Strategic Compass for Advanced Materials

Sweden's guide for sustainability and competitiveness

IAM4Sweden

What is a strategic compass?

This Strategic Compass is a collection of proposals for the development and acceleration of the field of advanced materials in Sweden. The ambition is to show how our country can maintain its leading position in the development and application of advanced materials, to enable societal benefits and increased sustainability.

What do we mean by advanced materials?

Advanced materials is a rapidly evolving field, which means that there are several different definitions of what is actually meant by advanced materials. In this document, we use OECD's[1] working description:

> "Advanced materials are materials that are rationally designed to have new or enhanced properties, and/or targeted or enhanced structural features, with the objective to achieve specific or improved functional performance."[2]

This description clearly encompasses many materials. Therefore, we deliberately embrace the materials field broadly and avoid going into overly specific aspects or individual materials. The focus of the Strategic Compass is on the structures and support needed to give Swedish actors (developers, suppliers, and users of materials) the capacity to act in ways that strengthen Sweden's position as a leader in the field.

1 Organisation for Economic Cooperation and Development
2 one.oecd.org/document/ENV/CBC/MONO(2022)29/en/pdf

Contents

Who are we behind the Compass?

The Strategic Compass is backed by IAM4Sweden, which brings together programmes and platforms including Bioinnovation, IMA, Innovair, LIGHTer, Metalliska Material, Net Zero Industry, Produktion2030, SIO Grafen, Smartare Elektroniksystem, Swedish Metals & Minerals and Swedish Chips Competence Centre, to drive the development of advanced materials in Sweden.

The Compass has been developed through a number of open roundtable discussions and a survey directed at Swedish stakeholders within the advanced materials ecosystem, who collectively hold all rights to the document. The content may be cited provided the source is clearly stated.

The development of the Strategic Compass has been funded by Vinnova, the Swedish Energy Agency, and Formas within the framework of the strategic innovation programme SIO Grafen.

A complete list of participating organisations can be found at the end of the document.

A guide for advanced materials

This is Sweden's first national strategy for the field of advanced materials. It brings together stakeholders across the field in a shared direction forward and a common message about what needs to be done to make this path a reality within the next ten-year period.

The purpose is to:

- Create long-term economic, environmental, and social sustainability.
- Promote national development of advanced materials, as well as products and systems that use them.
- Shorten the time to market for materials.
- Increase material circularity.
- Increase the robustness of value chains.

The overarching sustainability aspect is clearly linked to concrete societal needs in many areas. Advanced materials are an enabler in many different domains and necessary for transitions, and they play an important role in helping Sweden create benefits on many levels, including industrial and environmental, as well as related to climate and social security.

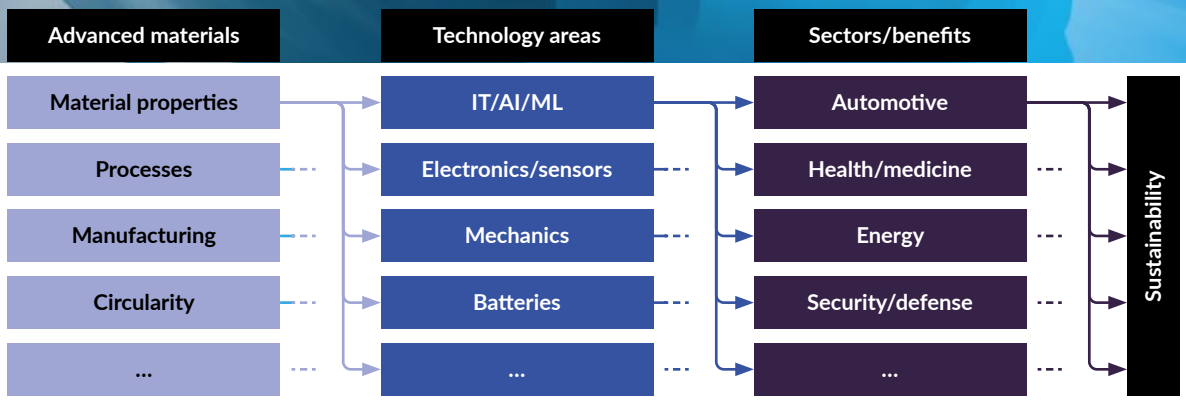
This results in a very broad picture, but there are a number of general aspects (see adjacent figure). These are the ones we will focus on.

Our focus is on applications and industrialisation of advanced materials, since several of the points above can only be realised if research results are brought all the way to competitive solutions on the market.

This focus requires necessary collaboration with other initiatives, not only within specific materials areas, but also with sectors where advanced materials are relevant, industrialised, and applied.

Although this Compass advocates a coordinated effort within the field – and between fields – there is no ambition to take a leading position that diminishes other parallel initiatives. The proposal is to create synergies to realise the benefits above; the field of advanced materials in Sweden becomes stronger through integration and connectivity.

The starting point for the Compass is that advanced materials are crucial for strategic autonomy and competitiveness in Sweden. The rapid developments currently taking place in advanced materials, digitalisation, sustainable energy solutions, and smart production are opening entirely new opportunities for product development and efficiency improvements across several industrial sectors. Advanced materials can play a key role in the substitution of rare and critical materials.



*From right to left: Increased **sustainability** can be achieved through efforts in different **sectors**, where **benefits** may arise. In all of these, societal benefits can be created with the help of a set of **technology areas.** These, in turn, benefit from strengthening the conditions for **advanced materials** across a number of aspects. Note that the figure is intended for illustrative purposes only and therefore shows only a few **examples** of aspects of advanced materials, technology areas, and sectors/benefits.*

Within the EU, advanced materials have in recent years increasingly been highlighted as an important competitive factor for European industry and as crucial components for resilience and strategic autonomy. A new European partnership for advanced materials, IAM4EU, has been launched.[3] During 2026, the EU is expected to launch an Advanced Materials Act, a legislative act intended to improve the conditions for the development and use of advanced materials in the EU.[4]

The Strategic Compass has been developed during the autumn 2025 and the spring 2026 based on a series of roundtable discussions with nearly 200 participants from across the triple helix (large and small industry, academia/research institutes, and the public sector) along entire value chains (suppliers, customers), including support functions (platforms, standardisation bodies) within several sectors (road transport, aviation, energy), and both civilian and military domains. The discussions have been followed up and complemented through a survey. The proposals have been circulated for open consultation.

3 IAM4EU Partnership | IAM-I
4 research-and-innovation.ec.europa.eu/research-area/industrial-research-and-innovation/chemicals-and-advanced-materials/advanced-materials-industrial-leadership_en

Vision 2035

In 2035, Sweden remains a strong materials nation with outstanding basic and applied research and competitive companies, both existing and new, within a well-functioning ecosystem. This means:

Security of supply: Swedish actors have secured access to raw materials and materials. Resilient value chains, both national and international, are developed and in use, reducing dependence on vulnerable or external suppliers.

Value chains: Robust and resilient value chains are developed and in use, reducing dependence on vulnerable or external suppliers.

Circularity and recycling: Developed and efficient recycling processes, circular material flows, and business models have led to radically increased recycling rates and minimised material losses.

Material efficiency and light-weighting: Materials and processes that reduce weight, climate impact, and/or energy use are widely used.

Industrialisation of new advanced materials: Continuous collaboration between research, supply chains, and industrial use enables accelerated ways of working.

Health and safety: Materials are safe to develop, manufacture, and use.

Internationalisation: Swedish actors participate in and influence EU initiatives on advanced materials and collaborate internationally to access key expertise.

Level playing field: Swedish actors operate under the same conditions as competitors in other countries.

Continuous development: The advanced materials of 2026 have become established materials. At the same time, new advanced materials continue to be developed.

Clear follow-up: Future development and use of advanced materials are guided by indicators reflecting circularity, time to market, lifecycle climate impact, and the robustness of value chains.

As a nation, we have strong starting points through leading positions in areas such as fossil-free steel, 2D materials, bio-/fibre-based materials, advanced electronics, and additive manufacturing, creating particularly favourable conditions for continued development and industrial application.

Three proposed areas of action

To strengthen Sweden's position as a leader in the field of advanced materials, we propose action in three areas.

Area of action 1: National collaboration platform for advanced materials

We propose a national collaboration platform with the following functions:

- **Meeting place** for stakeholders
- **Support function** for:
  - Matchmaking between stakeholders, including international.
  - Collaborative projects.
  - Access to infrastructure such as testbeds and analytical equipment.
  - Knowledge transfer regarding development and use of methods and processes.
  - Knowledge of compliance with laws, policies, and regulations.
  - Sustainability and chemical safety in the innovation chain in line with the SSbD framework.
  - Work environment, toxicology, and exposure risks.
  - Standardisation.
  - Resilience.
- **Materials data hub.**
- **Advisory body** for issues relating to:
  - Laws, policies, and regulations.
  - Sustainability and chemical safety in line with the SSbD framework.
  - Work environment, toxicology, and exposure risks.
  - Standardisation.
  - Resilience.
- **Strategic forum** for foresight and dialogue with policymakers.
- **Connection to European initiatives** to ensure Swedish participation and influence.
- **Communication,** both internally among stakeholders and externally to demonstrate results, benefits, and needs.

A successful arena with the functions proposed above requires that relevant parts of the recommended activities under area of action area 2 below are implemented, and in the long term also that the recommended activities under focus area 3 are carried out.

Within this area of action, **all relevant programmes and arenas** need to be involved. The IAM4Sweden platform is willing to take the lead on this issue.

Area of action 2: Five long-term funding tracks

We propose five specific funding tracks:

- **Programmes for innovation activities** at all relevant levels, from basic research to market-ready products – both regarding the materials themselves as well as the products and systems that utilise them – resulting in resilient and circular value chains.
- **SME-focused investment programme** combining long-term risk capital for upscaling with project-based support for building applications.
- **Government tax/procurement tools and/or strategic investments** to reduce the financial risk for companies introducing advanced materials in applications.
- **Targeted funding for use of infrastructure and testbeds.** Increase the visibility of existing opportunities and speed up the processes for using them.
- **Strategic funding for overarching issues** such as sustainability, regulations, work environment, resilience, and skills supply.

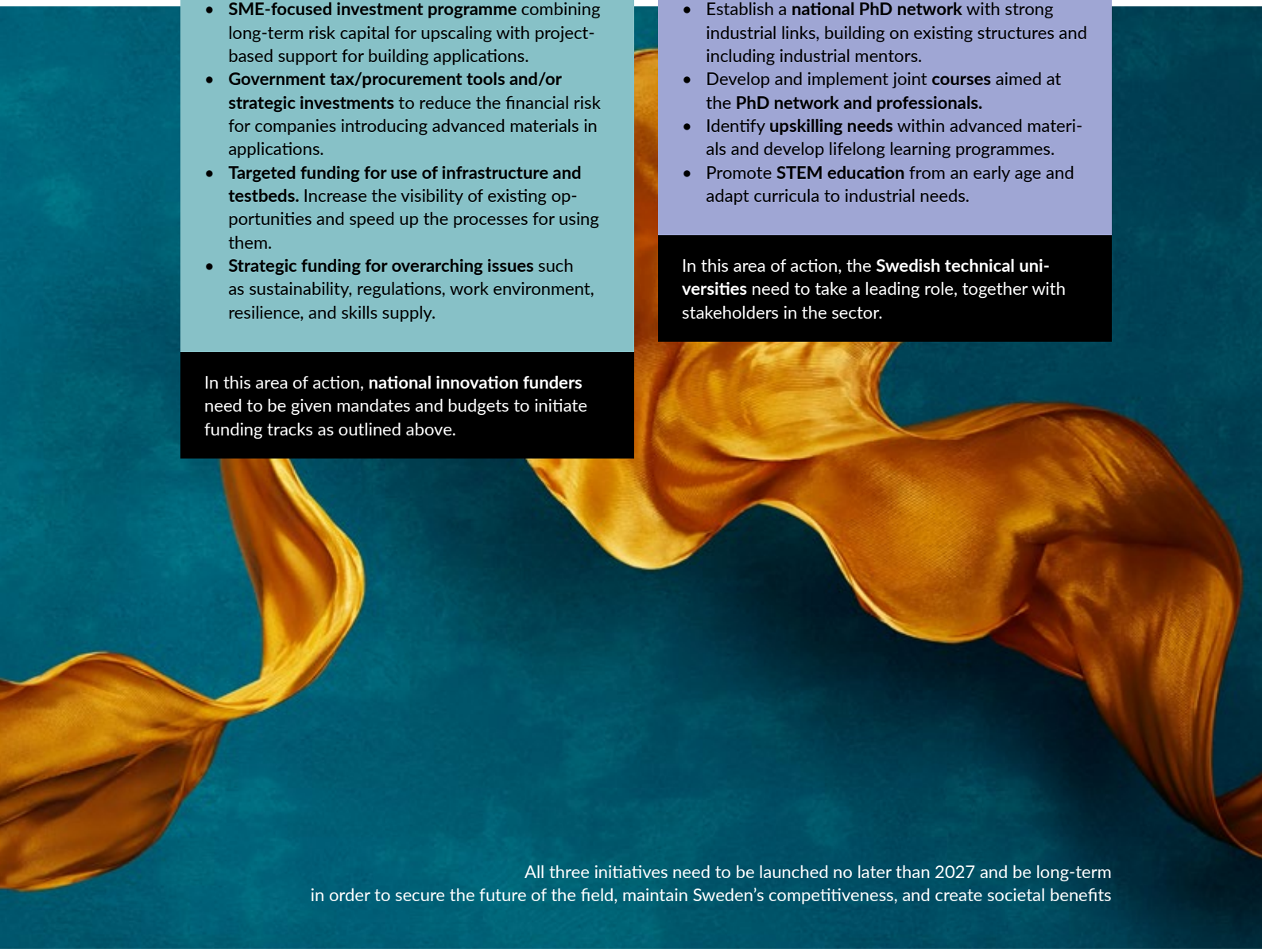
In this area of action, **national innovation funders** need to be given mandates and budgets to initiate funding tracks as outlined above.

Area of action 3: Skills supply

We propose the following measures:

- Develop the marketing of **materials-oriented undergraduate programs** jointly at Swedish universities with support from previous work.
- Develop **new undergraduate courses** focused on new advanced materials and their production and use.
- Establish a **national PhD network** with strong industrial links, building on existing structures and including industrial mentors.
- Develop and implement joint **courses** aimed at the **PhD network and professionals.**
- Identify **upskilling needs** within advanced materials and develop lifelong learning programmes.
- Promote **STEM education** from an early age and adapt curricula to industrial needs.

In this area of action, the **Swedish technical universities** need to take a leading role, together with stakeholders in the sector.



All three initiatives need to be launched no later than 2027 and be long-term in order to secure the future of the field, maintain Sweden's competitiveness, and create societal benefits

Underlying areas of need

Here we present the outcome of the data collection carried out within the framework of the Strategic Compass. The presentation is overarching, yet divided into specific issues and areas of need to enable the analysis that has led to the Compass's three proposed initiatives in the previous chapter.

Area of need: The innovation chain between research and industrial production

- **Collaboration between industry, institutes, and academia** Sweden needs long-term and deep partnerships, joint projects, and platforms for continuous dialogue to ensure that research meets industrial needs and that industry is prepared for new and emerging material types.
- **Funding for scaling and higher-TRL projects** Resources must be secured to take innovations from lab scale to full-scale production, including support for pilot lines and Proof of Concept.
- **Knowledge transfer and industrial PhD students** More industrial PhD students, boundary-spanners, and joint educational initiatives are needed to build dual competence between research and production.
- **Support for SMEs** Innovative SMEs need better access to financing, national and international networks, and test environments to enable faster commercialisation.
- **Digitalisation and test infrastructure** Digital twins, models, and shared testbeds need to be developed for faster validation and robust production.

Area of need: Circularity and other sustainability goals

- **Circularity and recycling** There is a lack of efficient recycling processes and design for reuse/disassembly, and it is difficult to maintain material performance during recycling.
- **Resource and energy issues and resilience** There is a need for fossil-free energy, carbon-free processes, and reduced material use. The carbon footprint is high in the production of certain materials.
- **Standardisation and quality** Standards for new materials are lacking, and there is insufficient traceability and quality control for circular flows.
- **Scaling and implementation** There is a gap between research and industrial production. The costs of scaling and establishing supply chains are high. Supply chain capabilities need to be developed in parallel with materials research.
- **Regulations and policy instruments** Regulations are needed to promote circular solutions, for example by creating certification for energy-efficient materials and processes linked to CO_2 reduction and financing through climate credits. Legal requirements, incentives, and regulatory changes for sustainable materials are often difficult to understand.

Area of need: Scaling up production

- **Financing and risk sharing** It is difficult to find investors willing to invest in scaling up the production of new advanced materials.
- **Production and product** An integrated approach between academia, institutes, and industry is needed to create early understanding of production and product aspects already at the research stage.
- **Access to infrastructure and equipment** Opportunities to test and scale up new materials in pilot and demonstration environments are limited, and the costs of investing in production equipment are high.
- **Slow qualification and standardisation processes** New materials require extensive verification and certification, which is time- and resource-intensive and slows market introduction.
- **Technical and skills-related challenges** There is complexity in process control during scaling, a need for advanced modelling and digital solutions, and a lack of knowledge transfer from research to production.

Area of need: Deployment of advanced materials in applications

- **Long lead times** The time to commercial breakthrough and the first major customer is too long, which eliminates innovative ideas and weakens national competitiveness.
- **Economic barriers and cost issues** High initial costs are a barrier, as are difficulties in demonstrating long-term value and a lack of funding for scaling and qualification. Startups and scaleups need financing.
- **Slow and complex qualification processes** Requirements for extensive testing, certification, and documentation dampen innovation, especially in safety-critical areas such as aviation, medicine, and nuclear power.
- **Organisational and cultural barriers** There is a lack of cross-functional roles between research, development, and commercial operations, and many actors struggle to change existing ways of working and solutions.
- **Lack of standards and common quality frameworks** Standardised methods for developing new materials, circularity, and advanced manufacturing are lacking, making rapid adoption more difficult.
- **Technical and skills-related challenges** Knowledge of material properties is limited, and there is a need for better simulation models, pilot facilities, and knowledge transfer from research to industry.

Area of need: Standards related to advanced materials

- **Standards for new advanced materials** There is a lack of standards and frameworks for new advanced materials, for example in characterisation, quality assurance, and performance.
- **Standards for sustainability and circularity** Material standards for circular material flows are lacking, as are material definitions and methods for evaluating recycling potential and reuse.
- **Standards for additive manufacturing** Faster qualification of materials is needed, as well as standards for repair and remanufacturing, particularly in the aerospace industry.
- **Digital and data-driven standards** Digital material passports and data formats linked to simulation, digital twins, and AI/machine learning models need to be developed.

Area of need: Sharing of material data

- **AI/machine learning and digital twins** Sweden needs to scale up the use of AI/machine learning and digital twins for material design and optimisation.
- **Confidentiality and sensitive information** Confidentiality agreements for access to data are a competitive advantage that must be ensured.
- **Standards and common formats for material data** Company-specific procedures need to be developed.
- **Data sharing across the value chain** Access to data and open, secure platforms is insufficient.
- **Cost and resource requirements** Processes for generating detailed data are costly.
- **Fragmented processes** Data is only shared within individual projects.

Area of need: Infrastructure for testing and demonstration

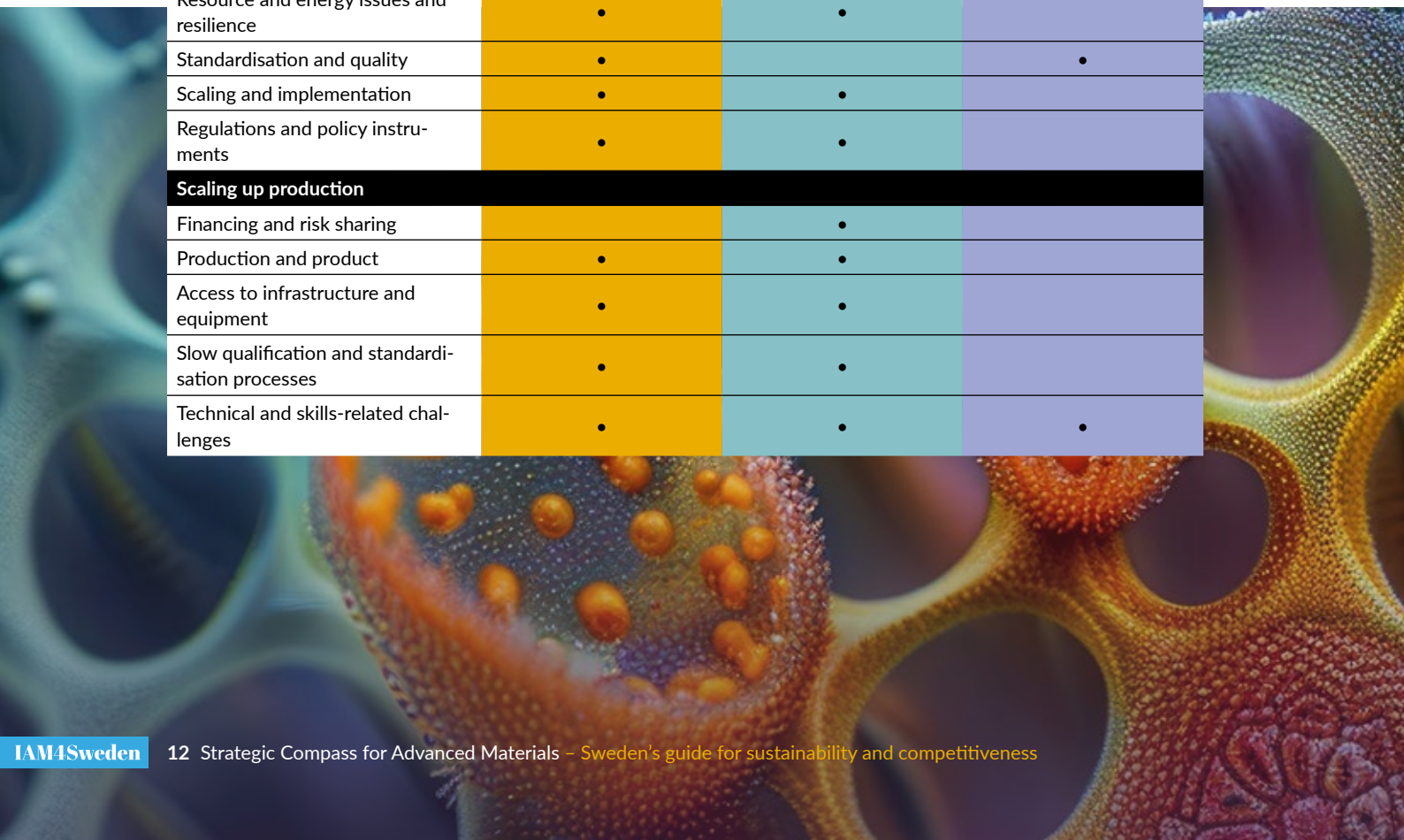
- **High costs** Pilot and demonstration facilities are expensive to use and require significant investment to maintain.
- **Limited capacity and equipment** Certain types of test equipment (e.g. for extreme operating conditions, battery materials, full-scale production) are entirely lacking or very limited in Sweden.
- **Coordination and accessibility challenges** Infrastructure exists but is poorly coordinated between actors; potential users have difficulty identifying and accessing resources.
- **Funding issues** There is a lack of project funding to cover testing and demonstration costs, especially in the scaling phase.
- **Organisational and knowledge-related barriers** Awareness of available resources is low, while competition for research funding is high. Requirements for industry-close environments that are difficult to access can also be a barrier.

Area of need: Materials-related competence

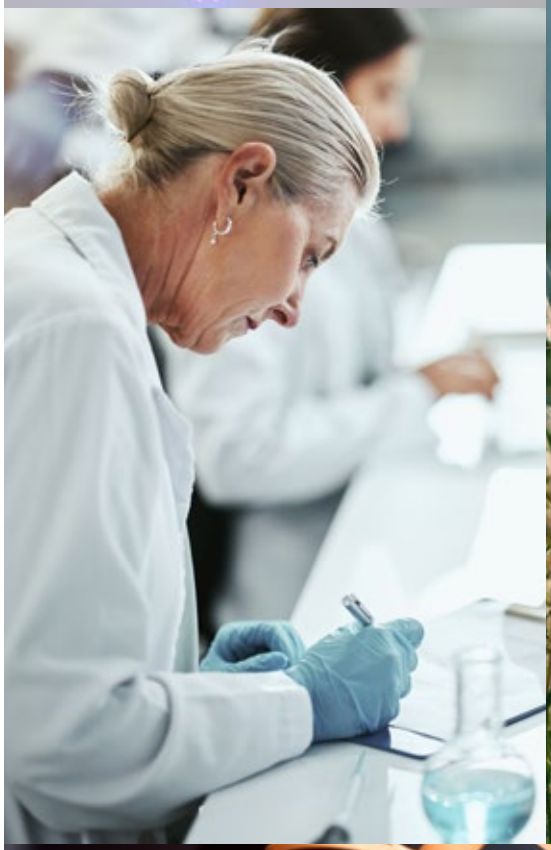
- **Materials expertise** There is a lack of expertise in directly material-related fields, from the macro to the atomic level, as well as in advanced material characterisation and analysis.
- **AI and simulations** Capabilities are needed to use AI and simulations to link material structures at the atomic level to the properties they create at the macro level.
- **Combined competencies** There is a lack of combined expertise in materials and, for example, AI/machine learning/digitalisation, simulation, and application knowledge, including hands-on workshop experience.
- **Operational competence for industrialisation** The ability to take materials from development to full-scale production needs to be strengthened. Knowledge of recycling complex material mixtures and quality assessment for reuse needs to be increased.
- **Relevant education and lifelong learning** Education for materials engineers is needed, including lifelong learning, to attract and retain talent. Industry needs to be involved in education at different levels to exchange knowledge and ensure relevance. The skills supply challenge is long-term rather than an acute shortage today.

Mapping between areas of need and proposed actions

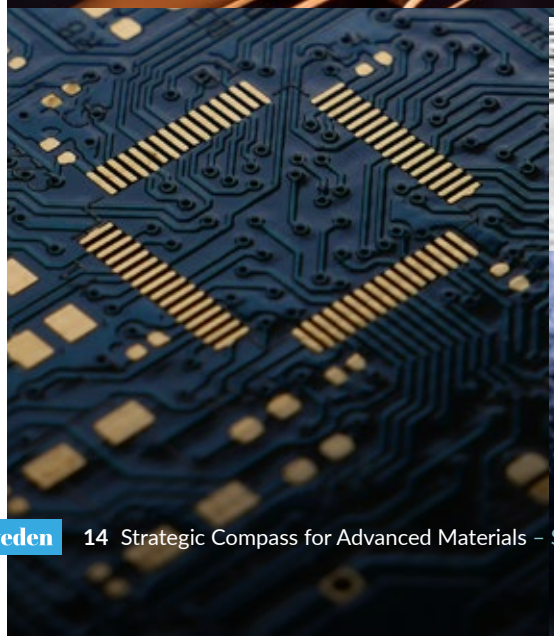
	Area of action 1: National collaboration platform for advanced materials	Area of action 2: Five long-term funding tracks	Area of action 3: Skills supply
The innovation chain between research and industrial production			
Collaboration between industry, institutes and academia	•		•
Funding for scaling and higher-TRL projects		•	
Knowledge transfer and industrial PhD students	•		•
Support for SMEs	•	•	•
Digitalisation and test infrastructure	•	•	•
Circularity and other sustainability goals			
Circularity and recycling	•	•	•
Resource and energy issues and resilience	•	•	
Standardisation and quality	•		•
Scaling and implementation	•	•	
Regulations and policy instruments	•	•	
Scaling up production			
Financing and risk sharing		•	
Production and product	•	•	
Access to infrastructure and equipment	•	•	
Slow qualification and standardisation processes	•	•	
Technical and skills-related challenges	•	•	•



Deployment of advanced materials in applications			
Long lead times		•	
Economic barriers and cost issues		•	
Slow and complex qualification processes	•		
Organisational and cultural barriers	•		•
Lack of standards and common quality frameworks	•		
Technical and skills-related challenges	•	•	•
Standards related to advanced materials			
Standards for new advanced materials	•		
Standards for sustainability and circularity	•		
Standards for additive manufacturing	•		
Digital and data-driven standards	•		
Sharing of material data			
AI/machine learning and digital twins	•	•	•
Confidentiality and sensitive information	•		
Lack of standards and common formats for material data	•		
Data sharing across the value chain	•		
Cost and resource requirements	•	•	
Fragmented processes	•	•	
Infrastructure for testing and demonstration or similar			
High costs		•	
Limited capacity and equipment		•	
Coordination and accessibility challenges	•	•	
Funding issues		•	
Organisational and knowledge-related barriers	•		•
Materials-related competence			
Materials expertise	•		•
AI and simulations	•		•
Combined competencies	•		•
Operational competence for industrialisation	•	•	•
Relevant education and lifelong learning	•		•



Participating organisations

2D fab, ABB, Bona Sweden, Bright Day Graphene, Business Sweden, Celluxtreme, Chalmers University of Technology, Chalmers Industriteknik, CirculAir, Swedish Defence Research Agency, GKN Aerospace, Grafoam, Grafren, Graphmatech, GreenMateria, University of Gothenburg, University of Borås, University West, ic2vil, In2Great Materials, Innovair, Innovation Partners, Innovative Materials Arena, IPCO, IVL Swedish Environmental Research Institute, Jernkontoret, Jönköping University, Karolinska Institute, KTH Royal Institute of Technology, LIGHTer, Lindholmen Science Park, Linköping University, Linnkonsult, Luleå University of Technology, Lund University, Mid Sweden University, Net Zero Industry, Outokumpu, Polyniora, ReliefedB, RIC2D, RISE Research Institutes of Sweden, Saab, SeaTwirl, SIO Grafen, Swedish Institute for Standards, SKF, Smartare Elektroniksystem, Stockholm University, Söderberg, Traton, Turboion, Uppsala University, Vinnova, Volvo Cars, Volvo Group, XDefine, YbotX.

Involved in planning, implementation, and analysis

Boel Wadman RISE and LIGHTer
Eleonor Hendar Chalmers Industriteknik and SIO Grafen
Elisabeth Sagström-Bäck Chalmers Industriteknik and SIO Grafen
Gunnar Linn Linnkonsult
Helena Theander Lindholmen Science Park
Johan Ek Weis Chalmers Industriteknik and SIO Grafen
Jon Wingborg Chalmers Industriteknik and SIO Grafen
Katinka Ernstsson RISE and LIGHTer
Margareta Groth Luleå University of Technology
Svjetlana Stekovic Linköpings University and Innovair/SARC

Production

Project Manager Elisabeth Sagström-Bäck, Chalmers Industriteknik and SIO Grafen
Facilitators: Margareta Groth, Luleå University of Technology; Helena Theander, Lindholmen Science Park
Editor/Layout: Gunnar Linn, Linnkonsult
Images: Astrid Hedenström/IAM4Sweden, Shutterstock, Unsplash
Printing: Billes, 2026
Contact: compass@iam4sweden.se

iam4sweden.se

IAM4Sweden