with intrinsic, triggerable switches for single use, short-term and long-term applications allowing a defined decay of the polymeric chains shortly after reaching the end-of-life status. Polymers that are likely to end up in nature after a short period of use must in future be provided with biodegradability that can be triggered. And polymers intended for long-term use need to be degraded in a defined way for an optimized chemical recycling. Therefore, we are currently working on redesigning polymers so that they are equipped with chemical breakage points for customized degradation.

One focus of our projects is on polyurethanes (PU). The global PU market in 2024 reached a volume of more than 25 million tons. PU are used in numerous applications and contribute to the global plastic waste crisis. For this reason, the customized degradability of PU, which has been little addressed to date, will become increasingly important. We are introducing chemical breakage points based on amino-acid linked phosphorodiamidates (APdA) and phosphoramides (APtA) in the PUs' backbones. We show that PU degrade faster as the number of APdA or APtA units increases, already at neutral pH 7 and even more pronounced at acidic pH 3. We are currently applying this approach to PU foams used in seats and mattresses. With the help of these chemical breakage units in the polymer structure, we hope to contribute to solving the plastic waste crisis.

The full research article can be found online.

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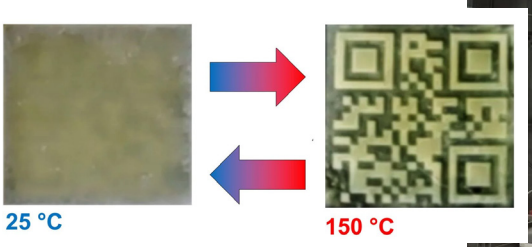


Depending on the temperature, you see either an unremarkable material—or a QR code.

From left to right: Dominik Laa, Katharina Ehrmann (PI), Michael Göschl.

TU WIEN

# Invisible Secret Codes from the 3D Printer

**A recent publication from TU Wien introduces a groundbreaking method for embedding invisible security codes into 3D printed objects, marking a major advancement in additive manufacturing. The research, published in Nature Communications, focuses on newly developed temperature responsive materials that allow printed components to display different optical properties depending on thermal conditions. At the heart of the innovation is the ability to control material characteristics at every point within a printed structure. This overcomes a long-standing limitation of traditional 3D printing, where printers typically process only a single material with uniform properties throughout the object.**

The team, led by Katharina Ehrmann at TU Wien's Institute of Applied Synthetic Chemistry, uses liquid precursors that solidify when exposed to precisely controlled light. By varying light intensity, wavelength, or temperature during fabrication, researchers can tune the degree of crystallinity within the printed material. This fine-grained control determines whether the material becomes transparent, opaque, flexible, or rigid. In practical demonstrations, the researchers created an invisible QR code embedded within a plastic object. The code remains hidden under normal conditions but becomes visible when exposed to specific temperatures, showcasing potential applications in product authentication, anti-counterfeiting measures, and secure information storage.

The work not only expands the design possibilities of 3D printing but also opens new avenues for smart materials that react dynamically to environmental stimuli. By enabling point by point customization of material properties inside a single printed object, the TU Wien team demonstrates how future manufacturing could merge form, function, and security in unprecedented ways. Invisible Codes from the 3D-printer.

The full research article can be found online.

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TECHNISCHE UNIVERSITÄT WIEN

# Member Updates

JOHANNES KEPLER UNIVERSITY LINZ

# JKU – Let's Get Connected!

**As a new member of BNN, the JKU already hosted BNN's Annual Forum in October 2025 and has thus already made contacts in the BNN network. There are numerous points of contact for cooperation in the fields of advanced materials, life sciences and sustainable chemistry, among others.**

With its four faculties, six schools, almost 150 institutes and clinical institutes, and 25 000 students, the Johannes Keppler Universität Linz is the largest educational and research institution in Upper Austria and an important partner for many regional, national and international companies.

Two university-wide research priorities – **Digital Transformation and Sustainable Development: Responsible Technologies & Management (JKU sustain)** – bundle expertise in these areas of research, as well as the emerging field of **Personalized Technical Medicine.** In all areas, there are contact points for collaborations with other partners in the BNN network, which must now be exploited.

Some examples of ongoing research projects are presented in this Quarterly edition and recent research successes by JKU researchers show the enormous potential:

A research collaboration between the University of Cambridge and semiconductor physicists at JKU has recently achieved a breakthrough in the field of quantum networks. This allows quantum information to be stored temporarily for a longer time – an essential prerequisite for the development of **quantum networks** for quantum communication and quantum computers. The result was published in Nature Physics and will be further developed with the colleagues from Cambridge. The contact person is **Univ. Prof. Dr. Armando Rastelli**, see also our feature here.

As part of the OeAW's APART-USA funding, the chemist **Dr. Bhanwar Malviya** has been recruited for the JKU. He worked at the University of Wisconsin-Madison and will soon start his research work at the Institute of Organic Chemistry at the JKU (Head of the Institute: Univ. Prof. Dr. Mario Waser). His research focuses on the development and design of **continuous electrochemical flow reactors** for scaling reactions in split cells. The research is carried out in close cooperation with leading international pharmaceutical companies.

Physicists at the JKU and researchers at Imperial College in London have disproved a long-standing biochemistry theorem that says that **photosynthesis** is only possible if the light has a wavelength of no more than 700 nanometers. With quantum physical calculations, the optical signatures of “Chlorophyll f” were analyzed and subsequently high-precision electron diffraction experiments were carried out, which showed that certain cyanobacteria are able to survive even under exclusively long-wave exposure. In the long term, this discovery could mean a **breakthrough to higher agricultural yields** if more sunlight can be used for energy conversion. The results were published in Science. The contact person is **Univ. Prof. Dr. Thomas Renger** from the Institute for Theoretical Physics.

**A TRANSFER. S2S project** funded by Christian-Doppler Gesellschaft and led by **Prof. Eleni Priglinger** from the Department of Orthopedics and Traumatology, **Prof. Ian Teasdale** (Institute of Polymer Chemistry) and **Prof. Florien Jenner** from University of Veterinary Medicine Vienna is developing novel biomimetic resins that consist of amino acids and phosphate like natural bone, which are to be used in regenerative bone medicine.

Many of the JKU's research infrastructures – as the high-performance computer MUSICA, the Core Facilities at the Center for Medical Research and the NMR spectrometer in Biochemistry – are available to external users and are listed here.

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OCSIAL

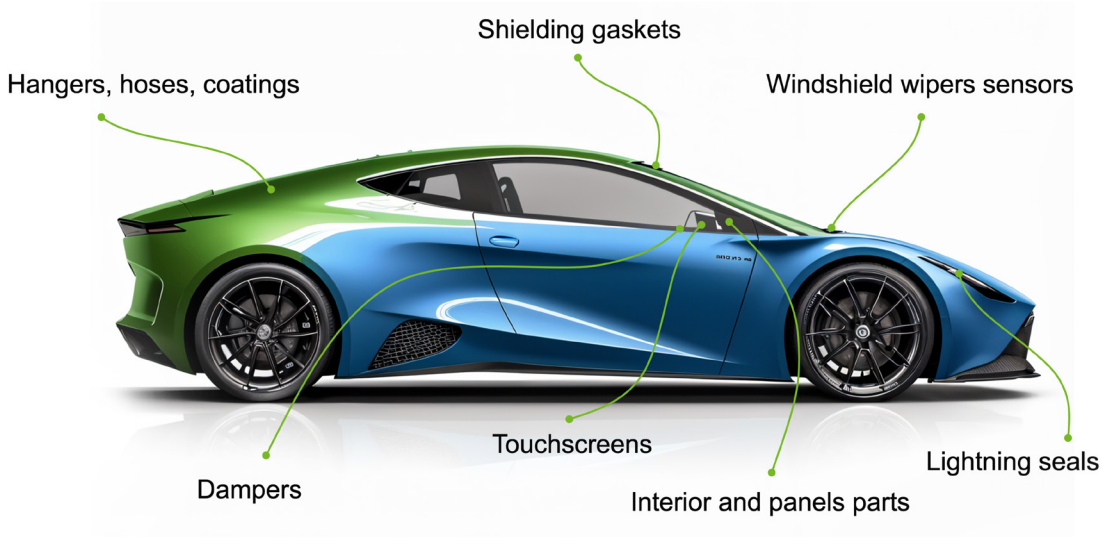
# OCSiAl Opens New Laboratory in Europe to Power Smarter Silicone Applications for a More Connected World

**OCSiAl's new silicone laboratory in Serbia brings a complete innovation chain from formulation to pilot production to accelerate nanotube-based silicone development. The Graphene nanotubes enable a new class of conductive, durable, flexible silicones—from EV components to wearable sensors and antistatic robotic parts—delivering performance that traditional fillers cannot match.**

The silicone industry is moving toward smarter, safer, and more energy-efficient materials. OCSiAl, the global leader in nanotechnology and the producer of TUBALL™ graphene nanotubes, has opened a new laboratory for liquid silicone rubber (LSR) and room-temperature-vulcanizing (RTV) systems and added a product line for silicones to its rapidly expanding production site in Serbia — built to keep pace with the fast-rising global demand for graphene nanotubes.

The new silicone laboratory is fully equipped for formulation, curing, molding, and electrical testing. The lab focuses on developing graphene nanotube solutions for silicone systems across industries, leading the shift toward electrification and intelligence. The demand for graphene nanotubes continues to rise, and the company is steadily and responsibly expanding its capacities in every direction. This includes both production and R&D facilities, ensuring that everything delivered to the end customer meets the highest standards — standards set by the graphene nanotubes themselves.

## Silicones in mobility




In the silicone industry, graphene nanotubes make it possible to create materials that are permanently conductive while still being flexible, soft, and colored as silicone should be: a combination long considered incompatible. In automotive applications, this means unlocking the whole conductive spectrum, from antistatic to EMI-shielding silicones that maintain elasticity and durability even under extreme mechanical and thermal stress. Beyond mobility, robotics benefit from antistatic protection granted by graphene nanotubes, ensuring consistent precision in sensitive components, such as silicone finger prostheses compatible with touchscreens, featuring electrical resistance between 5 and 200 Ω, without skin contamination and without releasing carbon onto the surface. Wearable and wellness devices gain reliable conductivity and comfort, enabling accurate, real-time body data monitoring.

With accelerated research, stronger partnerships, and a fourfold increase in graphene nanotube production capacity next year, OCSiAl aims to make graphene nanotubes an accessible standard for advanced materials worldwide, helping European and USA manufacturers design lighter, smarter, longer-lasting products that will shape future technologies.

### Contact

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From left to right: Bahram Haddadi (CHASE), Karin Wieland (CHASE), Christoph Haisch (TU Munich), Dagmar D'hooge (Ghent University), Giancarlo Cravotto (University of Turin), Christian Paulik (CHASE), Patrick Pammer (CHASE).

CHASE

# CHASE Xpert Days 2026 in Linz

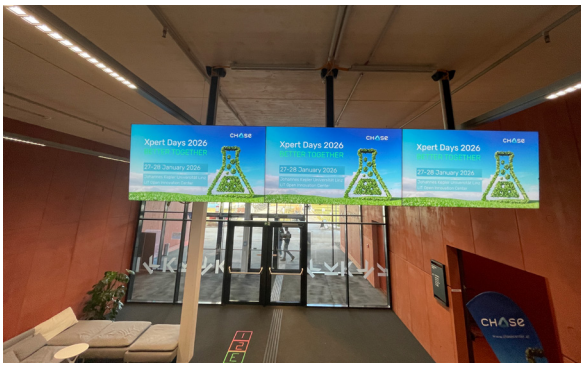
**On 27th and 28th January the Competence Center CHASE GmbH held its annual Xpert Days, hosted this year in the Stufenforum of the LIT Open Innovation Center at Johannes Kepler University Linz. Prominent partners from research and management participated in the two-day conference under the motto "Better together – Sustainability with strong partners".**

The sustainability for the chemical process industry was commented by several members of the community. Univ.-Prof. DI Dr. Christian Paulik, Scientific Director of CHASE stated: *"Sustainability works better when we work together. That is why we bring together successful partners from the chemical process industry to present and discuss practical examples of sustainable development."* Also, Patrick Pammer, Managing Director of CHASE, highlighted the benefits of a collaboration: *"We support companies and institutions in digitalizing, intensifying, and transforming production processes in line with the circular economy. This leads to energy efficiency, resource savings, and thus to sustainability. The benefit is immediate because our partners collaborate from day one, allowing for an instant transfer of knowledge and results."*

The Xpert Days brought together prominent speakers and guests: Christoph Haisch (TU Munich), Dagmar D'hooge (Ghent University), Giancarlo Cravotto (University of Turin), Stephan Winkler (University of Applied Sciences Upper Austria), Flavio Manenti (Polytechnic University of Milan), Michael Heyde (ALPLA), and CHASE experts such as Simon Herber, Dominik Wieland, Bahram Haddadi, Magdalena Pöttinger (JKU Linz/formerly CHASE), Michael Wenninger, Matei Miron, Thorsten Jonach, and Janos Birtha. The event took place on the JKU Linz campus, which will be the future home of the Competence Center CHASE starting in 2027, located in the Technikum II building currently under construction.

Competence Center CHASE GmbH is a European Research and Technology Organization that enables companies in the chemical process industry to make their production more energy-efficient, resource-friendly, and sustainable. The company was founded in 2019 in Linz as part of the COMET Competence Centers for Excellent Technologies (K1) program of the Austrian Research Promotion Agency (FFG). It is funded by the Federal Ministry for Innovation, Mobility and Infrastructure (BMIMI), the Federal Ministry for Economy, Energy and Tourism (BMWET), the provinces of Vienna and Upper Austria, and its scientific partners. Shareholders include Johannes Kepler University Linz (JKU Linz), TU Wien, Upper Austrian Research GmbH (UAR), and the Association of Partner Companies.

Since its founding, the company has successfully supported over 50 partners from industry and science, realized more than 20 cooperative projects with a research volume exceeding 20 million euros, published over 270 scientific publications, supervised more than 100 doctoral and master's theses, and advanced sustainability through digitalization with more than 50 employees.





Photos (Credit: CHASE).

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# Fighting Cancer with Calcium, Phosphate, and Citrate

A team lead by Hanna Engelke at the Institute of Pharmaceutical Sciences at the University of Graz is working on nanoparticles consisting of calcium, phosphate, and citrate as anti-cancer agents. Although all these components are non-toxic, when combined in nanoparticles, they effectively kill cancer cells. Conversely, healthy cells stay alive. High amounts of calcium phosphate or citrate have long been discussed as anti-cancer agents, yet their breakthrough has been hampered by the lack of an administration approach that overcomes the strict regulatory mechanisms of the cell. The nanoparticles now offer such an approach that allows for administering sufficiently high amounts of the ions into cancer cells. Unlike previously explored crystalline calcium phosphate materials, the amorphous calcium-phosphate citrate nanoparticles readily dissolve in the acidic endosome allowing for efficient release into cancer cells. A lipid coating around the nanoparticles mediates the cellular internalization and “hides” the high amounts of ions. The nanoparticles show high efficacy in reducing pleural tumors in mice without significant detectable side effects. The team is currently working on expanding the portfolio of the nanoparticles to other types of cancer with the goal of bringing them to the patient.

How does the selectivity of the nanoparticles for cancer cells work? This is still an unsolved question that the team aims to solve. Currently, we just know that they work. Knowing the mechanism will greatly help to predict under which conditions such a therapy is successful.

The team at the University Graz is actively seeking partners for the upcoming preclinical and clinical development and are open to collaborations with academia and industry. An out-licensing of the technology is also conceivable. The development program has already yielded a patent family (grants in the USA and Australia, and a pending European application based on WO2017025359). In addition, the group is actively pursuing funding (grants, investments, and strategic partnerships) to accelerate scale-up, preclinical validation, and the initiation of clinical studies.

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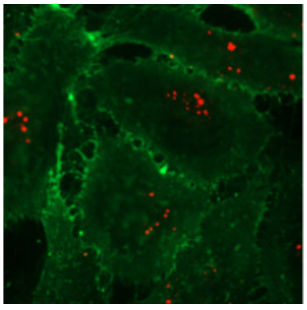

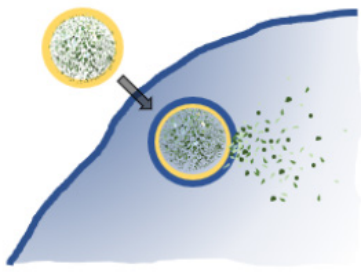

Nanoparticles for Drug Delivery.

# Collaborative Project with Partner Agrobiogel

**The Challenge – A Thirsty Planet.** Global agriculture is currently grappling with a dual crisis: the intensification of extreme drought cycles and the systemic degradation of soil health. Traditional interventions frequently rely on synthetic polymers; while these offer short-term hydration, they often leave behind a persistent environmental footprint. The society of tomorrow demands materials that do more than merely "function", hence they must integrate seamlessly into the Earth's natural cycles.

**The Solution – Wood-Based Smart Materials.** Within the COMET research framework, Agrobiogel and the Austrian Centre of Industrial Biotechnology (acib) are jointly developing next-generation soil-improving materials derived from lignin, an abundant plant-based side stream. Building on the success of RETENTIS®, the collaboration aims to transform this wood based hydrogel into a multifunctional "smart sponge" through scientific and technological advances accessible through a high impact research environment. Researchers are now evolving RETENTIS® into a multifunctional, advanced polymer to

- Regulate Hydration: By absorbing, storing, and slowly releasing water over extended periods, it buffers plants against erratic rainfall. For irrigation-dependent farming, this translates to reduced watering frequency and significant savings in energy and labor costs.
- Revitalize Soil Biology: By maintaining consistent soil moisture, RETENTIS® stimulates microbial activity, which in turn enhances soil fertility and natural plant vigor.
- Optimize Nutrient Delivery: New product iterations serve as high-efficiency carriers for essential plant nutrients. By syncing water and nutrient availability in a single reservoir, the material ensures plants receive exactly what they need, where they need it, reducing fertilizer runoff.

To align with Global Mandates, the outcomes of the joint research approach support major policy frameworks. First, the EU Circular Economy by transforming industrial plant side-streams into high-value agricultural inputs. Second, Climate Neutrality (EU 2030): Traditionally, lignin is incinerated for energy, releasing significant CO2. RETENTIS® "locks" this carbon into the soil, offering a greener alternative to combustion. Third, supporting the Farm to Fork Strategy, by reducing the environmental footprint of primary production while ensuring fair economic returns for the farming community. And fourth the Sustainable Development Goals (SDGs). The project contributes to global targets for water security, responsible production, and climate action.

**The Impact – Programming the Soil for a Greener Future**. The partnership between acib and Agro-Biogel demonstrates how cutting edge biotechnology and industry driven innovation can reshape agricultural practices. The joint research is paving the way toward:

- Significant reductions in agricultural water use
- Healthier soils that maintain fertility over time
- More resilient food production systems in a changing climate
- A scalable pathway to reforest and restore arid regions

This project shows that we are not merely improving water retention—we are engineering soil environments that actively support life, strengthening the resilience of ecosystems and agriculture alike.

### Contact

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Anja Haase and Laura Angermann-Krammer with printed electronics.
Credit: JOANNEUM RESEARCH/Suppan

JOANNEUM RESEARCH

PCCL
Polymer Competence Center Leoben

Montanuniversität Leoben

JOANNEUM RESEARCH

# Blood Diagnostics Without a Laboratory

**An international EU consortium is developing a groundbreaking diagnostic platform that enables precise blood testing directly on patients – without lab equipment or power supply. Thereby, a new microfluidic patch enables accurate testing for HIV and syphilis directly on site.**

At the heart of the EU-project FORTIFIEDx is an innovative microfluidic test strip that works with a simple finger press. It automatically doses, processes and analyses capillary blood using a purely mechanical system. Three Styrian research institutions are involved: JOANNEUM RESEARCH (MATERIALS, LIFE), Montanuniversität Leoben and the Polymer Competence Center Leoben.

The researchers' idea is that blood samples are taken using tiny needles that penetrate the skin painlessly and extract a defined amount of capillary blood. This is precisely dosed, mixed and directed to various detection zones in a closed microchannel system. Valves inside the test system control the flow purely mechanically – without any external pump or power supply. This makes the system particularly robust and mobile.

The rapid test is manufactured using a roll-to-roll process involving UV nanoimprint lithography.

JOANNEUM RESEARCH in Weiz (MATERIALS – Institute for Sensors, Photonics and Production Technologies) specialises in this field. Anja Haase, project manager at JOANNEUM RESEARCH, explains the advantages: *"This process enables parallel micro- and nanostructuring over large areas, with a high throughput rate and low unit costs. We can integrate biofunctionalisation and sealing of the parts directly into the process. This makes industrial production efficient and the innovation scalable as a product."*

The system is currently being validated for detecting infectious diseases such as HIV, syphilis, Ebola and Lassa, with potential applications ranging from routine diagnostics to outbreak response in regions without laboratory infrastructure.

This innovation strengthens European medical technology expertise while closing critical diagnostic gaps worldwide.

Learn more about the project.

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# Additive Manufacturing Austria – Challenges and opportunities of Advanced Materials

AM Austria is the national Austrian stakeholder platform for additive manufacturing and a member of the ATIMA project consortium, which is led by BNN. It connects research institutions and companies across the AM (Additive Manufacturing) value chain, fostering collaboration, knowledge exchange, and coordinated action.

A central challenge—and opportunity—is understanding how advanced material properties interact with processing technologies in AM. The relationship is complex, but getting it right is crucial for reliability, performance, and future- solutions. At the same time, it unlocks new pathways for advanced materials. By aligning expertise and resources, AM Austria aims to turn these AM materials–processes interplay into practical solutions for industry and research alike.

In 2025 AM Austria launched an initiative to identify, which types of advanced materials are becoming pivotal for AM—and to map the property files and the application domains likely to emerge. An initial questionnaire assessed the needs in the AM community related to advanced materials, explored those requirements in detail, and examined the importance of different material groups for AM. The questionnaire then informed a visionary futures workshop on 9 December 2025 in Leoben, aiming at identifying entirely new options for advanced materials in AM.

Here, we want to summarise the objectives, proceedings, and principal outcomes of the workshop "Advanced Materials for Additive Manufacturing." The workshop sought to build a shared understanding of "advanced materials," identify future technology drivers and the attendant materials requirements, and derive concrete implications for AM research and development. Advanced materials were defined as purposefully engineered, new or improved materials with superior properties over conventional counterparts, conceived through multidisciplinary research for high-technology applications across alloys, polymers, composites, nanomaterials, and functional materials—enabling innovation in energy, electronics, mobility, and construction, and underpinning the green and digital transition.

An initial horizon-scanning session mapped technology trajectories from the past through 2030, highlighting the sustained and cross-fertilising roles of aerospace, mobility, artificial intelligence, novel process technologies (including digital manufacturing and AM), IT and communications, and nanotechnology. The discussion consolidated future priorities into four thematic clusters: Quantum Technologies, SelfX (adaptive, self-healing, sensor-integrated, and medical materials), Autonomous Technology Systems, and bio-based advanced materials.

Against these clusters, participants articulated property requirements for advanced materials: for quantum applications, optical responses (including transparency to specific frequencies), entanglement, load-controlled elasticity, novel magnetic and electrical behaviours (e.g., superconductivity), and surface structurability. Advanced materials are conceived as autonomous, actively functioning systems built by combining base and auxiliary constituents.

Figure 1: Workshop participant in discussion on Advanced Materials and Additive Manufacturing.

Their profile includes embedded sensing for defect detection, self-organisation (SelfX), anisotropic functional properties, high strength at low density, and robust processability. At interfaces and in service, they enable on-demand bonding and debonding, self-healing, pH-responsive electromechanical effects, crack arrest and repair, and adaptive performance.

A subsequent assessment ranked advanced materials with high potential for AM-enabled multifunctional product design, converging on four representative types and associated AM-specific opportunities and constraints. These included:

1. "Autonom AM" (NoControl): AM-enabled multimaterials via material extrusion, graded or layered conductivities, reversible joints through trigger elements (e.g., metal–polymer), surface appearance changes under high load (yield exceedance), printed overload-detection patterns, auxetic responses from cellular architectures, and realisable biomimetic functionalities, balanced against regulatory, sensing, programming, and cybersecurity constraints.
2. "Bio-Aerospace (Baero)": Terrestrial and in-space manufacture with cellular structures and topology optimisation, multimaterials and layered architectures, method adaptations for low volumes, steel–bio composites, circular organic materials, and applications in heat exchange, HVAC, and mounting systems.
3. "SelfX AM": *In-situ* integrated materials for force and vibration sensing, multimaterial systems combining structure and function, hybrid processes for large multimaterial components, and metamaterial fabrication.
4. "Biomimetic Metals": Metal-ceramic combinations inspired by nature (e.g., crack arrest and toughness enhancement), porosity and cell structure engineering via powder-based AM hybrid techniques, and controlled-growth gradients in porosity, hardness, and strength for preforms enabling fluid-solid functionalities (cooling and flow control).

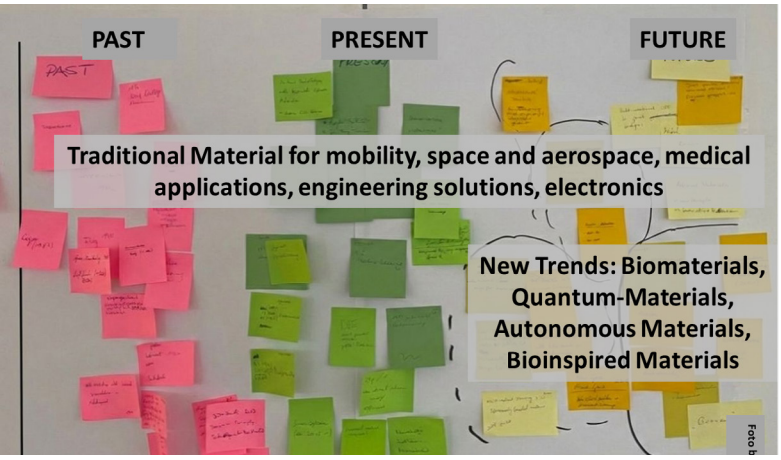


Figure 2: By cocreation of all participants the initial horizon-scanning session map of technology were developed, which built the bases for the workshop discussion on advanced materials.

Cross-cutting challenges and gaps emerged from the deliberations. Several themes stood out and reinforced one another. A stronger knowledge base is needed in general such as biomimetic materials architectures to targeted properties and to AM manufacturability. Advanced materials development must be tightly coupled to application-driven AM process selection and to design integration. Participants stressed the need for optimal co-design of material, structure, function, and geometry. They also called for better metrology for AM processes and for in-situ control of embedded sensing. Finally, they emphasised improved scaling and upscaling methodologies, including model-based acceleration.

In conclusion, future technology demands will necessitate the re- and co-development of materials and AM processes, increasingly blurring the boundaries between material, structure, product geometry, and function. The workshop's synthesis frames a programme in which design, processing, and materials chemistry are jointly orchestrated. This is targeting autonomous, adaptive, and bio-inspired systems that are realised through improved and quality-assured AM processes.

## Contact

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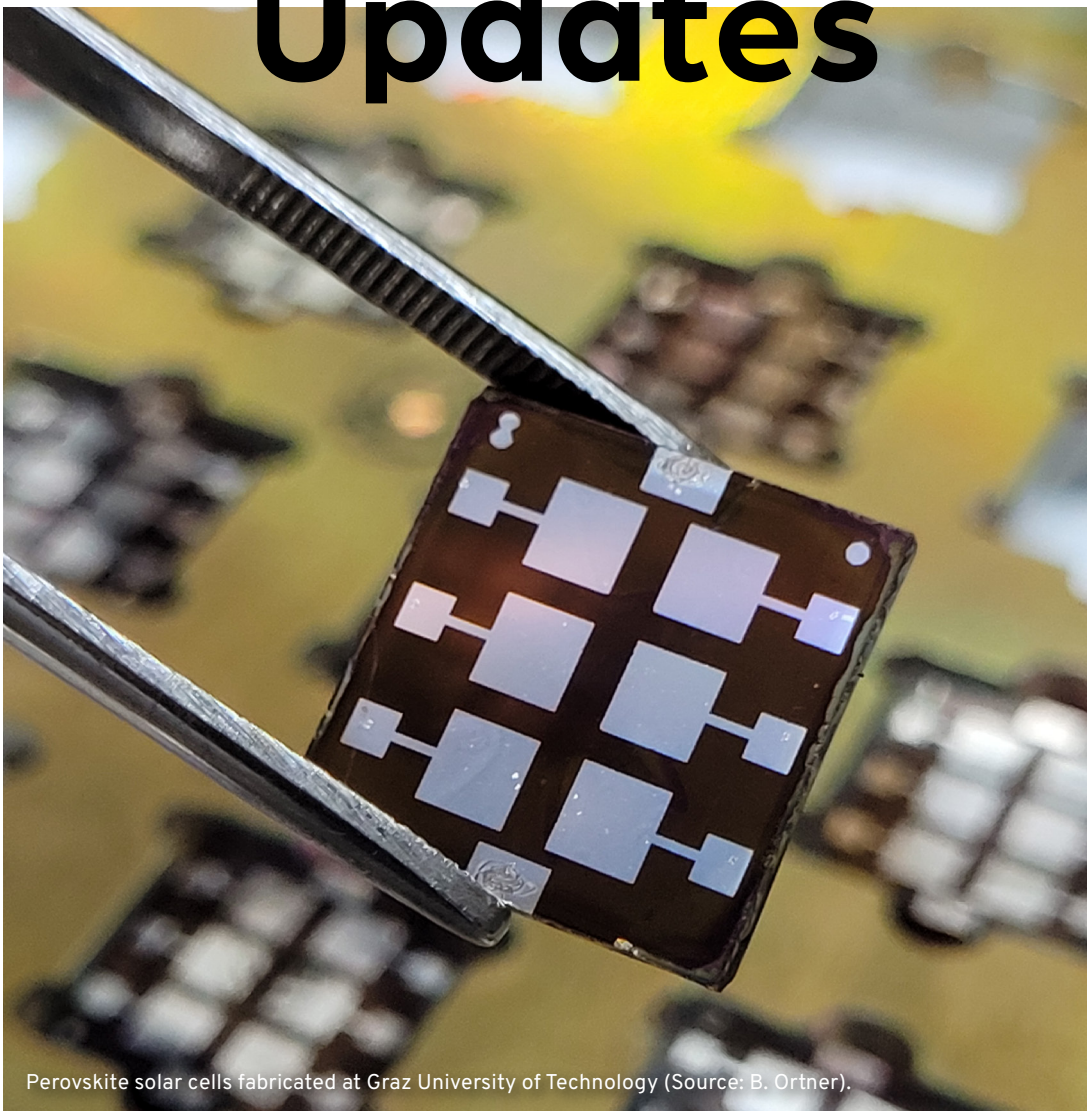
# Project Activities & Updates



Perovskite solar cells fabricated at Graz University of Technology (Source: B. Ortner).


ATIMA

# Recap of ATIMA Activities (December 2025 – February 2026)

**ATIMA: Driving Innovation in Austria in the field of Advanced/Innovative Materials for a Sustainable Future.**

Within the last months (December 2025 – February 2026), ATIMA and its partners have continued their activities for raising awareness on the project and its goals, engaging with different stakeholder groups, and strengthening the identity of Austria's advanced/innovative materials (AdMa) community.

Highlights of activities in the last three months include:

**AdMa-strategy development work of BNN in the frame of ATIMA**

The BNN-team engaged with key stakeholders in Austria to strengthen the advanced materials community and prepare the next steps towards the Austrian AdMa-Roadmap we are developing in the first half of 2026. Amongst other activities and interactions, we performed high-level-meetings with national (e.g., TUW, BMIMI, BMLUK, BABEG, CHASE, JOANNEUM RESEARCH, SFG) and international colleagues (e.g., IAM-I, InnoMatSyn, European Commission – DG-RTD, RIVM, Chalmers, RISE, etc.) – this will be continued along the next months.

**Business breakfast AC-Styria**

*(01.12.2025, Graz, Austria) – ASMET*

On December 1st, a business breakfast in Graz addressed AI developments and applications, including a technical presentation on AI in materials development and production. Data-driven models, industrial examples, and implementation prerequisites were discussed. The event enhanced networking and increased the visibility of the ATIMA project, emphasizing its role in AI-supported materials development. Read more about this activity here.

**"AM Connect 2025": Slovenia-Austria Interreg Program**
*(03-04.12.2025, Villach, Austria) – AM-Austria*

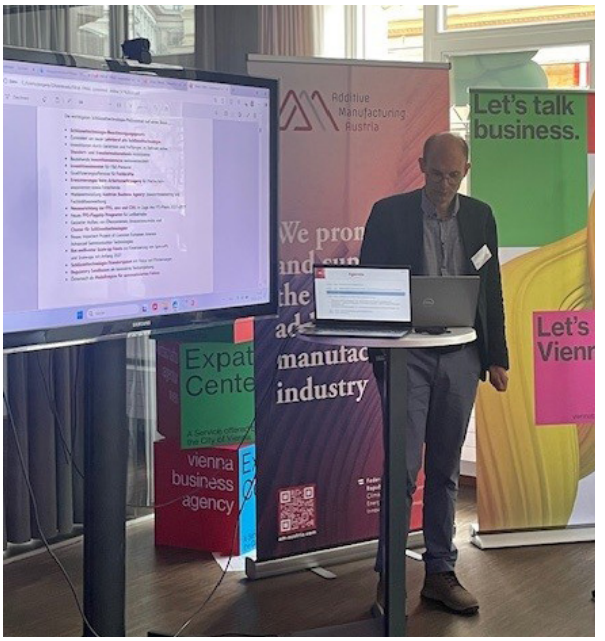
The International Conference on Research and Industrial Advances in Additive Manufacturing gathered experts from research and industry to exchange knowledge, build networks, and explore emerging technologies, trends, challenges, and cross-sector opportunities. ATIMA was represented by AM-Austria's President, Dr. Johannes Gartner, who emphasized the project's role, objectives, and contribution to innovation in additive manufacturing and materials development. Read more about this activity here.

**Working group "Advanced Materials for Additive Manufacturing" (AdMa4AM)**
*(09.12.2025, Leoben, Austria) – AM-Austria*

At the AdMa4AM working group, 24 participants discuss, elaborated and defined advanced material (AdMa) requirements for additive manufacturing, addressing challenges from material combinations to certification and sustainability. The workshop highlighted promising material types and stressed coupling material and process development as boundaries between material, structure, and function increasingly blur. The outcomes represented an important contribution to ATIMA, underlining the growing necessity of advanced materials in additive manufacturing. Read more about this activity here.

**Working group F&E - Workshop "FFG calls for tenders 2026"**
*(26.01.2026, Vienna, Austria) – AM-Austria*

On 26 January 2026, the Working Group F&E workshop “FFG Calls for Tenders 2026,” organized by AM-Austria in Vienna, addressed upcoming additive manufacturing funding opportunities. Alexander Pogany (BMIMI) outlined 2026 measures. Discussions covered production concepts, technologies, materials, digitalisation, AI, and data processing, strengthening ATIMA’s visibility within the community. Read more about this activity here.





**AM Village Madrid**
*(27-28.01.2026, Madrid, Spain) – AM-Austria*

On 27–28 January 2026, AM-Austria joined the AM Village coordination meeting in Madrid to prepare AM Village 2026 in Albacete (Spain). The platform connects AM experts and stakeholders from Armed Forces, industry, research, and academia to discuss military applications. Dr. Johannes Gartner participated, reinforcing ATIMA’s visibility internationally. Read more about this activity here.

**The 26th International Nanotechnology Exhibition & Conference**
*(28-30.01.2026, Tokio, Japan) – nanoNET Austria*

At nanotech2026 in Tokyo, ATIMA supported an Austrian exhibitors' booth, backed by the Federal Ministry Innovation, Mobility and Infrastructure (BMIMI). Research organizations and companies were presented, visitor numbers exceeded 45,200, and a Silicon Austria Labs talk by Dr. Heer highlighted nano-fabrication services, marking the event a success overall for Austrian participants. Overall, the exhibition was highly successful for the Austrian participants and demonstrated strong international interest. More details about the event here.

**Workshop on Advanced Textile Materials**
*(04.02.2026, Lustenau, Austria) – V-trion*

Within the PREVIEW initiative at Gymnasium Lustenau, the Smart Textiles Platform Austria organized a Workshop on Advanced Materials, introducing students to advanced and smart materials, research topics, innovation processes, and applications. Representing ATIMA, it highlighted advanced materials and cross-sector collaboration, supporting informed career choices and young talent development in research. More details of this activity here.


**3D-Makers Zone – 3DMZ**
*(13.02.2026, Haarlem, Noord-Holland) – AM-Austria*

On 13 February 2026, AM-Austria joined the 3D Makers Zone (3DMZ) in Haarlem, joining industry, government, and academia to advance additive manufacturing innovation and market development. Dr. Johannes Gartner (AM-Austria president) presented on EU policies and market development, reinforcing ATIMA's European engagement. Participants included voestalpine, Shell, ESA, and leading universities and research platforms. More details of this activity here.

**1st InnoMatSyn Event: Workshop with Materials Ecosystem**
*(12.02.2026, Bilbao, Spain & online) – BNN*

At the 1st InnoMatSyn Event (12th February 2026, Bilbao/hybrid), the ATIMA-project was presented as the single AdMa-community, a best-practice example in terms of bringing together initiatives platforms on national level. Furthermore, the success story of bringing AdMa into strategic documents in Austria was highlighted. Read more about it here.

**Working group NORMS & STANDARDS**
*(27.02.2026, Vienna, Austria) – AM-Austria*

On 27 February 2026, the AM-Austria Working Group "Norms & Standards" met in Vienna to discuss the role of standards in advancing additive manufacturing for serial production. The workshop emphasized active engagement with evolving norms, knowledge exchange, and collaboration. The ATIMA project was presented with a roll-up display, strengthening its visibility. Read more about it here.

You can find more information about the project, on their website.

**Role of BNN in ATIMA:**

Coordination, Roadmap development, AdMa-community building, international representation, Communication & Dissemination.

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# One Language, One Vision: Co–Creating SSbD Terminology Together

**Dear SSbD practitioners, welcome to our joint SSbD terminology harmonization across the SSbD community,**

The **PLANETS Wordbook** has been initiated within the PLANETS project (GA n° 101177608) with the aim to share among our project the SSbD vocabulary used and, thus, obtain a common understanding between the different interdisciplinary areas of expertise. Additionally, we used it to share knowledge on safety- and sustainability-related terms for the innovators operating our case studies on plasticizers, flame retardants, and surfactants.

The first version was published on Zenodo on 27 June 2025 and since then has raised attention by colleagues across the SSbD communities incl. PARC, IRISS, etc.

Now we invite SSbD practitioners across the entire SSbD community to participate in this **SSbD terminology harmonization exercise** based on the Wordbook. We are eager to collect your vision and are happy for your comments **before the end of July 2026**!

For your contribution, please follow following process:

1. Download the most current version of the SSbD Wordbook from Zenodo: https://doi.org/10.5281/zenodo.15755125
2. Deposit our comments in the “comments” column (E) in the “SSbD Wordbook” sheet.
3. Put general comments, if you have, in the “ReadMe” sheet (rows 34-51).
4. Send your commented version to: info@project-planets.eu

The last version (v2, published in 2026) contains approximatively 130 words dealing generically with SSbD, human health/safety (composed of the subdimensions hazard and exposure), environmental, economic, and social impacts, complemented by functionality/performance-related aspects. The aim of the Wordbook in terms of exhaustivity is to contain as many terms as relevant for the discussion of results or trainings, etc., but as few as possible to not get overwhelmed. The user is able to filter the wordbook either by the word itself (column “Name”), by its *theme*, or by its *type*. The aim of the Wordbook in term of exhaustivity is to contain as many as relevant for results discussion/trainings but as few as possible to not get overwhelmed.

This wordbook was initially designed within the task T2.1, entitled “Selection of methodologies and tools to assess safe and sustainable substitution”, in the PLANETS project. This excel tool is a living document and, therefore, can be modified (when relevant/upon new input or harmonization requests) by the PLANETS experts in their regular agreement sessions. Modifications are listed in the “version of history” sheet.

If you have any question, do not hesitate to contact us.

Thank you for your collaboration.

The PLANETS team

# What Are Flame Retardants—and Why Should We Care?

The Horizon Europe project PLANETS has prepared an **infographic on flame retardants** for explaining them in a clear and accessible way:

- **WHAT** flame retardants are
- **WHERE** they are used
- **WHY** we need them
- **HOW** they work
- The **role** of Safe-and-Sustainable-by-Design (SSbD)
- And what the **future** of safer and more sustainable flame retardants looks like

As discussions around chemical safety and sustainability grow, it's more important than ever to understand the substances we interact with every day.

This infographic aims to provide that clarity in a simple, visual format. Check it out and feel free to share!

More information about the project, on the website.



# Help Design the Next Generation of Safer Baby Products with PLANETS

The EU-funded project PLANETS applies the **Safe and Sustainable by Design (SSbD) framework**, to develop and demonstrate **safer and more sustainable alternatives to existing** substances of concern in different applications: **surfactants, flame retardants,** and **plasticizers**.

For one of the plasticizers applications, to better understand **parents' and caregivers' expectations and preferences regarding baby products**, such as **spoons and teething rings**, PLANETS has created this anonymous survey.

The survey is available in *English, French, Spanish, Italian, and German.*

Your opinion would be greatly appreciated and would help to guide the development of these products!

# PLANETS: Explore PLANETS' Latest Training Materials

The Horizon Europe PLANETS aims to demonstrate the applicability of the **SSbD Framework** while technically developing **alternatives** for 3 of the most important classes of molecules in chemical industries (**plasticizers, flame retardants and surfactants**) at TRL 6 and their incorporation into broadly available **consumer goods at TRL7**. The new molecules and products will be significantly safer for workers and consumers and will have considerably **lower environmental impact**, while ensuring **economic viability** and **social awareness** throughout the 3 value chains.

Additionally, PLANETS is very active in organising internal trainings and adapting the materials for external users!

Explore their **publicly available materials** here:

- Safe-and-Sustainable-by-Design(SSbD) scoping: SSbD policy background, basics, actions of scoping, the PLANETS SSbD workflow, as well as practical exercises in break-out groups on system boundary definition
- SSbD Tier 1 assessment: theory, application and adaptation
- Conducting a SSbD Tier 2 assessment using QSAR modelling
- Introduction to FAIR data & models, and Digital Product Passport (DPP)
- Introduction to Life Cycle Sustainability Assessment (LCA)

More information about the project, on their website.

### Role of BNN in PLANETS:

Communication & Dissemination, Stakeholder Engagement, Graphic Design and Training.

### Contact

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# The SSbD4CheM Knowledge Sharing Platform: Turning Safe and Sustainable by Design into Practice

The transition to safer and more sustainable chemicals and materials requires more than good intentions — it needs accessible knowledge, practical tools, and shared understanding across disciplines. This is exactly the main aim of the EU-funded project SSbD4CheM project. The project is developing the **SSbD4CheM Knowledge Sharing Platform**, a centralized, web-based infrastructure that offers tools, data, guidance, and training to support the implementation of the SSbD framework for chemicals and AdMa, as elaborated by the EC Joint Research Centre (JRC), and help stakeholders (researchers, industry, policymakers, etc.) translate the SSbD principles into real-world decision-making throughout their innovation processes.

The platform brings together a wide range of **tools, data resources, methodologies, and guidance materials** relevant to SSbD. Instead of navigating multiple disconnected sources, users can access structured information that supports safety and sustainability considerations **from the earliest design stages** through to assessment and evaluation. One of the platform's key functions is to enable **structured SSbD assessment workflows**. Users can explore digital tools that support hazard screening, sustainability evaluation, and life-cycle thinking, helping them document and compare design choices in a transparent and reproducible way.

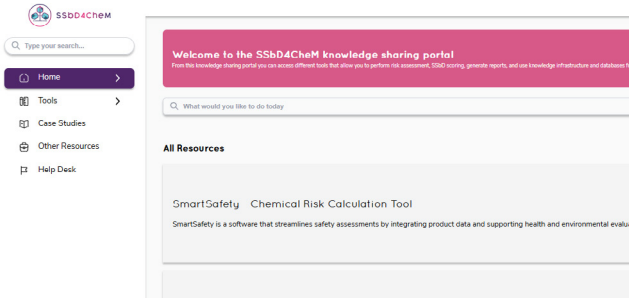


Figure 1. Overview of the SSbD4CheM Knowledge Sharing Platform.

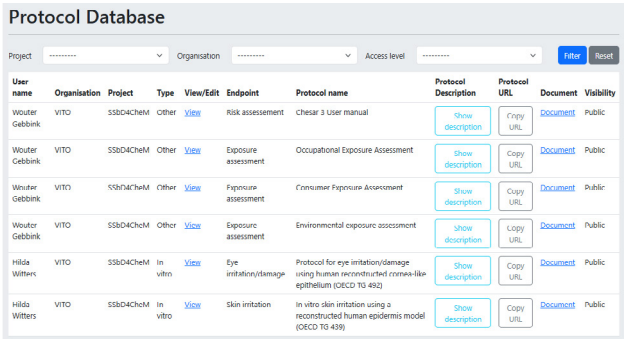


Figure 2. SSbD4CheM Protocol Database with uploaded protocols.

Beyond tools and data, the Knowledge Sharing Platform also serves as a **learning environment**. It provides access to training materials, guidance documents, and explanatory resources that help users understand SSbD concepts, methodologies, and regulatory contexts — supporting capacity building across sectors and disciplines.

In line with EU best practices, the platform promotes **FAIR principles** (Findable, Accessible, Interoperable, Reusable), ensuring that data and resources hosted or linked through the platform can be more easily discovered, reused, and integrated into other tools, projects, and innovation processes.

Through the platform, users can access different tools that allow them to perform risk assessment, SSbD scoring, generate reports, and use knowledge infrastructure and databases for integrated, safer, and sustainable-by-design workflows. By the beginning of January 2026, the platform contains following resources:

- *Risk Assessment Report - Case Study*: This report is generated by the SSbD4CheM integrated assessment tool designed to support safe and sustainable innovation across sectors such as cosmetics, textiles, and automotive.
- *SmartSafety – Chemical Risk Calculation Tool:* Software that streamlines safety assessments by integrating product data and supporting health and environmental evaluations.
- *ASPA-assist:* Web-based graphical interface which guides users through the steps and decisions involved in applying the SSbD process.
- *ToxTemp:* Web-based tool and database designed to document methods by supporting various readiness levels to ensure method evaluation and transparency.
- *ACCORDs KI:* Platform for accessing and submitting research protocols, experimental data, and images, offering standardised upload templates and a materials characterisation tool box.
- *SDS collector/extractor:* Tool that allows users to search, download, and extract structured data from SDS using CAS numbers or IUPAC names, exporting the information in CSV format.
- *PubMed ChemInsight:* To accelerate literature discovery on chemicals and biological targets with smart search, synonym expansion, and automated result delivery.
- *PubChemPal:* Interactive, user-friendly application that enables scientists, researchers, and regulatory professionals to retrieve, clean, and explore structured PubChem compound data using CAS numbers or PubChem CIDs.
- *ECHA database and notebooks:* Provides access to chemical safety data and organized documentation (e.g. Chemical similarity search on RDT studies from REACH database, Repeated dose toxicity studies from reach database, EdelweissData dataset for CLP classifications, EdelweissData dataset for ecotoxicological endpoints).
- *Protocols area - guidance and database:* Database of in silico and in vitro protocols used throughout the project, providing standardized methods and guidance.
- *Data area - guidance and access:* Guidance page for information on data management.

The SSbD4CheM Knowledge Sharing Platform is designed as a collaborative space. By connecting tools, knowledge, and stakeholders, it supports dialogue and exchange between scientists, innovators, regulators, and sustainability experts working toward the same goal: chemicals and materials that are **safe and sustainable by design**. It is a practical enabler for embedding SSbD thinking into chemical and material innovation, helping turn policy ambitions into actionable, science-based practice.

Explore now the SSbD4CheM Knowledge Sharing Platform here.

More information about the project, on their website.

# Meet the People Behind SSbD4CheM!

SSbD4CheM is an EU-funded Horizon Europe project working to introduce **screening and testing methods for safe and sustainable material development** in three relevant demonstrators: the **textile, automotive and cosmetics industries**. The project aims to meet the EU's strategic objectives for digital, enabling, and emerging technologies, sectors, and value chains by developing a comprehensive **Safe and Sustainable by Design (SSbD) framework** that uses new science-based approaches to **identify and address potential hazards and risks**, and innovative technologies to support the design of **safer and more sustainable products and processes**.

Get to know one of our Work Package leaders.

**Barry Hardy** is CEO of Edelweiss Connect (Switzerland). Within SSbD4CheM, he is leading the work package dealing with the project **SSbD framework and workflow**.

**Tell us a bit about yourself. What is your area of expertise?**

Barry Hardy is the Founder and CEO of Edelweiss Connect, working at the intersection of computational toxicology, FAIR data infrastructure, and Safe and Sustainable by Design (SSbD) innovation. Our expertise focuses on developing knowledge infrastructures and mechanistically interpretable modelling workflows that integrate experimental and computational evidence to support predictive safety assessment. This includes development of FAIR-compliant data frameworks, AOP-based mechanistic modelling, and AI-assisted workflows such as ASPA, designed to generate high-quality, traceable evidence suitable for industrial decision-making and future regulatory acceptance.

**How does your specific work package "SSbD4CheM framework and workflow" contribute to the project?**

Our work package contributes by developing the SSbD framework implementation layer that connects FAIR data, mechanistic knowledge infrastructure, and industrial innovation workflows. We are extending ASPA workflows to support SSbD applications, enabling structured integration of experimental data, mechanistic pathway knowledge, and predictive models into reproducible evidence packages. This infrastructure ensures that safety and sustainability assessments are transparent, traceable, and reusable, supporting industrial partners in making informed design decisions and preparing evidence that can ultimately support regulatory evaluation and acceptance.

- Barry Hardy

CEO AT EDELWEISS CONNECT AND FOUNDER OF SAFERWORLDBYDESIGN

*"By integrating FAIR data, mechanistic knowledge, and AI-assisted workflows, we are transforming fragmented scientific evidence into predictive, transparent, and reusable knowledge—empowering industry to design safer and more sustainable chemicals and materials from the earliest stages of innovation, while building the foundation for future regulatory acceptance."*

**What is the most exciting thing about the activities in your work package?**

The most exciting aspect is enabling a transition from fragmented data and isolated experiments to integrated, mechanistically grounded evidence that can directly guide safer and more sustainable chemical and material design. By combining FAIR data principles, knowledge graphs, and mechanistic modelling workflows, we are creating a foundation where safety and sustainability can be evaluated predictively and early in innovation. This opens the door to faster, more reliable development of safer products while building confidence in new approach methodologies (NAMs) that can eventually replace animal testing and support regulatory transformation.

**From your point of view, who can benefit the most from the project?**

Industrial innovators and product developers will benefit significantly by gaining tools and frameworks that allow them to design safer and more sustainable chemicals and materials more efficiently and with greater confidence. At the same time, regulators and the broader scientific community will benefit from access to structured, high-quality, and reproducible evidence that supports transparent safety and sustainability assessment. Ultimately, society as a whole benefits through safer products, reduced environmental impact, and accelerated adoption of innovative, human-relevant methods for safety evaluation.

Read through this powerful reflection poem from Barry Hardy, on humanity standing at a crossroads, armed with powerful intelligence and technology yet risking ecological collapse, social fragmentation, and moral drift if wisdom and empathy do not guide action. It calls for stewardship, compassionate AI, cultural renewal, and collective responsibility to consciously design a safer, more humane world while there is still time.

More information about the project, on their website.

**Role of BNN in SSbD4CheM:**

Communication & Dissemination, Stakeholder Engagement, Graphic Design and Training.

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# PeroVscale – Scaling Sustainable and Stable Perovskite–Silicon Tandem Photovoltaics

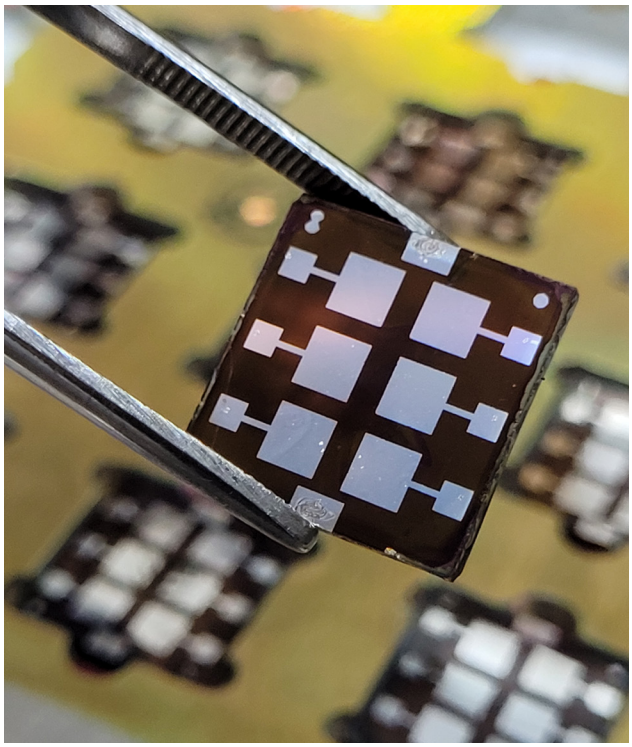
**Perovskite solar cells** have emerged as one of the most dynamic developments in photovoltaic research. In combination with silicon solar modules in tandem architectures, they have already demonstrated efficiencies that exceed those of conventional single-junction technologies. Although this promising technology has reached a comparatively high technology readiness level (TRL), three major challenges continue to limit its commercialization: demand for large-area processing, high lead content (problem of safety and sustainability), and challenging long-term stability.

The FFG-funded R&D project **PeroVscale (Scalable Production Technology for Sustainable, Efficient and Stable Perovskite-Silicon Tandem Solar Cell Modules)** directly addresses these issues through a comprehensive and industry-oriented development strategy. The three-year project started in October 2025 and its overall objective is to **increase efficiencies, enable scalable production routes, lower manufacturing costs and optimize sustainability and safety of perovskite-silicon tandem solar cell modules**.

One central goal of PeroVscale is to enhance the environmental sustainability of the perovskite technology. To achieve this, the consortium develops an energy-efficient plasma-assisted crystallization process using environmentally friendly solvents and significantly reduced lead content. The target is to reach power conversion efficiencies above 23%, while simultaneously improving environmental compatibility. It is foreseen to reduce the lead content by more than 50% compared to state-of-the-art materials, improving alignment with regulatory frameworks such as RoHS.

To increase device stability, PeroVscale combines improved material quality with advanced interface engineering and optimized encapsulation strategies. By enhancing crystal quality and suppressing degradation pathways at interfaces, the project aims to demonstrate long-term operational stability under continuous illumination for encapsulated mixed lead/tin perovskite solar cells. This stability concept tackles both intrinsic material degradation and extrinsic environmental influences.

Figure 1: Perovskite solar cells fabricated at Graz University of Technology (Source: B. Ortner).



Scalability represents another core pillar of the project. PeroVscale develops highly homogeneous large-area perovskite films using slot-die or spray coating in combination with plasma-assisted crystallization under nitrogen atmosphere.

Figure 2: The PeroVscale team at the kick-off meeting in November 2025 (Source: L. Troi).

This approach allows film fabrication under near-ambient conditions and at low process temperatures, offering good compatibility with industrial roll-to-roll manufacturing. Target parameters include deposition speeds above 5 m/min, and minimal efficiency loss during scale-up from a single solar cell to module level. For tandem integration, the project pursues a 4-terminal (4T) architecture in which perovskite and silicon subcells are fabricated separately before they are combined. Compared to monolithic 2-terminal designs, the 4T approach offers higher flexibility and reduced sensitivity to spectral variations in real-world operation. The goal is to increase the efficiency of the underlying silicon solar module by more than 20% (relative), enabling highly efficient tandem modules suitable for rooftop and building-integrated photovoltaic applications.

From the earliest development phase onward, PeroVscale integrates Safe-and-Sustainable-by-Design principles like eco-design, resource efficiency and circular economy principles into its technological development. By reducing the dependency on critical raw materials, minimizing critical or toxic substances, improving recyclability and embedding sustainability assessment into material and process design, the project aims to enhance also societal acceptance and long-term environmental compatibility of perovskite solar modules.

The consortium held its kick-off meeting on 11 November 2025 at Graz University of Technology. Researchers and industry partners engaged in fruitful discussions on technical strategies, milestone planning and pathways toward industrial implementation. The meeting marked the starting point of a tightly coordinated collaboration across materials development, plasma technology, module engineering and sustainability assessment.

PeroVscale is coordinated by Graz University of Technology and includes JOANNEUM RESEARCH, BNN, INO and Heliavolt as partners. By combining scientific expertise with industrial know-how and sustainability competence, the consortium aims to move the perovskite - silicon tandem technology closer to commercial reality.

**Role of BNN in PeroVscale:**

SSbD

**Contact**

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# From Idea to Approval: What Every Medical Device Needs

As part of our ongoing exploration of the scientific, technical, and regulatory foundations behind the Nabiheal project, we are pleased to present one of four expert interviews, made possible through the valued collaboration of the University of Maribor (UM).

In this edition, we speak with Sergio Veiga of Asphalion, our partner in regulatory and ethics. Sergio provides a clear and insightful perspective on the key steps required to bring a medical device to the European market under the Medical Device Regulation (MDR).

From accurate device classification and compliance with safety and performance requirements to the preparation of robust technical documentation and effective collaboration with a Notified Body, he outlines the essential building blocks of a successful regulatory strategy. Above all, Sergio emphasizes the importance of integrating regulatory and quality expertise from the earliest stages of product development—an approach that can fundamentally shape the success of the entire project.

Watch the full interview here.

**Role of BNN in NABIHEAL:**

SSbD concept & guidelines, Dissemination, Communication & Stakeholder Involvement.

**Contact**

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# Outlook

## BNN EVENTS & EVENTS SUPPORTED BY BNN

### FAME–EcoSys event

*14 April 2026 | Lund, Sweden*

FAME-EcoSys stands for Future of the European Advanced Materials Ecosystem and is implemented together with regional and national advanced materials communities.

It is organized in collaboration with SIO Grafen, IAM-I Association, and InnoMatSyn project.

The program will explore how advanced materials can move from fundamental research to market-ready products, featuring three panel discussions with perspectives from researchers, startups, established companies, and funding agencies.


The outcomes of the event will contribute to strategic initiatives such as the IAM-I Strategic Research and Innovation Agenda (SRIA), the InnoMatSyn advanced materials ecosystem development and funding strategies, and RTI strategies, and will be communicated to the European Commission, particularly in the context of the Advanced Materials Act (AdMa-Act).

View event details here.

### Lange Nacht der Forschung

*24 April 2026 | Graz, Austria*


The Long Night of Research is Austria's largest event dedicated to science, research, and innovation, aimed at all age groups. The event takes place every two years across Austria. In all nine federal states, you can discover—free of charge—what is often hidden: exciting, surprising, astonishing things!

With over 2,000 program highlights such as guided tours, workshops, lectures, live presentations, and hands-on experiments to marvel at and explore, the Long Night of Research offers something for everyone: for science professionals and those who aspire to be, for adventurers and the curious, for out-of-the-box thinkers, for tinkerers, for young and grown-up explorers, and for all who want to know things in detail.

View event details here.

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### BTechPro! Conference

*06-08 May 2026 | Sigulda, Latvia*

The International Conference for Young Scientists on Biorefinery Technologies and Products BTechPro! is a biannual conference with the aim of promoting the professional development of early career researchers and establishing contacts between research groups working on biomass processing challenges.

Deadline for extended abstract: **8 April 2026**.

View event details here.


**SETAC 2026 – SETAC Europe 36th Annual Meeting**

*17-21 May 2026 | Maastricht, The Netherlands*

Join us in Maastricht, the Netherlands, from 17–21 May 2026 for the 36th Annual Meeting of SETAC Europe – Europe's premier event. Embrace the Outlier: In Science, Regulations and Networks.

You can look forward to five days packed with on-site (poster and platform) presentation sessions, keynote lectures, satellite meetings, student mixers, and exhibitor and networking events.

Registration for the event already open!

Late abstract registration deadline: **29 April**.

View event details here.


**Carinthia innovates 2026**

*20 May 2026 | Lakeside Science & Technology Park in Klagenfurt, Austria*

Discover Carinthia's innovation and research landscape in a single day: meet leading researchers, technology companies, and ecosystem partners, explore cutting-edge projects, and build new networks and collaborations that drive the region forward.

View event details here.


### NILindustrialday 2026 – the 15th anniversary edition

*01-02 June 2026 | Berlin, Germany*

Thirty years have passed between the beginnings of NIL technology and today's state of the art. This technology has now left the pure development phase behind and found its way into a wide range of industrial and commercial applications.

Commercially available tools and materials are constantly opening up new application possibilities. The NILindustrial Day, now in its 15th year, serves as a link between industrial manufacturers of equipment and materials, users, and researchers, and has established itself over the years as one of the most important events in the industry. Speakers from all areas are looking forward to reporting on their work, successes, and trends

View event details here.

### Technologie Forum Millstatt 2026

*07-10 June 2026 | Millstatt, Austria*

At the Millstatt Technology Forum, Austria's technology-oriented universities present the potential that arises when excellence is pooled and targeted cooperation takes place.

The Millstatt TechForum stands for: Exchange. Networking. Shaping the future. Together with business, politics and society, impulses are set in motion that have an impact – beyond disciplines, sectors and the academic sphere.

The main topics for 2026 are:

- Quantum technology and artificial intelligence
- Water
- Mobility

View event details here.


**ETPN 2026**

*17-19 June April 2026 | Dublin, Irland*

The 21st Annual Event of the European Technology Platform on Nanomedicine (ETPN) will be hosted by RCSI University of Medicine and Health Sciences and will bring together the European nanomedicine community and the wider HealthTech ecosystem for three days of science, collaboration, and networking.

Key themes will include emerging therapies, nano-enabled diagnostics, precision medicine, advanced therapies, theragnostic, AI approaches, and clinical translation.

View event details here.

**35th Annual Conference of the European Society of Biomaterials**

*07-11 September 2026 | Antwerp, Belgium*

Organised by the Belgian Society for Tissue Engineering with chairs Sandra Van Vlierberghe (Polymer Chemistry & Biomaterials Group of Ghent University), Veerle Bloemen (KU Leuven), Liesbet Geris (ULiège).

View event details here.

# Finally

We hope you enjoyed reading our BNN QUARTERLY! Please do not hesitate to contact us if you have any suggestions or feedback!

Our next BNN QUARTERLY will be published in **July 2026** and will focus on the topic **"Women at the Forefront of Science & Innovation"**.

BioNanoNet members are welcome to send their contributions regarding this focus topic and articles about their scientific research by **5th of June 2026**! Articles on other topics can be published any time on the BNN website.

**Contact**
info@bnn.at

# Projects' Acknowledgements

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