The
Federal Government

Future Research and Innovation Strategy

Executive Summary

Foreword

Dear reader,
We need a strategy for the future!

Why? The challenges are obvious: Climate change is forcing us to rethink the way we live and work. The technological, particularly digital transformation is already part of everyday life in a society that is undergoing fundamental change. Russia's war against Ukraine has shown us that our prosperity depends on our access to energy. Much of what we took for granted for a very long time is now being called into question. We must think and act anew. This applies to us in Germany but also to Europe and the World. The pace of change will even increase. We must therefore react now.

The solution is obvious to me: education, research and innovation. But education, research and innovation depend on the people who drive them forward: the teachers at our schools, in companies providing training, at our universities and at research institutions; the researchers who have new ideas which they pursue and develop; and the companies which put successful research into practice. And all of them need the best possible conditions.

The Future Strategy is our compass that we are using to realign the Federal Government's research and innovation policy and strengthen its focus in order to provide such excellent conditions. To that end we are combining our efforts and resources right across government so that we can set clear priorities for addressing the challenges and the processes of change.

Three aims are very important to me in this respect: First of all, we must defend our technological leadership and in some cases regain it. Now is the time that will decide who will set the global standards of tomorrow and thereafter, and who will make money from innovations and thus enable prosperity for the whole population. We want to be equal partners in shaping this development. For this, we need to be able to understand, develop and produce key technologies by ourselves here in Germany and in the European Union. This will make us more independent. We will then have a choice as to what technologies we use and how. In this way, we will also create valuable jobs. And we will safeguard our standards, for example with regard to data protection and sustainability.

Secondly, we are strengthening transfer of research results into application. Science provides us with many good solutions. People who can see what is already possible in theory today are much less likely to be concerned about the future. Free and evidence-led basic research is therefore of immense importance. But we need to get the ideas out of the research labs and into real life. Basic and application-oriented research must go hand in hand. For this reason we want to use the Future Strategy to develop and optimise the structures for innovation and transfer. It is true that we can only deal successfully with the multitude of challenges if the technological and social innovations are interlocking. A more interdisciplinary approach and greater involvement of the social sciences and the humanities will open up new potential.

And a third point: We need to be open to new technologies. We need to think freely and include every good idea if we want to strengthen social cohesion and successfully modernise our economy in the context of tough global competition and ambitious climate action goals. This is also important for intergenerational equity. An openness to new technology ensures freedom of action for both us and the generations to come. Standing still, on the other hand, will soon mean going backwards, particularly as innovation cycles are getting ever shorter.

We want to create opportunities where none yet exist. We want to seize opportunities where others hesitate.

Dare more progress – that is for good reason the leitmotiv of our government coalition agreement. These three words and their message are more topical than ever. This is precisely what our Future Research and Innovation Strategy stands for. It lays the foundations for greater progress today, tomorrow and beyond.

Bettina Stark-Watzinger
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Federal Minister of Education and Research

Table of contents

Introduction 2

Driving forward research and innovation together 3

Science, research and transfer 4

Actively shaping transformation processes 6

Enabling resource-efficient and on circular economy based competitive industry and sustainable mobility ... 7

Spearheading climate protection, climate adjustment, food security and the preservation of biodiversity..... 8

Improving health for everyone 8

Securing Germany's and Europe's digital and technological sovereignty and harnessing the potential of digitalisation..... 9

Strengthening astronautics, exploring, protecting and sustainably using space and oceans 9

Strengthening social resilience, diversity and cohesion 10

Fostering communication, dialogue and engagement 11

Imprint 12

Introduction

As the Federal Government, we are striving to boost progress. For us, progress means looking for solutions in the approaches of the future and not just in the answers of the past. This Future Research and Innovation Strategy lays the foundation in this regard – a foundation that we intend to build on during our term of office. It paves the way in terms of ensuring that Germany and Europe continue to play a crucial role in the major issues of research and innovation policy in the years to come. It is on this basis that we plan to harness ideas and experience and, in particular, tackle and shape the transformation processes emerging from current crises.

Germany has always been a country of progress and innovation. It boasts a diverse scientific community, a broad research landscape with strong fundamental and applied research, innovative regions and an industrial base featuring internationally successful corporations and innovative SMEs. International comparisons, however, show that Germany cannot easily keep up with very innovative countries and high-performance locations and that Germany lags behind in the pioneering field of cutting-edge technologies and digitalisation. If Germany is to have a strong future as a hub of innovation, it is not only necessary to preserve the foundation, but also build on them in a targeted and forward-looking way.
In order to achieve modernisation that puts wealth, quality of life and the greater good at the forefront, there is a need for systematic and sustainable cross-sector approaches that link up technological, economic, geopolitical, environmental and social changes. To this end, we need targeted strengthening of Germany's entire innovation capabilities.

Driving forward research and innovation together

The Federal Government's research and innovation policy is underpinned by a holistic understanding of innovation that spans a broad range of innovations, such as technological innovations, new business models and social innovations. Here, we take into account the entire research and innovation process, from basic research on the part of curiosity-driven suppliers and the inventors of new possibilities through to the transfer and development of market-ready and social innovations. Through research and innovation, we seek to safeguard the natural basis of life, strengthen society's resilience and protect our prosperity.

Federal research and innovation funding represents the central tenet of its research and innovation policy. It goes hand in hand with investments in infrastructure, training and education, as well as with legal issues and potential solutions. The interdisciplinary approach makes it possible to closely interconnect the multiple activities and measures of the Federal Ministries involved and thus offer targeted funding that reflects different underlying conditions and requirements.

The Future Research and Innovation Strategy has been designed as an evolving strategy, meaning that it can be continuously and dynamically readjusted and optimised in tandem with business, the scientific community and civil society. As a learning strategy, the Future Research and Innovation Strategy will respond quickly and flexibly to change. To this end, progress will be monitored on an ongoing business, experience contributed, and goals adjusted where necessary.

All measures emerging from the strategy will be taken in accordance with constitutional areas of responsibility and are subject to funding approval. Where specific measures or future measures that build on such measures result in expenditure from the federal budget, they are subject to the proviso that sufficient federal funds are available and sufficient positions filled and that they do not prejudice any current or future budgetary negotiations.

Science, research and transfer

Following the pressures of the coronavirus pandemic, the Russian war of aggression in Ukraine and its consequences are presenting Germany and Europe with major challenges in a changing era, leading to a shift in political priorities. At the same time, the effects of climate change are becoming more apparent from year to year, highlighting the urgent need to take action to limit climate change. The global battle for knowledge, markets and talents is intensifying. These social challenges and rapid changes in the international environment necessitate swift responses, with research and innovation playing a key role. They are the source of our current and future prosperity and therefore the source of progress and opportunities. We want to be at the forefront of change, as this reduces dependency and creates valuable jobs. Standstill soon becomes regression, especially in an era in which innovation cycles are becoming shorter all the time. It will soon become clear who sets international standards.

Excellent basic research, applied research relevant to real life, strategic knowledge transfer and Germany as an attractive science hub for international students, researchers and companies represent key pillars in terms of ensuring the competitiveness and forward-looking development of our country. In order to find answers to global challenges, there is a need for international, European, national and regional partnerships, as well as a strong European Union as a player on the global stage. A major challenge lies in combining the central actors with the existing expertise in science, business and society in advance and focusing on shared goals. Moreover, the government, politicians and administration need to be able to respond to unforeseen challenges with more flexibility in order to remain capable of taking action.

Innovation support and transfer, coupled with a bolstering of the start-up scene, constitute key tasks of research and innovation policy. Future viability and innovative strength hinge on how well ideas, knowledge and technology are transferred between science, business, politics and use in society. Scientific excellence and transfer or fundamental research and applied research are not a contradiction in terms, as applied research and innovation are fostered and facilitated by knowledge-oriented research. We want to strengthen transfer, allowing research results to be turned into innovations and safeguarding our natural basis of life, prosperity and quality of life here in Germany. As such, the aim is to foster both the development of innovation ecosystems and individual, research-based transfer steps and innovations.

If we are to preserve and boost our competitiveness while also living up to our responsibility to help solve the current global challenges – climate change, biodiversity crisis, environmental pollution, the fight against poverty, and sustainable development – it is imperative that Germany is involved in and actively shapes global knowledge flows and innovation processes. This is contingent upon strong European and international networking as a hub of science and research, as well as on the creation of new and effective research and innovation partnerships,

especially with like-minded countries. Partnerships within the European Research Area, especially through the EU Framework Programme for Research and Innovation, are vital in this regard.

We also aim to involve business and society more closely in innovation and research. We will harness the existing innovation potential in both areas, strengthen dialogue with civil society, broaden the knowledge and innovation basis in a structured way and therefore drive forward a dynamic culture of research and innovation.

Creating educational opportunities and giving people the opportunity to gather a variety of experience and acquire expertise is what secures the future of our country. This is not just about economic participation, but also social and political engagement. To continue meeting the need for skilled labour, it is important to optimally harness domestic, European and international potential in this area. In order to foster talent appropriately, both at the cutting edge and across a broad spectrum, we need an education system that continuously evolves, as well as continuous evolution of the vocational training and professional development system.

In the years ahead, the research and innovation system must be strengthened in a targeted way in order to safeguard competitiveness and lay the groundwork for being able to quickly and effectively respond to unforeseen events. It is also the job of government administration to adapt to changes with flexibility. All this requires agile research and innovation policy.

Actively shaping transformation processes

The current challenges range from climate protection, resource protection, biodiversity and marine protection and the solving of global health issues through to the elimination of technological and energy dependencies and their corresponding social impacts. The Sustainable Development Goals set out in the United Nations Agenda 2030 and the climate targets of the Paris Agreement harbour huge innovation potential. We want to leverage this potential in global competition. Our focus is on activities with both incremental and disruptive innovation potential. With an effective research and innovation policy, we aim to bridge the gap between economic, social and environmental interests. We need to take responsibility on the international stage, but also prevent one-sided dependencies. In this regard, it is also important to retain future room for manoeuvre: New solutions are needed now in order to build and preserve future quality of life and prosperity in Germany. We are striving to boost progress: bearing in mind the research and innovation policy challenges, we have therefore defined six central areas for the future. On the basis of the Future Research and Innovation Strategy, we plan to better integrate research and innovation policy within other political fields and focus our activities more effectively in the form of missions. The Future Research and Innovation Strategy lays out transformation road maps for these missions, identifies areas for action and prioritises goals and activities accordingly.

Future Research and Innovation Strategy

Enabling resource-efficient and on circular economy based competitive industry and sustainable mobility

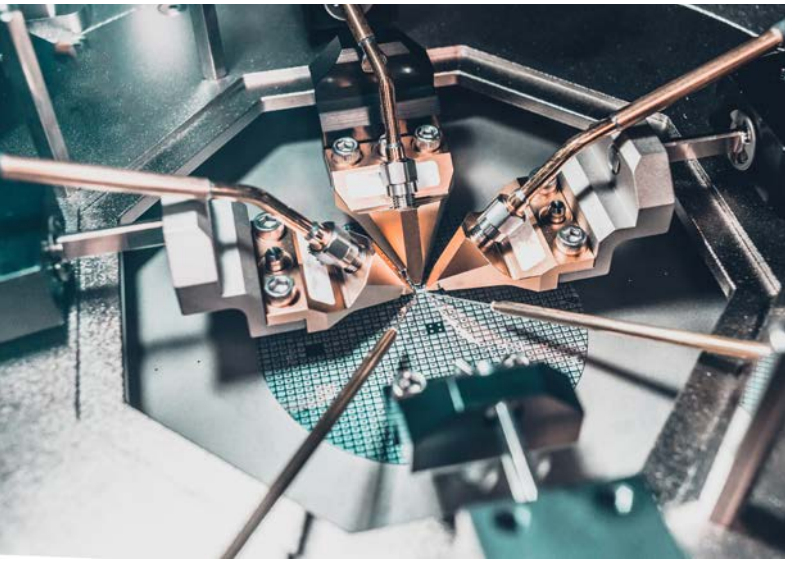
Germany's prosperity rests on a strong and innovative economy. We are striving to preserve and build on this asset while preparing the economic system for the future; in other words, it needs to be sustainable, climate-neutral and resilient while remaining internationally competitive. Sustainability and greenhouse gas neutrality – and the related innovations – need to be enshrined more closely and consistently as part of social and corporate innovation processes. We will also achieve these aims through innovation-friendly policy, from the initial idea through to market success, a deep-rooted transformation of the economy and a technology-friendly society that regards innovation as an opportunity for sustainable business and that is aware of the finite nature of resources. In order to become greenhouse gas-neutral by 2045, we urgently need technologies and concepts for climate-neutral industry, the efficient deployment of resources, circularity, an energy and heating supply based on renewable energies, and the mobility of the future. This requires comprehensive technological and social innovations, as well as a joint approach wherever there is the greatest unharnessed potential, in order to spearhead the transformation to sustainability, avoid or reduce greenhouse gases and use resources more efficiently.

Spearheading climate protection, climate adjustment, food security and the preservation of biodiversity

Protecting people, the environment and the natural world is essential in order to safeguard humanity's natural basis of life. Climate change and the loss of biodiversity represent the greatest challenges in this context. In order to slow down and stop this menacing development, there is a need for faster and more decisive action, ideally at international level. One focal point of research in the years ahead will be to fully understand the global connections and regional impacts of global warming and species loss while simultaneously developing and implementing strategies and solutions for minimising and adapting to the causes and negative consequences. One focus of research policy lies in the question of how the global population can be sustainably fed, i. e. achieving food security without jeopardising biodiversity and climate protection. Healthy soils are of fundamental importance in this regard. They play a crucial role in both the preservation of biodiversity and food security.

Improving health for everyone

The health care system of the future needs to be accessible, effective, high-performance, crisis-resistant, inclusive, rehabilitative, digitally connected, needs-oriented and easily available for all. The medical care of the future needs to be increasingly preventive, personalised, precise and participatory and participation-oriented within the overall innovation process. Of central importance here are close ties between research, development and application within health care in order to advance medical progress in a patient-centred manner and to integrate innovations even more quickly within health care (and subsequent rehabilitation). Health care spending represents investment to tackle the central challenges of the future. It boosts the performance level of society and paves the way for people to take part in the social arena. Training young researches and expanding research, transfer and application expertise also represent central aims.



Securing Germany's and Europe's digital and technological sovereignty and harnessing the potential of digitalisation

Technological sovereignty means upholding our commitments and capabilities, to shape key technologies and digital applications as an important international partner and in line with our values and to exploit them economically, even in times of geopolitical crises and conflicts, as well as disruptions and reshaping supply and value chains. To this end, we need to identify critical dependencies in central technological fields at an early stage and tackle them appropriately. We will strengthen the technological sovereignty of Germany and Europe in this decade by making up lost ground in key technologies, taking leading international positions and exploring new topics – for a sustainable and free future and the defence of our values. In this regard, we see digital and technological sovereignty as being of paramount importance and as a guiding principle of our industrial, digital and innovation policy. We want to pick up the pace of digitalisation, reclaim lost ground and seize the opportunities of digitalisation for research and innovation, as well as individual opportunities for social inclusion and excellent work, in a faster and more systematic manner. The Future Research and Innovation Strategy indicates important measures to bolster digital and data expertise, which will contribute to the implementation of the Federal Government's Digital Strategy alongside infrastructure measures and the data strategy. With our digital initiatives, we are seeking not only to strengthen the individual and their self-determination in a digital world, but also to strengthen and empower the resilience of society and the innovation strength and competitiveness of business, scientific institutions, education and administration.

Strengthening astronautics, exploring, protecting and sustainably using space and oceans

Space and oceans have always been a source of huge fascination. Oceans represent the world's largest ecosystem, with many species and habitats still unresearched. They play a pivotal role in the world's climate and carbon balance and, with their manifold ecosystem contributions, are of economic significance for many nations. It has only recently been possible to develop instruments and equipment that allow deeper insights into these still largely unknown realms.
The ongoing development of space exploration and astronautics research represents a challenge of the decades ahead and will have considerable impacts on the use of natural resources, environmental protection, risk prevention, disaster management and the emergence of new value chains on earth. The particular importance of oceans for life and business on our planet makes their protection, restoration and sustainable use a top priority.

Strengthening social resilience, diversity and cohesion

The free and democratic societies in Germany and Europe are facing a multitude of challenges. The free and democratic model increasingly finds itself in ever fiercer competition with authoritarian systems and extremist activities that, for their part, actively support and illegally influence anti-democratic and divisive tendencies within free societies. Solving major societal challenges goes hand in hand with fundamental transformation processes that question current structures and that affect the lives of each and every one of us. In light of these challenges, social resilience is paramount. Here, resilience does not just mean a return to the original state, but an evolution to a future society that is capable, crisis-resistant and cohesive. We not only aim to strengthen the ability to anticipatory management of crises, but also to shape transformation processes to sustainable development proactively and innovation-driven and to strengthen and defend free, open and democratic societies.
Whether these transformation processes are successful lies in the hands of local cities and municipalities. Sustainable and integrated urban development that includes all sectors in metropolitan and regional research and innovation spaces is an essential prerequisite for resilience and cohesion in society.

Fostering communication, dialogue and engagement

Politics and society have a high need for information on scientific insights. After all, it is science and research that help to solve the major challenges facing society. Maintaining trust in science and research is no less important. Nobody can answer all technical questions on their own in a highly specialised society, which is why there needs to be fundamental and informed trust in the work of these institutions. Alongside the freedom and independence of science, participation and transparency are also major prerequisites. After all, the reciprocal dialogue between science, society, politics and the media is a central tenet of the informed scientific understanding of our democratic society and Germany's innovation capability. Scientific communication and journalism are vital in terms of encouraging a constructive public debate on science- and innovation-related topics. Research findings and analysis should be communicated in a way that each audience understands. At the same time, science needs access to the perspectives, innovation potential and research needs of citizens, companies and civil society, as well as the support of society in order to preserve its performance capability. In order to achieve these aims, it must actively incorporate ideas from society and seek close dialogue with politics and society.

The Future Research and Innovation Strategy thrives on direct involvement and engagement. It benefits from the ideas, suggestions and thoughts of people up and down the country. Within this framework, we will offer numerous formats to report on our results, examine the progress of the Future Research and Innovation Strategy and invite citizens to contribute their ideas and stimuli.

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