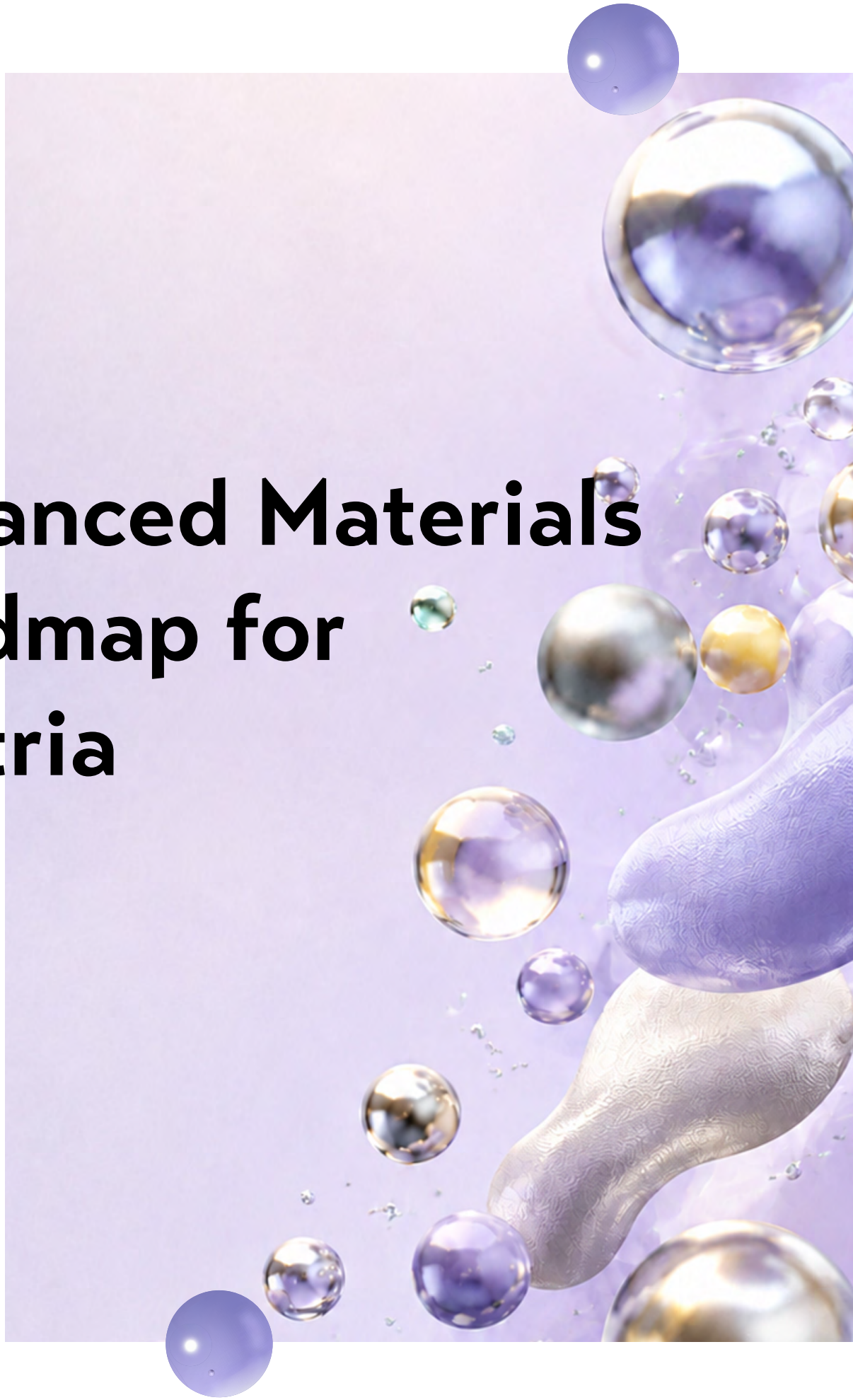
Advanced Materials Roadmap for Austria



Imprint

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[1]ATIMA – Austrian Advanced Materials Community (atima.at)

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Foreword

In January 2026, the Austrian Federal Government adopted the 'Austrian Industrial Strategy 2035'. In addition to the definition of framework conditions and measures for the further development of Austria as an industrial and business location, nine key technologies and fields of strength with high innovation and growth potential have been defined, which are to be strengthened in a targeted manner in the future. One of these key technologies is advanced materials. They enable lighter vehicles, more efficient solutions for energy storage, more environmentally friendly construction and improved health technologies. In addition, they serve as a basis for the development of other key technologies such as quantum technologies and robotics and enable the more resource-efficient production of electronic components. When used correctly - i.e. through safe and sustainable design - advanced materials enable the industrial transformation to a circular economy and sustainable and thus cost-efficient production. Advanced materials thus make a significant contribution to high value creation, increased productivity, product durability and thus to increasing the competitiveness of Austria as a business and industrial location.

Austria has outstanding expertise, for example in high-performance alloys, composite furnaces, plastics or smart nanomaterials, all of which are combined in the overarching key technology field of advanced materials. To translate these strengths into long-term competitiveness and technological sovereignty, it is important to close systemic gaps and make targeted investments in them. The road map now available serves as one of several important pieces of evidence for the design of future measures in this dynamic field of technology.

The roadmap identifies seven strategic fields of action: from targeted scale-up and industrial demonstration to positioning Austria as a location for sustainable advanced materials to the promotion of digitalisation and AI in materials development.

It is also essential to support material-related research, which should lead to better and more efficient products, with greater benefits and more safety for customers. This also includes internationalisation, the accompanying monitoring of the effects of these technologies for technology impact and risk assessment and the associated communication to the population.

In a broad-based participation process with the participation of the Austrian Advanced Material as Community, which is organised as part of the national networking platform 'ATIMA', stakeholders along the entire value chain for advanced materials were involved.

The challenges on the way from research to industrial application are complex. The roadmap provides concrete recommendations to expand pilot and demonstration infrastructures to accelerate the transition from research to production. It calls for the consistent provision of resources to exploit Austria's full potential in global competition.

This roadmap is intended as a living framework document that is to be further developed together with science, industry and politics. It is a tool to lead Austria to the forefront of the industrialised nations in this area with a specific focus on circular advanced materials and to secure our successful prosperity and social model in the long term.

I would like to thank all those involved for their committed contribution and invite all stakeholders to jointly implement the measures and activities identified in this roadmap.



Peter Hanke
Federal Minister for Innovation, Mobility and Infrastructure



01 Executive Summary

Advanced Materials (AdMa) are among the key technologies for Europe's competitiveness, innovative strength and sustainable transformation. They enable progress in areas such as **energy, mobility, electronics, production technologies, environmental technologies** and the health sector and thus form an essential basis for future industrial value creation.

Austria has excellent conditions to benefit from this development. A strong research landscape, internationally successful companies and long-standing expertise in materials science form a solid foundation for the further development of the location. **Advanced materials are not only a key technology, but also a cross-sectional technology** that supports and develops numerous Austrian strengths.

The aim of this roadmap is to create a **strategic framework** for the development of the Austrian Advanced Materials ecosystem for the next decade and beyond. The focus is on a clear approach: **building on existing strengths, occupying international niches in a targeted manner and using sustainability and the circular economy as strategic competitive advantages**.

Austria will not be able to play a leading role in all areas of materials development. Rather, the greatest opportunities lie in the targeted further development of existing competencies and in creating international visibility where scientific excellence, industrial implementation and market potential come together. The expansion of such fields of strength is intended to make a significant contribution to the **long-term competitiveness** of the location.

At the same time, sustainability, resource efficiency and resilience are becoming increasingly important. **Recyclable and bio-based materials, the reduction of critical raw material dependencies and the implementation of the Safe and Sustainable by Design** (SSbD) concept will become important drivers of future innovations. Austria offers good prerequisites for technological performance with sustainable added value and to establish itself **as a location for sustainable Advanced Materials**.

The roadmap identifies the following as key fields of action: the expansion of pilot and demonstration infrastructures, the greater use of digitalisation and artificial intelligence in materials development, the development of specialists and skills, the intensification of technology transfer and greater integration into European innovation and value creation networks.

The roadmap sees itself as a living document and is to be further developed together with the relevant actors from science, business and politics. Its goal is to position Austria as a relevant European location for innovative, sustainable and high-performance advanced materials and thus to contribute to the country's long-term competitiveness, technological sovereignty and sustainable transformation.

02 List of abbreviations

A2LT	Plattform ‘Austrian Advanced Lightweight Technology’
AdMa	Advanced Materials
ALPmat	Active Learning Platform for Accelerated Materials Design
AM-Austria	Technology platform to promote and support the Austrian additive manufacturing industry
ASMET	The Austrian Society for Metallurgy and Materials
ATIMA	Austrian Advanced Materials Community
BioNanoNet	BioNanoNet Association
BMIMI	Federal Ministry of Innovation, Mobility and Infrastructure
BNN	BioNanoNet Forschungsgesellschaft mbH
DRI	Direct Reduced Iron
FAIR	FAIR-Principles (Findable, Accessible, Interoperable, Reusable)
EU	European Union
HBI	Hot Briquetted Iron
LD	Linz-Donawitz Process, also known as Basic Oxygen Process (BOP)
KI	Artificial Intelligence
KMU	Small and medium-sized enterprises
MCL	Materials Center Leoben Forschung GmbH
MAPs	Materials Acceleration Platforms
nanoNET	nanoNET Austria Association
OECD	Organisation for Economic Co-operation and Development
OÖ	Upper Austria
v-trion	V-Trion GmbH
WKO	Austrian Federal Economic Chamber
WPMN	OECD Working Group: Working Party on Manufactured Nanomaterials

03

Introduction to Advanced Materials

The present roadmap creates a strategic orientation framework for the targeted further development of Austria's fields of strength in the field of advanced materials, bundling innovation potential and strengthening long-term competitiveness, technological sovereignty and sustainable transformation of industry and research. **Advanced Materials (AdMa) are among the central key technologies** of the 21st century. They form the basis for innovations along almost all industrial value chains and are essential for Europe's green and digital transformation.

From high-performance materials to functional surfaces and intelligent material systems to energy, quantum and microelectronic applications, they are increasingly determining the competitiveness of modern economies. At the same time, they make a significant contribution to the decarbonisation of industrial processes, energy efficiency, the circular economy and Europe's technological sovereignty and resilience.

The increasing importance of advanced materials is closely related to global transformation processes. These include the electrification of industrial systems, the digitalisation of production and material development, new requirements for sustainability and circularity, as well as geopolitical changes and critical raw material dependencies. Materials are thus increasingly becoming a strategic factor for industrial value creation, security of supply and international competitiveness. Accordingly, advanced materials are regarded at the European level as a critical technology area for economic security, industrial resilience and the open strategic autonomy of the European Union.

Advanced Materials enable progress in almost all fields of technology and applications.

These include, in particular:

- Energy and climate systems (climate neutrality, energy efficiency, renewable energy systems)
- AI, digitalisation and data-based production
- Semiconductors, electronics and quantum technologies
- Mobility and lightweight applications
- Industry, production and circular economy (resource-efficient and sustainable manufacturing systems)
- Medicine and health technologies
- Environmental technologies
- Circular developments that enable resilient value creation systems and strategic technological sovereignty (including supply chains and critical infrastructures).

The demand for advanced materials will increase significantly in the coming years, as shown in a recent potential analysis (see chapter 'Potential Analysis of Advanced Materials in Austria'). Key drivers include renewable energy systems, batteries and energy storage, emission-free buildings, modern semiconductor technologies and applications in the Healthcare industry, agriculture and packaging industry. At the same time, approaches to the substitution of critical and hazardous substances, the use of alternative raw materials and the development of recyclable, resource-efficient and bio-based materials are becoming important.

At the same time, the way materials are developed, produced and used is changing. Data-driven material development, artificial intelligence, digital twins, autonomous laboratories and digital research infrastructures are significantly accelerating innovation processes and creating new opportunities for cooperation between science and industry. This creates new innovation ecosystems that significantly advance the development of sustainable and high-performance materials.

Europe therefore sees Advanced Materials as a strategic future field for industrial innovation, sustainable competitiveness and technological sovereignty. At the same time, they make an important contribution to the implementation of the European Green Deal, the European Circular Economy Strategy and the Chemicals Strategy for Sustainability.

Austria has a strong basis in this field. A high-performance industry, excellent research landscapes and highly specialised competencies in materials science and technologies create the prerequisites for actively contributing to the development of the next generation of materials and industrial technologies. The close cooperation between universities, technical colleges, non-university research institutions and industrial partners creates synergies that accelerate the transfer of knowledge and technology and enable the rapid transfer of new material innovations into industrial applications. In this way, Austria strengthens its position in European and global value chains and makes a significant contribution to a resilient, sustainable and innovation-driven European economy.

OECD Working Description of Advanced Materials[2]

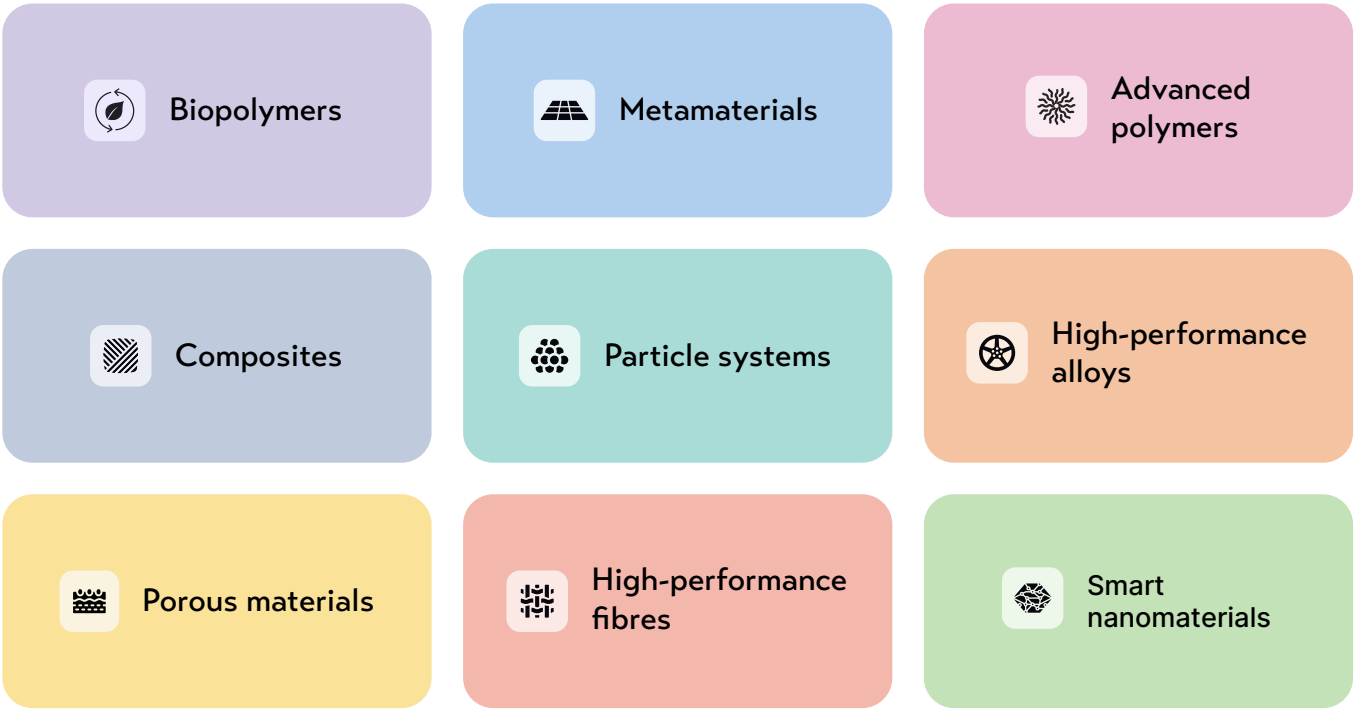
The OECD Working Party on Manufactured Nanomaterials (WPMN) has been dealing with the risks of nanomaterials for humans and the environment since 2006.

> *In this context, Advanced Materials (AdMa) means materials that are rationally designed to exhibit new or improved properties and/or targeted or improved structural features with the aim of achieving specific or improved functional performance. This includes both emerging materials and materials made from conventional materials. This also includes materials from innovative manufacturing processes that allow the creation of targeted structures from starting materials, such as bottom-up approaches. It is recognised that what is currently considered AdMa will change over time*

Over the years, it has become increasingly clear that government considerations on new materials should not be limited to 'simple' nanomaterials, as many of these (nano) materials have an additional complexity, e.g. a new or improved functionality and/or several components. This can lead to further challenges compared to 'simple' nanomaterials. They are part of a broader group of materials: the so-called 'advanced materials'.

[2] Advanced Materials: Working Description

Advanced Materials according to OECD



AdMa are described in the work description as materials that are characterised by their improved physical, chemical or biological properties as well as novel functions. These materials are the result of advanced scientific research and technical development and are used in innovative products and processes that surpass traditional materials in their properties.

Advanced Materials Ecosystem in Austria

The **ATIMA** initiative was developed as part of the ‘National Networking Platforms 2024’ call of the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (2024 BMK, now: BMIMI). The aim of this call was to promote topic-specific mobilisation and networking measures in strategically relevant technology fields, including various key technologies such as: digital technologies, production technologies as well as space and aviation technologies. Against the background of the increasing European and international importance of advanced materials, ATIMA was launched as a national platform initiative for bringing together Austrian players in the field of advanced materials.





The objectives of ATIMA are:

- bring together all actors in the community,
- to promote the exchange of knowledge within the community and beyond, in Austria as well as internationally,
- initiate joint innovation projects,
- to identify trends and innovative developments at an early stage, and
- to derive recommendations for action and positions for Austrian research and innovation policy from this and to communicate them to relevant decision-makers at national and European level.

An essential element of ATIMA is its broad national anchoring across the federal states.

Existing regional fields of strength, clusters and innovation areas are to be networked more closely with each other and integrated into a joint national strategy. Six national technology platforms and networks play an important role as multipliers for pooling expertise and strengthening the exchange between industry, research and regional actors.

ATIMA also acts as a central Austrian coordination and interface for the further development of the national Advanced Materials Roadmap, the systematic involvement of large, medium and small sized industry and science, as well as the targeted strengthening of young talent, training and qualification. In the long term, the initiative pursues a strategic time horizon up to 2035 – in line with the Austrian industrial strategy – with the aim of expanding existing areas of strength, addressing new future fields at an early stage and positioning Austria as a leading European business and science location in the field of advanced materials

The ATIMA Platforms

Within the ATIMA initiative, synergistically relevant technology platforms work together with the following thematic focuses: nanotechnology (nanoNET-Austria), bionanotechnology (BioNanoNet/BNN), lightweight construction (A2LT/Business Upper Austria), Smart Textiles (Smart Textiles Platform Austria/v-trion), Additive Manufacturing (AM-Austria), and Metallurgy (ASMET).

nanoNET-Austria association[3]: nanoNET-Austria is the network association for application-oriented research. The convergence and integration of nanotechnology as an opportunity that requires intensive cooperation between commercial and industrial users, manufacturers and research institutions is the focus of its activities.

BioNanoNet Association / BioNanoNet Forschungsgesellschaft mbH (BNN)[4]:The non-profit association

BioNanoNet, which is also operationally coordinated by BNN, has set itself the goal of strengthening innovative research by fostering collaborations and synergies between experts in the fields of health & safety, data & sustainability, and key technologies. With around 70 member organizations, BioNanoNet brings together a diverse network of experts and stakeholders, all dedicated to the advancement of research and development in these important areas.

A2LT / Business Upper Austria – OÖ Wirtschaftsagentur GmbH[5]: A2LT – Austrian Advanced Lightweight Technology is a platform that combines the expertise of Austrian companies and research institutions in the field of lightweight construction. Cross-industry and material-independent A2LT promotes exchange and innovation through collaboration, enabling achievements that exceed the capabilities of individual members. Through international networking, knowledge sharing and joint development, A2LT drives progress in lightweight technology and strengthens the global competitiveness of its members

Smart Textiles Platform Austria/ v-trion[6]: The Smart Textiles Platform Austria is a dynamic network that unites over 80 international companies and research institutions. The aim of the platform is to promote innovative solutions and products in the field of intelligent textiles and to exploit their potential in a wide range of application areas – from fashion and medicine to the automotive industry.

AM-Austria / Additive Manufacturing Austria (AM-Austria) e.V[7]: AM-Austria is a technology platform to promote and support the Austrian additive manufacturing industry. By bringing together key players from industry, science, education, media and politics in a single organization, AM-Austria has established itself as a leading association in the field of additive manufacturing (AM). With 92 institutional members and close cooperation with the Federal Ministry of Innovation, Mobility and Infrastructure (BMIMI), AM-Austria functions as a central point of contact for the national AM sector. Its mission is to promote interdisciplinary exchange, facilitate international knowledge transfer and strengthen Austria's position as a competitive player in the global AM industry.

ASMET[8]: 'The Austrian Society for Metallurgy and Materials' is a non-profit association. The purpose of the association is to promote metallurgy, materials science and the associated processes in scientific, technical and economic terms.

Potential Analysis of Advanced Materials in Austria (Executive Summary)

In 2025, the BMIMI commissioned a potential analysis of advanced materials in Austria, which was completed in June 2026. The following excerpt from the executive summary of this study is intended to provide an insight into its findings, which provides complementary information to the roadmap.

The study, conducted by the company Brimatech[9], is based on a multi-stage methodological approach. In addition to a literature and documentation analysis, an Austria-wide online survey (133 adjusted responses), a short survey of selected WKO trade associations (six professional associations) and three guideline-based expert interviews were conducted. The aim was not to provide a complete statistical quantification of the entire material sector, but rather to take stock of key competences, potentials and needs for action.
For the study, an Austrian working definition of advanced materials was developed: Advanced materials are specifically developed and designed materials with new or significantly improved features and functions. Based on this, a distinction was made between four classes of materials: structural and high-performance materials, functional and intelligent materials, nanostructured and hybrid materials, and bio-inspired and sustainable materials. This classification serves as an analytical grid to systematically map the Austrian landscape according to material competences, fields of application and development potential.

[3] nanonet.at
[4] bnn.at
[5] a2lt.at
[6] smart-textiles-platform.com
[7] am-austria.com
[8] asmet.org

The Austrian advanced materials ecosystem is broadly positioned and organised across multiple regional hubs. It includes universities, non-university research institutions, cooperative research centres, large companies, SMEs, start-ups, clusters, platforms, trade associations, funding agencies and public bodies. Competence areas are particularly visible in Styria, Vienna and Upper Austria, although other federal states have relevant material-related competences. Thematic areas of strength consist of high-performance metals, polymers and composites, lightweight construction, additive manufacturing, micro-electronics, sensory, photonic, and power electronics, surface and coating technologies, tribology, bio-based and circular material systems, as well as smart textiles.

***The empirical survey** shows that advanced materials are already of great strategic importance for many organizations in Austria. The stakeholders surveyed are active along the entire value chain, in particular in material characterisation and testing, material design and development, basic research, material production and synthesis, system integration, circular economy and recycling, as well as quality control, certification, consulting and regulation. This means that Austria has a strong research and competence base as well as relevant industrial points of contact.*

***The assignment of the material classes to areas of application** shows clear patterns. Structural and high-performance materials are particularly strongly associated with mobility, lightweight construction, vehicle and aerospace applications as well as alternative drive systems. Functional and intelligent materials are closely linked to electronics, sensor technology, digitalisation, energy and health technologies. Nanostructured and hybrid materials are particularly relevant for electronics, energy, surface technologies and health. Bio-insulated and sustainable materials are particularly relevant for health, mobility, construction, packaging and the circular economy. Energy, health, mobility and electronics are seen as the areas with the greatest future potential.*

At the same time, all survey steps unanimously show that the greatest challenges are not primarily a lack of research capability, but the transition from research and development to industrial application. Central barriers are low technology maturity levels, difficult scaling, high costs and uncertain return on investment, lack of scale-up, pilot and demonstration infrastructures, the integration of new materials into existing systems, regulatory requirements, lack of data on exposure and toxicity, shortage of skilled workers, and dependencies on critical raw materials and global value chains.

The feedback from the WKO trade associations and the experts confirms this assessment. Austria has strong research, training and niche competencies, but needs to transfer them more strongly into industrial application, market launch and value creation. Particular emphasis is placed on the need for clear strategic priorities, larger consortia, better transfer mechanisms, suitable scale-up funding instruments, entrepreneurial exploitation competence, regulatory orientation, European networking and greater visibility of advanced materials as an independent key technology field.

The central conclusion of the study is that Austria has a strong research base in the field of advanced materials, relevant industrial competencies and active network structures. However, in order to generate additional value creation, international visibility and contributions to industrial transformation, stronger strategic bundling, clear priorities, better scale-up conditions, digital tools, sustainable material strategies, regulatory orientation and active involvement in European initiatives and value chains are needed.[10]

[9] Brimatech Services GmbH;
[10] Advanced Materials – Potential of Advanced Materials in Austria, BMIMI, 2026 (before publication)

Reference to the Austrian Industrial Strategy 2035[11]

The importance of advanced materials is also reflected in the Austrian industrial strategy 2035. There, advanced materials are defined for the first time as one of nine central key technology fields that are of strategic importance for the future competitiveness and transformation of Austria as an industrial location.

1. Artificial Intelligence and Data Innovation
2. Chips, Electronic Components and Systems
3. Advanced production technologies and robotics
4. Quantum technology and photonics
5. **Advanced Materials**
6. Life-Sciences & Biotech
7. Energy and Environmental Technologies
8. Mobility technologies
9. Space and aeronautical technologies

At the heart of the industrial strategy is a technology-neutral key technology offensive, which is intended to specifically strengthen those technology fields that have a high potential for innovation, growth and spillover for Austria. Advanced materials play a special role in this, as they enable numerous industrial applications as a cross-sectional technology and further develop existing Austrian strengths. New materials such as ultra-light composites, self-healing polymers, multifunctional biomaterials or high-performance alloys improve performance durability and sustainability of products in a wide range of industries – from metal processing over energy and medical technology to mobility and aerospace.


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Advanced Materials in the context of the Austrian Industrial Strategy 2035

Advanced Materials as a Strategic Strength of Austria as an Industrial Location[12]

The manufacturing industry is an essential pillar of the Austrian economy. It secures value creation, employment, export success and technological innovation far beyond the borders of individual sectors. At the same time, industry has been undergoing profound change for years. Digitalisation, automation, new requirements for sustainability and the circular economy, changed global value chains as well as social and geopolitical developments are shaping the industrial environment more than ever.

The '**Platform Industry 4.0 Austria**' has been accompanying this transformation since its founding in 2015. The platform sees itself as a network and dialogue forum of business, science, politics and social partners with the aim of strengthening the competitiveness of the Austrian production site through technological innovations and actively shaping the transformation of industry. The focus is on intelligent production, the use of digital technologies and the development of long-term strategies for key future fields of industry.

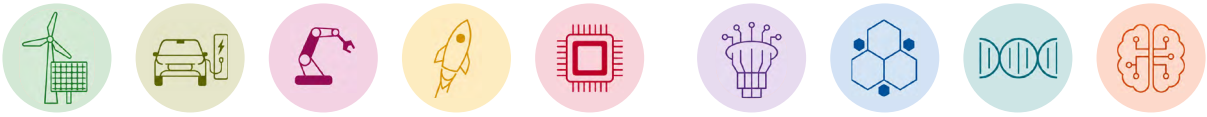
Change has become the norm for Austrian industry. Technological upheavals, increasing automation, new demands on energy and resource efficiency as well as geopolitical shifts require companies to be highly adaptable. Especially in such a volatile environment, it is crucial to have a clear understanding of one's own areas of strength: those areas in which Austria has unique competencies, in-depth process knowledge and internationally visible competitive advantages.

Materials and their processing are a particularly important field of strength. Materials form the basis of numerous industrial innovations and are often the invisible building blocks of modern value creation. Their properties determine performance, sustainability, energy efficiency and functionality of products and technologies along the entire value chains.

Austria has an exceptionally broad and at the same time deeply rooted competence landscape in this area. Numerous companies, research institutions and training institutions work along the entire value chain – from raw material extraction and material development to industrial processing and application. Metal and plastic processing, for example, has been one of the country's core industrial areas for decades. Its innovative strength is essentially based on a deep understanding of materials and their processing.

In addition, Austria has been one of the world's recognised innovation centres in the field of materials for decades and has fundamentally shaped modern steel production with the LD process developed in the 1950s. The close cooperation between industry, research and universities enables continuous progress in high-performance steels, light metals and functional materials. Austrian companies occupy a leading global position in several niches, such as rail steels, tool steels, high-performance wires or refractory materials for the steel industry. With their high quality and technological specialisation, these materials supply customers all over the world. Austria is thus an example of the successful combination of traditional industrial and innovative materials research.


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Newer, hydrogen-based direct reduction processes enable the production of sponge iron (DRI/HBI) without fossil fuels and can – when using green hydrogen and renewable electricity in the electric steel process – reduce CO_2 emissions by 80 to 95 percent compared to the blast furnace LD converter route. With pilot and demonstration projects such as H2FU-TURE15 and Hy4Smelt16 as well as the green-tec steel programme, Austria is playing a pioneering role in this area, which could shift global steel production towards climate-neutral steelmaking processes.

Mining also plays an important role. In the current debate on European sovereignty, the availability of critical raw materials is often discussed. However, the competencies in the mining and processing of these raw materials are at least as relevant. It is precisely in this area that Austria has capabilities that are often underestimated by European standards. In many areas, the country takes on the role of a 'hidden champion' and has know-how that goes far beyond its geographical size.

Materials have a long tradition in Austria. For generations, various institutions have stood for excellence in material-related areas such as: mining, metallurgy, materials science, etc. At the same time, the topic is clearly oriented towards the future. Year after year, Austrian companies prove on international markets that innovations in the field of advanced materials and their processing make a significant contribution to the country's competitiveness.

Against this background, we expressly welcome the inclusion of 'Advanced Materials' as a strategic element of the Austrian industrial strategy. Equally important is the development of the present sector-specific Advanced Materials Roadmap, which provides orientation for an extraordinarily diverse industry and shows common perspectives for the future. It offers the opportunity to make existing strengths visible, to tap into new cooperation potentials and to strengthen Austria's international position in the field of advanced materials.

For Platform Industry 4.0 , cooperation with the various key organisations and competence networks is of central importance. The ATIMA project plays a particularly valuable role. ATIMA networks stakeholders from science, business and public institutions, bundles existing competencies and creates visibility for Austrian activities in the field of advanced and innovative materials. By bringing together established networks from areas such as metallurgy, nanotechnology, lightweight construction, additive manufacturing or smart textiles, there is an important, central hub for knowledge transfer, cooperation and strategic development in Austria. In this way, ATIMA makes a significant contribution to strengthening the Austrian innovation ecosystem in the field of advanced materials.

Advanced materials combine industrial tradition with a technological future. They are an area in which Austria has internationally recognised strengths and at the same time a field that will be decisive for Europe's industrial competitiveness. The present roadmap can help to leverage this potential and create the basis for the next development steps.

MaterialsCommons – Relevance to Austria

The importance of digital methods and infrastructures for accelerating and increasing efficiency in the development, production and application of advanced materials is of high relevance to Austria.

Development, production and use of advanced materials is a central prerequisite for the technological competitiveness of Europe and Austria in particular. Advanced manufacturing substances are the key to innovations in numerous industrial value creation systems – from the energy and mobility transition to electronics and sustainable production. In this context, digital tools and infrastructures are playing an increasingly decisive role. They form the basis for a significant acceleration along the entire material-related innovation process.

Traditionally, materials development has been characterised by time-consuming and cost-intensive experimental processes, which often take place in isolation in individual organizations or disciplines. This fragmentation leads to inefficient use of existing data and methods and makes the reuse of existing knowledge considerably more difficult. Materials Acceleration Platforms (MAPs) are digital infrastructures that address precisely this challenge by systematically integrating data, models and processes and making them accessible. As a result, they enable data-driven material development in which experimental, simulation-based and data analysis approaches are intelligently combined.
Central elements of this transformation are the creation of semantic foundations and standards for material data as well as interoperable data spaces that ensure the exchange and interpretability of data. This maximises the availability, quality and reusability of data. At the same time, material development itself is accelerated by an improved data basis and redundant experiments are avoided.

Against this background, joint European initiatives such as MaterialsCommons are of particular strategic importance. The mission of MaterialsCommons aims to promote innovation and cross-sectoral collaboration in materials science by building a user-centreed digital infrastructure. This infrastructure is intended to seamlessly connect researchers and developers from different organizations in industry and academia, provide semantic and easy access to expertise, material data, workflows and software tools for materials research and development, and standardise procedures for creating and making this data available according to the FAIR principles (Findable, Accessible, Interoperable and Accessible).

Materials Commons is also based on a cooperative architecture, which creates a decentralised, yet networked infrastructure that ensures both the sovereignty of data holders and the necessary collaboration across organizational and sectoral boundaries. The integration of existing platforms into the overarching infrastructure of MaterialsCommons creates a powerful ecosystem that combines national strengths with European initiatives. This addresses current limiting challenges of fragmentation of the research landscape and incompatibility of data and tools to achieve a data and knowledge-centricity where the meaning of data is consistent and precise, while it can flow across sectors and along the value chain. This is essential for achieving the overarching goals of innovative advanced materials in Europe.

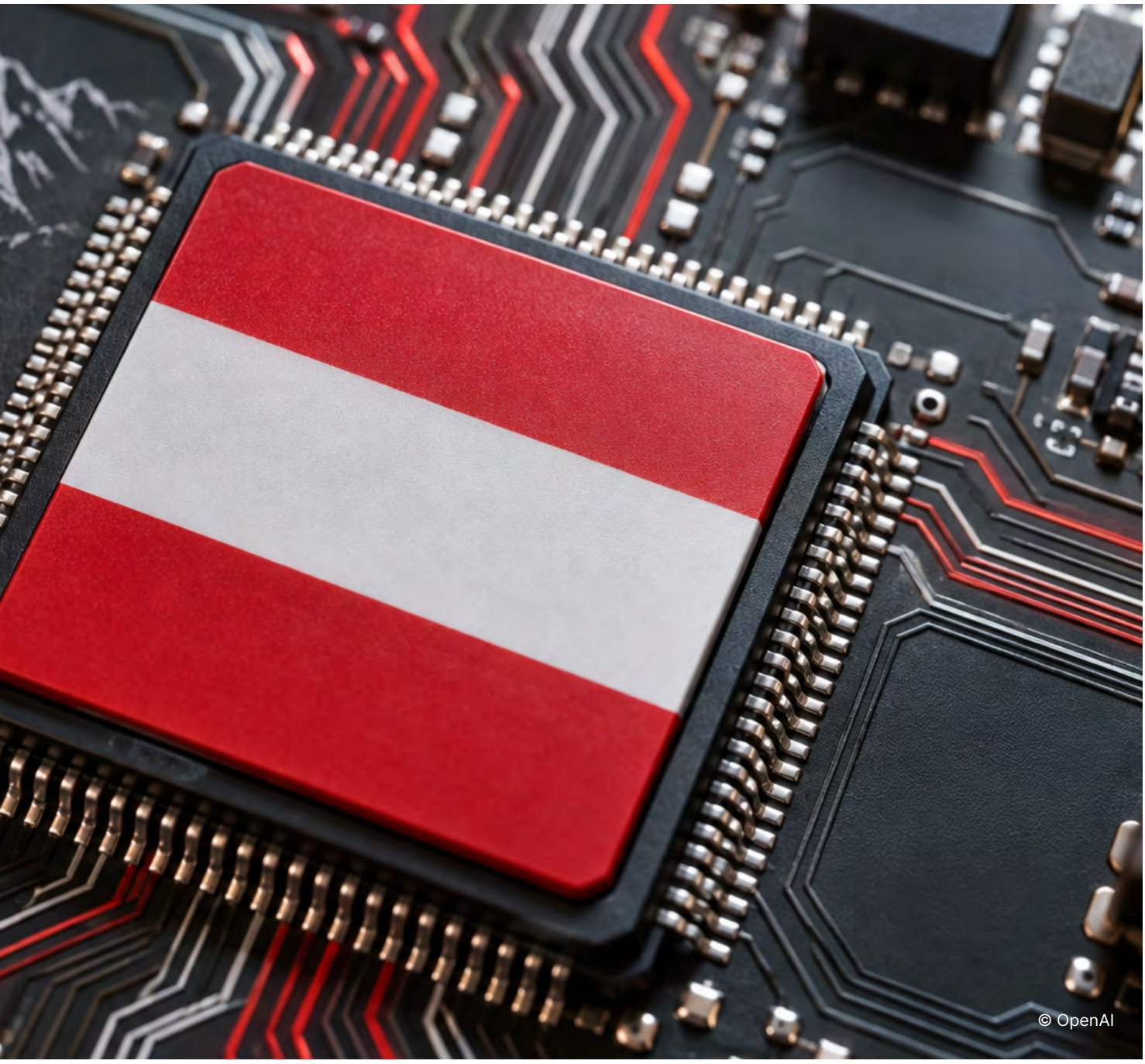
[11] Industriestrategie.pdf
[12] This article was submitted by Michael Fälbl, Plattform Industrie 4.0
[13] Platform Industry 4.0;
[14] LD process: 'Linz-Donawitz process', production method for steel production;
[15] H2Future
[16] Hy4Smelt

For the Austrian Advanced Materials Roadmap, this results in a clear mandate for action: The development and integration of national competencies into such European and international digital infrastructures are crucial to remain competitive in the long term. The Materials Center Leoben (MCL) as the Austrian representative, business implementation manager and national hub in MaterialsCommons represents the starting point to the newly created European digital material infrastructure. MCL can function here as an integrative hub that applies data, methods and competencies from MaterialsCommons and can also integrate them into the central digital infrastructure. With the ALPmat platform developed at MCL, there is also a digital infrastructure in Austria as an interface. This platform already integrates high-end experimental investigation methods, high-throughput experiments, advanced simulation techniques and data-driven models into end-to-end digital workflows. This drastically shortens material innovation cycles and at the same time improves the quality and performance of new materials, processes and products. ALPmat is an example of the transformation towards systematic, digital and automated material engineering.

In summary, it can be said that digital infrastructures play a key role for the future of advanced materials in Austria and Europe. They not only enable a significant acceleration and increase in efficiency of innovation processes but also create the basis for greater accuracy in the development of new environmentally and resource-friendly materials. Initiatives such as MaterialsCommons provide the strategic framework for cross-sectoral, data-driven cooperation. In combination with the technological and methodological expertise of key regional institutions, a powerful innovation ecosystem is emerging that will significantly support the implementation of the Austrian Advanced Materials Roadmap.



[17]This article was submitted by Werner Ecker, Materials Center Leoben Forschung GmbH.
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Advanced Materials in the European Ecosystem

With the Communication 'Advanced Materials for Industrial Leadership'[19] of 27 February 2024, the European Commission has established a coherent strategic framework for advanced materials for the first time. These are understood as specifically developed materials with novel properties and are classified as a key technology for Europe's competitiveness, resilience and strategic autonomy.

From the EU's point of view, advanced materials are a central enabler of green and digital transformation ('twin transition'). They enable innovations in areas such as renewable energies, batteries, semiconductors, construction, mobility or health, while at the same time contributing to the substitution of critical raw materials, the circular economy and the reduction of environmental pollution. Against this background, the strategy pursues the goal of building an integrated European materials ecosystem that systematically combines research, industrial implementation and market integration and thus secures Europe's technological leadership role in the long term.

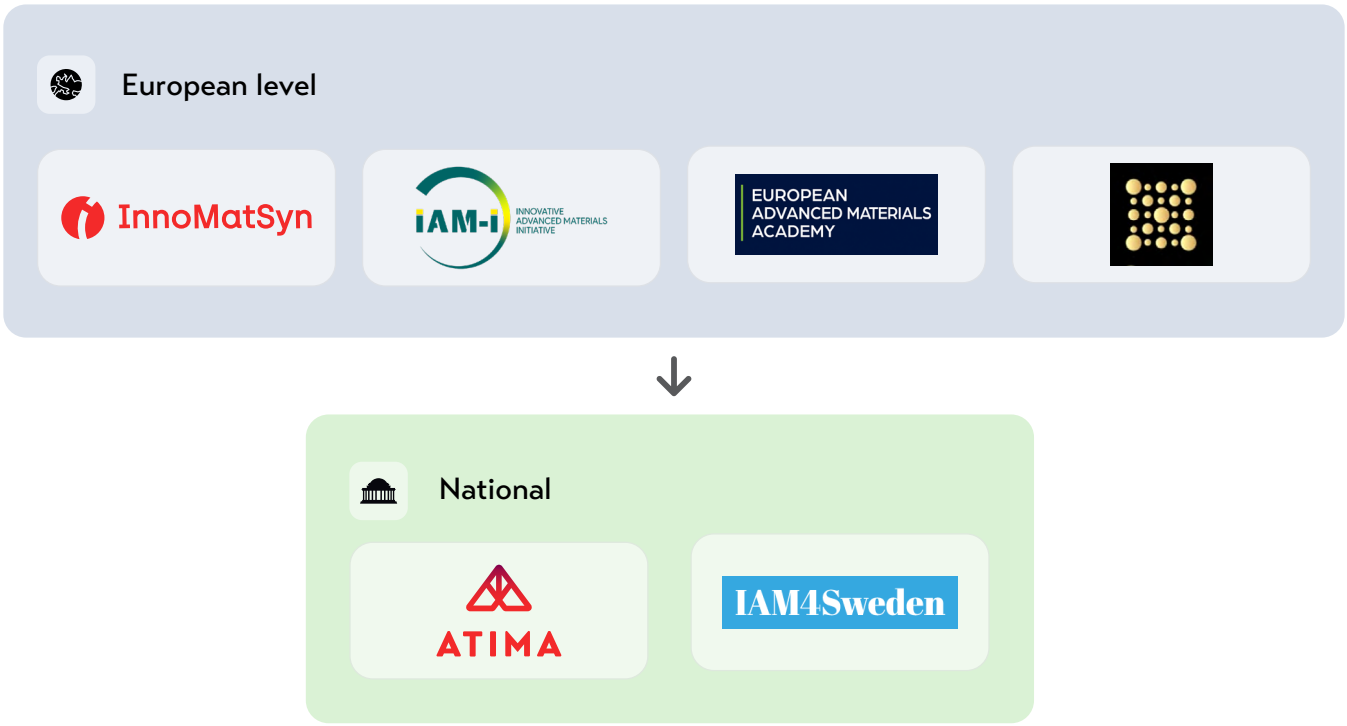
Integrated policy and innovation approach

The European Advanced Materials Strategy is not designed as an isolated initiative, but as a cross-cutting strategy within European industrial, innovation and transformation policy. It is closely linked to key EU programmes and legislative initiatives:

- European Green Deal[20]: Advanced Materials are a fundamental prerequisite for climate-neutral technologies and sustainable production systems.
- Net Zero Industry Act[21]: Advanced Materials drive the development and scaling of key net-zero technologies (e.g., batteries, hydrogen, renewables) and support their industrial production in Europe.
- Critical Raw Materials Act[22]: Advanced Materials make a significant contribution to reducing strategic dependencies, for example through substitution, more efficient use and recycling critical raw materials.
- Chips Act[23]: Advanced Materials are essential for the development of the next generation of semiconductor technologies and thus for Europe's digital sovereignty.
- Horizon Europe[24]: The central financing instrument for the implementation of the strategic research and innovation goals in the field of advanced materials.

In addition, initiatives such as the **IAM-I Association** (Innovative Advanced Materials Initiative)[25], the international network of funding organisations **M-ERA.NET**[26] (Strengthening the European advanced materials ecosystem through transnational Programme collaboration), and the EU project InnoMatSyn[27] are specifically building structures for better coordination of actors, funding instruments and value chains. While IAM-I strengthens the strategic alignment of research and industrial needs at the European level through the management of the **IAM4EU**[28] partnership, M-ERA.NET has been promoting transnational R&D projects in the low to medium TRL sector for many years, thus closing a gap in the European funding landscape. InnoMatSyn focuses on establishing the Advanced Materials ecosystem as an umbrella across such initiatives to network regional, national and European activities as well as leveraging synergies in the innovation system. For the next Framework Programme, a continuation of this partnership as IAM4EU+ in accordance with the **Advanced Materials Act** (Q4 2026, European Commission) is envisaged. In addition to the European Partnership on Advanced Materials, Austria also participates in the EU-co-financed partnership **RAMP**[29] (The Raw Materials Partnership for the Green and Digital Transition) on Raw Materials. The aim is to ensure the diversification of the supply of critical raw materials and materials and to significantly reduce dependence on imports. RAMP supports international research and innovation projects.

Advanced Materials Ecosystem



Other initiatives worth mentioning are the **European Advanced Materials Academy**[30] led by the EIT Raw Materials, as well as the **MaterialsCommons**[31] project, which aims to connect existing national digital material infrastructures (e.g. PMD in Germany, DIADEM in France, CAPEX in Denmark, ALPmat in Austria) into a common European infrastructure and is coordinated by the Fraunhofer Institute for Mechanics of Materials in Germany.

This will create an increasingly integrated, multi-level coordinated innovation ecosystem for advanced materials in Europe.

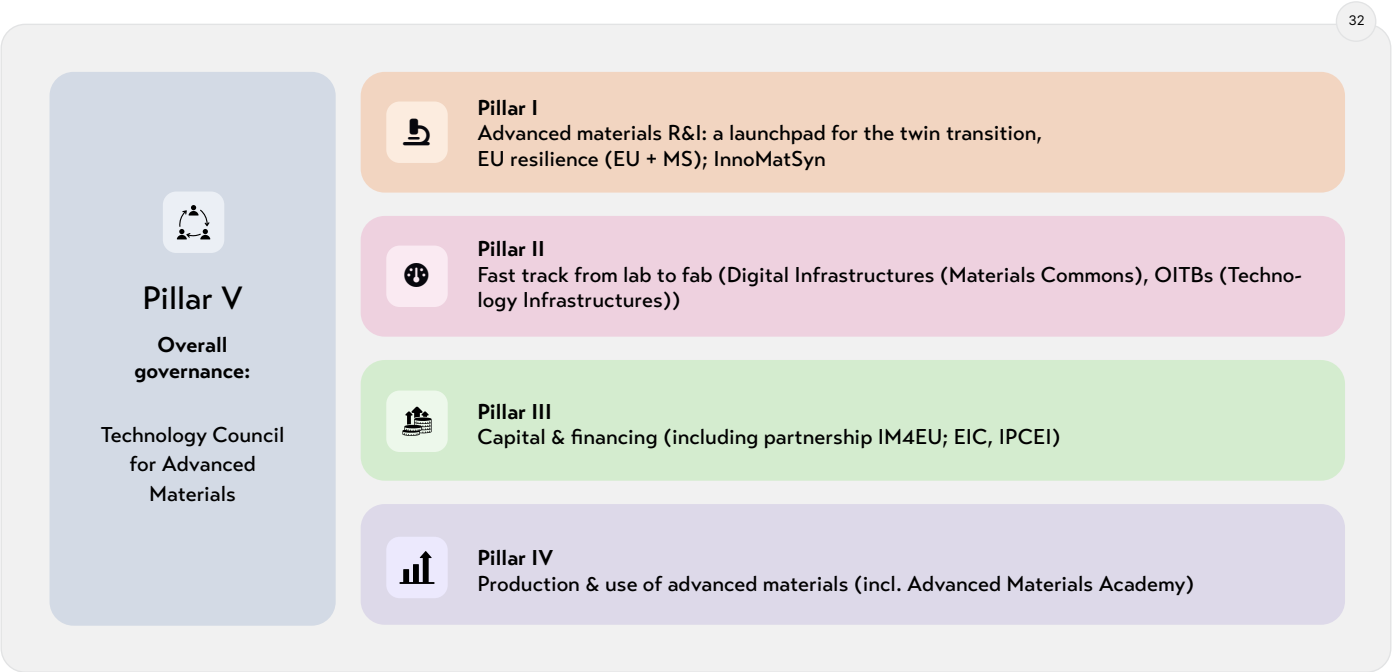
[19] Advanced Materials for Industrial Leadership.pdf
[20] European Commission: Directorate-General for Research and Innovation, European Green Deal – Research & innovation call, Publications Office of the European Union, 2021
[21] Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724 (OJ L, 2024/1735, 28.6.2024)
[22] Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020
[23] Regulation (EU) 2023/1781 of the European Parliament and of the Council of 13 September 2023 establishing a framework of measures for strengthening Europe's semiconductor ecosystem and amending Regulation (EU) 2021/694 (Chips Act)
[24] European Commission: Directorate-General for Research and Innovation, Horizon Europe – The next generation of European partnerships – Contributing to a greener and more digital Europe, Publications Office of the European Union, 2021
[25] IAM-I
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[28] Innovative Materials for Europe' (IAM4EU) - Horizon Europe Partnerships
[29] ramprawmaterials.eu
[30] eitrawmaterials.eu/education-skills/european-advanced-materials-academy
[31] materialscommons.eu

Five fields of action as an implementation framework

To implement this strategic objective, the European Commission defines five closely interlinked pillars of action that operate along the entire value chain.

[32] Graphic created at BNN, Derived from: Advanced Materials for Industrial Leadership

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Pillar I
Research and innovation

Strengthening the European knowledge base through coordinated research priorities, joint investments and new digital infrastructures (e.g. MaterialsCommons). The aim is to position Europe as a leading location for materials innovation.

Pillar II
Accelerating the transition from research to production

Shortening innovation cycles through pilot plants, test infrastructures, digitalisation and closer integration of science and industry.

Pillar III
Mobilising capital and financing

Strengthen investment mechanisms and partnerships, under Horizon Europe, to overcome scaling barriers and enable industrial implementation.

Pillar IV
Promotion of industrial application

Strengthening demand and market launch through standardisation, public procurement and qualification measures along the entire value chain.

Pillar V
Governance and European coordination

Establishment of a coordinated governance framework, including through a Technology Council for Advanced Material that systematically supports cooperation between Member States, industry and research. These five pillars specifically address existing structural weaknesses in Europe, in particular the fragmentation of research and innovation, slow industrialisation processes and insufficient private investment.

Strategic importance for the European transformation

Overall, the European Strategy for Advanced Materials pursues a systemic approach, technological development, industrial value and political frameworks.
Advanced Materials will be positioned as a central enabling technology for Europe's industrial transformation:

- They enable technological breakthroughs in key climate-relevant and digital industries.
- They strengthen the resilience of European supply chains and reduce strategic dependencies.
- They promote sustainable production methods and a circular economy.
- In this way, they make a decisive contribution to the development of a resilient, sustainable and innovation-driven European industrial ecosystem and form an essential basis for Austria's long-term competitiveness in the European and global context.



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04

Objectives of the Roadmap

The Austrian Advanced Materials Roadmap aims to serve as a guideline for research, industrial development and political measures. Attention is paid to inclusiveness in the involvement of relevant actors from industry, science, politics, etc. Nevertheless, due to the voluntary nature of participation in strategic developments, no claim is made to completeness.

The starting point is the current state of technology (state-of-the-art), a far-reaching survey of the current landscape of research and development with a specific focus on important industries in which advanced materials play a key role, e.g. mobility, electronics, construction, healthcare and energy. In addition to these sectors mentioned at the European level, MedTech and environmental technologies are highly relevant specifically for the Austrian ecosystem, and as identified in the Industrial Strategy 2035, advanced materials should be classified as a separate economic sector or key technology field.

By implementing the options for action outlined in the roadmap, national and European competitiveness can be strengthened, specific strengths as niche strengths and Europe is brought into a leading role in global competition. The decisive factor for long-term success is the consistent increase in resources for groundbreaking scientific research, which is subsequently built up and expanded in the direction of industrial use.

From the authors' point of view, it will be necessary to:

- to consider the topic of Advanced Materials as a separate sector,
- to dedicate at least 150 million euros per year from national science and economic development funds to this sector in the federal budget,
- to join **forces nationally in the long term and integrate them into the European ecosystem**.

05 Methodology and roadmap development process

The development of the roadmap was carried out in a multi-stage, participatory process that combines qualitative survey formats with strategic analysis. Various workshop and discussion formats were carried out as part of the ATIMA project to capture key topics, trends and challenges. These included, in particular, a **national multi-stakeholder** workshop in the course of the ATIMA Workshop & BNN Networking Event in Vienna (March 2025) with broad participation of stakeholders from science, industry, public administration and international institutions, as well as supplementary interactive surveys (including Mentimeter), **small group discussions** and an accompanying online questionnaire. At the same time, as part of the IMAGINE25 – the BMIMI's innovation forum in cooperation with the FFG – further perspectives from politics, research, business and civil society were integrated into a **thematic ideas workshop** on advanced materials. The results achieved there are based on moderated group work, structured discussions and subsequent prioritisation and reflection in the plenary session and complement the previously identified topics with strategic impulses and systemic issues.

The results of this early process phase were documented, compiled and integrated into the further analysis. Based on this, a **structured stakeholder** survey was carried out in the form of an online survey, which was disseminated via the ATIMA platforms and beyond to relevant stakeholders along the value chain. A total of 76 qualified responses were received. The survey served to systematically evaluate and prioritise challenges, development needs and fields of action along the material and innovation chain. In addition, an analysis of relevant European strategy documents and initiatives was carried out to place the identified topics in an overarching innovation and industrial policy context and to ensure connectivity at the European level.

In the course of several rounds of consultations on the draft roadmap, which were carried out with representatives of the federal states, the BMIMI and experts from all over Austria, the contents of the document were reflected on and optimisations were made. In particular, the catalogue of actions and measures as well as the fields of action were reviewed in this process, which lasted several months.

The roadmap is seen as a living document, with which periodically recurring updates are to be carried out to obtain the best possible balanced information situation over time due to a variable feedback structure. The current version shows a strong participation of the metalworking and metal-related industries. Due to the temporal proximity of relevant activities in this environment (MaterialsDay of the mobility industry, lightweight construction events, etc.), the great interest in advanced materials in this sector is conclusive.

06

Results from the surveys[33]

Strategic relevance

The feedback shows that the strategic relevance of Advanced Materials in Austria is largely due to its close link with existing industrial strengths. The importance for the automotive supply industry, steel and metal processing, mechanical and plant engineering, lightweight construction, environmental technologies and electrification (electric motors, generators) is particularly frequently emphasised. Several contributions emphasise that Austria has strong market positions in individual material segments – such as refractory metals, carbides or special alloys, as well as plastics or (bio)polymers – up to global niche leadership, which are crucial for value creation, jobs and innovative strength and must be secured in international competition. At the same time, reference is made to existing dependencies on non-European markets and the importance of regional production and raw material availability is emphasised. A recurring motif in the feedback is also the role of advanced materials for sustainability, resource efficiency and circular economy, in particular through recycling, the use of secondary raw materials and the safeguarding of domestic material flows. In addition, potentials in fields of application such as sensor technology, medical technology, microelectronics, printed electronics and nanotechnology are highlighted, often in connection with existing research and industrial competencies in Austria. Individual feedback also addresses challenges such as social acceptance issues or structural framework conditions. Overall, the responses reflect that, from the point of view of the stakeholders surveyed, advanced materials play a central role in securing Austria's industrial competitiveness, technological independence and future innovation potential.

Specific requirements

The feedback also shows a clear need for action for Advanced Materials in Austria that is graded along the entire material and innovation chain. The focus is on securing the material and raw material base in the long term. Particular emphasis is placed on the availability of critical raw materials within Europe, the preservation of domestic material flows – for example in the area of recycled materials – and the development of suitable substitution solutions. At the same time, there is a need to expand the use of secondary and bio-based raw materials in a targeted manner and to better understand their properties in order to be able to ensure high quality and performance requirements in the long term.

Building on this, research and understanding of materials are seen as a central prerequisite for future innovation and competitiveness. The respondents particularly emphasise the need for in-depth knowledge of material behaviour, microstructure-property relationships and complex material science phenomena such as embrittlement, phase reversalandor the effects of recycled content on material properties. This development of knowledge is to be strengthened by long-term basic research as well as by application-oriented research programmes. Close cooperation between science and industry as well as access to specialised research infrastructure, modern characterisation methods and data-driven development are essential approaches.

Another strategic focus is on the industrial implementation and scaling of new materials and processes. The transfer of developments from the laboratory to industrial applications continues to be perceived as a central challenge. Requirements for process stability, quality assurance, standardisation, qualification and approval, as well as the integration of new solutions into existing production environments are particularly relevant. At the same time, there is a need for the further development and optimisation of manufacturing technologies, from classic metallurgical processes to additive, pressure-based or roll-to-roll processes. In addition, the importance of robust models and simulations is emphasised in order to validate industrial applications at an early stage and make them scalable.

In addition to research and production, the market penetration of new materials is also addressed as a strategic field of action. The responses point to the need for greater harmonisation of requirements along the value chains, for example between suppliers and OEMs, as well as the need to position new materials in a targeted manner in international competition. This includes ensuring suitable sales markets, accelerating qualification and approval processes, and making visible economic and technological advantages over established solutions. In addition, fair competitive conditions and dealing with international price distortions are cited as essential framework conditions.

The feedback also underlines the importance of suitable funding and framework conditions as well as stronger networking of the stakeholders. In particular, sufficient funding is mentioned along all development phases – from basic research and pilot projects to demonstration plants, topic-specific calls for proposals and companies, support services for high-risk projects. The need for interdisciplinary cooperation, regulatory adaptation and appropriate standardisation processes and measures to promote the circular economy and sustainable materials. Overall, the need for an integrated strategic approach, material development, industrial scaling, market launch and suitable framework conditions.

[33] surveys on the Austrian Advanced Materials (AdMa) Roadmap – your expertise is in demand

Category	Mobility	Energy	MedTech	Electronics	Con	Environment
Advanced Alloys	25	20	15	18	12	10
Composites	12	8	6	7	9	10
Advanced Polymers	4	5	4	5	4	5
Biopolymers	2	3	5	2	2	4
Porous Materials	2	3	2	3	2	3
Smart Nanomaterials	3	4	5	6	2	3
High-performance Fibres	2	1	2	2	0	1

less 0-2 3-5 6-10 11-15 16-25 more

Heatmap of the mentioned areas/sectors and categories[34]

The results of the surveys were listed in the following 'heat map' according to the nine material categories of the OECD working specification on Advanced Materials (one mention per material), whereby the experts were able to assign one or more fields of application to each material. This takes into account the fact that a material can be relevant for different fields of application. It should be noted here that no mentions were received for the areas of 'metamaterials' and 'particle systems'.

The four sectors of mobility, energy, electronics and construction are based on European strategy documents (Materials Manifesto[35], Materials 2030 Roadmap[36] and Materials). AMI2030-strategic materials agenda[37]), whereas, in addition, **MedTech** (in-vitro diagnostics, medical devices, pharmaceuticals) and environmental technologies are identified as specific strong fields of application in Austria could be identified. At the time of the survey and on the basis of the contributions received from Austrian experts, it can be deduced from the heat map that in Austria (in addition to the four AdMa sectors) niche strengths exist in the two fields of application mentioned above.

In the following, selected advanced materials along the OECD categories are selected as examples in order to demonstrate the spectrum of technological approaches as well as central industrial application areas.

The examples are to be understood as a representative selection and not as a complete illustration of the respective material field.

1. High-performance alloys (Advanced Alloys)

Advanced alloys are highly developed metallic materials for extreme mechanical, thermal and functional requirements. They are characterised by high strength, excellent toughness properties as well as corrosion and temperature resistance. TRIP steels and aluminium crossover alloys are examples of a paradigm change in material development: Instead of classic property compromises, innovative microstructural concepts are used to simultaneously realise properties that were previously considered contradictory, such as high strength, ductility and formability. In addition, materials with a complex multiphase structure, intermetallic materials with ordered crystal structures and high thermal stability, high-entropy alloys consisting of several main components in almost equal proportions and also shape memory alloys that return to their original shape after deformation by temperature change.
In addition, the following can be mentioned here: rail steels, steels for rolling bearings, wires and tubes, nickel-based alloys and super alloys,

[34] No feedback was received in the consultation process for the OECD categories of 'metamaterials' and 'particle systems'
[35] Materials 2030 manifesto
[36] Materials 2030 Roadmap

titanium alloys, high-strength austenitic stainless steels, duplex steels, corrosion and heat-resistant alloys, and free-cutting steels. These materials are used in aerospace, energy technology, medical technology, the automotive industry, oil and gas, and railways, among others. If necessary, it is also possible to use them as a composite material. The excellent research opportunities in the circular economy, reusability and recyclability as well as the design as sustainable CO^2-reduced steel should also be emphasised. Properties such as hardness, ductility and wear resistance can be optimised through targeted alloy development.
Examples of high-performance alloys mentioned in the survey:

- Udimet 720 Li (nickel-based superalloy for turbine applications)
- MoRe41 / MoRe47.5 (molybdenum-rhenium high-temperature alloys)
- Non-grain-oriented electrical steel (EN10106) (electrical and energy engineering)
- Böhler P514 (high-alloy shape memory management for prestressing steel application)
- Böhler E185 AMPO (Low-alloy case-hardening steel for mechanical engineering, automotive and rapid prototyping applications)
- Böhler T210 (High Alloy Corrosion Resistant Austenitic Precipitation Hardened Steel for Hydrogen Compressor Applications)
- Martensitic steel
- DUMOMET (microdoped molybdenum material)
- WVM and WK65 (ultra-high-strength tungsten fine wires)
- CrossAlloy 57
- AlSi7.Rec
- Semi-Conductor Plate Aluminium
- 3rd generation of advanced high strength steel (3rd Gen. AHSS)
- Sustainable steel belt with the best properties
- MC99 Intermet (Powder Metallurgical Advanced Intermetallic Precipitation Hardenable Cutting material for hobbing)
- Interface-optimised structural and functional materials
- Advanced nanomaterials and nanocomposites
- Medium Mangan Steel
- Third-generation powder metallurgical tool steels for highly stressed applications in toolmaking and as cutting materials

2. Composites

Composites are material systems for the targeted combination of lightness, strength and functionality and combine two or more different materials to achieve specifically improved properties. Typically, they consist of a matrix and reinforcement phases such as fibres or particles. This results in materials with high strength, stiffness and low weight at the same time. Well-known examples are carbon or glass fibre reinforced plastics. They are used in particular in lightweight aerospace construction, automotive engineering and construction. Composites enable energy savings through weight reduction and high load-bearing capacity. Modern developments include multifunctional composites with integrated sensor technology or self-healing properties. Challenges exist above all in recycling and sustainable manufacturing processes.

Examples of composite materials:

- Metal-FRP hybrids (multi-material lightweight structures)
- Nanocomposites (reinforced polymer or metal matrices)
- UD tapes (high-strength unidirectional fibre semi-finished products)
- Tungsten carbide/co-carbide (wear-resistant tool materials)
- Multi-material polymer composites (functionalised lightweight construction systems)
- DiaCool
- LD Slag
- colofer HVAC = organically coated material for HVAC applications
- Sealing for hot-dip galvanised steel strip
- Biocomposite
- Nanomaterial-enabled Wood
- Silicones (polydimethylsiloxane)
- Self-reducing conductive ink formulations (e.g. silver, copper, etc.)

3. Advanced Polymers

High-performance polymers are plastics with particularly high thermal, chemical and mechanical resilience. The most important representatives include PEEK, PTFE, PPS and polyimides. They retain their properties even under extreme temperatures, aggressive chemicals or high loads. As a result, they are used in aviation, electronics, energy technology and medical technology.

High-performance polymers enable lightweight, corrosion-resistant and durable components. In electronics, they serve as insulation and structural materials for high-performance applications. Many of these materials also have good sliding properties and low friction coefficients. The research focuses on improved processing, sustainability and functional material integration.

Examples of high-performance polymers:

- PDMS / silicone (elastomers for medicine and microfluidics)
- Functional photopolymers (additive manufacturing, lithography)
- Printed Electronics Inks (conductive and functional printing systems)
- Imprint Coatings (Nanoimprint Lithography)
- Self-reducing conductive inks (flexible electronics)

4. Biopolymers

Biopolymers, in this context, are natural or bio-based macromolecular materials that are produced from renewable raw materials such as starch, cellulose or lactic acid. They can be biodegradable or compostable and thus make an important contribution to the circular economy. The most important representatives include PLA, PHA and bio-based polyamides. Biopolymers combine sustainability with functional properties such as flexibility, barrier effect or biocompatibility. Applications can be found in particular in packaging, agriculture, medical technology and consumer goods. In medical technology, they are used, for example, for implants, suture materials or active ingredient carriers.

Examples of Biopolymers:

- Bio-based and bio-inspired materials for sustainable applications.
- Biocomposites (natural fibre-reinforced materials)
- Proteins as functional biomaterials
- Lipid-based material systems
- Cellulose-based materials (packaging and membranes)

5. Porous Materials

These are materials with a controlled pore structure for filtration, storage and energy applications. Porous materials have specifically created cavity or channel structures in the micro, meso or nano range. These pores give them a large inner surface area as well as special transport and storage capabilities. The most important classes include foams, aerogels, zeolites and metal-organic framework structures (MOFs). They are used in filtration, gas and energy storage, catalysis and thermal insulation. Porous materials enable the efficient absorption, separation or release of substances. In batteries and hydrogen technologies, they play a central role for storage and electrode materials. Due to their low density, they are also suitable for ultra-light structural materials. The development focuses on precisely controlled pore architectures and multifunctional properties.

Examples of porous materials:

- Activated porous carbon materials (adsorption and energy storage)
- Cellular solids (structured lightweight foams)
- Paper-based membranes (filtration and diagnostics)
- Metallic foams (energy absorption and thermal management)
- Porous electrode structures (energy systems)
- Catalysts and electrode materials for small molecule activation (CO_2, CO, H_2O, O_2, N_2)

6. Smart nanomaterials

Smart nanomaterials react specifically to external stimuli such as temperature, light, magnetic fields or chemical signals. Their special properties are created by nanoscale structures and controlled surface functions. They can dynamically change their shape, conductivity, colour or chemical activity. Applications can be found in sensor technology, medicine, electronics, robotics and energy technology. In medicine, they enable intelligent drug release and precise diagnostics. Self-cleaning surfaces or adhesive coatings are also based on smart nanomaterials. Flexible electronics and energy-efficient systems also benefit from these materials.

Examples of smart nanomaterials:

- Nanostructured materials with functional or adaptive properties.
- ZnO Nanomaterials (Sensing and Photonics)
- Laser-Induced Graphene (flexible electronic)
- Nanomaterial-enabled wood (functionalised natural materials)
- Topological Nanomaterials (Quantum and Electronic Systems)
- Functional sensor materials (integrated measurement functionality)
- π-conjugated polymers
- Sol-Gel Atmospheric Pressure Plasma Layers
- Zinc Oxide Nanomaterial
- Atmospheric Pressure Plasma Composite
- Functional coatings

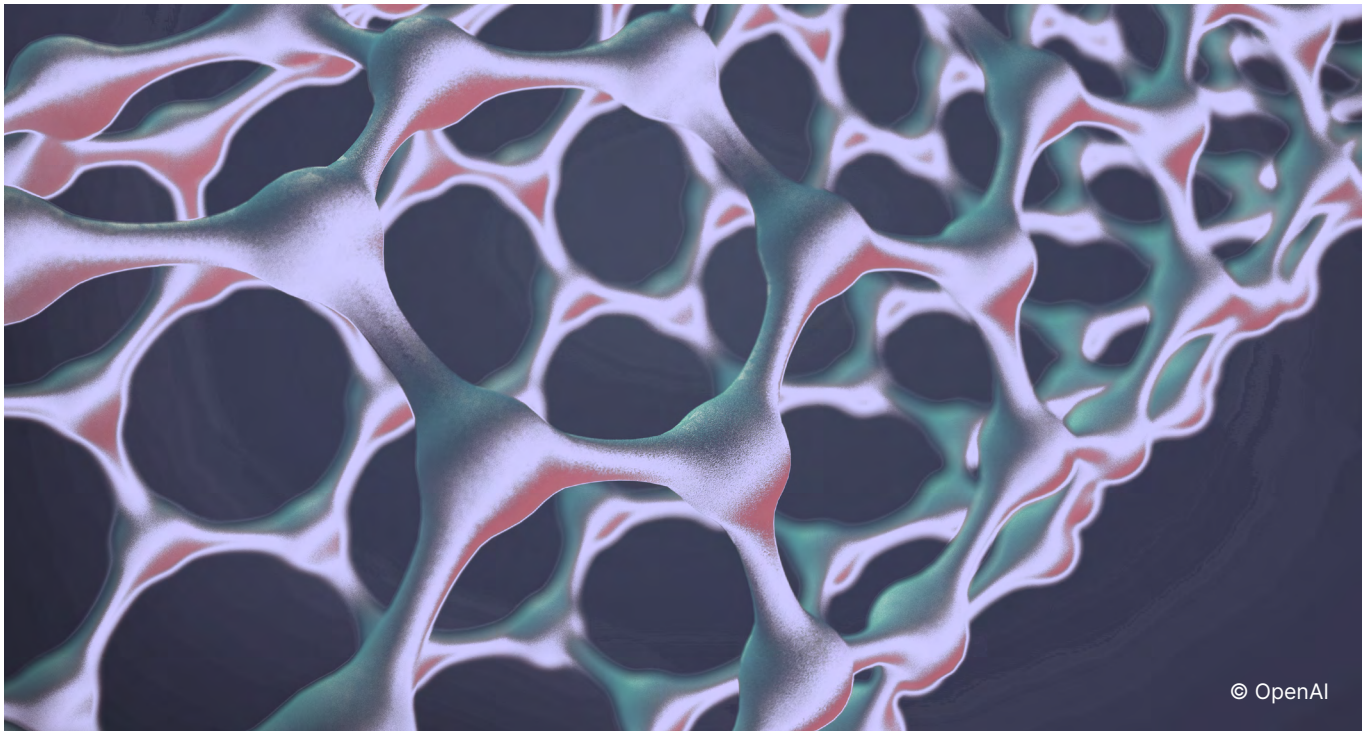
7. High-performance fibres (Advanced Fibres)

High-performance fibres are characterised by extraordinary mechanical and thermal properties. These include carbon, aramid, basalt and ceramic fibres in particular. They have a high tensile strength, low density and excellent temperature resistance. This makes them ideal for lightweight construction and protection applications. Areas of application can be found in aerospace, wind energy, the automotive industry and safety equipment. Carbon fibres, for example, enable particularly light and at the same time stable structural components. Aramid fibres are used in protective clothing due to their impact and cut resistance. Current developments focus on cost-effective production, recycling and multifunctional fibre systems.

Examples of high-performance fibres:

- Electrospun Polymer and Hybrid Nano Fibres
- Carbon fibre-based reinforcement systems
- Aramid fibres for high-strength applications
- Fibreglass composite systems for lightweight structural construction
- Functionalised textile fibres for sensor technology
- Unidirectional Tapes





Metamaterials[37]

Metamaterials are artificially structured materials with extraordinary physical properties. Their functions are less due to their chemical composition than to targeted micro- and nanostructures. This allows light, sound or electromagnetic waves to be controlled in a novel way. Examples are materials with negative refraction, electromagnetic camouflage or programmemable mechanics. Metamaterials open up applications in sensor technology, telecommunications, optics and medical technology. Acoustic metamaterials for sound insulation or vibration control are also gaining in importance. In photonics, they enable compact and high-performance optical components.

Particle systems[38]

Particle systems consist of finely distributed micro- or nanoparticles with specifically adjustable properties. Due to their high specific surface area, they have special chemical, electrical or optical functions. They are used in batteries, coatings, catalysts, pharmaceutical products and printing technologies. Nanoparticles enable improved conductivity, reactivity or mechanical reinforcement, for example. In medicine, particle systems are used as drug carriers or for imaging procedures. Functional inks, pigments and additives are also often based on tailor-made particle systems. The properties depend heavily on the size, shape and surface structure of the particles.

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[37] Strategic materials agenda

[38] No feedback was received in the consultation process on the OECD categories of ‘metamaterials’ and ‘particle systems’

07

Challenges and systemic gaps

The analysis shows that the key challenges in the field of advanced materials relate primarily to the transition from research to industrial application, in particular due to the lack of pilot and demonstration infrastructures as well as inadequate scale-up and validation environments. This is complemented by structural bottlenecks in the financing of deep-tech innovations and growth phases, a pronounced shortage of skilled workers in materials and data-driven disciplines, and deficits in networked research and data infrastructures. At the same time, regulatory requirements for sustainability, transparency and circular economy, risk assessment and its communication, as well as questions of raw material supply and resilience, are becoming increasingly important and will have a significant impact on the future development of the materials and innovation system. Meanwhile, it is essential to build an ecosystem between research, industry, politics and regulation. The following is a summary of the key challenges in the respective areas.

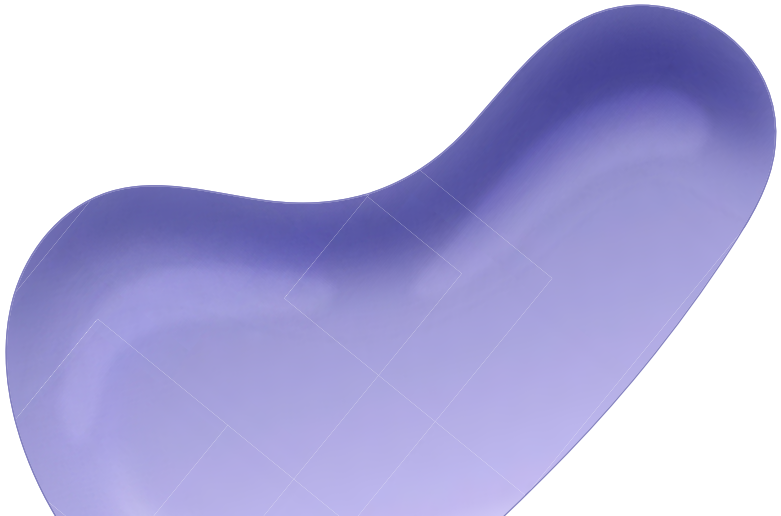
Area	Key challenges
Scale-up & Pilot Plants	Lack of pilot plants, test centres, demonstration and validation infrastructures; Gap between research and market.
Financing	High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing.
Specialists & Competencies	Lack of expertise in materials science, AI in materials development, process development, production technologies and sustainability.
Infrastructure & Data Spaces/AI	Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments.
Regulation & Standards	Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency and circular economy, harmonisation and development of standardised OECD test guidelines, risk assessment and communication.
Raw Materials & Resilience	Security of supply, circularity, substitution of critical materials and European resilience.

08

Catalogue of actions and measures

The previously identified needs for action and systemic development barriers along the innovation and value chains of advanced materials result in specific activities as well as concrete solutions and measures for the individual advanced materials categories according to the OECD classification. These address technological, infrastructural and economic challenges and contribute to accelerating the transfer of research results into industrial applications, strengthening the competitiveness of Austria as a business location and supporting the sustainable transformation of industry. Many activities are therefore proposed for a better transition of research into industrial application, often citing scale-up facilities or AI infrastructure for implementation. This requires not only the efforts of companies to build up the same, but also good coordination in the ecosystem with correspondingly predictable and plannable financial support and rapid implementation possibilities with a sluggish bureaucratic structure at the same time. The proposed minimum of 150 million euros per year should be seen as the basis for the establishment and expansion of applied research in the ecosystem.

The following catalogue of measures presents a non-exhaustive compilation of action options that was discussed in the context of the ATIMA workshops 2025 as well as a broad-based stakeholder survey. The activities and solutions presented reflect the main needs in the various advanced materials categories and form a basis for further strategic development research, innovation and industrial development policy in the field of advanced materials.



01 Biopolymers

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures; gap between research and market

Activities

- Scaling up bio-based polymer production from biological starting materials
- Development of industrially usable synthesis and processing processes
- Construction of demonstration plants for bio-based polymer materials and their processing in applications

Solutions/Measures

- Construction of pilot and demonstration plants for bio-based polymer production
- Industrial upscaling infrastructure for fermentation, extraction and polymerisation
- Integration of bio-based materials into existing production chains
- Validation of performance against fossil polymers

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments

Activities

- Development of data on bio-based polymer structures, process parameters and material properties
- Optimisation of bio-synthesis pathways
- Digital modelling of bio-based material development

Solutions/Measures

- Material and process data platforms for biopolymers
- AI-powered optimisation of fermentation, polymerisation and material properties
- Digital infrastructure for bioeconomy and material integration

02 Composites

Scale-up & Pilot Plants

Key challenges

Materials for the automation of manufacturing processes

Activities

- Implementation of large-scale trials and demonstration projects for novel composite materials and coating systems
- Validation of high-performance surfaces with high resistance to corrosion, UV radiation and scratching
- Demonstration of circular composite solutions

Solutions/Measures

- Development of pilot and demonstration infrastructures for composite production, coating and recycling
- Promotion of industry-related test fields for the qualification of new composite solutions
- Supporting scaling from laboratory to industrial scale

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments.

Activities

- Cooperation with partners for organic and inorganic nanomaterials as well as particle technologies
- Data collection on material properties, ageing behaviour and sustainability
- Digital support for material development and manufacturing processes

Solutions/Measures

- Establishment of joint research and testing infrastructures for composite materials
- Use of material databases and AI-supported tools for material selection and raw material substitution
- Networking of laboratories and testing facilities

03 Porous Materials

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures; gap between research and market

Activities

- Construction and operation of pilot plants for the reproducible production of porous materials on different substrates
- Scaling of laser-based structuring and functionalisation processes
- Validation of material and sensor integration in real components
- Implementation of industrial demonstrators and long-term tests

Solutions/Measures

- Establishment of pilot and demonstration lines for porous functional materials and laser-based processes
- Access for industrial trials and upscaling studies
- Infrastructure for component integration and real application validation
- Promotion of TRL barriers (Lab → Pilot → Application)

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments

Activities

- Use and networking of high-end analytics (synchrotron, in-situ measurements, high-resolution characterisation)
- Establishment of common data spaces for material and process parameters
- Digital capture of structure-property relationships

Solutions/Measures

- Access to large-scale research infrastructures (synchrotron, in-situ imaging, etc.)
- Development of digital material data platforms
- AI-supported analysis of structural, process and performance data
- Joint European research infrastructure for porous materials

04 Metamaterials

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures; gap between research and market

Activities

- Development and experimental validation of mechanical, acoustic, optical and electromagnetic metamaterial structures
- Construction of demonstrators for functional micro-/nanostructures
- Transfer of additive manufacturing and microstructuring into reproducible processes

Solutions/Measures

- Establishment of specialised pilot lines for microstructuring (e.g., lithography, 3D nanoprinting/microprinting, laser structuring)
- Demonstration environments for functional components (e.g., vibration damping, EM shielding, adaptive optics)
- Scaling platforms for periodic structural designs

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments.

Activities

- Use of simulation tools for inverse material design
- Building data on structure-function relationships
- Experimental validation of complex geometries on micro/nanoscale

Solutions/Measures

- AI-powered design platforms for inverse metamaterial development
- Databases for structure property mappings
- Access to high-performance computers for multiscale modelling

05 Particle Systems

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures; gap between research and market

Activities

- Development and scaling of functional particles (nano- and microparticles) for applications in coatings, composites, catalysis, sensing and energy systems
- Control of particle size, morphology and surface functionalisation
- Industrial process validation (dispersion, stability, processing)

Solutions/Measures

- Construction of pilot plants for particle synthesis, functionalisation and dispersion
- Scale-up of wet and gas phase processes

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments

Activities

- Characterisation of particle systems (size, zeta potential, morphology, surface chemistry)
- Building data on process-structure-property relationships
- Digital modelling of dispersion behaviour

Solutions/Measures

- Material data platforms for particle systems
- AI-supported optimisation of synthesis and dispersion processes
- Access to high-resolution characterisation (electron microscopy, DLS, XPS, etc.)

06 High-Performance Fibres

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures; gap between research and market

Activities

- Scaling up technology for high-performance UD tapes
- Transfer of laboratory spinning processes into continuous production lines
- Validation of functionalised fibres for applications in mobility, security and medical technology
- Industrial demonstration of complex fibre architectures

Solutions/Measures

- Establishment of pilot lines for high-performance fibre production
- Scale-up of spinning and coating processes (incl. wet, dry and electrospinning)
- Demonstration environments for functionalised fibres and tape laminates
- Process window for industrial reproducibility

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments

Activities

- Characterisation of fibre architectures (diameter, porosity, layer thickness, core-shell structures)
- Process data on spinning parameters and additive distribution
- Development of data-based process control

Solutions/Measures

- Development of digital material and process data spaces for fibre systems
- AI-supported optimisation of spinning and coating processes
- Access to high-end analytics (microscopy, tomography, rheology, inline sensors)

07 Advanced Polymers

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures; gap between research and market.

Activities

- Material and process development for the digital printing of silicones
- Scaling laboratory processes into roll-to-roll (R2R) and industrial manufacturing processes
- Construction of demonstrators for UV-curable functional coatings and microstructures of polymer surfaces
- Development and scale-up of new sorting and process plants for mechanical, physical and chemical recycling of plastics to improve the application-related recycle quality

Solutions/Measures

- Establishment of pilot and demonstration lines for digital printing of elastomers and functional polymers
- Establishment of scale-up and pilot plants along the plastics circular value chain to increase the sorting depth and improve the application-related recycle quality
- Industrial upscaling infrastructure for silicones and UV-curable systems
- Demonstrators for sensory and biofunctional polymer surfaces

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments.

Activities

- Development and analysis of process and material data for the plastics circular value chain
- Surface analysis for functional coatings
- Data-based optimisation of process parameters and recipes

Solutions/Measures

- Establishment of material and process data rooms for polymer digital printing
- AI-supported optimisation of the sorting of relevant secondary material streams
- Access to high-resolution surface analysis and in-line process control
- Digital R2R simulation and control systems

08 High-Performance Alloys

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures; gap between research and market

Activities

- Production of complex 3D nanoarchitectures for functional applications (e.g. sensor technology, photonics) sintering, thermomechanical processes
- Industrial implementation of high-precision wire and cable technologies
- Development for homogeneous distribution of microdoping elements
- Optimisation of connection technology for high-performance wires and cables
- Development of cost-efficient machining processes for the tightest tolerances (<2 µm)

Solutions/Measures

- Construction of pilot and demonstration plants for powder metallurgy and high-performance alloys
- Industrialisation of wire/cable production with high structural control
- Scale-up of thermomechanical process chains
- Infrastructure for high-precision manufacturing and surface quality
- Further development of high-performance steel alloys in conjunction with manufacturing routes, accompanying elements or input material qualities (scrap)

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments

Activities

- Expansion of material databases for high-performance steels and alloys
- Development of quantitative models on the influence of accompanying elements from scrap
- Structure of microstructure-property data (strength, ductility, permeability, core losses)
- Data-based description of structural development

Solutions/Measures

- Establishment of a European materials data room for high-performance alloys
- AI-powered modelling of phase transformations and microstructure development
- Digital cross-OEM material requirements platform
- Simulation of scrap-based alloy variations

09 Smart Nanomaterials

Scale-up & Pilot Plants

Key challenges

Lack of pilot plants, test centres, demonstration and validation infrastructures, gap between research and market

Activities

- Development and scaling of nanostructuring processes using multiphoton lithography
- Production of complex 3D nanoarchitectures for functional applications (e.g. sensor technology, photonics)
- Transfer of high-resolution laboratory technology into reproducible process chains
- Validation of functional nanostructures under real operating conditions

Solutions/Measures

- Construction of specialised pilot plants for multiphoton lithography and high-precision 3D nanofabrication
- Demonstration platforms for functional nanostructures
- Infrastructure for industrial process scaling of nanoproduction technologies
- Access to high-resolution structuring hardware for research and industry

Infrastructure & Data Spaces/AI

Key challenges

Need for open research infrastructures, pilot lines, material databases, AI infrastructures and digitally networked test environments

Activities

- Development of process and structural data sets for nanostructured materials
- Modelling of structure-function relationships at the nano level
- Integration of design and manufacturing data for inverse material development

Solutions/Measures

- Development of digital design platforms for nanostructures (incl. simulation and manufacturing coupling)
- Data spaces for nanomaterial performance
- AI-powered optimisation of structural designs for specific functions (optical, mechanical, electrical)

01 Biopolymers

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Ensuring the supply of biological starting materials
- Development of stable bio-based raw material chains
- Use of residues and biomass as a starting point for polymer production
- Development of circular material flows

Solutions/Measures

- Development of European bio-raw material chains (biomass, residues, by-products)
- Substitution of fossil base materials by biogenic sources
- Development of closed-loop systems for bio-based polymers
- Integration of waste and residue streams in material production

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Development of know-how in bioprocess engineering, polymer chemistry, fermentation technologies and bio-based material systems
- Combining biotechnology and materials development

Solutions/Measures

- Centres of excellence for biopolymers and bioeconomy
- Interdisciplinary training in bioprocess and polymer technology
- Industrial training programmes for bio-based material production and processing

02 Composites

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Securing the supply of fibre, matrix and functional materials
- Development of substitutes for critical or potentially hazardous raw materials (e.g. cobalt, nickel, chromium)
- Development of recycling and reuse solutions for composite materials

Solutions/Measures

- Research programmes on raw material substitution (e.g. high-entropy alloys, alternative coating systems)
- Building resilient supply chains
- Development of recycling and separation technologies for composite materials
- Strategic partnerships with material suppliers and raw material players

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Expansion of know-how in the field of production automation and the impact on material properties
- Knowledge transfer between research, suppliers and users

Solutions/Measures

- Competence networks for composite technologies
- Continuing education courses on sustainable materials, material characterisation, circular economy and process automation
- Stronger networking along value chains

03 Porous Materials

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Development and optimisation of bio-based precursors
- Development of sustainable material systems for porous structures
- Ensuring the availability of raw materials for functional additives and polymer systems
- Development of circular usage concepts

Solutions/Measures

- Substitution of fossil feedstocks with bio-based alternatives
- Development of recyclable porous material systems
- Development of closed material cycles despite low volumes
- Strategic safeguarding of specialty chemicals and functional additives

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Development of interdisciplinary expertise in chemistry, polymer science, laser technology, component development and materials testing
- Close cooperation between industry and academia
- Training in in-situ and high-end analytics

Solutions/Measures

- Interdisciplinary training and research programmes
- Centres of excellence for porous functional materials
- Structured industry-science collaborations (e.g. COMET module logic)
- Targeted promotion of young talent

04 Metamaterials

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- On the material side, less raw material-driven, but focus on process materials (polymers, metals, ceramics for microstructuring)
- Ensuring reproducible manufacturing quality

Solutions/Measures

- Development of process-stable material systems for micro-/nanostructuring
- Substitution of rare lithography or coating materials
- Sustainable process chains for high-precision manufacturing

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Building competencies in structural design, computational materials science, topology optimisation, multiphysics simulation and micro-/nanofabrication

Solutions/Measures

- Interdisciplinary training programmes (physics, mechanical engineering, materials science, simulation)
- Competence centres for functional structural design
- Stronger coupling of simulation and experimental manufacturing

05 Particle Systems

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Substitution of critical elements in functional particles (e.g., precious metal reduction in catalysts, replacement of critical oxides)
- Use of sustainable raw materials
- Recycling of particle-containing systems

Solutions/Measures

- Development of precious metal-free or reduced catalyst and functional particles
- Circular concepts for particle-functionalised materials
- Sustainable raw material sources for nanomaterials

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Development of expertise in colloid chemistry, particle synthesis, surface chemistry, dispersion stability and process engineering

Solutions/Measures

- Interdisciplinary training programmes in chemistry, materials science and process engineering
- Competence centres for functional particle systems
- Industrial internships in synthesis and coating technologies

06 High-Performance Fibres

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Development of bio-based polymers and sustainable solvent systems
- Substitution of fossil polymer raw materials
- Optimisation of sustainable additives and functional fillers
- Ensuring stable raw material supply for high-performance fibres

Solutions/Measures

- Development of bio-based fibre platforms (e.g. PLA, PHA, bio-based polyamides)
- Development of low-solvent or solvent-free spinning processes
- Recycling and recovery concepts for fibre systems
- Substitution of critical additives

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Building expertise in polymer chemistry, spinning technologies, nanoparticle integration, rheology of complex solutions and fibre characterisation
- Interdisciplinary development between chemistry, process engineering and application

Solutions/Measures

- Centres of excellence for advanced fibres and spinning processes
- Training programmes for structural design of fibres, rheology and integration of additives
- Industry-related training for production and quality control

07 Advanced Polymers

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Optimising sustainable polymer and silicone formulations
- Development of alternative monomers and additives
- Improving the recyclability and material efficiency of thermoplastics, elastomers and duromers

Solutions/Measures

- Substitution of fossil polymer building blocks with sustainable or bio-based alternatives
- Increasing the quality of circular polymers through increased sorting depth and further development of the compounding processes and additives
- Recycling concepts for elastomers and functional coatings
- Reduction of critical chemical components in coating formulations

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Development of know-how on AI and process automation in the circular economy of plastics
- Interdisciplinary cooperation between material development, process engineering and functionalisation

Solutions/Measures

- Competence centres for advanced polymer processing and functional coatings
- Training in digital printing of elastomers and UV polymerisation
- Industrial training programmes for R2R process control and functional surfaces

08 High-Performance Alloys

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Avoidance of aluminium and steel scrap runoff from Europe
- Securing and expanding access to critical alloying elements such as: cobalt, rhenium
- Development of scrap-resistant alloys
- Handling of varying accompanying elements from recycled streams

Solutions/Measures

- Development of European raw material and scrap cycle strategies
- Securing critical elements (cobalt, rhenium, etc.)
- Development of scrap-tolerant high-performance alloys
- Strengthening regional value chains and secondary material recycling

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Development of in-depth expertise in metal physics, physical metallurgy, microstructure design, powder metallurgy and materials modelling
- Interdisciplinary development of alloys for automotive, energy and industry
- Linking research and industrial application

Solutions/Measures

- Centres of excellence for high-performance alloys
- Training programmes in metallurgy, phase transformations and material simulation
- Industry-integrated research networks (e.g. FFG projects such as Aerocon)

09 Smart Nanomaterials

Raw Materials & Resilience

Key challenges

Security of supply, circularity, substitution of critical materials and European resilience, harmonisation and development of standardised OECD test guidelines, risk assessment and communication

Activities

- Ensuring suitable high-purity starting materials for nanostructuring
- Development of stable and reproducible material systems for multiphoton processes
- Minimisation of critical process materials

Solutions/Measures

- Development of standardised material systems for nanofabrication
- European security of supply for high-purity photoresists and precursors
- Substitution of critical process chemicals with more sustainable alternatives

Specialists & Competencies

Key challenges

Lack of expertise in materials science, AI in materials development, process development, production technologies, and sustainability

Activities

- Building expertise in nanostructuring, photonic processes, 3D micro/nanofabrication and functional material design
- Interdisciplinary combination of physics, materials science and engineering

Solutions/Measures

- Centres of Excellence for nanofabrication and functional nanomaterials
- Training programmes for multiphoton lithography and nanostructure design
- Industrial training in high-precision manufacturing technology

01 Biopolymers

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication.

Activities

- Development of standards for bio-based materials and their comparability with fossil polymers
- Ensuring sustainability and circularity assessments
- Development of processes for material separation and recycling

Solutions/Measures

- SSbD, LCA and Material specification sheet integration for biopolymers
- Development of harmonised assessment and certification standards
- Regulatory equivalence of bio-based materials in a market comparison

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep-tech and growth financing.

Activities

- Support for the development of new bio-based base materials with high technological and economic risks
- Financing scaling and industrialisation
- Supporting the transition from fossil to bio-based value chains

Solutions/Measures

- Specific funding programmes for bio-based materials (incl. TRL 4-8)
- Economic equality with fossil polymers through targeted funding and investment instruments
- Support for demonstration and first-of-a-kind plants

02 Composites

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication

Activities

- Development of alternatives to systems containing chromium (VI) and chromium (III)
- Proof of sustainability and circularity of composite solutions
- Creation of transparency along the material life cycle

Solutions/Measures

- Support for SSbD, LCA and ESG assessments
- Development of standardised test methods for performance and sustainability
- Monitoring of regulatory changes in the field of critical substances

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing

Activities

- Development and demonstration of automatically produced composite materials
- Execution of risk- and capital-intensive large-scale tests

Solutions/Measures

- Specific funding programmes for composite innovations, demonstrators and scale-up projects
- Support for investments in pilot plants and industrialisation
- Support for high-technological risk projects

03 Porous Materials

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication

Activities

- Development of standardised methods for material and sensor characterisation
- Validation under real operating conditions
- Integration of SSbD, LCA and sustainability assessments
- Standardisation of new laser-based manufacturing

Solutions/Measures

- Development of norms and test standards for porous functional materials
- SSbD and LCA integration into development processes
- Regulatory support for new bio-based precursors and laser processes
- Certification frameworks for sensor and component integration

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing

Activities

- Financing of interdisciplinary research programmes along the entire value chain (chemistry, polymer processing, component design, testing)
- Support for high-risk laser process development and new bio-based precursors

Solutions/Measures

- COMET-like programmes for basic and applied research on porous materials
- Funding lines for piloting and industrial demonstrators
- Support for capital-intensive upscaling and process development projects

04 Metamaterials

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication.

Activities

- Development of standardised test methods for novel effect materials (e.g. negative stiffness, programmable materials);
- Validation under real load scenarios

Solutions/Measures

- Development of new standards for functional structural materials
- Standardisation of test methods for dynamic and adaptive properties
- SSbD integration for functional microstructures

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing.

Activities

- Development of high-risk, design-driven material systems with long development cycles
- Validation of novel structure-property relationships
- Development of function-integrated components with low TRL maturity

Solutions/Measures

- Funding programmes for design-based deep-tech material systems
- Support for high-risk/high-gain metamaterial projects
- Targeted financing of demonstrators with clear functional evidence (e.g. negative Poisson ratio, EM control)

05 Particle Systems

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication

Activities

- Safety and environmental assessment of nanoparticles
- Development of standardised characterisation methods
- SSbD-compliant development of functional particles

Solutions/Measures

- Harmonisation of testing and safety standards for nanomaterials
- Regulatory roadmaps for industrial particle applications
- Integration of LCA/SSbD into development processes

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing

Activities

- Development of novel functional particles (e.g. conductive, catalytic, bioactive, corrosion-inhibiting)
- Risk development for new synthesis and functionalisation routes

Solutions/Measures

- Funding programmes for nano and particle technologies with a focus on functional applications
- Support for scale-up and production plants
- Financing of demonstrators in real-world applications (e.g. coatings, electronics, energy)

06 High-Performance Fibres

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication

Activities

- Standardisation of quality control for high-performance fibres and UD tapes
- Evaluation of particle release, leaching behaviour and long-term stability
- Development of safe bio-based fibre systems

Solutions/Measures

- Development of standards for UD tape quality and functional fibres
- SSbD and LCA-compliant evaluation frameworks for fibre systems
- Regulatory assurance for med-tech and safety applications

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing

Activities

- Development and industrialisation of complex fibre architectures with functional additives
- Risk development of new spinning and fibre functionalisation technologies
- Validation of bio-based and sustainable fibre systems

Solutions/Measures

- Funding programmes for high-performance fibres
- Support for TRL-4-8 projects in the field of fibre innovation
- Financing of pilot plants for functionalised spinning processes and composite integration

07 Advanced Polymers

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication.

Activities

- Standardisation of test methods for UV-curable functional coatings and DNA immobilisation
- Validation of signal stability, reproducibility and functional performance
- Evaluation of transferability to industrial processes

Solutions/Measures

- Development of standards for functional polymer coatings and biofunctionalised surfaces
- SSbD and LCA-compliant evaluation of UV polymer systems
- Regulatory assurance for bioactive and diagnostic polymer applications
- Quality standards for R2R-UV processes

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing.

Activities

- Support for innovations along the plastics circular value chain to improve the application-related recyclate quality
- Validation of new coating formulations and functional coating systems
- Transfer of laboratory results into industrial demonstrators

Solutions/Measures

- Funding programmes for polymer-based digital printing and functional coating technologies
- Targeted support for TRL 4-8 (incl. piloting and scale-up)
- Funding for R2R-UV process development and industrial validation
- Promotion of high-risk functional polymer projects

08 High-Performance Alloys

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication

Activities

- Standardisation of requirements between automotive OEMs and supplier industry
- Standardisation of material characteristics and test methods
- Hedging of critical raw materials (e.g. cobalt, rhenium)

Solutions/Measures

- Harmonisation of OEM specifications
- European standardisation for high-performance alloys
- Strategic raw materials policy for critical elements (cobalt, rhenium)
- Regulatory instruments against market distortion and for material access security

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing

Activities

- Long-term research initiatives for complex high-performance alloys
- Support for basic and applied research on phase transformations and distribution mechanisms
- Development of new alloys under raw-material restrictions
- Hedging industrial high-risk developments

Solutions/Measures

- Combination of basic and industrial funding programmes (e.g. FFG)
- Long-term programmes for high-performance steels and special alloys
- Subsidies for powder metallurgy, process development and material-data development
- Protection against market distortions (anti-dumping instruments)

09 Smart Nanomaterials

Regulation & Standards

Key challenges

Requirements and opportunities through SSbD as a driver of innovation (incl. ESG, LCA, sLCA), material transparency, circular economy, development of standardised OECD test guidelines, risk assessment and communication

Activities

- Development of first standardised test methods for complex nanostructures
- Assessment of stability, reproducibility and functional performance
- Safety and environmental assessment of novel nanomaterials

Solutions/Measures

- Development of standards for 3D nanofabrication processes
- SSbD-compliant assessment frameworks for nanomaterials
- Regulatory guidelines for functional nanostructures and their industrial use

Financing

Key challenges

High capital intensity, long innovation cycles, low risk appetite, lack of deep tech and growth financing

Activities

- Promotion of highly innovative nanofabrication and material design projects with long development cycles
- Support for high-risk developments in the field of functional nanostructures
- Hedging the transfer from laboratory to pilot scale

Solutions/Measures

- Specific funding instruments for smart nanomaterials (high-risk/high-tech) programmes for hardware-based nanofabrication (multiphoton lithography)
- Combined funding logic for basic research, prototyping and industrial demonstration
- Long-term funding pathways for TRL transitions

09

Strategic fields of action in Austria

The previous analysis shows that Austria has a strong starting point in the field of advanced materials. Scientific excellence, industrial expertise and established areas of strength in numerous application areas form a solid foundation for further development. At the same time, there are challenges along the entire innovation and value chain – from the availability of critical raw materials to the scaling of new technologies and the market launch of innovative materials.

In order to secure and expand Austria's competitiveness in the long term, it is therefore necessary to supplement the measures already outlined with strategic priorities in the following fields of action.

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Field of action 1: Strengthening scale-up and industrial demonstration

One of the greatest challenges continues to be the transition of **research results into industrial applications**. While Austria has an efficient research landscape, there is a lack of suitable **pilot, demonstration and validation infrastructures** in many areas. The targeted expansion of such capacities is therefore a central prerequisite for shortening innovation cycles, accelerating industrial implementation and bringing new materials into application more quickly. In particular, open and cooperative infrastructures should be created that are equally accessible to research institutions, companies and start-ups.

01

Field of action

Strengthening scale-up and industrial demonstration

2026–2030 Building capacity & enabling scaling

National inventory of existing pilot and demonstration infrastructures; establishment of an open access network; networking of pilot plants, test centres and high-end analytics; expansion of pilot, demonstration and validation infrastructures; accelerated TRL transitions (laboratory → pilot → demonstrator); implementation of industrial demonstration projects and networking with European pilot infrastructures

2031–2035 International leadership & sustainable value creation

Austria is establishing itself as a European scale-up location with internationally visible pilot and demonstration infrastructures as well as a routine transfer of new materials into industrial applications and markets

Leading actors

BMIMI, FFG, federal states and their funding agencies, COMET centres, universities, non-university research, industry, clusters

Field of action 2: Positioning Austria as a location for sustainable advanced materials

Sustainability, circular economy and resource efficiency are increasingly becoming decisive competitive factors for material development. Austria has good prerequisites to establish itself as a **visible European location for sustainable advanced materials** in this environment. Particular opportunities lie in the development of recyclable materials, bio-based materials, low-CO_2 production processes and in the early integration of sustainability aspects into development and innovation processes. **The combination of technological performance with ecological responsibility** can become a key differentiating feature of the Austrian innovation system. A key pillar for this is technology assessment, which generates continuous added value – also in material development – through its accompanying activities and corresponding consideration of the findings derived from it.

02 Field of action

Positioning Austria as a location for sustainable advanced materials

2026–2030 Building capacity & enabling scaling

Integration of Safe-and-Sustainable-by-Design (SSbD), LCA/sLCA and material specification sheet into research and innovation processes; analysis of critical material dependencies; development of recycling, reuse and substitution strategies; promotion of circular-by-design; introduction of standardised assessment, testing and certification procedures as well as material transparency along the value chain, risk and technology assessment and their communication or accompanying research on approaches to the regulation of advanced materials

2031–2035 International leadership & sustainable value creation

Austria is positioning itself as a European pioneer for sustainable and recyclable advanced materials with high resource efficiency, resilient value chains and internationally recognised sustainability standards

Leading actors

BMIMI, BMLUK, Austrian Standards, Research Institutions, Industry, Recycling Industry

Field of action 3: Accelerating digitisation and AI for materials

Digital methods are fundamentally changing the development, characterisation and optimisation of materials. Data rooms, digital twins, automated laboratory environments and artificial intelligence enable significantly faster and more efficient material development. To exploit this potential, Austria should **push ahead with the development of appropriate data and research infrastructures and at the same time strengthen competencies** at the interface of materials science, digitisation and data analysis. It should be noted that in the case of functional materials, data on pure material property data is often not sufficient. Coupled material – recipe – process – structure – function – component – reliability data are therefore also crucial. The **digital transformation of materials research** is becoming a key success factor for future innovation and competitiveness. In any case, an Austrian data infrastructure must be built in an integrative and standardised way so that experimental process and device data can be integrated by different organisations and the publicly (co-)financed infrastructure is made freely accessible to all stakeholders.

03

Field of action

Accelerating digitisationand AI for materials

2026–2030 Building capacity & enabling scaling

Establishment of interoperable material data spaces and common data standards; networking of research, analysis and test infrastructures; introduction of AI-supported methods for material design, characterisation, simulation and process optimisation; sharing of research infrastructures

2031–2035 International leadership & sustainable value creation

Full integration into European data spaces; AI is standard along the entire material lifecycle – from material design to production to circular economy – accelerating research, development and industrial implementation

Leading actors

Universities, research institutions, digitisation initiatives, industry

Field of action 4: Strengthening European integration

The development of advanced materials is increasingly taking place in European innovation and value creation networks. Austria should consistently **expand its participation in European initiatives, partnerships and funding programmes** and link **national activities even more closely with European strategies**. This not only increases access to knowledge, infrastructure and financing, but also strengthens the visibility of Austrian competences in the European environment. An active role in European networks makes a significant contribution to the further development of national areas of strength and to the intensification of international cooperation.

04

Field of action

Strengthening European integration

2026–2030 Building capacity & enabling scaling

Systematically align national activities with European strategies, partnerships and funding Programmes; expand participation in European pilot projects, technology platforms and data space initiatives; share European research and innovation infrastructures

2031–2035 International leadership & sustainable value creation

Austria is a recognised European hub for advanced materials, takes on coordinating roles in European initiatives and actively shapes strategies, value networks and standards

Leading actors

BMIMI, BMBWF, FFG, universities, industry, European networks

Field of action 5: Developing competencies and talents

The long-term success of the advanced materials sector depends largely on the availability of qualified specialists. At the same time, new technologies are changing the requirements for training and qualification. In the future, there will be an increased need for interdisciplinary skills that combine materials science with digitalisation, production technologies, sustainability and data analysis. Austria should therefore develop targeted measures for education and training and at the same time strengthen its attractiveness for international talent. The development of appropriate competencies is an essential prerequisite for the successful implementation of technological innovations.

05

Field of action

Developing competencies and talents

2026–2030 Building capacity & enabling scaling

Establishment of interdisciplinary competence centres; development of new study Programmes, micro-courses and continuing education Programmes; stronger networking between science and industry; targeted promotion of young talent and attracting international talent

2031–2035 International leadership & sustainable value creation

Austria is establishing itself as an internationally recognised competence location for advanced materials with excellent training, high availability of skilled workers and a strong international network of science and industry

Leading actors

BMBWF, universities, universities of applied sciences, research institutions, COMET centres, industry

Field of action 6: Strengthening deep-tech transfer and start-ups

The commercialisation of material-based innovations places special demands on the innovation system due to long development cycles and high technological risks. In order to better exploit the **economic potential of new materials, technology transfer, industrial cooperation and the development of innovative business** models should be supported in a targeted manner. Start-ups and technology-oriented SMEs are of particular importance in this context, as they often play an important role in the transfer of new scientific findings into marketable applications. A high-performance innovation ecosystem must therefore systematically promote the exchange between science, industry and entrepreneurship. In any case, a **system change in the funding logic** must be implemented in order to generate fertile ground for technology transfer: in addition to classic research projects, pilot batches, process transfer, demonstrators, validation with users, infrastructure access and small industrial pre-series.

06

Field of action

Strengthening deep-tech transfer and start-ups

2026–2030 Building capacity & enabling scaling

Development of specific deep-tech and scale-up financing instruments; development of co-investment and matching fund models; strengthening of technology transfer structures; promotion of spin-offs and start-ups; financing of demonstration plants and first-of-a-kind projects

2031–2035 International leadership & sustainable value creation

Internationally competitive deep-tech innovation ecosystem with successful scale-ups, technology-oriented SMEs and high international visibility of Austrian advanced materials companies

Leading actors

FFG, venture capital funds, economic development agencies of the federal states, technology transfer offices, industry

Field of action 7: Establishing national governance

The long-term development of the **Austrian advanced materials ecosystem requires coordinated and strategic management**. The large number of **actors, topics and technological developments** requires close coordination between **science, industry, politics, regulation and funding** organisations. At the same time, it must be ensured that new developments, European strategies, standardisation, regulation, risk and technology assessment and technological trends are continuously incorporated into the further development of the roadmap. In particular, the **standardisation and development of suitable test methods and OECD test guidelines** in cooperation with the Malta Initiative[39] (to answer risk/safety questions or toxicological tests of chemicals and advanced materials) can be mentioned as the basis for a prosperous economic environment: certainty about the requirements created by clear **standards and laws** enables economic success as well as the clear safeguarding of the market (and thus society) against harmful or problematic products. A suitable **governance structure** can also help to pool forces, create synergies and strengthen Austria's strategic positioning in the European context in the long term.

07

Field of action

Establishing national governance

2026–2030 Building capacity & enabling scaling

Establish a National Advanced Materials Steering Committee; establish a governance, KPI and monitoring system; align roadmap with European strategies; conduct regular progress reports and roadmap reviews

2031–2035 International leadership & sustainable value creation

Institutionalised governance with continuous monitoring, international benchmarking and regular updating of the roadmap; Austria has a long-established and adaptive governance structure for Advanced Materials

Leading actors

BMIMI, BMBWF, BMLUK, FFG, federal states, industry, science

[39] See: malta-initiative.org

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Conclusion and outlook

In the coming decades, **advanced materials will play a central role in Europe's competitiveness, technological sovereignty and sustainable and digital transformation**. The present roadmap shows that Austria has a strong scientific base, industrial competencies and international visibility in selected material fields. At the same time, it becomes clear that the successful exploitation of this potential requires a **coordinated further development of the entire innovation ecosystem.**

The fields of **action and strategic priorities identified** in this roadmap form an orientation framework for the development of Austria as an advanced materials location through 2035. It will be crucial to jointly further develop research, industrial implementation, skills development, European networking and strategic management, and to coordinate these areas with one another in the long term.

The roadmap is not intended as a completed strategy paper, but as a **living document** that is periodically developed together with the relevant stakeholders. The activities identified in the catalogue of actions and measures are explicitly described in relation to individual material categories, which means that the entire potential of the various types of advanced materials can be leveraged and is not restricted by sector-specific requirements. Building on this, there is room for funding calls based on this roadmap to define concrete target sizes. The further sharpening of strategic priorities and regular adaptation to technological, economic and regulatory developments will be part of this ongoing process.

With the Austrian Advanced Materials Community **ATIMA, which has been established since 2024 as a central hub for this subject area**, the federal government has laid a valuable foundation for accelerating the **cooperation of all relevant AdMa actors in Austria**.

With the consistent continuation and expansion of this contact point, the implementation and permanent update of the roadmap over the next 10 years, supported by the federal government and in the future through increased cooperation with the federal states, will strengthen Austria as **a relevant player in the international advanced materials ecosystem** in the best possible way. A key success factor for this will be the ongoing interaction with all actors in Austria, made possible by ATIMA as the central point of contact, which also forms the **Austrian hub in the international AdMa ecosystem** as a bidirectional communication channel.

Austria therefore has the prerequisites to expand its existing areas of strength in a targeted manner and to position itself as a visible European location for **sustainable, high-performance and resilient advanced materials**. The implementation of the fields of action identified in the roadmap in the coming years is intended to provide the framework for consistently transferring the existing potential into scientific excellence, industrial value creation and international competitiveness.





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Download the Roadmap from ATIMA-webpage:

atima.at