

DEEP TECH BERLIN

AGENDA



BERLIN



Pioneering Tech for Freedom

Dear readers,

Berlin stands for progress, the courage to embrace change and a belief that we can actively shape the future. As Senator for Economic Affairs, Energy and Public Enterprises, one of my key priorities is to establish our city as Europe's innovation capital. The Deep Tech Berlin Agenda marks another milestone towards achieving that goal – with an approach rooted in creativity, collaboration and a commitment to turning ideas into long-term value creation.

The challenges facing us today are considerable: global competition, technological upheavals and social transformations demand resolute action. Now more than ever, we can see what makes Berlin special: a unique combination of scientific excellence, pioneering entrepreneurship, specialised enterprises in key technology areas and a vibrant start-up scene. Our city is a place where research and practice are closely interwoven, where international talent meets local innovation, where we work together to find solutions to the challenges of tomorrow.

But excellence alone is not enough. To ensure Berlin's long-term success as a hub for innovation, we must overcome structural barriers – and foster conditions in which visionary ideas can become market-ready products and services. Innovation is the key to creating secure future jobs, attaining economic sovereignty and building a liveable city for all Berlin residents.

The Agenda focuses on five key technology areas that will strengthen Berlin's role as European innovation leader:

- Artificial Intelligence as a driver of business innovation
- Biotechnology as a key to mastering global health challenges
- Microelectronics, Photonics & Quantum Technologies as a foundation for European digital sovereignty
- Advanced Materials & Manufacturing as a basis for future-ready industry
- Software Technologies as an engine of digital transformation in all areas of life.

The Agenda is not a static document, but a call for collective action. It is aimed at anyone who wants to help shape Berlin's innovation ecosystem: researchers who translate their study findings into real-world applications; businesses that make bold investments; government agencies that deliver agile, citizen-centric services; civil society organisations that contribute to our city through their work and ideas. Innovation is a shared task. It can succeed only if we build bridges – between research and business, tradition and progress, local roots and global impact.

Berlin has shown that it can continually reinvent itself. This ability to transform is our greatest strength. With the Berlin Deep Tech Agenda, we are taking the next step to ensure our city remains resilient, competitive and squarely focused on the future – while also contributing to the federal government's High-Tech Agenda. Because today's innovations are tomorrow's jobs, quality of life and sovereignty.

I invite you to be part of making this Agenda a reality. Any contribution you can make will be valuable – whether it be through your specialist knowledge, your dedicated work or your brilliant ideas. Together, we can make Berlin Europe's innovation capital.

Franziska Giffey

Mayor of Berlin and Senator for Economic Affairs, Energy and Public Enterprises

Franziska Giffey



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Executive Summary

Germany and Europe are faced with challenges that can only be mastered through innovation. With the Competitiveness Compass and High-Tech Agenda Germany (HTAD), EU and federal policymakers have realigned their priorities to focus on key technologies and strategic research areas. In this context, the Deep Tech Berlin Agenda, supplementing the Innovation Strategy of the Capital Region Berlin-Brandenburg 2035 (InnoBB 2035), will help to strengthen tech-based innovation in the state.

The German capital offers superb conditions for bringing technology-intensive innovations into use and onto the market: an outstanding, internationally connected research sector with a high concentration of institutions, a vibrant start-up scene and specialised enterprises in highly relevant technology and application areas. At the same time, there are structural gaps in the innovation process: too little private investment in research and development (R&D), underdeveloped transfer pathways between academia and industry, a lack of market access, complex regulations and red tape, and barriers to growth and scaling.

This Agenda is Berlin's strategic response to changing conditions and the new demands that innovation policy must meet. It will sharpen the state's tech innovation profile by focusing on technology and application areas where Berlin is already leading the way today or could be in future.

The Agenda follows three overarching strategic goals:

1. **To establish Berlin as one of Europe's leading locations for deep tech innovation** and leverage its strengths and potential to ensure impact-focused adoption of technological breakthroughs.
2. **To make Berlin one of the most attractive locations for rapid, reliable transfer** from research to initial applications by encouraging more spin-offs, commercialisation and collaboration.
3. **To foster exceptional conditions in Berlin for deep tech companies to scale up and grow** by developing the most innovation- and growth-friendly structures and conditions anywhere in Europe.

Within a dynamic innovation portfolio, the Agenda focuses on five strategic technology areas which, in combination with Berlin's strongest and most promising application areas, give rise to thriving innovation ecosystems:

-  **Artificial Intelligence**
-  **Biotechnology**
-  **Microelectronics, Photonics & Quantum Technologies**
-  **Advanced Materials & Manufacturing**
-  **Software Technologies**

Ten overarching strategic levers provide the toolbox for targeted measures to strengthen these technology and application areas according to any specific needs that arise:

- **Operationalisation and governance as a shared task**
- **Accelerating and simplifying knowledge and technology transfer**
- **Supporting and expanding regulatory sandboxes**
- **Strengthening talent pipelines, skills development and entrepreneurship**
- **Improving research, innovation and test infrastructure**
- **Making government an enabler of innovation**
- **Creating interoperable data spaces and facilitating access**
- **Establishing funding partnerships and mobilising growth capital**
- **Facilitating innovative procurement and market access**
- **Raising Berlin's international profile as a deep tech location**

With these ten levers, the Deep Tech Berlin Agenda will create a strategic framework for tech-focused innovation policy over the next ten years. The Agenda will be managed on a cross-departmental basis, and its implementation will be a shared task for Berlin's government agencies and all innovation stakeholders. As a learning strategy, it will be monitored, evaluated and refined with a focus on maximising impact.

1

THE CHANGING FACE OF EUROPEAN AND NATIONAL INNOVATION POLICY

The growing erosion of once seemingly secure economic partnerships and established security alliances is permanently changing Europe's role. The EU finds itself in an intensifying geopolitical competition over technology and sovereignty, and is lagging behind the major economic powers in fields of crucial future importance. At the same time, there are opportunities to use cutting-edge innovations in key technologies to tackle fundamental challenges arising from economic and social transformation. But that requires accelerated implementation and a realignment of innovation policy - with new, clear priorities being set at European, federal and regional level, as in Berlin.

Productivity and innovation gaps are limiting Europe's competitiveness and technological sovereignty

Mario Draghi's report to the European Commission on the future of European competitiveness identifies structural weaknesses in Europe in terms of productivity, innovation and companies' capacity to scale up. The innovation gap described in the report can be broken down into the following main elements:

- inadequate knowledge generation and development in key technologies, due among other things to a lack of private investment in R&D and inefficiencies in public R&D funding - a research gap;
- weaknesses in translating research into market-ready applications, due for example to inadequate R&D collaborations and uncertainties in relation to knowledge-based spin-offs and the transfer of intellectual property (IP) - a transfer gap;
- regulatory fragmentation and inadequate funding for scaling up technology, which limits growth and the diffusion of innovations - a scaling gap.

A new innovation and competition agenda for Europe and Germany as a shared task

The European Commission has responded to these challenges with its Competitiveness Compass, which is intended to close the innovation gap with global competitors, increase the pace of decarbonisation and strengthen economic resilience and European security by reducing strategic dependencies. That requires greater competitiveness, growth and innovation in key technologies. In future, these priorities will also guide other European strategies, initiatives and programmes, such as the EU Startup and Scaleup Strategy, Horizon Europe, the European Innovation Council, the EU Cohesion Policy, the European Competitiveness Fund, the planned European Innovation Act and the European Research Area Act.

At the domestic level, the High-Tech Agenda Germany (HTAD) is addressing the challenges and innovation policy trends identified above by prioritising key technologies and strategic research areas for future research and innovation policy. The Microelectronics Strategy and Fusion Action Plan that have already been agreed under the HTAD will be followed by other framework programmes dealing with areas such as artificial intelligence (AI), quantum technologies, biotechnology and technologies for net-zero mobility. Implementation of the HTAD is institutionally embedded in roadmaps agreed between the state and federal governments. Contributions by individual states will also play an important role in federal innovation policy above and beyond the HTAD. Examples include the Federal Agency for Breakthrough Innovation (SPRIND), to whose projects numerous Berlin companies and institutions contribute solutions and ideas from local technology and innovation ecosystems, and the proposed National and Regional Partnership Plans, which are intended to better integrate national and regional investment priorities for EU funding.

Looking at these strategies and structures shows the growing importance of collaboration between the state and federal governments on innovation and technology policy in order to achieve greater impact for Berlin, Germany and Europe through innovation. The Deep Tech Berlin Agenda is intended to provide crucial impetus towards such collaboration.

Berlin's contribution to an innovative, sovereign and competitive Germany and Europe

By harnessing its strengths and development potential in technology-intensive innovation fields, Berlin can help bolster Germany's and Europe's technological sovereignty, competitiveness and resilience. Berlin's unique qualities and dynamic innovation ecosystem provide an ideal basis for integrating key Berlin stakeholders into these emerging national and European innovation processes and allowing them to contribute their ideas, increasing their visibility as co-designers of central programmes, development partnerships and roadmaps and boosting the impact of state policy measures.

2

A DEEP TECH AGENDA FOR BERLIN

Berlin has become a dynamic and innovative hub for business and research. Its innovation activities are primarily driven by knowledge-intensive services, as well as by technology- and application-focused research, development and business models – complemented by industry in R&D-intensive sectors. Berlin has particular innovation potential in areas where researchers, businesses, intermediaries and government agencies work together across industry and sectoral divides to form innovation ecosystems, which pool resources to support innovation – especially at the points of convergence between technological development and real-world application. That includes dynamic technology areas such as AI, biotechnology and quantum technologies and application areas such as medicine, mobility, energy and financial services – in short, areas where technological innovations drive value creation. Berlin has particular strengths and potential in innovative deep tech solutions at the intersections between these areas.

Why Berlin needs an innovation policy update

A look at global developments and innovation trends makes clear that success in technology-intensive innovation processes – from basic development to ideation to adoption and scaling – will be crucial for future sovereignty, value creation and competitiveness. That is true for Berlin, too. Technical innovations and robust deep tech ecosystems provide an important foundation for the state, supporting the emergence of strong companies whose solutions can effectively shape the course of transformation processes such as digitalisation, decarbonisation and demographic change and meet growing demands for security and resilience.

Since 2011, the Joint Innovation Strategy of the States of Berlin and Brandenburg (innoBB) has provided the framework for Berlin’s innovation policy. On this basis, highly effective clusters have emerged, which correspond to sectoral value chains, bring stakeholders together and support project development. Cross-cluster ecosystems have been addressed with broad-based measures to promote innovation. The innoBB clusters have enabled significant progress towards building an innovative capital region. In future, Berlin aims to utilise and further develop this foundation.

To raise the visibility and impact of Berlin’s innovation profile and deep tech ecosystems at global, European and national level, the state needs a new innovation policy focus that concentrates resources and activities on technology and application areas where it has established strengths and/or high potential for development.

Berlin is enhancing its technology and innovation profile

With the Agenda, the state is adopting this new strategic direction and enhancing its technology and innovation profile. The Agenda focuses specifically on technology and application areas where Berlin has strong R&D capability and high potential for innovation and value creation. In short: the State of Berlin’s innovation policy will consistently prioritise points of intersection between key technologies and the areas in which innovations are applied. Resources and instruments will be deployed in ways that allow Berlin to operate more effectively in the integrated capital region while strengthening its contribution to strategic national and European priorities, partnerships and programmes. The Agenda sets the direction of Berlin’s innovation policy for the next ten years. It has been designed as a learning strategy with a stable framework, which means that Berlin will review and adapt its strategic innovation portfolio at regular intervals in order to keep pace with the ever more rapid and difficult-to-predict developments in technology, markets and wider conditions.

From technology to early adoption to scaling up – along the stages of the innovation process

The Agenda understands innovation as a process that builds on technological developments and trends, extending from R&D to validation, piloting and transfer through to commercialisation and competitive scaling. In future, the core task of Berlin’s tech-focused innovation policy will be to support these stages of product and process innovation, augmented by measures in other policy areas that will significantly contribute to the success of the innovation process. In the early innovation phases, it will mainly be science and research policy that is relevant, while general economic and industrial policy as well as productive investment in manufacturing will be critical for success in

Figure 1: The Agenda addresses the gaps in the innovation process



the close-to-market innovation phases. Adoption and use by a majority of companies and widespread diffusion of innovations will primarily be supported by economic and industrial policy measures.

Deep tech refers to technical innovations based on substantial scientific discoveries and technological breakthroughs. These innovations offer considerable technological advantages over existing solutions and usually involve complex development cycles and high capital requirements over long timescales. Due to its novel nature, the development and implementation of deep tech often comes with great risks and uncertainties in terms of technological feasibility, regulation and market acceptance. What is critical to the success of deep tech is therefore not just excellent R&D but also the capacity to quickly and reliably turn technical innovations into market-ready products and processes, and to successfully scale them up in the marketplace. Deep tech innovations can make an impactful contribution to solving strategic challenges in relevant application areas and to mastering key future tasks, such as strengthening competitiveness, sovereignty and security, creating social value and improving environmental sustainability.

Enhancing strengths, leveraging potential, creating critical mass through focus

Deep tech innovation emerges from collaboration between researchers, businesses, intermediaries and government agencies in innovation ecosystems. This Agenda seeks to bolster the best-performing ecosystems and open up growth pathways in areas with high potential, focusing on areas and applications of deep tech where Berlin already has a solid foundation to build on or can harness dynamic potential for expansion. This priority will create critical mass for cutting-edge innovations, international visibility and a resource focus that enables dynamic, continuous development pathways along the innovation chain.

Working in partnership to close innovation gaps and turn knowledge into impact

Under the Agenda, innovation policy will focus on addressing the structural gaps – the research gap, transfer gap and scaling gap – that exist in Europe's, Germany's and Berlin's innovation processes. Enabling continuous development pathways from excellent basic research to transfer and commercialisation through to market scaling requires close collaboration with all innovation stakeholders across departmental and sectoral divides. As one key step towards this collaboration, the Agenda is being closely aligned with the Berlin Research Policy Strategy. The Berlin Transfer Bridge serves to link the two strategies together. The Research Policy Strategy develops the structural conditions for science and excellent research to flourish in Berlin. The Agenda will build on this, helping research institutions and businesses to convert technological R&D into value creation by improving transfer, commercialisation and scaling processes and

closing structural gaps in the innovation process. This closer integration within the framework of the Agenda is vital to enable systematic synergies between high-quality research and business innovation in Berlin.

Furthermore, Berlin has aligned its Agenda with the federal government and EU, making it possible to mobilise additional resources, deepen and expand strategic partnerships and better coordinate research, innovation and business programmes. This vertical integration will increase the reach and impact of innovations from Berlin in Germany and Europe. It will also strengthen the instruments described in this Agenda and accelerate their implementation along the innovation chain.

Against this backdrop, the close economic ties and complementarities between Berlin and Brandenburg continue to be important drivers of economic dynamism in the capital region. The Deep Tech Berlin Agenda will complement the new Innovation Strategy of the Capital Region Berlin-Brandenburg 2035 (InnoBB 2035), which will extend collaboration between Berlin and Brandenburg so as to harness synergies between the states' individual strengths and unlock shared potential for value creation and innovation. The Berlin Agenda's tech-focused approach and strategic levers directly feed into InnoBB 2035's key objectives of strengthening regional innovation ecosystems, bolstering regional competitiveness and solving transformation-related challenges.

A joint, evidence-based, learning agenda

In line with the requirements of the EU's Smart Specialisation Strategy (S3) approach, evidence-based prioritisation of innovation strengths and potential lies at the core of the Deep Tech Berlin Agenda. The Agenda is based on data analysis of Berlin's innovation ecosystem and a comprehensive participation process with stakeholders from business, research, intermediaries and government agencies. This analytic, integrative process will continue throughout the implementation phase, with ongoing monitoring of various indicators to measure success and enable targeted adjustments and refinements to the Agenda.

3

BERLIN'S INNOVATION PROFILE:

DYNAMIC AND INTERNATIONAL WITH A STRONG RESEARCH BASE

Berlin's innovation profile is characterised by a combination of strong research, a dynamic start-up scene and deep tech ecosystems focused on real-world applications – all embedded within a highly international environment. In the EU's Regional Innovation Scoreboard, Berlin is classified as a 'leader', ranking in the most innovative 5% out of more than 200 European regions.

An exceptional science and research landscape with a high concentration of institutions

Berlin has a greater concentration of higher education (HE) and research institutions than almost any other European city, with four universities, 39 professional and technical colleges, the Charité (Europe's leading university hospital) and more than 70 non-university institutions. Four thousand professorial posts provide the foundation for excellent, wide-ranging research and teaching of highly qualified professionals and future leaders. Berlin's HE sector ranks second in Germany for R&D as a proportion of GDP, attesting to the high research intensity at Berlin institutions and the strong role played by R&D alongside teaching. Its excellent research profile in technological fields such as AI, robotics, quantum technology, biotechnology, medical technology, optics, photonics, materials science, energy and mobility is complemented by outstanding research in the natural and life sciences, mathematics and the humanities and social sciences. The Berlin University Alliance highlights this strong research ecosystem with its clusters of excellence, showcasing Berlin as a leading international location for science and research.

International research partnerships, a large talent pool and a strong entrepreneurship culture

More than 250,000 people research, work, teach and study at Berlin's HE institutions. Berlin universities collaborate on teaching and research with more than 1,000 partner institutions worldwide. Berlin-based academics publish almost twice as many papers with international partners as the EU average – an indicator of the high research quality and extent of international networks. Berlin graduates are prolific company founders: the state's three largest universities rank in the top ten institutions Germany-wide for number of founders. However, despite the number of start-ups and the high concentration and quality of research, there is still a lot of untapped potential at Berlin's HE institutions in terms of patent and IP commercialisation, indicating the existence of transfer gaps.

A growing economy with a technology-intensive service and knowledge sector

Berlin's economic output is among the highest of any German state, and it has recorded above-average growth since 2013. The service and knowledge sector make a significant contribution to its economic structure and gross added value, especially the software, finance, media and creative industries. Berlin also has specialised, technology-intensive companies in fields such as AI, biotech, medical technology, optics, photonics, energy and mobility. With its strong base of mid-sized industrial enterprises, the state occupies niches in some of these fields that are closely integrated with international markets and boast high export figures, even if industry overall makes up a lower proportion of gross value added than in other German states.

Berlin companies' exceptionally high innovation activity and spending

Berlin companies invest heavily in innovation compared with other German states, spending an average of 4% of turnover. In 2023, that spending totalled a new record of 6.2 billion euros, with a large portion coming from small and medium-sized enterprises (SMEs). Compared with other, more industrial cities, Berlin's private R&D investments make up a lower proportion of GDP, are less concentrated in big companies and are more broadly distributed. Large R&D investments by companies - which are important for capital-intensive, growth-oriented deep tech innovations - are therefore less structurally embedded here. Innovation activity is strongly focused around the knowledge and service sectors. IP tends to be generated in the areas of software, data and technology-intensive business models - for example, platform- and AI-based solutions and applications for digital healthcare, cybersecurity and fintech. Berlin holds a particular edge in applied innovations in the digital and data sectors, with Berlin companies numbering among Germany's leading users of AI and the proportion of information and communication technology professionals well above the German and EU average.

Internationaler Hotspot für Startups und Investoren

In the last ten years, more than 4,000 start-ups were founded in Berlin, around one-fifth of the German total - underscoring the state's role as an incubator. Many of these start-ups are successful: six of the 15 new German unicorns since 2022 originated in Berlin. Berlin is consistently listed as one of the top 20 global start-up locations across several different rankings. On an international comparison, Berlin performs especially well in the early founding phase, thanks to the start-up scene's close links to the research sector, the international environment and the exceptional thematic diversity. Berlin's dynamic start-up landscape also attracts a high level of capital: in 2024, 2.1 billion euros of venture capital (VC) was invested in Berlin, almost 30% of the total for Germany overall. At the same time, there is still a lot of potential for scaling up growth companies, with gaps in enabling conditions and scale-up capital limiting access to high-volume growth funding and lead markets.

An international employment and innovation hub that's open to the world

Internationality and integration are core elements of Berlin's start-up ecosystem. Founders rate Berlin for having a far more open culture than other German states. That attracts talent to the state from all over the world: 42% of employees in Berlin start-ups are from abroad (Germany overall: 30.8%). Half of Berlin start-ups have English as their primary working language. 21% of company founders were born abroad, one of the highest rates in Germany. Berlin's start-up and innovation ecosystems thus have strong international links and are readily able to engage with the wider world.

Strong, wide-ranging innovation and research infrastructure

Berlin has a diverse range of modern innovation and research infrastructure: testing facilities, specialised laboratories and centres, including technology parks, business incubators and 'Future Sites', which can be used for regulatory sandboxes, pilot projects and testing in areas such as microelectronics, photonics, biotech, AI, robotics, renewable energy, circularity and smart mobility. Numerous urban test environments, neighbourhood projects and facilities such as the Berlin Future Sites provide real-world use contexts for disruptive, innovative technologies and solutions. This infrastructure is utilised by the whole innovation ecosystem and supported by partnerships between different stakeholders.

Established innovation networks and collaborative structures

Strong networks exist between Berlin companies, research institutions and government agencies. The Regional Innovation Scoreboard ranks Berlin as a European leader when it comes to innovative SMEs collaborating with others. Moreover, knowledge and technology transfer is actively supported by the business development agency Berlin Partner via established cluster structures and specialised innovation networks. In the last three years, the clusters have supported more than 400 R&D projects with more than 1.7 billion euros in funding for companies and research institutions, making a major contribution to cooperation, knowledge generation and innovation in Berlin. Moreover, with the new start-up factory Just Unite to Innovate (JUNI), more than 50 partners from research, business, politics and civil society in the capital region have come together to support science-based start-ups and transfer in deep tech.



Figure 2: Strengths of Berlin's innovation profile

4

VISION AND GOALS

Berlin's innovation ecosystem offers ideal conditions for deep tech innovations to drive competitiveness, value creation and technological sovereignty. Based on those conditions and the new approach to innovation policy, the Agenda sets out a clear vision for Berlin's future role as a deep tech location, with strategic goals for the next ten years.

From knowledge to impact with deep tech innovations - a common vision for a forward-looking Berlin at the heart of Europe

Over the next decade, Berlin will become one of Europe's leading and most influential centres for deep tech innovation, boldly setting the agenda for trusted technological solutions with social impact. Researchers, businesses and government will work seamlessly together to generate pioneering innovations.

These innovation ecosystems will...

translate outstanding research into crucial impetus for sustainable, high-growth, international entrepreneurship,

increase sovereignty through bold innovations and strategic partnerships at regional, national and international level;

pave the way for a resilient, liveable, future-ready Berlin at the heart of Europe.

1. Goal

to establish Berlin as one of Europe's leading locations for deep tech innovation and leverage its strengths and potential to ensure impact-focused adoption of technological breakthroughs.

To achieve this goal, Berlin will strive to foster an effective interplay of excellent research, highly innovative companies and innovation-friendly administration – with a fertile development environment, cutting-edge research infrastructure, an outstanding talent and skills pool and flexible measures and delivery by government agencies to promote innovation. More private investment and better targeted public R&D investment will be needed to close the research gap and reliably enable complex processes of technology-intensive development, with the aim of bringing innovations to market and driving value creation.

2. Goal

to make Berlin one of the most attractive locations for rapid, reliable transfer from research to initial applications by encouraging more spin-offs, commercialisation and collaboration.

To achieve this goal, Berlin will focus on faster, more reliable transfer pathways between research, start-up teams and companies, with a shared emphasis on implementation and the market. This will involve more commercialisation, more science-based spin-offs, more commercially focused partnerships and far faster, more reliable IP transfer processes. The Agenda will strive to establish dynamic, close-knit innovation ecosystems to close the transfer gap, so that high-quality research findings can be more quickly translated into market-ready solutions, partnerships and new, highly innovative enterprises.

3. Goal

to foster exceptional conditions in Berlin for deep tech companies to scale up and grow by developing the most innovation- and growth-friendly structures and conditions anywhere in Europe.

To achieve this goal, Berlin will work with the federal government and European Commission to create conditions in which cutting-edge innovations can give rise to viable business models and products for companies. The aim is to mobilise more private and public growth capital throughout the scaling phases and make it substantially easier to access lead markets and major private- and public-sector users. The Agenda seeks to create favourable conditions for Berlin scale-ups to further expand and diversify their international links and exports, to be more competitive in global value chains and to contribute to value creation and employment in the state. It also aims to establish reliable regulation and faster administrative processes to achieve the necessary pace of development. By closing the scaling gap, Berlin wants to enable more effective growth and value creation pathways for deep tech companies.

Achieving the goals by setting thematic priorities, using strategic levers and ensuring measurability

The vision and strategic goals describe the Agenda's ambitions, setting the direction for Berlin's innovation policy measures. At the same time, they are designed to be flexible, and will be further refined during implementation and underpinned by measurable indicators. Effective thematic priorities and strategic levers will be crucial to provide an actionable framework for achieving the goals and translating them into specific focal areas and approaches.

5 STRATEGIC TECHNOLOGY AND APPLICATION PORTFOLIO

To achieve the Agenda's vision and strategic goals, it is necessary to set priorities for tech-focused innovation policy in Berlin. The Agenda therefore focuses on an evidence-based innovation portfolio comprising five strategic technology areas with the potential to drive value creation in strong, dynamic application areas. Berlin's strengths and areas with potential for growth primarily exist at the points of intersection between technological development and use, with collaboration across industry and sectoral divides in innovation ecosystems bringing together a critical mass of stakeholders, ideas and resources for innovation.

The following pages present the technology and application areas where Berlin already has strong innovation ecosystems and which are a particular focus of the Agenda. They also identify areas with potential for development in Berlin and formulate specific goals for the technology areas. These goals feed into the Agenda's strategic goals and build on national and European priorities.

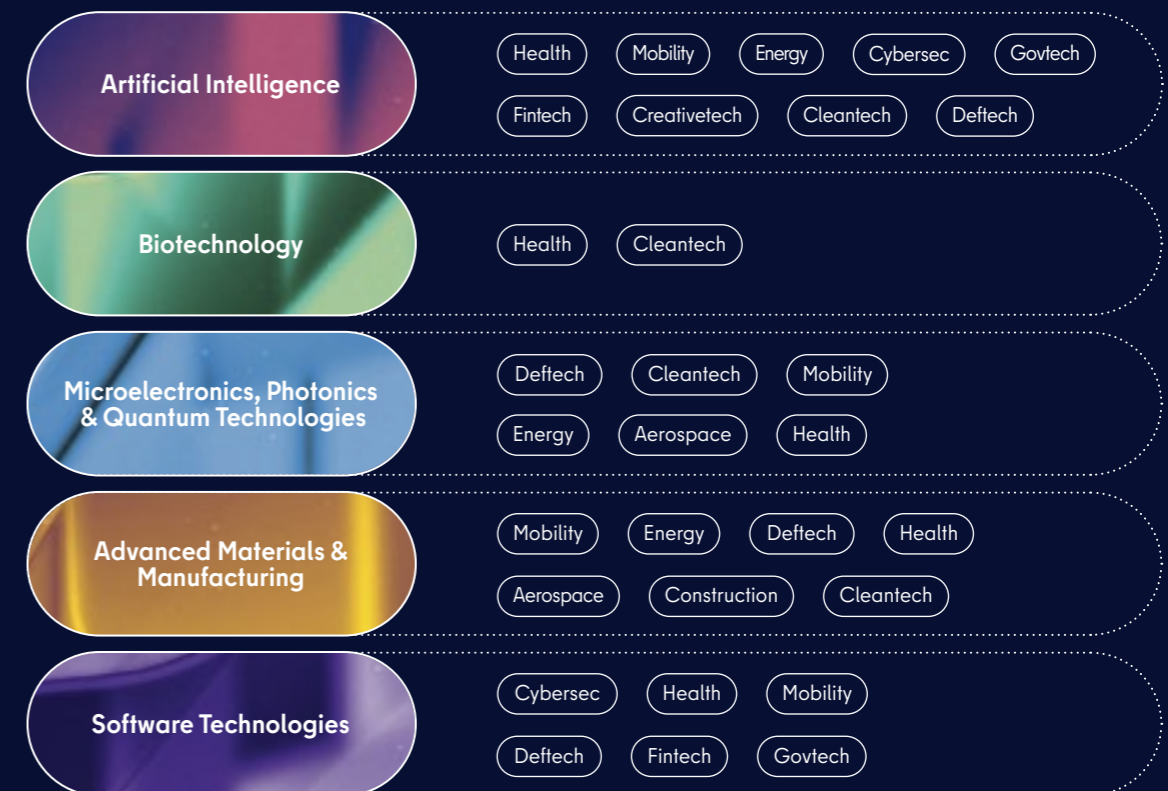


Figure 3: Berlin's technology and application areas at a glance

In line with a learning strategy approach, over the course of implementation Berlin's innovation portfolio will be regularly reviewed, refined and if necessary adapted - for instance, in the event of new technological developments, changes in market conditions (or in conditions more broadly) or new insights emerging out of monitoring and evaluation.

ARTIFICIAL INTELLIGENCE

5.1 Artificial Intelligence

AI has enormous potential for innovation and value creation in almost all application areas. It is the key technology for unlocking more productivity and growth in industry and services, as it creates a new basis for developing products, processes and business models. At the same time, developing higher-performing and more energy-efficient AI models, creating more secure, explainable, trustworthy and domain-specific AI solutions and continuously developing data centre infrastructure, chips, cloud technologies, LLM architectures and applications will open up significant opportunities to actively shape technological leaps such as agentic AI. As one of Europe's leading centres for AI innovations, Berlin has strong R&D stakeholders and robust structures.

There are hundreds of leading international researchers in Berlin who specialise in the study, development and use of AI. Outstanding academic institutions such as Technische Universität Berlin (TU Berlin), the Berlin Institute for the Foundations of Learning and Data (BIFOLD), the German Research Center for Artificial Intelligence (DFKI), the Zuse Institute Berlin (ZIB), the four Berlin Fraunhofer Institutes (FOKUS, HHI, IPK, IZM) and the National Metrology Institute (PTB) are conducting R&D on AI and helping to make the German capital an international centre for AI. Institutions such as the PTB and ZIB provide state-of-the-art research and testing infrastructure for AI that many other stakeholders benefit from. The research landscape spans a wide range of AI topics, from basic research on language processing and image/pattern recognition to studies on energy-efficient, explainable AI and human-machine interaction. With institutes like the BIFOLD, HHI and FOKUS, Berlin is one of Germany's leading centres for research at the intersection between machine learning and big data. The Center for Tangible Artificial Intelligence and Digitalization (ZEKI) also works to increase public acceptance of AI technologies. Moreover, there is an abundance of research in Berlin on innovative applications of AI in business and society, such as in predictive maintenance, robotics and industrial quality control. Another of Berlin's strengths is R&D geared towards making AI models easier to understand, tailoring them to specific tasks and incorporating them into secure, trustworthy, market-ready applications.

Thanks to its broad base of AI companies with a strong R&D focus and vibrant start-up scene, Berlin is one of Europe's leading and fastest-growing business locations for AI innovations. There are more than 280 start-ups whose core activity is developing AI products and processes - equivalent to around 30% of all German start-ups with a primary focus on AI. Around twice that many companies in Berlin are developing

digital services based on their own AI developments. Around one-third of all German AI start-ups set up their offices in Berlin. Many of them are already enjoying international success with their innovative business models and products. 80% of Berlin's AI companies operate in the B2B sector, in fields such as healthcare, production, e-commerce, mobility, energy, cleantech, media and creative industries, financial services, public administration and education. These companies are successfully building on the state's strengths and utilising local business and research ecosystems, as well as a diverse range of AI support structures, in order to develop and commercialise their products.

Berlin's AI innovation ecosystem benefits from specialised networking platforms and a strong software and IT community with a large talent pool and well-developed open-source landscape. High-reach networks like Data Natives, internationally renowned conferences like the Bitkom AI & Data Summit and Rise of AI, and the platform #ai_berlin underscore its status as a vibrant hub for sharing AI knowledge, showcasing AI developments and networking among AI professionals. AI start-ups benefit from a varied landscape of dedicated platforms and infrastructure and a high concentration of tech-aligned VC investors. AI-focused incubators and accelerators like AI NATION underscore the exceptionally rich offering of specialised start-up and transfer services, as well as Berlin's role in forging cross-regional strategic partnerships. In addition, private innovation centres, such as the Merantix AI Campus and KI Park, are generating some of Europe's most innovative AI and start-up projects. Other specialised hubs and initiatives, such as the TÜV AI Lab and aethos, have made Berlin a major centre for developing secure, standardised AI applications and trustworthy, human-centric AI. Additionally, collaborative research and innovation spaces like Berlin AI Square, Silicon Allee and initiatives like the Forum Digital Technologies offer researchers and businesses a wealth of opportunities for cross-sectoral collaboration.



Figure 4: Key application areas for Artificial Intelligence in Berlin

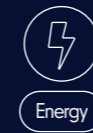
Berlin is a major centre for AI-based health innovations



One highly innovative application area for AI in Berlin is healthcare. There is especially high potential for value creation in areas where large volumes of complex data come together, such as technology-intensive medical specialties, analysis of laboratory and imaging data, personalised therapies, and clinical process and resource management. AI-assisted analysis of health and research data can support diagnostics and clinical decisions and speed up the development of novel agents. AI innovations can alleviate the workload of medical practitioners and allow possibilities for new treatments and health markets to be opened up more quickly.

Berlin's healthcare sector offers outstanding structural conditions and receptive markets for innovative AI applications. The state is a national centre for the healthcare industry and life sciences, with internationally leading research institutes and hospitals like the Charité, a dynamic start-up scene and a strong base of R&D-focused companies in the fields of medical technology and biotechnology, pharmaceuticals and digital health. In these fields, Berlin companies and institutions study, develop and bring to market many of the most innovative AI-based processes and products. The Agenda aims to further integrate the strengths of the healthcare sector with Berlin's AI expertise and develop Berlin into a leading innovation and growth centre for AI-based applications and companies.

Berlin is developing AI-based technologies for intelligent systems in industry, energy and cleantech



AI also enables a new level of automation in industrial manufacturing, for example in combination with robotics, sensor technology and the Industrial Internet of Things (IIoT): processes are becoming more adaptive, systems learn from data and even high-variety production and unstructured environments can be more precisely and flexibly managed with intelligent autonomous systems. Key application areas for Berlin are AI-based robotics and image/pattern recognition, which are used for example in industrial quality control and predictive maintenance. Berlin also has a lot of innovation potential in AI-assisted software platforms (for example to allow process and shopfloor data to be utilised and analysed in real time), digital twins and simulation-assisted AI. In these areas, Berlin can draw on leading-edge international applied research, including an exceptional number of R&D projects. It can also draw on a large number of innovative spin-offs at points of intersection between industry and AI.



There is further potential for innovation in the application areas of environmental and energy tech and the water and energy industries, where AI is being used to improve sensor systems and to monitor and manage energy flows. The Helmholtz Centre for Materials and Energy (HZB) uses AI for tasks such as identifying energy needs/surpluses and simulating future energy grids. The Fraunhofer Institute for Production Systems and Design Technology (IPK) is intensively studying the use of AI to improve energy

efficiency and environmental protection, while the Fraunhofer Institute for Reliability and Microintegration (IZM) is focused on developing sustainable, energy-efficient microelectronic systems at the intersection between AI, the environment, industry and energy. The Berlin Centre of Competence for Water (KWB) is studying the use of AI for sustainable water resource management and supporting numerous pilot projects. Research at TU Berlin has likewise focused on automated, standardised recording of environmental and groundwater data, which has already resulted in several spin-offs. The Agenda aims to unlock potential for new, sustainable business models that combine AI with applications in the manufacturing, energy and environmental industries.

Berlin is using AI to transform processes and services in fintech and govtech

Fintech companies from Berlin are already demonstrating how integrating AI into the development and provision of financial services enables automated processes, faster decision-making and greater personalisation and democratisation. AI-based analysis of large data sets also opens up new options for risk analysis and management of complex financial systems. Innovators can draw on Berlin's established strengths: with the highest concentration of innovative fintech companies anywhere in Germany, a workforce of more than 12,000 people and well-developed support and networking platforms, Berlin is blazing a trail in the fintech sector. The R&D is typified by strong market links, a large number of start-ups and scale-ups and close integration with Berlin's software, data, design and AI expertise. Areas with great potential for AI innovation are embedded finance, banking-as-a-service, the platform economy, digital financial products, cloud-native computing and secure, efficient financial transactions. The Agenda is intended to unlock and develop this cross-cutting potential.

In the application area of govtech, AI allows the use of intelligent assistants and agents in public administration, helping to automate public services and make them more efficient and accessible. A lot of innovation potential arises from AI software products and services that were originally developed for private-sector applications being transferred to govtech. With its high concentration of federal and state agencies, associations and public institutions, as well as the GovTech Germany innovation hub, Berlin has great potential to create value with AI-assisted govtech applications – for example, by modernising, interlinking and digitalising data and process management or supporting coordination and communication. AI solutions in the public sector, from automated administrative processes to predictive analyses for urban planning, not only increase efficiency but also ensure digital sovereignty and resilience. On the supply side, there are 250 govtech companies in Berlin working to advance tech-based innovations, such as law-as-code, digital record-keeping and government services, AI agents and open-source solutions. They are supported by platforms like the Global Government Technology Centre. Demand for govtech is an economically relevant factor, meaning Berlin is well placed to play a pioneering role in smart, data-driven governance. Without AI govtech innovations, the state risks falling behind international

developments and becoming a diminished player in a digitalised world. With the Agenda, Berlin aims to speed up the adoption of AI-assisted govtech solutions and scale them to the needs of innovation-friendly lead markets in the public sector.

Berlin is using AI to open up new worlds in immersive and creative tech



One important application area for Berlin AI innovations is the media and creative industries, where AI is being used in creative tech to automate development and production processes, to optimise video and sound editing and to allow digital content to be more efficiently produced and managed. AI also opens up new opportunities along the digital value chain, from personalisation and localisation of content to data-based workflows for distribution and marketing. Immersive technologies and spatial computing are another strong growth area for AI-based tech development in Berlin. AI innovations are enhancing the quality and usability of XR applications, for example by enabling improved image and pattern recognition, more precise environmental and object detection and interactive, real-time experiences in education, gaming, industry and cultural settings.

Berlin can build on a wide-ranging company and research landscape at the intersection between AI and creative/immersive tech. With some 42,000 companies, 265,000 employees and 44 billion euros in revenue, the media and creative industries offer one of the most exciting markets for AI applications in Berlin, with high local transfer and collaboration potential. Specialised platforms, hubs and networks like XRBB and MR4Business are already making prominent efforts to foster stronger links and communities within this sector. In the growth area of immersive tech, around 300 highly innovative companies and start-ups are working to integrate AI as a core element of XR and spatial computing solutions. Many Berlin institutions are conducting research in this area, such as the Fraunhofer Institute for Telecommunications (Heinrich Hertz Institute, HHI) and its Artificial Intelligence and Vision and Imaging Technologies divisions, the Innovation Center for Immersive Imaging Technologies and HTW Berlin – University of Applied Sciences through collaborations with its hubs DE:HIVE and the KI-Werkstatt. These institutions take an interdisciplinary approach to future trends such as XR, spatial computing, creative coding, generative media, narrative interfaces, digital twins and simulation applications, often incorporating AI.

The Agenda aims to further integrate Berlin's potential in immersive and creative tech with its AI expertise and to elevate it to a leading centre of innovation and development for AI-assisted immersive and creative tech.



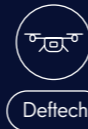
Berlin is developing AI-assisted autonomous systems and security applications in mobility and deftech

AI is an essential enabler of autonomous mobility. This is of crucial importance to Berlin's industrial sector, as it will allow new value chains to be opened up to compensate for the fall-off in traditional industrial production. Due to its scalability and global demand, autonomous mobility is an opportunity to secure highly qualified employment in Berlin and create new jobs, especially in fields like AI, software development, sensor technology and data processing, as well as in installation and maintenance, operations and logistics. AI also has great potential for smart mobility applications and is increasingly being used for purposes such as developing smarter traffic management systems. Many Berlin institutions are conducting R&D in areas such as AI-assisted autonomous systems, digital mobility platforms, multimodal control and data-based traffic management solutions. Besides the city's universities, the Fraunhofer Institute for Open Communication Systems (FOKUS) and the German Aerospace Center's (DLR) Institutes of Transport Research and Transportation Systems are carrying out leading-edge research at the intersection between AI and mobility. Berlin also has numerous mobility service providers, automotive and rail engineering companies and innovative SMEs and start-ups that are developing and marketing new products and platforms for AI and mobility. In addition, the research campus Mobility2Grid and the business development agency Berlin Partner provide established, innovation-focused platforms for collaboration in the state.

There is also potential for security applications involving autonomous systems in the deftech application area. Moreover, Berlin has potential for innovation in dual-use applications and in the development of autonomous drones and AI-assisted sensors, satellite technology and data analysis. With its AI strengths, Berlin can make a significant contribution to developing superior next-generation deftech solutions and strengthening Germany's and Europe's security and defence capability. In this context, cybersecurity is an application area that is already being transformed by AI and opens up great opportunities for Berlin's strong research and company landscape. Berlin already has some 130 companies active in the security and defence industry, with another 400 developing dual-use products, software and tech. The Agenda seeks to build on Berlin's strong AI ecosystem and systematically use AI to create next-generation security and dual-use applications.



Mobility



Deftech

Agenda goals for this technology area

The Agenda's aim is to strengthen the links between excellent AI research, data-driven AI applications and scalable products, processes and business models.

Berlin will become Germany's leading centre for AI innovations and play a pivotal role in the next generations of European AI development

With its outstanding research landscape and well-developed innovation ecosystem, Berlin has the potential to become Europe's leading centre of AI innovations. Berlin's diverse AI sector provides the basis for spearheading national and international collaboration and actively shaping European AI development. The state is focusing on secure, transparent, high-performing AI systems that pair technological competitiveness and sovereignty with the creation of social value. It is also seeking to strengthen these factors at European level. By combining leading-edge research, standardisation expertise and open-source approaches, Berlin is positioning itself as a leading European location for trusted next-generation AI.

Berlin will establish outstanding transfer and scale-up structures in prioritised AI application areas and secure a leading international position in pioneering niches

Berlin is developing Europe-leading transfer and scale-up structures in the prioritised application areas that will allow high-quality AI research to be translated more quickly and reliably into scalable value creation. It is occupying pioneering niches with technology- and market-leading AI products, processes and business models. AI developments and applications from Berlin are helping to shape the technology stack in economic areas of critical future importance, and thereby strengthening Germany's and Europe's productivity, competitiveness and sovereignty.

BIOTECHNOLOGY

5.2 Biotechnology

Biotechnology utilises biological systems in technological applications, providing an essential foundation for innovations in medicine, industrial manufacturing and sustainable environmental, energy and water management. With its exceptional concentration of internationally reputed research institutions and companies, proven strengths in genetic/cell engineering and bioinformatics, and established infrastructure for clinical trials, Berlin is superbly positioned to convert this potential into market-ready innovations.

Berlin occupies a leading position in the biotechnology sector, supported by a host of clinical and non-university research institutions, internationally reputed clusters of excellence and a high concentration of hospitals and biotech locations. The close integration of world-class biomedical research, strong clinical infrastructure and data-driven approaches to innovation provides a rich foundation that is almost unparalleled in Europe. Key pillars are the Charité university hospital, the Berlin Institute of Health (BIH), the Max Delbrück Center (MDC) and the Berlin branches of several German Centers for Health Research (DZG). Core facilities for genomics, proteomics and cellular biology, which are used by researchers from across different institutions, speed up the development of biotech processes. Clinical biobanks like the Charité Biobank and cohorts/registers like the German National Cohort (NAKO) provide high-quality biological samples and data for research. Initiatives like the Einstein Center 3R, the Network of University Medicine (NUM) and the Medical Informatics Initiative (MII) support data-driven biotech research and provide infrastructure that facilitates the secure use of medical data.

Around 300 biotech companies employing more than 8,000 people provide a dynamic ecosystem, encompassing international players from the pharmaceutical and diagnostics sectors and an active start-up scene. Berlin's strong research landscape is a major incubator for spin-offs. Almost 80% of the biotech companies work in biomedicine, with a focus on developing innovative therapeutic and diagnostic approaches to treating cancer, cardiovascular diseases and diabetes. With the Campus Berlin-Buch, Wuhlheide Innovation Park, berlin-biotechpark and Adlershof, Berlin offers attractive, state-of-the-art facilities and labs for start-ups and established companies. The Campus Berlin-Buch was recently expanded with a new incubator, the BerlinBio-Cube. Several major international companies have accelerators based in Berlin that support biotech start-ups. Established healthcare industry events and forums support networking between researchers and businesses.

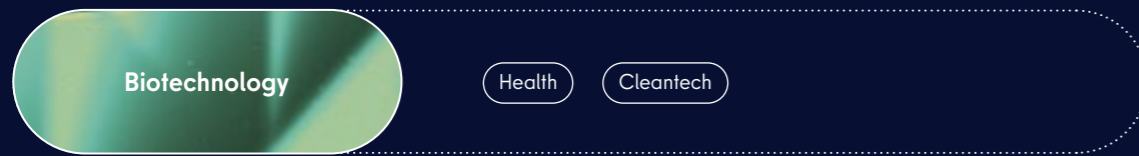


Figure 5: Key application areas for Biotechnology in Berlin

Biotech solutions strengthen Berlin's excellent health ecosystem and open up new potential for security-related applications

One area of particular strength for Berlin is biotech applications in medicine, which offer new, individualised diagnostic and therapeutic methods, sometimes in conjunction with AI. Potential applications for biotech in healthcare are varied and diverse, ranging from creating artificial tissue and 3D bioprinted organ models to developing innovative pharmaceutical agents through to combined applications with modern genetic analysis methods and genome editing. One flagship project currently under construction is the Berlin Center for Gene and Cell Therapies (CGT Berlin), which is intended to provide a central hub for translational development and clinical trials of highly innovative therapies that supports their transition to market-ready applications. The capital region's strong economic environment is further bolstered by around 300 medical tech companies, including several leading manufacturers. Initiatives like the NUM and MII support data-driven development and broad clinical implementation. The established HealthCapital cluster brings together innovators from the biotech, pharma, medical technology and innovative care sectors.

Berlin's position as federal capital also offers potential for innovations in public health, resilience and security: being able to work in close proximity to federal institutions like the Robert Koch Institute (RKI), Paul Ehrlich Institute and Federal Ministry of Health creates unique opportunities for biotech applications for crisis and pandemic preparedness, such as rapid vaccine and diagnostic test development, and for population-level prevention programmes. Biotech methods are also increasingly important to security policy: for example, the use of tools such as AI-assisted biosensors and integrated genomic surveillance to detect, monitor and control biological hazards. With the RKI – a partner of the federal chemical, biological, radiological and nuclear response consortium (UnterstützungsverBund CBRN) – and the WHO Hub for Pandemic and Epidemic Intelligence, Berlin is home to global centres of expertise in this field. Another security-related application area is innovative decentralised medical care, which uses technologies such as drones and digital tools to provide more rapid care over extended distances. Here too Berlin is well positioned with several start-ups. Biotech can make a host of valuable contributions in public health, resilience and security, offering important points of connection for Berlin's innovation ecosystems.



Health



Cleantech

The Agenda aims to harness Berlin's unique combination of strong translational research, clinical infrastructure and data-driven innovation potential to strengthen its leading position in Europe.

Berlin is using biotech solutions for sustainable cleantech

Environmental and water management is an important and established application area for biotech in Berlin. Biotech methods enable innovative wastewater treatment, nutrient recovery, trace element removal and carbon capture – and in Berlin, they are already being tested under real-world operating conditions. For example, Berlin sewage treatment plants are piloting biological methanation of CO₂, which is intended to support sector coupling between energy and wastewater management. Berlin has a long-established base of institutions conducting applied research on sustainable water management: TU Berlin's innovation centre Water in Urban Areas (FSP WIB) brings together interdisciplinary research on water from across five faculties. The KWB combines applied research on the whole water cycle with direct practice transfer and international networking. Innovative local SMEs in the water industry are increasingly taking an international, export-focused approach, and benefit from close ties to the research sector. The Agenda will strengthen transfer between biotech solutions and the environmental/water industry.

Biotech solutions from Berlin contribute to state-of-the-art manufacturing methods

Bioprinting is gaining importance as an industrial manufacturing technique, especially for the pharmaceutical industry and regenerative medicine. Berlin has a growing bioprinting start-up scene with internationally reputed spin-offs that emerged out of the state's research landscape. They include manufacturers of tissue implants and bioprinted organ models. The Einstein Center 3R also supports the development of printed human organ models as an alternative to animal testing for pharmaceutical development – a growing market in the capital region's pharma industry, with around 30 companies. This segment is closely linked to innovative materials and production technologies: biological processes and biotech materials are increasingly being incorporated into industrial manufacturing processes. Berlin research institutions such as the Humboldt-Universität's (HU) Center for the Science of Materials Berlin (CSMB) and the greenCHEM initiative are advancing the development of bio-based materials and sustainable chemistry.

The Agenda aims to combine Berlin's strengths in bioprinting and bio-based materials with application areas in pharmaceuticals, production and sustainable chemistry to position Berlin as a centre for the development of biotech-driven innovations in manufacturing.

Agenda goals for this technology area

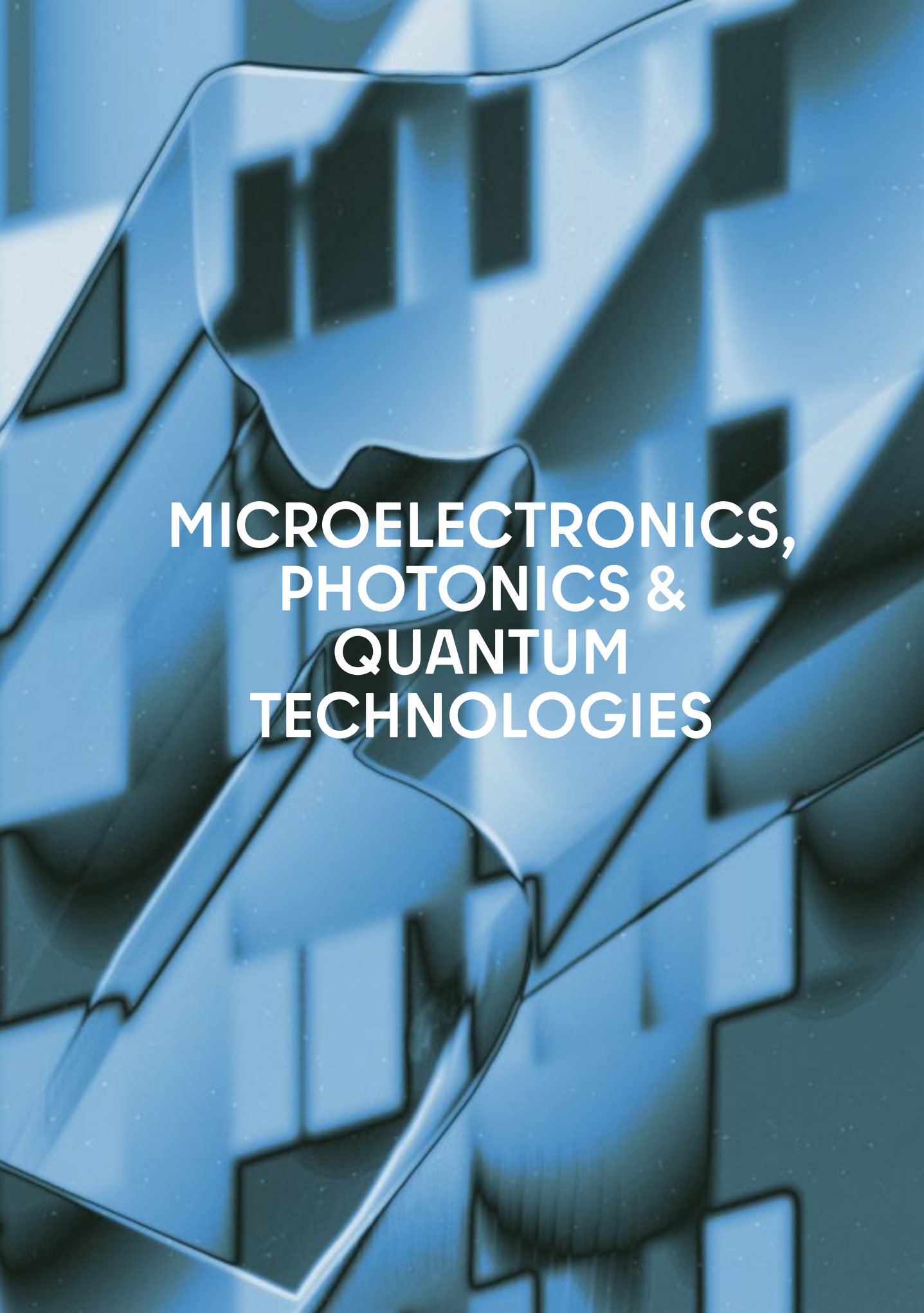
The Agenda will strengthen Berlin's position as a leading biotech location, with a particular focus on promoting transfer and scaling of innovative solutions from this technology area and beyond.

Berlin will extend its position as a leading European location for biotech-driven innovations in healthcare

The combination of outstanding biomedical research, clinical infrastructure and application areas offers ideal conditions for developing technologies like gene and cell therapy in compliance with clear ethical, technical and regulatory standards and responsibly bringing them into use and onto the market. Berlin is systematically strengthening transfer and scaling potential, extending regulatory compatibility and improving the available options for using medical data in order to enable quicker and more reliable adoption of Berlin innovations in practice.

Berlin will harness its biotech strengths to create competitive, innovative solutions in industry and environmental/water management

Biotech methods and bio-based materials are not just a foundation for medical innovation, but also key technologies for sustainable industrial processes. Berlin is using its established expertise in the environmental and water industries and their intersections with innovative materials to scale up biotech solutions in these growth markets. To that end, it is strengthening transfer and scale-up structures for biotech so as to help local SMEs scale up their innovation activities and boost their international competitiveness.



MICROELECTRONICS, PHOTONICS & QUANTUM TECHNOLOGIES

5.3 Microelectronics, Photonics & Quantum Technologies

Microelectronics, Photonics & Quantum Technologies will provide the foundation for the next generation of secure, high-performance and energy-efficient digital and cyber-physical systems. Optics and photonics innovations from Berlin are key to high-performance optical communication, sensors, spectroscopy, measurement and imaging systems and laser technologies. Microelectronics provide the technological basis for the next generation of semiconductors, energy-efficient computer architectures, advanced wireless and sensor technologies, microsystems engineering and power electronics. The pioneering field of quantum technologies benefits from Berlin's existing skills and knowledge base. Quantum communication, computing and sensors will open up new forms of data transmission, faster computing and high-precision processes.

Research on this technology area in Berlin, spanning from basic to applied research, can draw on internationally leading infrastructure and expertise. Over 34 HE and research institutions are active in optics, photonics and microelectronics. A key role is played by non-university institutes with a strong applied focus, such as the HHI, the IZM and the Ferdinand Braun Institute (FBH), which specialise in photonics, communications and laser systems. Furthermore, research institutions such as the PTB, the Federal Institute for Materials Research and Testing (BAM), the DLR, the HZB, the Paul Drude Institute, the Leibniz Institute for Crystal Growth (IKZ), the Max Born Institute, the Fraunhofer Institute for Production Systems and Design Technology (IPK), the Berliner Hochschule für Technik (BHT), HTW Berlin and the major Berlin universities support R&D and education in relevant subfields. Berlin is also embedded in core Germany-wide infrastructures for microelectronics research: the Research Fab Microelectronics Germany (FMD) is a leading institution for non-university-based R&D and a major German and European centre for the study of micro- and nanoelectronics, whose APECS pilot line is based in Berlin. Moreover, over 20 HE and non-university research institutions in the state are engaged in R&D across all subfields of quantum technologies, with a particular focus on quantum photonics and quantum information theory. The HHI is also involved in Q-Planet, an EU-funded project to build a pilot line for quantum chips.

The company landscape comprises many innovative mid-sized hidden champions and a few global players, highlighting the strength and international competitiveness of Berlin's microelectronics, optics and photonics sectors. Around 400 companies from these sectors are based in Berlin and Brandenburg – and with a total revenue of 6.3 billion euros and more than 20,000 employees in the capital region, they

provide a strong framework for technology-intensive value creation. More than 90% of companies are engaged in innovation activities, and the proportion of R&D staff and level of R&D investment are above-average. There is also a vibrant start-up scene for photonic hardware and systems – supplemented by around 40 Berlin-based quantum tech companies, creating an environment conducive to growth. Dynamic development is driven in particular by start-ups working in photonics and microelectronics or in the development of software for quantum computing (as well as by established companies in those fields that have expanded/relocated to Berlin).

Berlin has strong networks and transfer structures that bring stakeholders together, enable collaboration and facilitate participation in national and European programmes. OpTecBB, one of the world's largest regional industry associations for photonics, and other established networks like PolyPhotonics Berlin, Advanced UV for Life and the laser technology association LVBB offer excellent conditions for networking, profile-raising and project-based collaborations between companies, researchers and intermediaries. Around 100 companies and institutions, including the Centre for Photonics and Optics (ZPO) and one of HU Berlin's Integrative Research Institutes (IRIS), are clustered at the Adlershof Science and Technology Park, which provides a collaboration and innovation ecosystem with R&D and production sites, labs and spaces for dialogue and exchange. The Berlin Quantum initiative brings together businesses and organisations active in researching, developing and pioneering industrial applications of quantum technologies. Leap, based in Adlershof, is a practically oriented co-working space and hub for networking and business development, especially aimed at young companies and project teams. Adlershof is also home to several key German-wide initiatives to promote training and development of highly qualified professionals, both inside and outside the Berlin ecosystem. One example is the Microtec Academy, which is coordinated by the FBH under the Federal Ministry of Research, Technology and Space's (BMFTR) flagship skills4chips project. Another is proANH, a network of companies and research institutions dedicated to meeting the demand for skilled workers in the microelectronics industry.

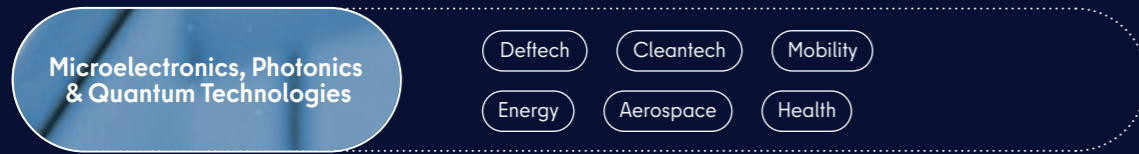


Figure 6: Key application areas for Microelectronics, Photonics & Quantum Technologies in Berlin

Berlin's photonics and microelectronics sectors are enablers of cutting-edge industrial automation

Industrial automation is an established application area for Berlin optics, photonics and microelectronics, especially in conjunction with innovative production technologies. Optical sensors and measurement technology enable quality control, process management and imaging in challenging production environments. Microelectronic system integration provides the hardware basis for cyber-physical production systems, digitalised process chains and smart manufacturing facilities, and these are core topics of research on Industry 4.0 at TU Berlin, HTW Berlin and the IPK. Testing facilities like the Berlin Center for Digital Transformation (LZDV-BE) and the Werner-von-Siemens Centre for Industry and Science enable smart production systems to be tested in collaboration with Berlin research institutions and companies. The Agenda is intended to further strengthen the close integration of photonics, microelectronics and production technologies in Berlin and make the state a favoured location for hardware-based innovations in smart manufacturing.

Power electronics, semiconductor materials and sensor technology from Berlin provide a key foundation for the energy transition

Semiconductor materials enable efficiency and speed gains in power electronics, for example for electric vehicles, solar modules and battery storage. Photonic sensors make it possible to manage and efficiently utilise complex energy systems, such as smart grids, battery storage systems and bidirectional charging solutions. The IKZ is conducting research on semiconductor materials for the next generation of power electronics, while the IZM is an international leader in advanced packaging, specialising in innovative microelectronic system integration methods that enable compact, high-performance, reliable electronic modules for diverse industry applications. The HZB is making fundamental contributions to the development of solar cells and semiconductor materials for the energy sector. Drawing on local expertise in photonics and microelectronics allows these to be incorporated into systems and applications. Berlin's energy industry rests upon a foundation of high-revenue companies, comprising



innovative SMEs as well as a few larger players. The Agenda aims to harness Berlin's strengths in semiconductor materials and photonic sensors to actively shape the energy transition using strong, locally developed technology.

Modern cleantech solutions based on photonic systems and sensors from Berlin



Optic and photonic measurement technologies and sensors enable precise real-time measurement of environmental conditions such as air quality, water pollution and energy loss. In a city like Berlin, this data provides the basis for efficient management of water resources, climate protection measures and smart city applications – as well as for innovations and new business models based on smart measurement systems, data-based environmental services and the like. The Berlin-based IZM and HHI are researching and developing sensors for environmental applications. In the water industry, the KWB combines applied research on the use of state-of-the-art sensors that enable smart, integrated monitoring of water with testing of the developed solutions under real-world conditions in collaboration with Berlin water companies. The Agenda will support the development and scaling of photonic sensor systems for environmental and water monitoring, opening up growth potential at the intersection between cleantech and resilient infrastructure.

Photonic systems and sensors enable connected and autonomous mobility



Optical communication forms the basis for high-performance networks and data-intensive vehicle-to-vehicle and vehicle-to-infrastructure communication (V2X). Quantum technologies open up potential applications in high-precision navigation and sensor systems. BVG (Berlin's main public transport company) and S-Bahn Berlin (the operator of the state's rapid transit rail network) function as an urban test market for connected mobility systems. They are conducting several of their own pilot projects on autonomous driving. The Digital Test Field Urban Traffic Berlin and the Mobility2Grid Research Campus (based at the EUREF campus) provide testing facilities for autonomous shuttle buses, urban logistics solutions and sector coupling between transport, energy and digitalisation. The Agenda will use the unique combination of test infrastructure and photonics expertise to establish Berlin as a centre for the development of next-generation connected and autonomous mobility.

Optics, photonics and quantum technologies from Berlin are supporting aerospace and security-critical systems

Optics and photonics from Berlin are key technologies for aerospace and security-critical applications. Space-based sensor systems (optical sensor systems, radar, GNSS), high-performance lasers and measurement/imaging systems are developed in the state. The DLR Institute of Space Research and Berlin universities collectively form a central hub for research on optical sensor systems used in planetary research, earth observation and security. The DLR Institute of Propulsion Technology and TU Berlin's Chair of Aero Engines develop system components that use photonic sensors and microelectronic control for efficient, low-emission propulsion solutions. Trustworthy hardware and resilient system architectures that emerged out of the state's microelectronics ecosystem form the basis for security-critical sovereign infrastructure. Quantum-safe communication is a strategic field at the intersection between quantum technologies, photonics and defftech. The HHI is an international leader in this field, developing miniaturised quantum-capable components that it will in future be possible to easily integrate into routers and telecommunications infrastructure to enable secure communication that cannot be intercepted.

Space-supported data from Berlin sensor systems also has an economic impact on downstream application areas such as infrastructure monitoring, energy, mobility and the environment.



Aerospace



Defftech

Optical systems and quantum sensors open up new possibilities in diagnostics and medical tech

Development and testing of cutting-edge diagnostic and therapeutic tools based on optical, thermal and magnetic sensors has been directly integrated into clinical studies and care processes at Berlin institutions, in particular the Charité, BIH and MDC. One specific flagship project in Berlin is the OPM-MEG Center at the Charité, which is testing quantum sensor applications in medical settings, thus combining quantum technologies with clinical infrastructure. As partners of the BMFTR's flagship QEED project, HU Berlin, the FBH and the Charité are also developing a method of microscopy based on quantum sensors with entangled photons that can be used, among other things, to diagnose cancer. Berlin's research strength and the expertise built up around the PTB and Charité form the basis for further translation into medical tech applications. The Agenda aims to speed up these development processes and raise Berlin's profile as a leading European location for optical and quantum-sensor-based medical tech.



Health

Agenda goals for this technology area

Berlin will aim to build end-to-end innovation chains in the areas of microelectronics, photonics and quantum technologies, extending from applied, industry-oriented research to transfer through to scaling up, and bolster innovations in these application areas and at the intersections between them.

Berlin aims to secure a leading role in developing innovative hardware and systems for the next generation of European microelectronic, photonic and quantum technologies

Berlin is strengthening its role as a centre for the development of leading-edge microelectronic, photonic and quantum technologies and their integration into European technology pathways. To achieve that, it will systematically translate its R&D strengths into effective transfer processes and strong innovation chains: from design and system integration to prototypes and demonstrators through to implementation in industry. This will allow Berlin to build stronger links with national and European programmes and raise the profile of its contributions to strategic projects, especially at the intersections between optics and photonics, microelectronics and quantum technologies.

Berlin will provide ideal conditions for scaling up quantum technologies and unlocking their value and growth potential

The Agenda aims to boost the impact of innovations in this area, driving and retaining value creation and growth in Berlin by raising its international profile and improving conditions for growth in the state. Quantum technologies are being established as a dynamic development field for companies, in which a strong foundation of scientific research and expertise facilitates early adoption of new applications and opens up new markets.

5.4 Advanced Materials & Manufacturing

Competitive industries need materials that are lighter, more stable and more resource-efficient, as well as more highly automated manufacturing processes that can be integrated more flexibly and precisely into digital, circular systems. Innovative materials and production technologies offer both new material properties, which will fundamentally transform products and applications, and new manufacturing processes, such as additive manufacturing, robotics and digital production systems, which will modernise industrial processes. These technologies, including innovative materials, additive manufacturing, AI, robotics and digital production systems, belong to the international field of innovation known as advanced manufacturing. Berlin has growing expertise in several subfields and is developing flexible, data-driven, next-generation production systems. Digital technologies are playing an increasing role in these systems. Here too, it is becoming apparent that AI opens up new potential for data-driven process management, quality control and adaptive manufacturing processes.

Berlin is home to world-leading research on a wide range of innovative materials and production technologies. TU Berlin, HTW Berlin, the HZB, the IKZ and the CSMB are contributing to research on innovative materials. The IKZ is playing a flagship role within the EU as a provider of disruptive crystal materials, while the BAM does important work in setting standards and conducting research on topics such as nanocomposites and various types of materials (smart materials, semiconductor materials, energy materials, lightweight construction materials). Technology centres like the Adlershof Science and Technology Park (WISTA) and the specialised labs of Berlin research institutions support the development and scaling up of modern materials.

In the area of innovative production technologies such as additive/digital manufacturing and robotics, there are around 30 research institutions working on process development, innovative materials, automation and connected production systems. In some niches, this work is world-leading. Besides the above-mentioned institutions, R&D in this area is primarily being carried out by the BHT, IPK and HHI. In the subfield of robotics, research on and use of AI-assisted image processing, special-purpose engineering, collaborative robotics and medical robotics are particular areas of innovation strength for Berlin. In the subfield of digital production technologies, research is being conducted on digital twins, cyber-physical production systems and connected process chains. This research benefits from Berlin's strong software and systems expertise.

ADVANCED MATERIALS & MANUFACTURING

These innovation strengths are frequently translated into business applications through start-ups and industry with a strong R&D focus. In the subfield of innovative production technologies, there is a strong base of technology providers, with over 40 companies specialising in additive manufacturing based in Berlin – the highest concentration anywhere in Germany. In the subfield of robotics, more than 140 Berlin-based providers are developing and marketing innovative solutions for diverse applications. In the subfield of digital production technologies, a diverse range of software- and platform-focused companies enrich the technology and application area. In the subfield of innovative materials, a host of researchers, mid-sized industrial companies and tech-focused start-ups are helping to translate new materials and material systems into practical applications. In Berlin, the close proximity to development and scale-up infrastructure and ease of tapping into industrial application areas with a strong research focus facilitate the translation of material-based innovations.

Berlin has a variety of networking platforms, hubs and transfer initiatives that bring together stakeholders from the materials and production segments. The Innovation Network for Advanced Materials (INAM) – a specialised network with incubator and accelerator programmes – is a crucial element of the innovative materials ecosystem, especially when it comes to supporting young companies and speeding up transfer processes. In the subfield of additive manufacturing, the AM Forum Berlin and Additive Manufacturing Berlin-Brandenburg (AMBER) support the innovation ecosystem. In the subfields of robotics and other manufacturing technologies, the Berlin Robotics Network, MotionLab.Berlin and the BHT's Haus der Robotik provide practically oriented development and testing facilities. In the subfields of digital production and connected systems, testing facilities like the LZDV-BE and the Werner-von-Siemens Centre for Industry and Science provide innovation spaces and infrastructure for developing and testing cyber-physical production systems. Innovation ecosystems for circular production processes, resource-efficient process chains and green chemistry are also increasingly coming to the fore. Initiatives such as greenCHEM bring together the various stakeholders involved.

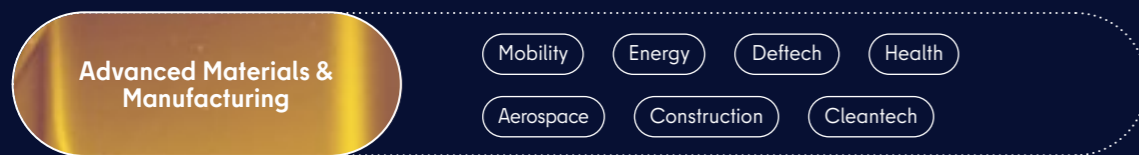


Figure 7: Key application areas for Advanced Materials & Manufacturing in Berlin

Berlin is developing innovative materials, technologies and processes for the health industry



Health is one of the strongest application areas for innovative materials and additive manufacturing in Berlin: biocompatible materials, personalised implants and printed tissue structures require both innovative materials and highly precise manufacturing techniques – both of which are among Berlin’s core strengths. Bioprinting can be used to manufacture tissue structures and organ models for research and future therapies. Additive manufacturing allows personalisation of implants, prosthetics and dentures. Medical robotics can provide support in surgical assistance systems, rehabilitation and automated laboratory processes. Digital twins enable patient-specific simulations when planning operations. As Germany’s national centre for the healthcare industry, Berlin is exceptionally positioned to develop innovative materials and production technologies for the industry and bring them into use. Almost half of AMBER projects focus on manufacturing technologies and innovative materials for biomedical applications. As clinical partner, the Charité enables new technologies to be developed and tested in real-world conditions. TU Berlin and HTW Berlin conduct research on medical tech, while a dynamic start-up ecosystem brings innovative solutions to the point of market-readiness. HealthCapital Berlin-Brandenburg brings together stakeholders from across a range of sectors. The Agenda aims to utilise these structures to elevate Berlin into a leading centre for the transfer of R&D into real-world medical tech applications.

In aerospace and deftech, Berlin is developing solutions for situations that demand ultra-lightweight construction and extremely high material stability and precision



Few industries face demands as challenging as those in aerospace. Lightweight components must withstand extreme thermal and mechanical stress, highly integrated structures demand ultra-precise additive manufacturing methods and series production of small satellites requires scalable, automated production processes. Berlin is exceptionally well positioned in this application area. Around 80 companies in the capital region operate in the aerospace sector, primarily in the development and manufacture of small satellites and nanosatellites, components, software and electronic elements. Three companies in the region manufacture complete small satellites. Another growth area for Berlin is space robotics: autonomous, sensor-based systems for inspection, maintenance and future in-orbit services, which pose new challenges in terms of connectivity, lightweight construction and manufacturing quality. The DLR’s Institutes of Space Research and Propulsion Technology and TU Berlin’s Chair of Aero Engines form a central hub for research on material-intensive aerospace technologies. Additive manufacturing processes play a growing role in this area, especially in the optimisation of lightweight construction and the manufacture of complex propulsion components. The AMBER network provides targeted support for projects at the intersection between additive manufacturing and aerospace applications. The DLR Startup Factory

supports transfer from research into scalable products. Berlin's dynamically growing deftech ecosystem opens up further applications, including lightweight materials and additive manufacturing methods that were developed for aerospace applications but offer dual-use potential (e.g. for drone technologies).

The Agenda aims to integrate Berlin's strengths in innovative materials and manufacturing methods with the needs of the local aerospace sector and to further strengthen Berlin as a centre for the development of additively manufactured aerospace components optimised for lightweight construction.

Berlin is developing innovative materials and production technologies to help companies use resources more efficiently and enable circular manufacturing

Innovative materials contribute directly to a circular economy: lighter, more durable and more recyclable materials reduce consumption and waste across the whole product life cycle. Furthermore, additive manufacturing methods enable efficient production that only uses materials where structurally necessary. Resource-efficient production and circular manufacturing are therefore promising application areas. So too is the water industry, where innovative materials and production technologies enable more efficient treatment methods, recovery of reusable materials from wastewater and reduced energy and chemical consumption, among other applications. Research institutions and initiatives such as greenCHEM, the CSMB and the major FU Berlin project WSS Resources are developing resource-efficient, circular-friendly materials, with a focus on recycling, upcycling and conversion technologies to close material loops. Berlin has strong innovation activity and a high concentration of start-ups in industries of high relevance to the circular economy, such as chemicals and pharmaceuticals. Assorted companies, institutions and technology parks, such as Adlershof and Clean Tech Park Marzahn, are pioneering the implementation of sustainability measures and driving forward circular economy pilot initiatives that utilise innovative materials and production technologies. In total, there are more than 700 companies in Berlin developing solutions for sustainability, environmental and circular technologies. Demonstration projects, FU Berlin's Scaleup Lab and the HU Innovation Lab enable testing under real-world conditions. The Agenda seeks to more closely integrate innovative materials and production technologies with water management and circular economy applications. For example, innovative materials and processes could help to close material loops in the water industry.



Cleantech

Berlin is developing materials and manufacturing methods for the future of mobility, energy and construction



Mobility



Energy



Construction

Innovative materials are an essential prerequisite for more efficient energy technologies: new semiconductor materials increase the efficiency of solar cells and power electronics, innovative electrode materials increase the energy density and lifespan of battery storage systems and special membrane materials improve the efficiency of fuel cells and electrolyzers. Additive manufacturing methods enable cost-effective manufacture of complex components that it would be virtually impossible to produce by conventional means. For example, the IKZ and FBH are studying semiconductor materials that reduce power conversion losses and so have the potential to decrease energy costs. The HZB's and IZM's research on decentralised energy, innovative battery technologies, solar cells and hydrogen technologies is based on high-performance materials. The recently founded Berlin Battery Lab (BBL) pools the expertise of HU Berlin, the HZB and the BAM to establish Berlin as a centre for research on sustainable battery technologies such as sodium, lithium-sulphur and sodium-sulphur batteries. CatLab - Catalysis Laboratory - is developing novel catalysts to ensure efficient conversion of chemical to electrical energy and vice versa. The high-quality research conducted by the BBL and CatLab makes use of advanced materials to develop next-generation batteries with potential applications in the energy and mobility sectors. Lightweight materials and additive manufacturing also offer great potential in the mobility sector, in particular to reduce the weight and improve the performance of rail and vehicle components; efforts are already underway in Berlin to unlock that potential. In the AMBER project Addgleis, Berlin companies and HE institutions are working together to develop additively manufactured lightweight stiffening structures for rail vehicles, with the goal of reducing energy use through weight-optimised design. Berlin's automotive manufacturing and rail engineering industries are direct consumers of these innovative materials, as well as partners in their development. The construction industry also benefits from innovative materials and additive manufacturing methods: low-carbon concrete with alternative binders reduces emissions, while robot-assisted 3D printing enables material-efficient, geometrically optimised components. Institutions such as TU Berlin are conducting R&D in this area. In the AMBER project MultiCarb3DBeton, Berlin companies and HE institutions are jointly developing multifunctional, 3D-printed concrete components for sustainable automated lightweight construction. The regulatory sandbox Reallabor B(e) Ware is studying and testing the scalable reuse of local secondary materials for complex building structures in the construction sector.

The Agenda aims to combine Berlin's strengths in materials science - from semiconductor materials for the energy transition to lightweight solutions for rail transport - with the state's manufacturing and consumer base, and so strengthen local value creation.

Agenda goals for the technology and application area

The Agenda supports highly innovative research on, and adoption of, innovative materials and production technologies, pooling Berlin's strengths in materials science, additive manufacturing, robotics and digital/circular production for scalable applications in prioritised application areas and the intersections between them.

Berlin aims to strengthen its international reputation for key material- and production-related technologies and translate research into industrial applications

Building on its strong position, Berlin will become an internationally reputed innovation centre for additive manufacturing, robotics and innovative materials. It will more closely integrate material development, manufacturing methods and digital production systems and create better conditions that allow internationally competitive products and innovative processes to emerge out of research and start-ups – especially at the intersections between materials, production, AI and biotech.

Berlin will position itself as a strong centre for the development of resource-efficient, circular manufacturing – and thereby unlocking new opportunities for value creation

Berlin is establishing innovative materials and production technologies as a central enabler of resource-efficient process chains and circular-friendly production. By combining innovative materials, digital and circular production and application-focused demonstration and transfer pathways, the state is facilitating the development of scalable solutions for industry and energy technology that will speed up the industrial transition and embed new opportunities for value creation in Berlin.

SOFTWARE TECHNOLOGIES

5.5 Software Technologies

In an increasingly digital world, distributed ledger technologies (DLTs) such as blockchains and Web3 are, in conjunction with cybersecurity, providing the basis for secure, transparent, resilient digital systems. These technologies are extremely relevant for any applications that require a high degree of data security and trust, from finance and public administration to manufacturing and defence. DLTs also have great potential when it comes to trustworthy AI applications and systems. As a decentralised trust and governance layer, they can help to make data and model processes more intelligible, documentation forgery-proof and compliance with regulatory requirements more transparent. Berlin offers a unique combination in this technology area: one of Europe's most vibrant blockchain and Web3 communities, a broad base of cybersecurity research, direct proximity to federal and state agencies as users and clients for security-critical solutions and a dynamic company landscape spanning diverse application areas.

Berlin is one of Germany's and Europe's leading locations for DLTs, including Web3 and blockchains. Research institutions like TU Berlin and HTW Berlin are working with established companies and start-ups to drive forward advances in this technology area, focusing on blockchain-based platforms, smart contracts, tokenisation, digital identities and secure, transparent transaction and data systems. Berlin established itself early on as a European hub for centralised blockchain ecosystems like Ethereum, Polkadot, Gnosis and IOTA. It combines a high concentration of tech-focused start-ups, developer communities with strong international ties and specialised investors. Active industry associations like BerChain and Bundesblock, international events like Berlin Blockchain Week and physical innovation and networking spaces like the W3.hub and CV Labs facilitate dialogue between start-ups, established companies, researchers and investors. Berlin has a well-developed base of around 100 highly innovative companies working on DLTs such as Web3 and blockchains, which offer great value creation potential and are already directly contributing to increased digital sovereignty.

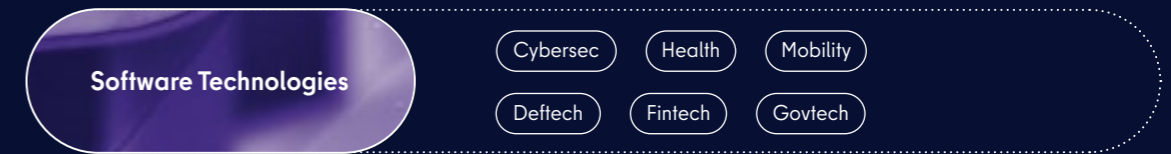


Figure 8: Key application areas for Software Technologies in Berlin

Cybersecurity technologies are being developed in Berlin for the new AI and quantum age



Cybersecurity is an indispensable element in the modern digital world. In this application area, DLTs and technologies such as AI and quantum computing offer completely new ways to protect digital spaces, infrastructure and cyber-physical systems and increase transparency, trust and the resilience of key structures. Cybersecurity is already widely embedded across Berlin's research and teaching, with specialised courses and research centres at institutions such as HTW Berlin, SRH Berlin, Fresenius University of Applied Sciences and Touro University Berlin. Teaching and research encompass both forward-looking areas such as quantum-safe communication and more immediately relevant areas of application such as penetration testing, AI-based cybersecurity and digital identities. One example of the integration between research and teaching is the collaboration between the FOKUS institute and HTW Berlin at the Cybersecurity Training Lab. Berlin's Fraunhofer Institutes also contribute research expertise at points of intersection with related technology areas: the FOKUS institute and HHI cover topics such as secure communication, cyberattack detection and quantum communication. The Fraunhofer Institute for Applied and Integrated Security (AISEC), which has a specialised department in Berlin, conducts research on AI, cybersecurity and post-quantum cryptography. With a well-developed base of some 420 companies in the cybersecurity field, Berlin is well positioned to convert research findings into products and services. Having the government as a client offers up unique opportunities for companies to develop innovative cybersecurity solutions. Regulatory sandboxes, research infrastructures and intermediaries like the Bundeswehr's Cyber Innovation Hub support Berlin-based companies and institutions and help them to build stronger networks. Sites such as Marienpark Berlin offer regulatory sandboxes that enable start-ups to develop technology to protect critical infrastructure.

Berlin is combining blockchain and cybersecurity expertise with its strengths in fintech to create a leading ecosystem for secure digital finance solutions

Blockchain-based infrastructure enables secure financial transactions, tokenised property assets, smart-contract-based financial products and decentralised identity solutions – and elevates embedded finance, banking-as-a-service and the platform economy to a new technological level. Complementing this, specialised cybersecurity solutions for cloud-native finance infrastructure and reliable transaction systems provide the necessary security in the highly regulated financial sector. With several unicorns, a large number of scale-ups and a host of internationally reputed networking and collaboration platforms, Berlin is one of Europe’s leading growth locations for fintech. Berlin’s fintech, DLT and cybersecurity sectors are already closely intertwined: around 30% of companies with blockchain activities are directly involved in fintech. The Agenda aims to leverage the potential of Berlin’s unique combination of fintech market depth and expertise in DLTs and cybersecurity to make it a leading European location for secure digital finance infrastructure.



Fintech



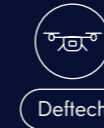
Cybersec



Cybersec

Berlin is using its strengths in software technologies for innovative defftech solutions

Defftech is a growing application area for security and connectivity technologies from Berlin. DLT-based trust infrastructure and cybersecurity offer great potential for a new generation of defftech products. Of particular relevance here is the dual-use nature of many of these technologies: solutions developed for critical civil infrastructure are often directly transferable to defence-related applications. Specialising in cybersecurity and digital security, the Bundeswehr’s Cyber Innovation Hub serves as an important intermediary between researchers, start-ups and the defence sector. The Agenda aims to harness synergies between defftech, cybersecurity and DLTs to drive progress across all these areas.



Defftech

Cybersecurity and DLTs from Berlin are enabling connected production systems and building trust in industrial value chains

The growing interconnectivity of production systems (a phenomenon referred to as Industry 4.0) greatly increases potential points of attack, which in turn increases cybersecurity requirements. Berlin research institutions such as FOKUS, AISEC and LZDV-BE can contribute specialist expertise in secure system architectures and IIoT security. DLTs add an additional level of trust: forgery-proof supply chain documentation, tamper-proof certificates of origin for components and decentralised identity solutions for connected machines create transparency and reliability in complex production networks. Practically focused testing facilities like the LZDV-BE and the Werner-von-Siemens Centre for Industry and Science allow these approaches to be tested under real-world conditions. The Agenda aims to mobilise these strengths to establish Berlin as a centre for the development of trusted production networks.



Cybersec



Govtech

Berlin is using the potential of DLTs, such as blockchains, to develop secure and transparent govtech

The digitalisation of government services and administrative processes is creating high demand in Berlin for secure, transparent digital solutions, for which DLTs as decentralised technologies can offer advantages in certain application scenarios. The use of blockchain-based approaches makes it possible to design forgery-proof digital identities, transparently document administrative processes and provide operable infrastructure for the public sector (on an open-source basis) and for smart city applications. Software solutions from the govtech context in turn provide the foundation for innovations that support register modernisation, digital educational infrastructure and secure communication networks. Thanks to a broad base of highly dynamic companies, Berlin is in an excellent position to put these approaches into practice. GovTech Germany, Unit GovTech Berlin and events like the Smart Country Convention connect stakeholders and support the development of practical solutions. Government agencies can themselves play a role as users and testing grounds for new digital infrastructure, thus enabling modernisation of public administration. Secure and transparent govtech solutions from Berlin can drive innovation, digital sovereignty and value creation, with a key contribution being made by DLTs and cybersecurity applications developed here

Berlin is developing cybersec and DLT solutions for connected mobility

Autonomous and digital traffic systems cannot operate without reliable security architectures. Cybersecurity and DLTs can provide the necessary basis for this. Research that takes an integrated approach to security and automation is already being conducted in Berlin. The FOKUS institute, the HHI and TU Berlin are developing cybersecurity solutions for digitalised traffic and rail systems, and are working with industry partners in the BerDiBa project to test AI-assisted technologies for automated train driving.



Mobility

Agenda goals for this technology area

The Agenda combines various technologies so that innovative solutions for greater digital transparency and security can be achieved in Berlin across a range of application areas.

Berlin aspires to be a leader for trusted security solutions, decentralised systems and cyber-resilient digital services

Berlin is developing internationally reputed, leading-edge solutions for digital security. 'Software from Berlin' is a byword for security, reliability, user-centric design and resilience – especially for critical infrastructure, the financial sector and digital public services. Berlin is strengthening its innovation pathways across different technology and application areas and harnessing the potential of public-private development. The aim is to support further advances in secure digital infrastructure and systems that combine Berlin's fintech strengths with its DLT and cybersecurity expertise, as well as in security and deftech solutions with dual-use potential.

Berlin will ensure trustworthy software technologies can be brought into use more quickly, boosting growth in key application areas

Berlin is using the potential of DLTs, such as blockchains, and cybersecurity technologies to ensure secure, transparent solutions for fintech, mobility, manufacturing and deftech can more rapidly make the transition to testing, implementation and value creation. It is improving its practically oriented transfer and testing pathways and creating better conditions for sustainable business models, scalable solutions and new value creation to emerge out of early-stage applications. In doing so, it is establishing itself as a leading centre for digital transparency and security.

6

THE DEEP TECH AGENDA'S STRATEGIC LEVERS

Ten strategic levers - a toolbox for strengthening Berlin's innovation system

The Agenda focuses on strategic levers that can be used to devise measures to address needs that arise during the course of implementation. These levers relate to action areas such as transfer, qualified workers and skills, general conditions, funding and scaling. In line with the strategic goals, the levers are selectively applied where key barriers to innovation exist in the technology and innovation ecosystems. This allows strengths and opportunities to be more quickly translated into effective innovations, value creation and applications.

The levers do not operate in isolation, but rather in concert as elements of an integrated approach through which Berlin continuously strengthens and sustains its role as a centre for leading deep tech innovations. They provide a strategic toolbox from which precisely tailored measures can be selected and applied either to Berlin's overall innovation system or to individual technology and application areas.

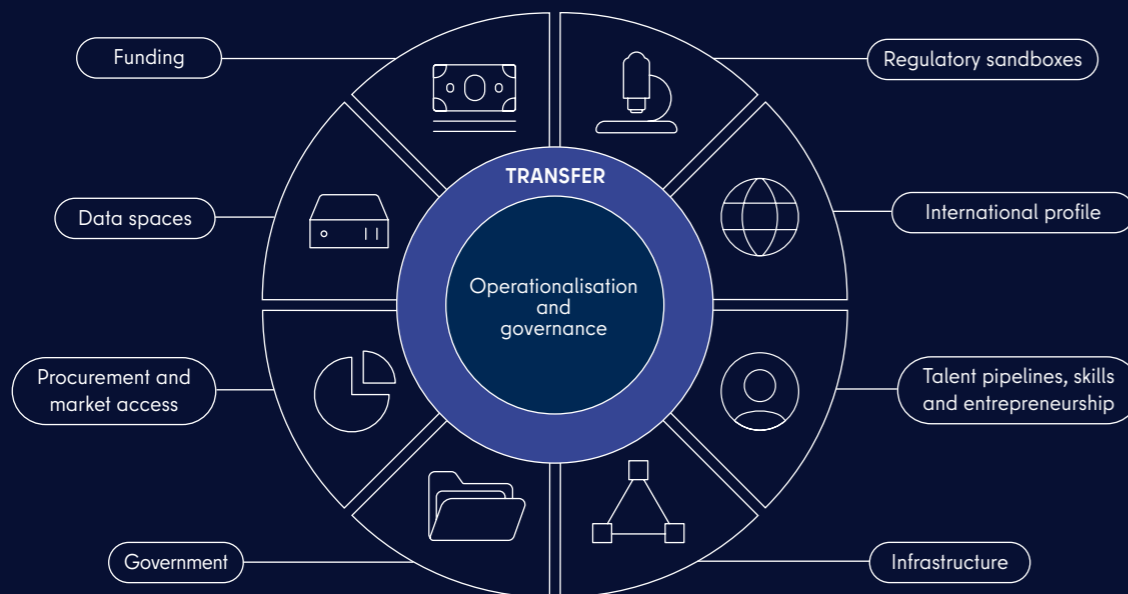


Figure 9: Strategic levers

6.1 Operationalisation and governance as a shared task

Complementing the regional innovation strategy InnoBB 2035, the Agenda provides a strategic frame of reference for an innovation policy for the next ten years that is focused on key technologies. It transparently sets out Berlin's deep tech innovation goals and the technology and application areas that are being prioritised within this segment, thus providing guidance for all stakeholders in the innovation ecosystem. The Agenda's goals can only be achieved if research institutes, businesses, civil society and government agencies work together. The task for Berlin and its institutions is

- to use levers and opportunities for influence at state level to reduce and overcome the gaps and barriers that have been identified in the innovation process and
- to exert influence on the course taken at federal and EU level

with the goal of providing innovation stakeholders with favourable conditions, flexibility, incentives and planning certainty.

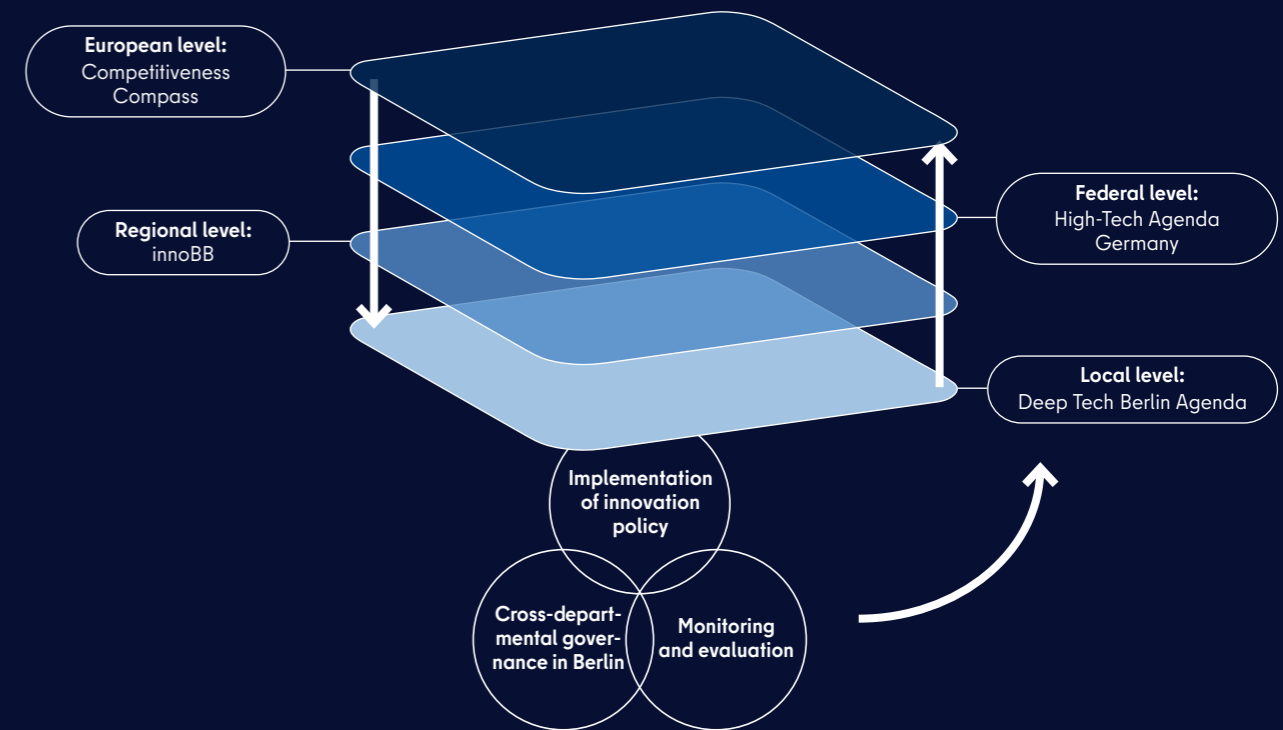


Figure 10: Operationalisation and governance

The Agenda will be operationalised on the basis of joint roadmaps

The Agenda's ambitious goals cannot be achieved with a one-off package of measures. Rather, its implementation needs to be structured as an ongoing process that accounts for national and European priorities and is coordinated across multiple levels. The key mechanisms will be goal- and impact-oriented roadmaps at state level for the prioritised technology and application areas, which will be jointly drawn up with innovation stakeholders. Where synergies arise between the Agenda's technology areas and those of the HTAD, the state-level roadmaps will provide a compatible yet Berlin-specific implementation of the HTAD's roadmapping processes. Supplementing this, the HTAD priorities that are relevant to Berlin must be systematically integrated with the state's missions, thematic implementation plans, programmes and funding mechanisms, as well as the existing strategies of the Berlin government departments responsible for science, research and economic affairs. This will reduce duplications, close gaps and direct measures towards creating critical mass and synergies. Within the technology and application areas, Berlin is also setting additional priorities and building strengths that go beyond the themes and mechanisms of the HTAD.

Effective governance requires clear roles, coordination and binding guidelines

To ensure effective implementation, responsibilities must be clearly assigned and backed up with the necessary staffing and organisational resources. The success of the Deep Tech Berlin Agenda depends crucially on functioning coordination and decision-making mechanisms across departments that set priorities, resolve dependencies between the different levers and areas and ensure structured coordination with relevant partners.

Central stakeholders must be systematically included in governance: academic and research institutions, established companies and start-ups, government agencies (especially those responsible for science, research and economic affairs), the business development agency Berlin Partner, the start-up factory JUNI and other intermediaries and networks, investors, funding bodies and civil society. Examples of governance bodies are the Berliner Transferrat (established in 2025), the coordinating committee for gene and cell therapies and the deftech governance structure that is currently being set up.

The goal is to establish governance structures that coordinate the various levels, are able to take decisions and support implementation in the relevant innovation ecosystems.

An adaptable, performance-focused learning strategy

The Agenda is designed as a learning strategy that operates on a long-term timescale, based on a foundation of dialogue with stakeholders in the innovation ecosystem and ongoing monitoring of the technology and application areas. This allows it to be implemented in a way that is robust and adaptable to changing circumstances.

6.2 Accelerating and simplifying knowledge and technology transfer

To enable effective and systematic transfer of knowledge and technology, Berlin has developed the Transfer Bridge, a joint initiative between the Senate departments responsible for science/research and economic affairs. It is intended to strengthen Berlin's research transfer structures while addressing the specific needs of the Agenda's technology and application areas. The goal of the Transfer Bridge is to create reliable pathways from research to early adoption, commercialisation and scaling. This will be achieved through clear standards, transparent processes, improved IP commercialisation, greater support for start-ups and closer integration between universities, non-university institutions, companies and intermediaries.

The Transfer Bridge provides the basis to systematically close the transfer gap and position Berlin as a place where outstanding research can be rapidly translated into market-ready solutions, partnerships and new, highly innovative companies.

6.3 Supporting and expanding regulatory sandboxes

Regulatory sandboxes already play a key role in many fields as a way to close the gap between research and real-world application. They allow new technologies and business models to be tested under real-world conditions, providing robust evidence and important showcase projects, and indicating where adjustments may be needed to the regulatory framework and government processes.

Regulatory sandboxes are intended to systematically support regulatory learning, speed up transitions to routine operation and make it easier to replicate successful solutions. The goal, where possible and appropriate, is to standardise approaches and processes and to establish uniform methodological standards for data collection and analysis, taking account of the specific features of individual technologies and application areas.

Berlin aims to feed the findings from regulatory sandboxes directly into regulations and practical implementation, in order to simplify planning and licensing procedures. Bridges will be built from pilot projects to routine operation, test environments created and interlinked, and showcase projects publicised.

6.4 Strengthening talent pipelines, skills development and entrepreneurship

Being able to recruit skilled workers, strategic skills management and strengthening entrepreneurship are key conditions for successful innovation activities. Berlin therefore aims to create an integrated talent, skills and entrepreneurship ecosystem that focuses squarely on the needs of key technology and innovation areas. One key element is the Berlin Skilled Labour Strategy 2035, whose goals include attracting and retaining skilled workers from Germany and abroad. That also involves supporting measures in other policy areas to create attractive conditions in Berlin (in terms of urban planning, social factors and administrative processes). Reducing access barriers and developing Berlin's welcoming culture are particularly important to attract international talent.

This lever is also intended to further strengthen entrepreneurship structures in Berlin's research, business and government sectors. To that end, one option that could be considered is to incorporate this topic into school education at an early stage.

6.5 Improving research, innovation and test infrastructure

The Agenda seeks to systematically align the construction, operation and use of infrastructure with the prioritised technology and application areas and to embed them in clear pathways, from development through to scaling up.

As well as new investment, there is a need to make more efficient use of existing capacities, as well as opening up access to and interlinking these capacities. Berlin also aims to expand basic digital infrastructure in innovation-related areas, to improve access to laboratory and testing capacities and to further develop start-up incubators and technology parks, with a focus on prototypical, production-oriented environments and spaces for scalable applications.

Supplementing this, priority will be given to providing computing and data infrastructure in line with demand, better coordination of infrastructure projects and accelerated approval and planning processes.

6.6 Making government an enabler of innovation

The Agenda positions Berlin as a centre of innovation-friendly government. To that end, and building on existing efforts, the state aims to increase the standardisation and digitalisation of government services and ensure they are delivered to a more reliable schedule. The goal is to significantly reduce time-to-market for innovations.

Government agencies see themselves as enablers, creating a framework in which new solutions can be more rapidly tested, scaled up and rolled out to a wider user base. At the same time, these agencies are themselves users and beneficiaries of emerging innovations; for instance, they benefit from digital sovereignty and a strategic return on investment. To foster innovation, mechanisms such as 'experimentation clauses' could be used in sensitive areas, and administrative processes across central innovation pathways could be systematically modernised and made more transparent and predictable.

Berlin is attempting to make complex procedures easier to navigate, for example by putting a single agency in charge of start-up permits and having clear points of contact. It will also strive to take a learning-focused approach to regulation, and to ensure that findings from regulatory sandboxes and pilot projects are fed into improving regulations and administrative processes.

6.7 Creating interoperable data spaces and facilitating access

The Agenda aims to make it easier to build and develop interoperable data spaces for specific purposes and to create links to existing data ecosystems that can be reliably used by companies, research institutions and government agencies. Berlin's Open Data Strategy commits the state to continuously pursuing that goal and incentivising relevant stakeholders to voluntarily open up access to data.

In the technology and application areas, technical and organisational foundations are to be put in place for strong, interoperable data infrastructure so that public and private-sector organisations can work together more effectively. Specifically, harmonised interfaces, clear governance rules and reduced barriers to access will support data-based innovations across all phases of the innovation process. The Data Hub Berlin enables sharing of data between government agencies and connections with external platforms. Berlin wants to facilitate easier access to data spaces, especially for SMEs and start-ups. Having transparent catalogues and clear rules on rights and responsibilities, promoting multiple use of data rather than creating new data silos and improving data literacy will help turn Berlin's data spaces into robust platforms and drivers of innovation.

6.8 Establishing funding partnerships and mobilising growth capital

The Agenda supports a coherent funding system that is sensitive to the specificities of different areas, creates compatible pathways to funding options along the entire innovation process and develops links with programmes and funding bodies at federal and EU level. Public and private funding should be combined in a way that spreads risk appropriately and gives companies, research institutions and investors more planning security and investment incentives.

To that end, Berlin will strive to develop suitable state-level programmes and other forms of funding. It will also seek to contribute to improved conditions for growth capital at federal and EU level. Funding sources will be better integrated across different innovation phases, greater account will be taken of specific needs within individual technology areas and conditions conducive to mobilising private capital will be created.

The aim in doing so is to ensure that the risk, follow-on and growth funding needed for complex development and market processes can be more easily mobilised for deep tech innovations.

6.9 Facilitating innovative procurement and market access

Procurement and tendering by Berlin government agencies and state-owned enterprises is an important lever to create lead markets. Public demand and access to markets will be structured in a way that systematically supports innovation. Existing legal requirements will be better utilised to promote development, testing and scaling of new solutions.

The public sector's role as early adopter will be used to support pilot innovations, in conjunction with regulatory sandboxes. Regulated markets will be made more transparent and accessible to start-ups and SMEs, tendering processes better integrated with funding and findings from pilot projects systematically analysed. The Senate is planning to reform the tendering system for goods and services, with a view to consolidating responsibilities more effectively and procuring goods on a centralised basis across the state. The goal is to facilitate market access to government contracts and ensure harmonised, innovation-friendly procurement processes with greater legal certainty.

6.10 Raising Berlin's international profile as a deep tech location

Berlin seeks to establish a clear international profile in the Agenda's technology and application areas, to consolidate communication and internationalisation activities and to address clearly defined target groups and regions.

Deep tech innovations and the prioritised technology areas will feature more strongly in Berlin's future location marketing. Existing strengths – such as the way planning of internationally reputed trade fairs is jointly coordinated in the state – will be systematically utilised. Moreover, strategic networks and partnerships, such as the Global Government Technology Center, will be more closely aligned with priority technology and application areas, flagship projects used as showcases and any joint presence on international platforms better coordinated.

International delegations and attendances at/participation in trade fairs will be geared towards systematically generating high-quality B2B contacts, approaching investors and forging partnerships with technology stakeholders. Curated matchmaking formats, especially in prioritised technology and application areas, allow established companies, start-ups and research institutions to lay the groundwork for future collaboration, unlock market opportunities and initiate international pilot projects.

This will not only raise Berlin's international profile, but directly feed into economic value creation and the scaling of innovative solutions from Berlin.

7 BE PART OF IT

YOUR CONTRIBUTION TO AN INNOVATIVE BERLIN AT THE HEART OF EUROPE

The Deep Tech Berlin Agenda is the strategic response to the new conditions facing an innovation-driven Berlin at the heart of Europe – and the new needs it must address. It provides guidance and sets a framework for collaborative action. What will now be decisive is consistent, goal-oriented implementation of the Agenda at the intersections between research, business, politics and civil society – at the points where technological innovation gives rise to concrete applications and value creation.

Innovation is a shared task. All stakeholders are invited to actively help shape this Agenda in practice and to fill it with life: by engaging in R&D, collaborations, projects and transfer processes; by making investments; by building, developing and making intelligent use of infrastructure and data spaces; by attracting talent; and by creating excellent conditions for scaling and growth.

We must pool together Berlin's innovation strengths and resolutely work to unlock potential. All those involved in implementing this Agenda will help to increase the speed and impact with which technological solutions are translated into real-world applications – thereby strengthening Berlin's position as a leading centre for deep tech innovation at the heart of Europe.

Glossary

Application area

An application area is a domain in which certain technologies are used for economic or social purposes. The designation of application areas helps to give structure, even if the dividing lines between them may be slightly blurry.

Cluster

Clusters are networks of companies, research institutions and intermediaries in strategically significant growth areas, which are typified by highly concentrated value chains and close geographic proximity. Cluster management teams (which sometimes include representatives from multiple states) support collaboration between stakeholders, initiate R&D and innovation projects involving businesses and researchers, and set the course of the cluster's strategic and operational development.

Deep Tech

Deep tech refers to technical innovations based on substantial scientific discoveries and technological breakthroughs that offer considerable added value compared with existing solutions. They are typified by long, complex development cycles up until the point of market-readiness, by high, long-term capital requirements and by greater uncertainty in terms of technological feasibility, regulation and market acceptance, which demands a high risk appetite. Deep tech innovations are often intended to help solve strategic challenges in relevant application areas and tackle key future tasks - for instance, increasing competitiveness, sovereignty and security, creating social value or improving environmental sustainability.

Experimentation clauses

Experimentation clauses stipulate that pilot applications are temporarily freed from certain regulations or obligations, either in whole or in part.

Innovation

Innovation refers to the development and practical utilisation of knowledge and ideas. It can be technical or non-technical in nature, and can generate new methods, processes, products or services.

Strategic lever

A strategic lever is a category of options for action that deploy specific types of measures to address certain barriers in the innovation process.

Technology area

A technology area is based on one or more related basic technologies that enable innovations in various application areas. Within a technology area, a variety of stakeholders - researchers, businesses, politicians, civil society organisations - come together to develop technology-based innovations. The designation of technology areas helps to give structure, even if the dividing lines between them may be slightly blurry.

Transfer

Transfer refers to the flow of knowledge, ideas and expertise between innovation stakeholders, in particular between the research sector and business/society.

List of abbreviations

AI	Artificial intelligence
AISEC	Fraunhofer Institute for Applied and Integrated Security
AMBER	Additive Manufacturing Berlin-Brandenburg
APECS	Advanced Packaging and Heterogeneous Integration for Electronic Components and Systems
BAM	Federal Institute for Materials Research and Testing
BBL	Berlin Battery Lab
BHT	Berliner Hochschule für Technik
BIFOLD	Berlin Institute for the Foundations of Learning and Data
BIH	Berlin Institute of Health
BMFTR	Federal Ministry of Research, Technology and Space
CGT	Berlin Center for Gene and Cell Therapies
CSMB	Center for the Science of Materials Berlin
DFKI	German Research Center for Artificial Intelligence
DLR	German Aerospace Center
DLTs	Distributed ledger technologies
EU	European Union
FBH	Ferdinand Braun Institute
FMD	Research Fab Microelectronics Germany
FOKUS	Fraunhofer Institute for Open Communication Systems
FSP WIB	Water in Urban Areas innovation centre
FU Berlin	Freie Universität Berlin
HE	Higher education
HHI	Fraunhofer Institute for Telecommunications (Heinrich Hertz Institute)
HTAD	High-Tech Agenda Germany
HTW Berlin	HTW Berlin - University of Applied Sciences

HU Berlin	Humboldt-Universität zu Berlin
HZB	Helmholtz Centre for Materials and Energy
IIoT	Industrial Internet of Things
IKZ	Leibniz Institute for Crystal Growth
INAM	Innovation Network for Advanced Materials
innoBB	Joint Innovation Strategy of the States of Berlin and Brandenburg
InnoBB 2035	Innovation Strategy of the Capital Region Berlin-Brandenburg 2035
IP	Intellectual property
IPK	Fraunhofer Institute for Production Systems and Design Technology
IRIS	Integrative Research Institutes
IZM	Fraunhofer Institute for Reliability and Microintegration
KWB	Berlin Centre of Competence for Water
LVBB	Laserverbund Berlin Brandenburg
MDC	Max Delbrück Center
MII	Medical Informatics Initiative
NAKO	German National Cohort
NUM	Network of University Medicine
PTB	National Metrology Institute
R&D	Research and development
RKI	Robert Koch Institute
SMEs	Small and medium-sized enterprises
SPRIND	Federal Agency for Breakthrough Innovation
TU Berlin	Technische Universität Berlin
VC	Venture capital
WISTA	Adlershof Science and Technology Park
ZIB	Zuse Institute Berlin
ZPO	Centre for Photonics and Optics

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