



The
Federal Government

**HIGH-TECH
STRATEGY** 
Talents. Skills. Innovations.

Research and innovation that benefit the people

The High-Tech Strategy 2025



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Foreword

Germany is a country of innovation. We have made a name for ourselves worldwide with innovative products and services. Our economy is one of the ten most research-intensive economies in the world. A great deal has been invested in achieving this leading position. Since the launch of the first High-Tech Strategy in 2006, investment in research and development has increased by more than 30 billion euros. Germany is thus one of the few EU countries to have almost reached the 3 per cent target of the Europe 2020 strategy ahead of schedule.

But what will the future bring – what are our perspectives, goals and opportunities? We want Germany to remain a country in which commitment and inventiveness thrive, in which quality of life and solidarity, prosperity and sustainable development continue to grow through innovation. But to achieve this, we must act today. After all, we are not only facing grand challenges, but must also deal with rapid technological change and fierce international competition.

With the High-Tech Strategy 2025, the Federal Government is therefore setting ambitious targets. On the one hand, financially: Together with the Federal States and the private sector, we aim to increase spending on research and development to 3.5 per cent of the gross domestic product by 2025. On the other hand, in terms of content: We want to make knowledge more effective, turning ideas into innovations that are successful worldwide and benefit the people. To do this, we support creative ideas, excellent research, and an effective transfer of new findings and technologies into practice. We will promote open forms of innovation and the development of breakthrough innovations with the potential to open up entirely new markets and tap into further social potential.

To advance research and innovation, we must also strengthen education. Making Germany fit for the future – to do this, we need top professionals in addition to a state-of-the-art technology base. That is why we will always invest in training and further education wherever new technologies and processes are fostered. It is only in this way that we can prepare ourselves for the working worlds of the future and everyday life in the digitally networked world. It is only in this way that we can motivate people and companies to participate in the innovation process. And it is only in this way that we can promote an innovative spirit in Germany. Let us tackle new challenges together with creativity, agility, courage and self-confidence!

Your Federal Ministry of Education and Research





KEY FEATURES IN BRIEF

With the High-Tech Strategy 2025, we aim to put knowledge into effect. To achieve this, we need the concerted cooperation of science, business, society and politics. Only with excellent research and the effective transfer of ideas, insights and results into practical application will we be able to find creative answers to the grand challenges and strengthen our economy in times of ever-faster change and ever-tougher global competition. In this way, we will help ensure that innovation continues to increase quality of life and social cohesion, as well as prosperity and growth in our country.

With the High-Tech Strategy 2025, we are creating the conditions for research and innovation to develop in an environment characterised by creativity, agility and openness. To this end, we are setting thematic priorities and focusing our efforts on fields that show particular dynamism, have great potential for growth and employment, and exhibit a high need for innovative solutions to pressing issues. At the same time, we are consistently developing all the competencies in technologies, training and further education, and society that are necessary for Germany to be a progressive research and innovation location, thereby strengthening the future viability of our country on a long-term and sustainable basis. We are strengthening knowledge transfer and networking so that all actors involved in innovation in science, business and society can participate in new constellations that overcome ingrained mindsets and disciplinary silos. Particular focus is on new forms of joint ideation and the acquisition and sharing of knowledge, which make it possible to reshape and open up innovation processes. Our research and innovation policy is based on a comprehensive understanding of innovation that encompasses both social and technological innovations.

For us to be successful, new and greater efforts are needed. We need to invest even more in research and development (R&D). Together with the Federal States and the private sector, we have set ourselves the goal of continuing the upward trend in R&D investment and spending at least 3.5 per cent of the gross domestic product (GDP) on R&D by 2025.

The High-Tech Strategy 2025 focuses on three major fields of action:

1. Tackling the grand challenges

We want research that is geared to current and future needs and that is relevant to people's everyday lives. Our goal is to achieve technological and non-technological innovations, including social innovations, which focus on benefiting the people. To this end, we are developing missions and setting ourselves concrete goals which unite the support of science, business and society.

With the High-Tech Strategy 2025, we are specifically promoting research into issues that are relevant to our economy and society. We are focusing in particular on the areas of 'Health and Care', 'Sustainability, Climate Protection and Energy', 'Mobility', 'Urban and Rural Areas', 'Safety and Security', and 'Economy and Work 4.0'. We will work on these areas together with all stakeholders in the innovation process.

2. Strengthening Germany's future competencies

We aim to systematically and consistently evolve future competencies for a progressive Germany. To this end, we are promoting key enabling technologies that also open up new and disruptive innovation potential with their broad range of applications and strengthen our economy in international competition. At the same time, we closely dovetail the promotion of research and technology with training and further education, because we can only shape progress with specialists who are equipped for the tasks of the future and can use and further develop new technology. And we rely on committed and enlightened citizens to help shape change and benefit from it in their daily lives.

3. Establishing an open innovation and venture culture

Creativity, agility and openness to new ideas are the keys to shaping the society of the future and opening up new perspectives for growth and prosperity. For innovative results, we need innovative forms of cooperation that create spaces for ideas and involve new actors in the innovation process. We are committed to achieving the greatest possible networking and cooperation, because a wealth of perspectives creates space for the development of ideas.



Working hand in hand in the entire innovation process to achieve is the key to success: from scientists who develop ideas, to innovators who bring ideas into the economy and society, to people who use the innovations very concretely in their everyday lives. To ensure that research results feed even more effectively into practical application, we are strengthening transfer, supporting open forms of innovation and the development of breakthrough innovations, promoting entrepreneurial spirit and innovative strength in SMEs, and intensifying our integration into European and international networks and innovation partnerships.

We can only achieve our research and innovation policy goals if the various stakeholders in science, business, society and politics all pull together. Only if we have a common awareness of problems, a clear distribution of tasks, transparent participation processes, and functioning coordination mechanisms will the strategy succeed. This includes closer inter-departmental cooperation at the political level so that the various policy areas can work together even more effectively. Strengthening them is a key element in the High-Tech Strategy 2025.

We see the High-Tech Strategy 2025 as an adaptive process. We will therefore jointly tackle its implementation and further development with an advisory committee made up of representatives from science, industry and society. This committee is intended to complement existing advisory bodies by addressing important issues for the future viability of Germany as a location for research and innovation and developing impulses for the implementation and further development of the strategy.

We will ensure the effectiveness of our research and innovation policy by consistently evaluating the funding instruments. We will also launch a new foresight process on future topics in science, business and society. This is intended to identify future technological and social developments and thus provide important impetus for education, research and innovation policy at an early stage.

We will involve citizens more closely in research and innovation. We rely on dialogue and discussion to achieve this. For example, through our Future Forums we will continue strategic exchange with citizens on current overarching political issues and further intensify our activities in the field of science communication.



FORWARD- LOOKING RESEARCH AND INNOVATION POLICY

Forward-looking research and innovation policy: The High-Tech Strategy 2025



Starting situation and action needed

Today, Germany is one of the ten most research-intensive economies in the world. Around 650,000 people are employed in research and development (R&D) in Germany. Figures such as patent applications show our innovative strength – with 371 patents relevant to the global market per million inhabitants, Germany is almost on a par with Japan (387) and has almost twice the patent intensity of the USA. In 2016, Germany achieved a global trade share of 11.6 per cent with research-intensive goods. This means Germany occupies a leading position compared to other European countries. These are performance figures that can be attributed to the clear focus of our policy in recent years. Our goal is to strengthen R&D as the key to a sustainable economy and society. We have invested a lot in this. Since the launch of the first High-Tech Strategy (HTS) in 2006, public and private spending on R&D has risen from just under 60 billion euros to over 92 billion euros (2016). The R&D ratio to gross domestic product (GDP) has also increased by almost a third, rising from a good 2 per cent to almost 3 per cent. Germany is thus one of the few EU countries to have almost reached the 3 per cent target of the Europe 2020 strategy ahead of schedule. In terms of absolute R&D expenditure, Germany ranks first in Europe.

The research and innovation funding of the Federal Government has made a significant contribution to this development. We want Germany to continue to be one of the leading locations for science and innovation. To this end, we will need an outstanding commitment to R&D in the future as well. This is the vital key to success. The German government has therefore set itself the target of spending at least 3.5 per cent of GDP on R&D by 2025, together with the Federal States and the private sector.

Our goal is to achieve top innovations that develop into resounding successes. We need more – and more effective – innovations so that we can increase prosperity, growth and quality of life in Germany and strengthen our international position. Without innovation, we will not be able to meet the challenges of the future or of global competition.

The High-Tech Strategy 2025

The High-Tech Strategy 2025 (HTS 2025) is intended to strategically underpin this target. It defines the strategic framework of the Federal Government's research and innovation funding, as is customary at the beginning of every legislative period. HTS 2025 formulates cross-ministerial goals, focal points, and milestones of research and innovation policy for the years ahead.

We want to build on the successes of HTS in recent years. But we also know that we must become even better if Germany is to maintain its leading position as a location for innovation. This will require new efforts. Technology companies and business models in many parts of the world are challenging our economy with innovative products and services. The leading locations in digital transformation are exhibiting a high level of dynamism with sometimes revolutionary changes in value creation, technology deployment and user behaviour. We will only be able to maintain the current strength of the German innovation model if we succeed in keeping pace with technological leaps forward and by exploiting opportunities for new business models. We will only be able to maintain our leading position in international markets if the German economy demonstrates more than just steady development in its strong value chains – we must significantly increase the opportunity for radically new, market-changing products and services 'made in Germany'.

In addition, there are major tasks for the future which we can only tackle with combined effort and as a society as a whole. Demographic change, shaping digital change, national implementation of the 2030 Agenda for Sustainable Development, a sustainable economy and energy supply, tackling climate change, and increasing global competition are just a few examples. To succeed in these and many other future tasks, innovative solution strategies are needed to seize the opportunities of these challenges and keep the risks low. For this we need an ambitious and forward-looking research and innovation policy – and this is where HTS 2025 comes in, both conceptually and in terms of content:

- One of the conceptual aims is to achieve even stronger interaction between the various policy areas. Strengthening cross-departmental cooperation in programme development and implementation is a key element of HTS 2025. All participating ministries will set joint research policy priorities more actively than in the past in order to promote innovation in a wide variety of policy fields and achieve progress through research. For internal government coordination, a round table of State Secretaries from all participating ministries will be held to shape the research and innovation policy agendas of HTS 2025 and address current impulses. We want to jointly define, anchor and financially underpin new initiatives in priority fields of action. We will jointly shape missions and future topics from the perspective of the various policy fields in order to increase the impact of research and innovation in many areas of work and life. Comprehensive consultant advice will support us in this endeavour and provide us with orientation.
- In terms of content, it will be important in the coming years to make even more consistent use of the opportunities offered by digitalisation, to expand our technological sovereignty in forward-looking industries and key enabling technologies, and to meet the demand for highly qualified specialists. For Germany as a business location, it will be crucial to improve the transfer of scientific insights into high-quality products and processes. In this way, we can broaden the innovation base and increase the opportunity for radically new, innovative products and services. We have to significantly increase the start-up dynamism and the innovator ratio – i.e. the proportion of companies that have introduced new products or processes within the past three years. The way to achieve this is to head towards a more open innovation and venture culture – with a broader understanding of technological and social innovations and with new, creative ways of cooperation in science, business and society. With new players who are involved in the innovation process. With discourses about the changes at an early stage of the process. And with more courage to take risks – for the benefit of the people and the environment!



Concrete fields of action

To achieve this we are focusing specifically on three fields of action:

I. Tackling the grand challenges

Our policy is centred around people. That is why our support consistently targets the major needs of society. We are focusing particularly on the areas of 'Health and Care', 'Sustainability, Climate Protection and Energy', 'Mobility', 'Urban and Rural Areas', 'Safety and Security', and 'Economy and Work 4.0'.

Our goal is to achieve quality leaps forward in these topic areas, changes that are noticeable and tangible for people in their everyday life. To this end, we look at the big picture – from the interaction of institutions and stakeholders in Germany, Europe and the world to the general conditions for research, development and innovation. We will unite science, business and society in the pursuit of concrete, jointly defined goals in these topic areas: our 'missions'.

To achieve success, it is necessary that all relevant stakeholders should be able to participate. On this basis, research and innovation can achieve excellence through access to and uptake of data, knowledge and technology, through the effective division of labour or by achieving a critical mass. National circumstances, the international environment, and the economic and social consequences need to be considered in a coherent and networked way.

We will promote digitalisation as a central, cross-cutting topic in all the fields mentioned and use its potential for greater prosperity, quality of life and sustainability. This includes thinking about possible undesirable effects as early as possible and developing forward-looking strategies to mitigate risks. Our understanding of innovation in this process is comprehensive. We will promote technological innovations and also intensify the focus on social innovation. Social innovation includes new social practices and organisational models aimed at finding sustainable solutions to the challenges facing our society.

An innovation concept in this sense upholds the precautionary principle and existing protection standards. In addition, it also identifies innovations that add to reducing risks to people and the environment.

II. Developing Germany's future competencies

In order for us to maintain our status as an innovative country in the future, three future competencies are central: firstly, the interaction of various key enabling technologies, through which new and even radical innovation potentials can be tapped; secondly, the training and continuing education of highly qualified skilled workers who make use of the opportunities offered by technology, thus increasing our prosperity; and thirdly, committed and enlightened citizens who help shape change and benefit from it in their daily lives.

We want Germany to be at the forefront of technological advances. In those areas where we focus on promoting new technologies, we will always also invest in training and continuing education, because forward-looking technologies are knowledge-intensive. They require new skills and abilities as well as modern qualification pathways. Digital change and the convergence of technologies are tangibly changing the way we work and live. Putting artificial intelligence (AI) into practice, harnessing the possibilities of space travel for people, designing materials intelligently or using resources efficiently: These are examples of future competencies that will be of outstanding importance in many areas of science, industry and society.

That's why we want to work together in promoting key enabling technologies to shape training services – from schooling through vocational training to academic education – with a view to the future. We will quickly take effective measures to counter shortages in skilled personnel – especially in the IT area – so that we can hold our own in international competition for the most promising talent. With forward-looking training and flexible further education, we aim to secure the specialist base at an early stage in up-and-coming research fields and industries and at the interface of disciplines.

We will also encourage society to play an active role in shaping technological change. This includes arousing curiosity in digital and new technologies and in innovative products, as well as enabling as many people as possible to deal with them competently and confidently. We will intensify the dialogue on the envisaged changes and create space for critical reflection. At the same time, we believe in an opportunity-oriented and responsible approach to technological progress and its potential. We will examine the possible consequences of both the use and non-use of innovations. We want to seize new opportunities in a sustainable, proactive and responsible way for the benefit of humankind and the environment, as well as for greater prosperity, justice and quality of life. Human beings in their individuality and their rights – for instance, with regard to self-determination and protection of privacy – are the focus of our attention.

III. Establishing an open innovation and venture culture

We support the move towards an open innovation and venture culture that offers room for creative ideas and actively involves new actors in the innovation process in our country.

Start-ups, small and medium-sized enterprises (SMEs), and users can benefit from new approaches and participation formats, as can large companies, the research sector and civil society organisations. We aim to encourage people to take entrepreneurial responsibility themselves and to develop technological or social innovations. We support new ways of finding common ideas and new forms of acquiring and sharing knowledge. In this way, we are making it possible to redesign and open up innovation processes. Innovation impulses should come more and more from ordinary citizens and from the diversity of entrepreneurial activity.

We will significantly strengthen the transfer of ideas, knowledge and technology. What is important here is the necessity for cooperation between a wide range of stakeholders – science, business and society should jointly generate knowledge and achieve innovation goals. We want to tap the opportunities of digitalisation to increase the dynamism in knowledge and innovation networks. We will promote cultural change in universities and research institutions so that research results can be transferred into practical application more effectively for the benefit of society and industry. The aim is for relevant knowledge to be widely applied and innovative products and business ideas to emerge quickly from cutting-edge research. That is why we are working on a transfer initiative. In order to promote breakthrough innovations, we want to support outstanding innovation experts and creative lateral thinkers from science and industry with new instruments to transform visionary ideas from research into new, innovative products and services.

HTS 2025 is implemented through programmes and funding initiatives and links these with the creation of the best possible general conditions for research and innovation. The measures described fall within the remit of the appropriate Federal Ministry, where they are financed under the budgetary and financial principles currently in force (including positions/permanent posts). Additional demand for material resources and personnel are counter-financed in each respective individual plan.





FIELDS OF ACTION

I. Tackling the grand challenges

In our funding for research and innovation, we are focusing on current and future needs, paying particular attention to the following topics: 'Health and Care', 'Sustainability, Climate Protection and Energy', 'Mobility', 'Urban and Rural Areas', 'Safety and Security', and 'Economy and Work 4.0'.

We aim to consistently use the potential of digital technology along with the findings and processes from the biological and life sciences as key drivers of progress in each of these areas. In addition to supporting technological innovations, we will also intensify our promotion of social innovations, because HTS 2025 can only succeed if we consistently think of the developments we are striving for in terms of people – in their various roles as citizens, employees or consumers.

In areas where solutions to major challenges can only be found in cooperation with all stakeholders, we will orient our funding towards missions that unite science, business and society behind common goals. We are convinced that real progress can be made in areas such as digital medicine, intelligent mobility in rural areas and regional conurbations, and the circular economy, particularly if we succeed in developing them into intelligently networked complete systems. Then research and innovation can reach new heights – through access to and uptake of data, knowledge and technology, through effective division of labour, and by reaching a critical mass. National circumstances, the international environment, and economic and social consequences must all be considered in context in this process.

Health and care: For an active and autonomous life

People in Germany are living longer and longer – compared to the middle of the last century, we have on average gained a decade of life expectancy. At the same time, both new and known diseases demand improved concepts for prevention, diagnostics and therapy. This is why we rely on high-performance health research, international research partnerships, and the use of digital innovations in medicine and healthcare.

Preventing and curing diseases

Cardiovascular diseases, cancer, diabetes, chronic respiratory diseases, diseases of the musculoskeletal system, allergies, dementia, psychological and psychosomatic diseases are widespread. As a strong research nation, Germany can make important contributions to combating such diseases.

We will declare a National Decade Against Cancer. Our goal is to measurably increase the proportion of early-detected and successfully treated cancers. We want to enable patients with cancer to enjoy a better quality of life. To this end, we want to initiate further developments in cancer research and bundle and strengthen successful activities.



Our mission: Combating cancer

We will declare a National Decade Against Cancer. We will work together with science, business, society and all stakeholders in the health system to make people with cancer live longer and better, while reducing the incidence of cancer. To this end, we will further strengthen cancer research in Germany, thereby advancing prevention, early detection, diagnosis and treatment. We want to enable the development and clinical validation of new preventive and therapeutic strategies. For example, risk-adjusted early detection measures are to be developed and tested for people with a significantly increased cancer risk. We want to improve the quality of life of those affected and also look at the long-term consequences of cancer disease and treatment.

We will promote patient-centred, systems approaches to research in medicine that investigate the effects of diseases on the entire organism to derive new diagnostic and therapeutic approaches. In order to better understand and prevent the emergence of diseases, we will strengthen preventive and population-based research (public health). We will expand our research into mental illnesses and paediatrics.

New societal challenges such as the increase in age- and lifestyle-dependent chronic diseases and multimorbidity should also be reflected in health monitoring and public health surveillance. We will therefore expand health reporting and prevention- and disease-related surveillance in order to map developments in the health situation and healthcare of the population in the long term, to identify changes in time, and to make these findings available in an appropriate form to health policy decision-makers, affected persons and the public. The guiding principle here is to make health-related data available for targeted health policy action.

Fast-tracking medical progress to the patient

We will strengthen medical research at universities, in university medicine, and in structures for clinical studies in Germany. In this process, we are committed to improving the framework conditions for physicians conducting research and will launch a relevant funding programme. We will advance translational research in order to combine findings from clinical application with basic research and fast-track this to patients. We will intensify the research on novel diagnostic and therapeutic procedures, based, for instance, on the use of endogenous molecules, cells or tissue, as well as on methods and procedures for nursing care and health-care. We will reinforce support for the science-based consideration of ethical, legal and social issues in the life sciences.

We are supporting the medical technology sector by promoting innovation with the needs of patients, nursing care and the industry in view. We will strengthen healthcare research and make appropriate healthcare in rural areas a priority topic. For example, telemedicine can help make top medical expertise available anywhere in Germany.

Developing active substances, fighting infections and strengthening research on global health

Infectious diseases are becoming an ever-greater global threat. The German government will promote the development of new active substances such as antibiotics through a national active substance initiative, in particular with new cooperation formats between science and industry. We are tackling antibiotic resistance together with the G7 and G20 countries and other international partners. In addition, the German government will strengthen research on global health and expand participation in international initiatives.

Digitalisation for preventive and personalised medical care

Digital medicine can save lives. Relevant information, research results and empirical data should be available to every physician at the touch of a button so that this can be incorporated into therapy decisions. The analysis of large amounts of data from biomedical research and patient care is an important basis for precise prevention, diagnosis and therapy tailored to the individual.

We will continue to employ effective measures to push the development of innovative methods and analytical tools for health research, to strengthen systems medicine, and to counter the lack of data scientists. Through networked infrastructures, we will enable cross-institutional access to the latest technologies and support quality-assured and standardised data collection and evaluation that takes account of the particular technical and legal data protection requirements.

We want to make Germany a pioneer in the introduction of digital innovations into the healthcare system. In order to use these opportunities for the benefit of as many patients as possible, the consistent cooperation of the various stakeholders is necessary. The first step is a roadmap for the development and implementation of innovative e-health solutions and the establishment of the 'Digital Health' dialogue platform.

Future-ready nursing care technologies

We are funding research and technical innovations in the nursing field with the aim of relieving the workload of nursing staff and relatives, giving them more time for human attention and improving the quality of life of those in need of care. We will bring science and industry together with users in order to research, develop and test new nursing technologies in nursing practice. We will also promote the development of intelligent, networked living environments that enable people to live longer and more independently in their own homes. The development of technical support systems must always be geared to people's needs and not just designed around technical capabilities.

Our mission: Digitally networking research and healthcare – for intelligent medicine

The Federal Government will work together with science, industry, society and all stakeholders in the healthcare system to ensure that a research-compatible, electronic patient file is available at all German university medical centres by 2025. To provide support for this, electronic patient files that can be accessed cross-institutionally will be introduced in healthcare institutions. The focus will be on patient benefits, data protection and data security.

Research for a healthy life

Health and the occurrence and progression of diseases are not determined by individual genetic and physical conditions alone. Factors such as age, place of origin, social background, gender, and the family, professional and social environment also determine who remains healthy and how diseases are managed. To better understand and prevent the emergence of diseases, we will intensify preventive and population-based research. We will enable the use of improved methods to make people's different everyday lives more conducive to good health. Particular attention will be paid to research into more effective access routes for hard-to-reach population groups such as socially disadvantaged people. In addition, we will support implementation research into promoting physical activity in order to motivate people to exercise more for a healthy life. We also want healthy nutrition to become a natural part of life in our society. To this end, we will work with business associations and professional bodies to develop a reduction and innovation strategy for sugar, fat and salt in finished food products.

New research and innovation policy initiatives 2018–2021

The new Health Research Framework Programme will define the strategic direction of funding in this area.	from 2019
The National Decade Against Cancer will bundle and intensify cancer research activities in Germany and initiate groundbreaking developments in cancer prevention and treatment.	from start of 2019
The National Active Substance Initiative will promote the development of new active substances, in particular through new forms of cooperation between science, the pharmaceutical industry and regulatory authorities.	from 2019
With the Roadmap for Digital Health Innovations we aim to optimise the cooperation of all responsible parties, from the development of innovative e-health solutions to their rapid implementation.	from 2019
Together with business associations and professional bodies, we are developing a National Reduction and Innovation Strategy for Sugar, Fats and Salt in Finished Products	end of 2018
In the Future of Care Cluster , research and industry are working together with users on new products, processes and methods to improve everyday nursing care in Germany for all those involved. Social and technical innovations are to be closely interlinked in this process.	since 2018

Sustainability, climate protection and energy: For generations today and tomorrow

As one of the most economically efficient countries in the world, Germany has committed itself to ambitious sustainability goals in the German National Sustainable Development Strategy. The Paris Agreement also sets the international framework for an ambitious German and European climate protection policy with the goal of being largely greenhouse gas-neutral by the middle of the century. The Federal Government's Climate Action Plan 2050 specifies the German climate action target to be achieved through concrete reductions in all sectors by the year 2030. We have firmly anchored our mission of sustainable and climate-friendly development in both our innovation policy and our education system.

Our mission: Substantially reducing plastic discharged into the environment

Plastics in the environment endanger species and ecosystems. We are putting research at the service of countermeasures in a comprehensive way. By 2025, marketable processes will be established for the sustainable production of plastics from bio-based raw materials. We will also continue closing the loop in the circular economy for plastics in all phases through recycling-friendly design, efficient use of materials, high-quality plastics from recycling, comprehensive collection and sorting systems, and ecologically sound solutions for abandoning or replacing plastics. With our targeted support for research and development, we are helping to rate up the recycling of plastic waste. With our research funding, we are also helping to significantly improve the biodegradability of certain plastics so that they can be completely degraded without endangering the environment or health. In addition, we want to work in partnership with the most affected regions to effectively reduce 'plastic refuse' worldwide.

We want to do justice to both present and future generations. To this end, our overriding goal is to uncouple economic growth from resource consumption and thus increase raw material productivity. To achieve this goal, we will press ahead intensively with the transition to a resource-efficient, circular economy. Resource efficiency also contributes to other sustainability goals, particularly to climate protection. At the same time, we are working to secure and expand the global market position of German industry in the green tech sector and to establish sustainable technology solutions. As a contribution to this, we will further expand the already initiated industrial structural change towards a sustainable, bio-based economy by our funding in this area. The current focus on replacing fossil raw materials with sustainably produced renewable raw materials wherever possible will be expanded with the aim of using the entire spectrum of bio-based methods on an industrial scale. To this end, we will intensify knowledge-driven basic research and application-based research and create a resilient technological basis for the bioeconomy through the development of future technologies. This is how we will secure and create high-quality jobs in Germany. In doing so, we will take into account global population growth and the associated increase in demand for food and land, as well as the protection of biodiversity.

Our mission: Achieving substantial greenhouse gas neutrality in industry

In order to achieve its ambitious environmental and climate policy goals, the German Federal Government intends to launch a decarbonisation support programme for industry in accordance with the Coalition Agreement. The Coalition Agreement also provides for the targeted provision of public funds within the framework of energy research for the development of low-CO₂ industrial processes and for the CO₂ circular economy. A research, development and market launch programme aimed at reducing climate-impacting industrial process emissions is already included in the Climate Action Plan 2050. These measures are intended to serve the long-term climate action goal of being largely greenhouse gas-neutral, i.e. achieving a reduction of 80 to 95 per cent compared to 1990, to safeguard Germany as an industrial location, to strengthen the international competitiveness of German companies, and to create and maintain sustainable jobs in Germany. The long investment cycles must already be taken into account in this process. The development of the planned funding programme requires comprehensive scientific groundwork, dialogue with the sectors concerned, and a time frame for the preparation and coordination of the funding directive and notification under EU State Aid Law.

Energy systems transformation remains a central task for Germany. The so-called energy policy target triangle is decisive for energy policy: security of supply, affordability and environmental compatibility. We will identify a variety of technological and social solutions and also look at long-term options. In order to use energy in a more climate-friendly, intelligent and efficient way, we will continue our drive to link the electricity, heating and transport sectors through forward-looking concepts and business models. Sector coupling is an important building block for making optimum use of the fluctuating

supply of renewable energies and for advancing decarbonisation in the heating and transport sectors as well. The further development of synthetic fuels can be an important building block for climate-neutral mobility, especially in heavy goods, shipping and air traffic. To achieve this, the framework conditions must be further adapted.

With research and development, we are activating energy systems transformation, a resource-efficient circular economy, and climate protection as engines of innovation and investment and as drivers of regional structural developments. In industry, it is particularly important to also press ahead with the switch to renewable energies for greenhouse gas-neutral production. Together with business partners, we want to develop new technologies and system innovations, pilot them, and open up new export opportunities for German technology and system solutions.

Sustainability research points the way to a sustainable lifestyle and economy. We will launch new national and international initiatives to conserve biodiversity and ecosystems and strengthen research into the decline of insect populations. Trace substances and resistant germs threaten the supply of clean water. The Federal Government will concentrate holistic water research 'from source to estuary' in a new, interdepartmental programme so as to preserve this basis for life. We want to tap the potential of digitalisation for sustainability research and will support the development of solutions and data spaces for big data.





Excellent sustainability research is based on highly effective infrastructures and innovative software solutions for their use. Together with the North German States, we will further increase the international visibility and effectiveness of German coastal, marine and polar research. We will expand climate research, in particular to provide new impetus for monitoring the sources and sinks of greenhouse gases and predicting regional climate risks. The huge and ever-growing data volumes required by global measurement systems and global modelling in this area will continue to set technological development standards in the future.

Our mission: Creating sustainable circular economies

We will work with industry, science and consumers to link economic growth to sustainability goals and achieve a 30 per cent increase in overall raw material productivity by 2030 compared to 2010. Material efficiency will be given priority in the manufacture of products. Together with all those involved, we want to press ahead intensively with the transformation of the traditionally linear economy into a resource-efficient circular economy. The focus will be on innovative business models in connection with digitalisation.

Our mission: Preserving biological diversity

In cooperation with science, the private sector and civil society, we want to counteract the loss of biodiversity. We will launch a new research-driven biodiversity flagship initiative to raise awareness of the importance and value of biodiversity. Innovative instruments and robust indicators will be used to measure and evaluate biodiversity loss more accurately. Options for action in the political and social context and innovative measures against the loss of biodiversity will be provided. In particular, we want to help stop insect mortality.

Sustainable development is a global task. With the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the German government will promote international structures for the political implementation of scientific findings. We will launch new international energy partnerships with Africa and Europe and give new weight to research for sustainability at the European level. We are committed to ensuring that the UN Sustainable Development Goals (SDGs) 2030 and the Paris Agreement are anchored in the new EU Research Framework Programme. In addition, we will continue to advocate an ambitious implementation of the 2030 Agenda at the European level.

New research and innovation policy initiatives 2018–2021

With the new **FONA Framework Programme**, we will support research for sustainability to identify options for a sustainable lifestyle and economy. 2020–2025

With the further development of the **National Research Strategy BioEconomy 2030** we aim to put biological knowledge and biotechnological processes into practice, strengthen applied basic research, and create a resilient technological basis for the bioeconomy. This will also take account of the limits of biomass availability and the efficiency of ecosystems. from 2019

We will develop a **National Research and Innovation Strategy for Resource Conservation Technology** in collaboration with the private sector. from 2019

We will contribute to the bioeconomy with the **National Research Agenda for the Material Use of CO₂** by promoting a better systems understanding of CO₂ cycles, new technologies and fields of application for the use of CO₂. from start of 2019

The guiding principle of the **Government Programme Water Research for Sustainability (Water:N)** is holistic water research ‘from source to estuary’. This is intended to help ensure that clean water will continue to be available for the people, the environment and industry in the future. from mid 2019

The **Decarbonisation in Industry Funding Programme** is designed to promote innovative technologies with process emissions, particularly in basic industries that have the potential to make a decisive contribution to climate protection and to securing Germany’s position as an industrial location in the long term. from 2020

The **Research Concept Resource-efficient Recycling Management** promotes innovative solutions for product recycling and the further development of digital technologies for recycling management. 2018–2023

The **7th Energy Research Programme of the Federal Government** will fund technological, economic and social innovations. The aim is to transform our existing energy system in Germany and Europe into a sustainable energy system. from 2018

A joint **Franco-German Initiative on Basic Energy Research**, which focuses on innovative ideas for storage facilities and networks, gives new impetus to cross-border cooperation in energy research and contributes to the technical implementation of the Energy Union. from 2018

With a joint **Research Initiative Energy Transition in Transport and Sustainable Mobility through Synthetic Fuels (NaMoSyn)**, we are advancing research on synthetic fuels and supporting their practical testing as a sustainable alternative to fossil fuels. from 2018

The research-driven **Flagship Initiative Biodiversity Conservation** aims to better assess biodiversity loss through innovative instruments and robust indicators and to develop options for effective countermeasures. Research on insect mortality will be a priority. from 2019

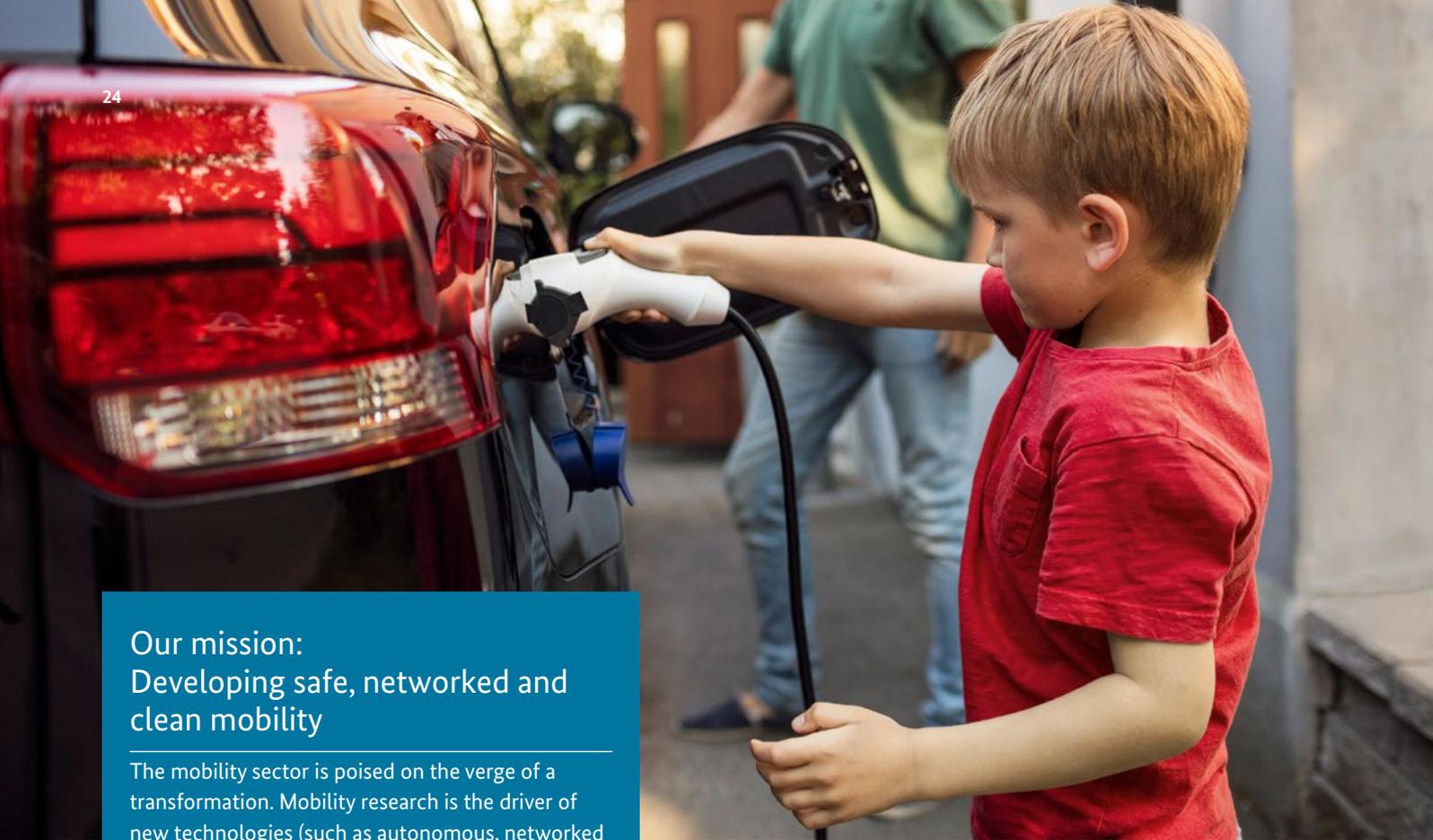
A **German Marine Research Alliance (DAM)** will consolidate Germany’s excellent marine research, making it more effective and internationally visible. from 2018

The **Dialogue Platform Industrial Bioeconomics** is designed to initiate early dialogue between industry and social stakeholders on the requirements for a changed raw material base. 2018–2021

The **Science Platform Sustainability 2030** brings together stakeholders from science and society in order to reflect scientifically on sustainability policy and, through dialogue, to provide politics and society with implementation impulses as well as directing open issues to research. Future priorities include dialogue on the implementation of the sustainable development goals (SDGs) and the topics of ‘Sustainable Consumption’, ‘The Future of Work’, ‘Global Commons’ and ‘Mobility’. ongoing since 2017

Real-world Laboratories will be introduced as a new pillar of energy research to support the transition from research to demonstration and market introduction. from 2019

EnMAP is a satellite with a novel hyperspectral sensor for observation of the Earth. The sensor can measure a very wide range of wavelengths – not just light. This makes it possible, for example, to determine the composition of rocks, plant growth, or soil and water quality to a degree previously unattainable. from 2020



Our mission: Developing safe, networked and clean mobility

The mobility sector is poised on the verge of a transformation. Mobility research is the driver of new technologies (such as autonomous, networked driving or alternative drives) and system innovations (such as new services and infrastructures). We place mobility in the context of the increasing individualisation and diversification of the transport sector (keyword ‘multimodality’) and of new technologies and (digital) services, as well as in the context of environmental and climate protection.

We are promoting investment in EV charging infrastructure under the Clean Air immediate action programme. In particular, the issue of low-cost EV charging, as well as EV charging in multi-storey car parks and depots, will be addressed. Another focus is on the removal of barriers to network expansion. The legal framework conditions will also be consistently adjusted to the evolving circumstances. For example, the European Directive on the Deployment of Alternative Fuels Infrastructure is due to be reviewed in 2020, and further implementation steps will follow at a national level.

Mobility: For intelligent and emission-free transport

Mobility and logistics are changing fundamentally: through digitalisation and new technologies, through changing mobility cultures, and through the consequences of climate change. We want to shape this change together with our citizens, a highly effective science sector, and a competitive economy.

We are responding to the changes in the mobility sector. In the field of mobility, we want to advance research by coordinating and combining the various competencies of the relevant departments. As we do so, we will consider the mobility of the future as an integrated complete system. In order to accelerate the transfer of knowledge and technologies into practical mobility concepts, we will focus more on participatory approaches in testing facilities. We also want to promote a stronger link between the mobility sector and other sectors such as energy, environment, labour, trade and production, and urban development, as well as big data and telecommunications.

The issues of alternative, pollution-free powertrains and electromobility remain the focus of research and transfer tasks. We will step up research into new energy storage systems for electric mobility, support the development of fuel cell production, and promote the establishment of battery cell production in Germany. In addition, we will promote the development of alternative concepts that keep electric vehicles powered out on the road – through power-supply systems in or on the transport infrastructure. At the same time, research into synthetic fuels needs to be driven forward and the conditions created for a timely market ramp-up. Our goal is to reduce emissions and the consumption of resources using innovative technologies and all-round concepts.

Mobility of the future will be more sustainable and intelligently networked. It will also rely on different technological solutions. Modern information and communication technologies make an important contribution and systematically bring together the previously largely separate areas of vehicle, energy and transport. We want to support the key sectors automotive and logistics, aerospace, rail and shipping, and public transport to emerge stronger from the transition. We will press ahead with networking the various modes of transport. Research for new materials and lightweight construction, for reliable and powerful sensors and electronics, for the deployment of intelligent and safe autonomous systems, for alternative drive systems and fuels, and for emission reduction are key for the success of this endeavour. We are promoting the development of automated vehicles for application scenarios in private transport, public transport, freight transport on land and water, and in aviation and aerospace.

New research and innovation policy initiatives 2018–2021

The **Action Plan Automated and Connected Driving** provides an overarching research framework for the promotion of research projects in the field of autonomous driving. It is intended to define priorities and ensure that the individual departmental activities complement each other in a meaningful way. Q4 2018

With the **Strategy Paper on Battery Research and Battery Cell Production**, we aim to identify existing potentials for covering the battery value chain and present options for making them industrially usable. Q4 2018

The first call for proposals for the **Federal Aviation Research Programme VI** will extend the industry 4.0 funding line and implement the electric hybrid flight funding line. Q4 2018

Under the motto **MARITIME.green and smart**, we are promoting green, smart mobility in the Maritime Research Programme. This includes high-performance alternative propulsion systems and new energy sources, as well as networked components, assistance systems and autonomous technologies for economical, safe and, in future, completely emission-free cargo and passenger shipping. from 2018

The **Modernity Fund (mFUND) Research Initiative** promotes data-based applications for mobility 4.0. The fourth call for proposals (July 2018) for Funding Line 2 sets nine thematic priorities for digital innovations in the transport sector, including artificial intelligence, blockchain applications, intelligent vehicle/plant maintenance, digital forms of citizen participation, data governance, and scaling and standardisation. ongoing since 2016

The cross-industry **Networking Initiative Space Moves!** will make space-based technologies and services available for future mobility. 2018–2021

With the establishment of **FestBatt, the Competence Cluster for Solid-state Batteries**, we are building the material and cell-based process chains for a future battery technology without liquid electrolytes. Q3 2018

By continuing **the Competence Cluster for Battery Cell Production**, we are further expanding our national competencies (on the research side) in the field of battery cell production in order to support industry. from 2019

In the **H2ORIZON Project** (sector coupling of space, energy and transport on a megawatt scale), technologies for a complete hydrogen cycle will be developed and applied at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) – from the generation of hydrogen by wind energy, to transport and storage, to its use in fuel cells for mobility, for electricity and heat supply or for missile tests. from July 2018

Our mission: Building up battery cell production in Germany

In order to ensure technological sovereignty and maximum coverage of the battery value chain, we want to support the development of our own capacities for battery cell production in Germany. To this end, we will continue to advance battery research and accompany consortiums with suitable support measures until cell production is established.



Urban and rural areas: For liveable towns and cities and sustainable regions

Innovative strength and economic performance vary in the different regions of Germany. The strong economic centres are confronted with spaces that are grappling with special challenges in structural change. They benefit little from the positive economic development – even though they have competences and potentials that can contribute to the creation of innovations and new value chains.

Structurally weak rural areas are particularly affected by demographic change as well as the migration of younger people to cities and the surrounding areas close to cities. Here there is less and less infrastructure available for central public service areas such as education, mobility, healthcare, culture and professional services. In the prospering large cities, on the other hand, increasing population growth brings with it new challenges to community life, including challenges to infrastructure.

It is our concern to develop all regions, cities and rural areas into viable living and economic areas. For this we need innovations, because they are the key to successful structural change and economic efficiency in all regions of Germany. Therefore, as a contribution to the nationwide German funding system for structurally weak regions, we will launch an additional funding programme that is open to new topics and – within the framework of our objectives – to new technologies. The aim of this is to build on the success of existing offers in order to boost innovation and initiate successful structural development, particularly in structurally weak regions. Connecting households and businesses to digital broadband networks nationwide also plays an important role, in particular providing under-served areas with fast Internet connections. In addition to the expansion of fibre-optic networks, satellite communication will be used to offer an alternative in areas where the infrastructure is particularly weak. It must be ensured that the public administration is also equipped with efficient and secure network connections so as to be capable of offering modern administrative services nationwide.

We will promote sustainable urban development in line with the 2030 Agenda for Sustainable Development. The national agenda is being jointly developed, implemented and further developed with all the relevant stakeholders from science, municipalities, business and civil society. We will support cities and regions in dealing with the challenges of climate change and making regional economic structures and infrastructures more sustainable and resilient. Our goal is to make cities and regions capable of acting nationally and internationally as drivers of sustainable development. We also aim to help meet the national and global demand for new housing of better quality at lower prices and in less time with a digital value chain for planning and construction that extends all the way to automated construction. This is because housing in the conurbations is scarce and expensive both nationally and globally.

Our mission: Ensuring good living and working conditions throughout the country

Economic structural change and demographic upheavals lead to spatially and socially unequal development. Ecological risks such as climate change often exacerbate these imbalances even further. We accept the challenge of creating equivalent living conditions for all. The opportunities offered by digitalisation are to be used specifically to secure and strengthen the attractiveness of peripheral and structurally weak regions as places to work and live. In order to successfully shape the future of our country and of structural change, we want to draw on local regional expertise and creativity, because regional know-how and experience are important for success. With new funding initiatives, we are actively working towards structural change that is innovation-based, sustainable and socially just. In this way, we are helping to ensure that innovations in 2025 are the most important drivers of growth, employment and prosperity – in all regions of Germany.

The Innovation Platform City of the Future and the joint initiative National Urban Development Policy serve to exchange solutions and coordinate financing for sustainable urban development. The implementation at municipal level will be developed with the support of research, and coaching by experienced municipalities will support the transfer. In this way, we will promote the development of resource-efficient locations, sustainable urban–rural relationships, and a regional circular economy, as well as the use of digital technologies in urban and rural areas. We want to turn municipalities into stakeholders in digitalisation who help shape digital change in the sense of sustainable urban development. We will support the testing of assistance systems for networked living and the implementation of an urban data space. We will address both data security and the reliability and controllability of these systems.



The agricultural and food sectors, along with a stable local economy, are of particular importance for the development of rural areas. We will promote research and innovation to strengthen regional value chains and develop new solutions to make rural areas attractive as places to live and work. In particular, we will support structurally weaker and peripheral regions in making economic structures, as well as social and technical infrastructures, fit for the future. The opportunities offered by digitalisation will be actively exploited for the development of rural areas. Our aim is to advance research on rural development issues in order to find specific and practical solutions to the challenges facing rural regions. In particular, nationwide broadband coverage is an important prerequisite for this.

New research and innovation policy initiatives 2018–2021

The **Framework Concept Innovation & Structural Change** is intended to pave sustainable, innovation-oriented development paths in structurally weak regions in eastern and western Germany.

launch of first nationwide initiatives in Germany from 2018

The **Call for Proposals for Rural Areas in Times of Digitalisation** within the framework of the **Federal Rural Development Scheme (BULE)** aims at a proactive, creative approach to digital change.

from 2018

The synthesis and transfer project of the cross-departmental **Funding Initiative Solar Construction/Energy-efficient Cities** will integrate six selected lighthouse projects at neighbourhood level into an overall view of the sustainable transformation of urban spaces.

expected 2019

As part of the **Funding Measure Stadt-Land-Plus (urban-rural-plus)** within the Flagship Initiative City of the Future, we will jointly support cities, urban environs, and rural areas in implementing efficient, resource-saving land management at regional level. This will strengthen regions and advance the development of equivalent, sustainable living conditions in urban and rural areas through new research findings.

from 2018

The **Funding Initiative Resource-efficient Urban Districts for the Future (RES:Z)** within the flagship initiative City of the Future will use research results to enable stakeholders at municipal level to design the planning of urban neighbourhoods in a resource-efficient manner. The focus will be on water management, land management and material flow management.

from 2018

New activities within the framework of the **Innovation Platform City of the Future: The Innovation Platform City of the Future** will be extended to include international aspects for the sustainable development of urban regions.

from 2018

The third phase of the **City of the Future Competition** will put into practice the holistic and sustainable visions 2030+ that have been developed.

from 2019



Safety and security: For an open and free society

Global security architectures and security risks have changed dramatically. Terrorism, organised crime, cybercrime and related attacks on internal and external security, scarcity of raw materials and energy, and climate change with its associated natural disasters pose fundamentally new challenges to security and safety. The increasing complexity of energy and transport networks, the Internet and telecommunications or commodity chains for food and pharmaceuticals leads to ever-new risk potentials.

Civil security

The Federal Government's aim is to contribute to protecting a free lifestyle. We want people in Germany to be able to rely on security and order in their country.

The Federal Government will therefore continue to further expand its support for civil security research. We will contribute to protecting and saving lives not only in the event of a disaster. Even more than this, we also want to make people's everyday lives safer – whether in their homes, in local and long-distance transport, at airports or at major events. We will focus on the protection of critical infrastructures, the opportunities of digitalisation for civil protection, and research on crime, extremism, terrorism and prevention.

We will set up competence centres and leading-edge research clusters for central fields of application and problem areas, such as the development of autonomous systems for hostile environments or the prevention of terrorism. Together, science, industry and security authorities will develop new methods and tools for threat prevention and criminal prosecution. These include simulation methods for situational representation, training and education systems for helpers, the improvement of protection and detection methods, and new forensic methods, including those to combat cybercrime, cyber espionage and cybersabotage.



We are intensifying research for satellite communications and satellite remote sensing for natural catastrophes, peacekeeping missions, and internal security, and further developing methods for relevant data use, for example in the context of the European Data Relay System EDRS. Satellite remote sensing is also an important data source for this purpose. With the Center for Satellite Based Crisis Information (ZKI) we are making an essential contribution to timely, comprehensive and nationwide crisis information.

IT security

Security in the digital world is of key importance. Secure information technology promotes innovation and is a necessary prerequisite for the competitiveness of Germany as a business location – whether in science and research, logistics and transport, energy supply, healthcare or the financial world. This also includes protecting the personal data of each individual on the Internet against illegal access and misuse. Data sovereignty and the protection of citizens' privacy must be ensured in the data economy and should be strengthened by technical innovations.

In accordance with its Cyber Security Strategy and on the basis of the research framework programme Self-determined and Secure in the Digital World 2015–2020, the Federal Government will considerably strengthen IT security research in Germany. New, holistic IT security solutions are needed to fully exploit the opportunities offered by digitalisation in all areas, such as industry 4.0, medical technology and mobility. The competence centres for IT security research in Germany are to be further developed and internationally networked. We will increasingly promote the development of effective, user-centred and demand-oriented IT security solutions, and the establishment and maintenance of innovative companies in the field of security technologies. The further development of quantum communication will also play an important role here. The Federal Government is therefore striving to establish a quantum communications infrastructure that takes account of public and private security interests.

New research and innovation policy initiatives 2018–2021

The **Framework Programme Research for Civil Security 2018–2023** supports the research and implementation of innovative solutions that enhance the safety, security and quality of life of citizens and ensure the protection of vital infrastructure. from 2018

With the implementation of the **Federal Government's Research Framework Programme on IT security Self-determined and Secure in the Digital World 2015–2020**, we want to improve the security of ICT systems and protect the privacy of citizens. We have started the agenda process to carry the programme forward from 2021. ongoing until 2020
new programme expected from 2021

With the **Funding of Research on Natural Hazards** (terrestrial and climate-induced), we are contributing to the protection of human lives and infrastructure through social innovations and state-of-the-art technologies. from 2018

The **go-digital Programme** supports SMEs and trades with consulting and implementation services in the modules 'IT Security', 'Digitalised Business Processes' and 'Digital Market Development'. ongoing until 2021

We are supporting civil maritime security with the **R&D Funding Line Real-time Technologies for Maritime Security**. Our key concerns are the protection of maritime infrastructure and the people who work there, the surveillance of maritime areas, and the protection of global supply chains, seafarers and passengers, as well as the environment. from 2018

The continued funding of the three **Competence Centres for IT security research** CISP (Saarbrücken), CRISP (Darmstadt) and KASTEL (Karlsruhe) will increase research capacities in the area of cyber security in Germany. from 2019

The **Communications Satellite Heinrich Hertz**, developed and built entirely in Germany, will serve both civilian scientific and technical objectives and the Bundeswehr's communications. from 2021

Economy and work 4.0: For a strong economy and decent work

Digitalisation is fundamentally changing production and value-creation processes, as well as job profiles and workplaces. For the majority of employees, the technical equipment in the workplace has changed in recent years. In industry, some employees are working with increasingly networked production systems that operate semi-autonomously or even autonomously and are able to learn and make their own decisions. Our goal is to design a modern, data-based economy 4.0 that is competitive, secure and sustainable. At the same time, we will hold to our principle that technology must serve the people. To this end, we will consistently pursue the successful path of combining production, services and work. The changes in the world of work inextricably affect the current and future role of services in our society. In the future, the proportion of employees in personal services will increase significantly. Our goal is to provide all people with an appropriate work environment. Therefore, the development of technologies, new services and good working conditions should be jointly promoted. This will ensure we take advantage of the opportunities offered by digital change and continue to focus the world of work around the people and their skills.

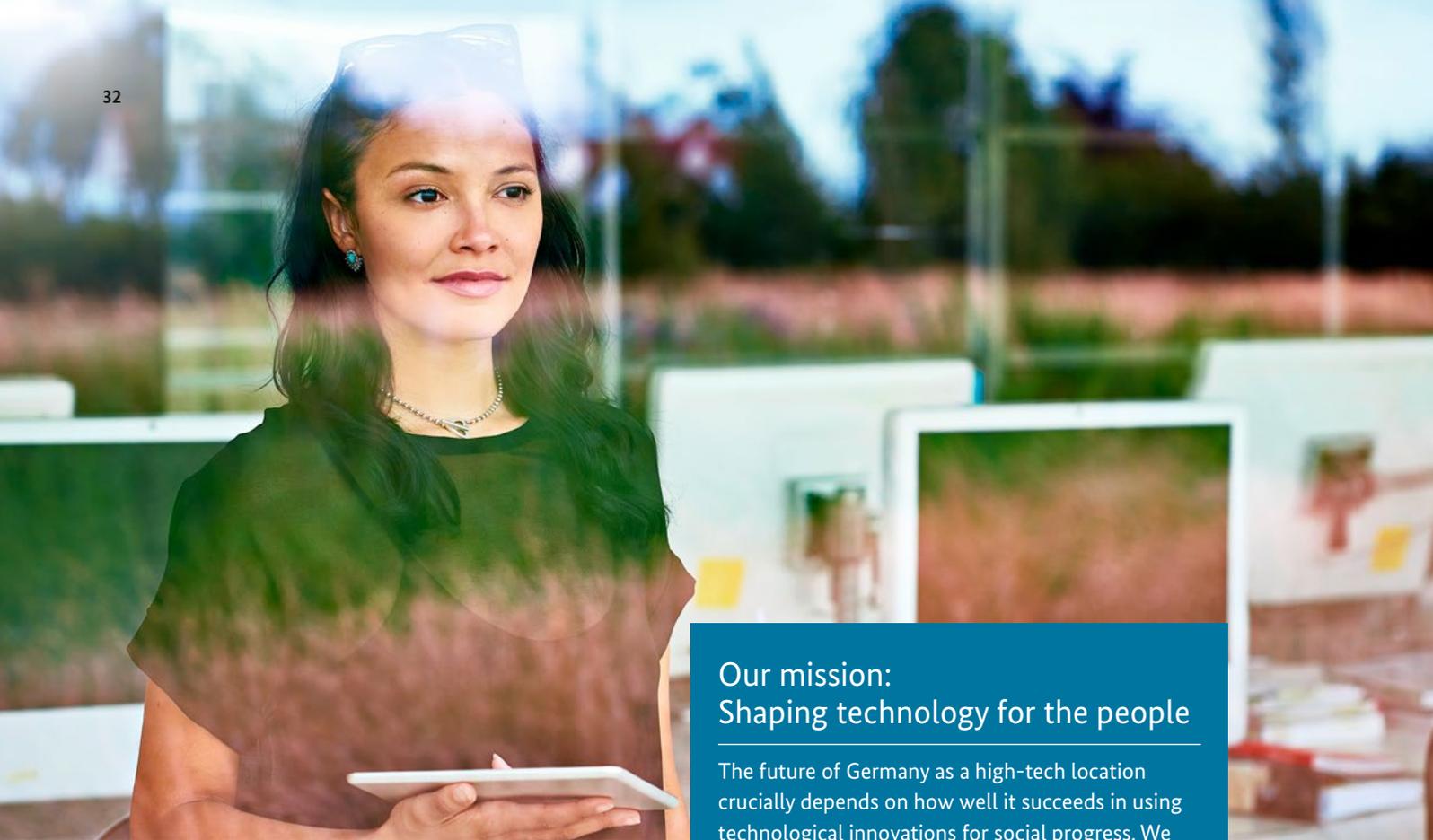
Economy 4.0

Germany has become a global pioneer in industry 4.0. Our support of the private sector and especially of SMEs will continue into the future in the research, testing and dissemination of industry 4.0 solutions and smart services, in the development of hybrid products and processes, and in new forms of business such as the platform economy. In this way, we will create the conditions for our economy, with its strong SME sector, to continue at the forefront of global markets with its products and services.

In the coming years, we will continue to write the success story of industry 4.0 and place the digitalisation of the German economy – especially of SMEs – on a broad foundation. To achieve this, the use of new technologies must be intensified in SMEs, in the service sector – especially in retail – and in public sector services. The development of digital innovations and new (data-driven) business models in enterprises must be accelerated. The development and integration of autonomous systems must also be promoted. By using smart industrial services, industry 4.0 can be further developed and the German economy can be strengthened in global competition. At the same time, the innovation potential of AI or new aviation and aerospace applications must be exploited for specific economic purposes. Satellite-supported applications such as Earth observation, communication and navigation are also growing in importance for the digitalised, globally networked economy.

On the way to a competitive and sustainable economy 4.0, we will strengthen new resource-efficiency technologies, additive manufacturing, the use of digital processes in technology development, and lightweight construction across materials and industries. We will also promote resource-saving digital materials research, from material and product design to the creation of digital twins and the intelligent control of production processes. The digitalisation of the value chain will be supported, from production, storage and sales through to the end customer, with subsequent maintenance and recycling in the sense of a circular economy.





The focus will also be on climate protection in production, storage and transport and on reducing packaging waste and resource wastage in the area of consumer goods and food. Through our research funding, we also want to provide the financial sector with the necessary foundations for evaluating sustainable value chains.

Digital technologies can already make work in agricultural businesses more sustainable today. The use of weather apps and other data management systems helps to optimise soil and harvesting methods. Cloud solutions, for example for base and nitrogen fertilisation, enable better plant cultivation. Sensors and climate control systems make a significant contribution to animal welfare.

With the help of digital applications, not only individual process steps can be optimised, but also entire value chains. Agricultural machines can be controlled with centimetre precision on the field. These applications of precision farming techniques enable fertilisers and pesticides to be used sparingly, thus protecting the soil as much as possible. At the same time, digitalisation can have structural effects. We want to push ahead with the digitalisation of agriculture in a responsible manner.

Our mission: Shaping technology for the people

The future of Germany as a high-tech location crucially depends on how well it succeeds in using technological innovations for social progress. We will use the technological and economic transformation to shape the world of work in a way that preserves people's health, is compatible with family, healthcare and civic commitment, and takes active account of ageing and equality between women and men. To achieve this, the opportunities and risks of new technologies must be researched and evaluated. These include, for example, digital assistance systems such as data glasses, human-robot collaboration, exoskeletons to support employees in their physical work, but also solutions for the more flexible organisation of work processes or the support of mobile work. We will accompany and supplement work 4.0 with occupational health and safety 4.0. By this we mean measures to promote safety and health in the digitalised world of work. Social and socio-political research makes a significant contribution to this.

We aim to combine the already developed individual technologies into complete digital solutions. Questions regarding technical interfaces between machines from different manufacturers will have to be clarified, as well as aspects of data protection, the integration of large amounts of data into the management systems of agricultural businesses, the expansion of the digital infrastructure in rural areas, and the balance sheet of environmental impacts. To this end, we will develop the Overall Strategy for Digitalisation, ranging from primary production and rural areas through to the consumer, taking into account the structural and environmental impacts.

Work 4.0

With our research funding on the future of work, we want to find answers to the question of how the world of work can be shaped in a way that preserves health, is compatible with family, healthcare and civic commitment, and is ecological, economical and sustainable.

It is already foreseeable today that digital technology will be used at almost every workplace in the future. This entails both opportunities and risks. New forms of work can help to better reconcile work and private life. They can help to better adapt the working environment to individual needs, for example by making the workplace more ergonomic. At the same time, risks arise, for example with regard to the possible consequences of constant availability or potential constant control, as well as with regard to work intensification due to the elimination of so-called ‘dead times’ in the production and service sectors.

Our goals are safety, security and health in the digital world of work. To this end, we are driving the development of technical and social innovations that enable new forms of work to be created. These include an ergonomic and functional technical environment, reliable protection of digitally generated employee data, support for managers in their increasingly complex tasks, intensive further training for supervisors with regard to the challenges of digitalisation, and support for employees themselves, who are expected to assume a greater degree of personal responsibility.

Sustainable interaction among the people, the company, the organisation and technology is essential for this. We want to accelerate the competence development for the work of the future, design new forms of the digital working worlds, and raise new value-creation potentials at the interfaces of sectors and industries. We also aim to support the development of the companies of the future with innovative human-machine interactions.

New research and innovation policy initiatives 2018–2021

As part of Science Year 2018 ‘Working Life of the Future’ , the German Federal Government is working intensively with citizens and experts on the future of work.	2018
The Lightweight Construction Technology Transfer Programme supports activities that strengthen cross-industry and cross-material technology transfer in Germany as a business location and accompanies it with R&D.	from 2019
As part of the Future of Work Programme , we are supporting the establishment of a nationwide structure of regional competence centres for work design, particularly at universities of applied sciences, which will operate as regional partners for companies. In addition, the programme supports fields of work design that are closely linked to new product developments and business models, especially for SMEs.	from 2018
The Umbrella Research Programme Innovations for Tomorrow’s Production, Services and Work supports applicable solutions to preserve value creation and jobs in Germany. In Dortmund in the Innovation Laboratory Hybrid Services in Logistics and its start-up factory, new forms of services and human-technology interaction are developed and tested. Support will be given to new developments to manage the complexity of the product development process (advanced system engineering), the creation of versatile, human-centred structures in factories and networks, and the development of intelligent production systems that learn.	opening of innovation lab 2018
Experimental Fields for the Testing and Further Development of Digital Applications in Agriculture are to be set up and a competence centre for their coordination shall be established.	from autumn 2018
The Retail Competence Centre is designed to support retailers in digitalisation issues. In the course of digitalisation, the retail trade will develop away from being a supplier of goods towards becoming a digital innovator. This includes new business models, innovative presentation options and new distribution channels.	opening expected Q1 2019

II. Developing Germany's future competencies

Germany must remain a country of innovation. We can only find solutions to the major challenges if Germany systematically and continuously evolves its future competencies as a location for science, research and innovation. Three components are essential for future competencies: firstly, the interaction of various key enabling technologies to open up new and radical innovation potentials; secondly, the training and continuing education of highly qualified skilled workers who make use of the opportunities offered by technology, thus increasing our prosperity; and thirdly, committed and enlightened citizens who help shape change and benefit from it in their daily lives.

The technological base

Germany can only maintain its innovative strength and competitiveness if it develops, maintains and expands its competencies in key enabling technologies. We will place special focus on AI. The national AI strategy will enable us to specifically target the development of competencies in this area.

In order to generate knowledge and added value from data and to deploy systems that learn, we are promoting the development of skills in machine learning, promoting the development of new methods for processing and analysing large amounts of big data, and providing modern research infrastructures, for example for high-performance computing. We are coordinating research in overarching platforms, such as Plattform Lernende Systeme – Germany's Platform for Artificial Intelligence.

We are strengthening IT security research and national key enabling technologies in the area of cyber and IT security. Digital systems should be designed to be fundamentally secure and reliable ('security by design') and meet data protection requirements (including 'privacy by design' and 'privacy by default'). For the user-friendly implementation of new technologies, we are specifically promoting new solutions in human-technology interaction, in particular interactive assistance systems such as robots suitable for everyday use, virtual reality technologies or gesture-controlled operation of technical devices in the home environment.

We are strengthening microelectronics research and driving forward the development of energy-efficient electronic systems for applications such as autonomous driving and industry 4.0. We also want to improve the transfer of research results and the global competitiveness of the German microelectronics industry.

For the communication systems of the future, we will promote secure intelligent architectures that make efficient use of available resources with the help of AI. We will also develop basic technologies for networking via the future 5G mobile standard and beyond, which will enable the realisation of new, innovative fields of application.

We are realigning materials research in Germany, focusing on the use of digital processes. Building on new and optimised materials, we also intend to further develop electrochemical storage technologies. In production research, we are further developing new product development processes to master the complexity of developing technical systems, as well as evolving innovative technologies and equipment and applying them in areas such as 3D printing, additive manufacturing, lightweight construction and production systems that learn. This will also lay the foundation for upscaling new processes and further developing new products from prototypes to production readiness.



In addition, we are demonstrating the practical use of new and groundbreaking digital technologies in business and administration, triggering imitation effects, and using targeted measures to accelerate the transfer of these technologies to the various sectors of the economy, especially to SMEs. In addition to proof of technological feasibility and economic benefits, issues of acceptance, sustainability, the legal framework conditions (especially with regard to data protection) and data security (IT security) are also taken into account.

Our mission: Putting artificial intelligence into practical application

We want Germany and Europe to be among the world's leading locations for research, development and application in the field of AI and thereby tap into the broad potential of AI as a horizontal technology for a large number of fields of application. We want to expand the skilled workforce base for AI in Germany, significantly increase the number of application examples of AI in various industries, and spark a new start-up dynamism triggered by AI-based business models and products. Our goal is to achieve AI according to European value standards, putting its focus on people and maintaining and developing the data sovereignty of citizens.

Bringing Germany to the forefront of technological progress

In the coming years, we want to develop Germany into a prime location for quantum technology research. Second-generation quantum technologies promise, among other things, a fundamental change in data processing by making quantum physical effects technologically usable. This allows existing technological limits to be overcome – in the computational simulation of complex systems or through new, highly precise and sensitive measurement and imaging methods.

The modern life sciences are providing new, groundbreaking insights at a rapid pace. The interaction of biotechnology, nanotechnology and digital technologies is providing new tools and methods to exploit these insights. Together with industry, science and civil society, we will develop an interdepartmental agenda 'From Biology to Innovation' within the framework of environmentally compatible boundaries. In particular, we will promote research at the interfaces between scientific disciplines, as well as the development of new procedures and their applications.

Today, space travel is a highly innovative tool for science, business and politics. It also touches the most diverse areas of people’s lives. We therefore want to specifically exploit the innovation potential of R&D in our space strategy for the benefit of our citizens. In addition to its significance for science, space travel makes valuable contributions to dealing with the challenges and megatrends in the environment, economy and society.

Filling the technology pipelines

With strong basic research and open technology funding, we are laying the foundation for ensuring that the technology pipelines in Germany remain full. In the large research infrastructures of basic scientific research, fascinating technologies are being developed in international cooperation that are stretching the limits of what is feasible with far-reaching applications, for example for the decoding of biological systems, for the development of innovative therapy approaches in biomedicine, for groundbreaking digital methods or for environmentally friendly production technologies.



New research and innovation policy initiatives 2018–2021

The German Federal Government will formulate an Artificial Intelligence (AI) Strategy based on the draft paper on artificial intelligence.	autumn 2018
The Umbrella Strategy for Materials Research focuses on the use of digital processes in materials research and development, as well as the use of biological principles to develop new materials.	from autumn 2018

The From Biology to Innovation Agenda aims to further integrate biological knowledge and biotechnological and bio-inspired processes into all areas of our lives and economic activities.	from 2019
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The Framework Programme Quantum Technologies – from the Fundamentals to the Market is intended to advance the application of second-generation quantum effects so as to utilise these effects for computing unsolved problems, and for secure communication, metrology and sensor technology.	from autumn 2018
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The new Framework Programme Exploration of Universe and Matter – ErUM promotes basic scientific research at major research infrastructures and aims to provide strategic impetus in the areas of gaining knowledge assets, key enabling technologies, innovation transfer and digitalisation.	ongoing until 2027
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The Action Plan ErUM-Data develops multidisciplinary activities in the fields of digitalisation and research data management in basic scientific research.	from summer 2019
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Plattform Lernende Systeme – Germany’s Platform for Artificial Intelligence brings together leading experts from science, business, politics and civil society organisations to discuss opportunities, challenges and framework conditions for the development and responsible use of systems that learn.	ongoing since 2017, first recommendations for action expected 2018
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Expansion of AI research in Germany: Funding for additional Centres of Excellence for Artificial Intelligence , as well as for their networking with existing centres and with Federal and State research institutions for artificial intelligence and big data. The objective is to establish a national research consortium.	from summer 2018
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In the Research Factory Research Fab Microelectronics , research capacities are networked, bundled and expanded nationwide in order to lend more weight to Germany as an international micro-electronics location.	under construction since 2017, fully operational from 2021
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The Important Project of Common European Interest (IPCEI) for micro-electronics provides the basis for the further development of new products from prototype to production maturity.	since 2017 (subject to approval by European Commission)
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The skills base

New research areas and new technologies require new skills and abilities. Our support for emerging research fields will go hand in hand with the support for highly qualified minds in their respective fields. We will significantly strengthen continuing education with a national strategy by bundling the continuing education programmes of the Federal and State Governments and establishing a new continuing education culture. We will adapt training and further education to the requirements of modern research and development cycles. We want to support universities in expanding their continuing education programmes. With the Preventive Healthcare Act (PrävG), we are strengthening workplace health promotion (BGF), especially for SMEs and high-stress occupations such as nursing care for the elderly and the sick.

It will be important in the future to tap the potential of digital education in all educational areas. We will support the establishment of new qualification profiles and discuss the establishment of new occupations with social partners. We will continue to promote the development of skills for future-conscious thinking and action through activities in the field of 'Education for Sustainable Development' (ESD).

We will intensify our promotion of young scientists and technicians in future-oriented STEM subjects and open up promising career prospects for them. We will give girls and women even greater encouragement to develop their talents and even more opportunities to use their abilities. We support the development of a nationwide STEM e-portal for more transparency and information, as well as the development of quality criteria for relevant qualification offerings. In addition, we want to expand competitions in the STEM sector.

We will support the promotion of talented trainees, qualified professionals, doctoral candidates, and university and school students as an important cross-sectional measure.



Supporting universities in the modernisation of teaching and instruction

The Federal Government is committed to the expansion of the skilled workforce in cutting-edge disciplines – for instance in the data sciences and artificial intelligence. To this end, the handling of data must become a field of science in its own right and at the same time a central component of a wide variety of disciplines. We will fund the creation of new AI professorships at selected locations in Germany within the scope of the German Basic Law. The digitalisation of universities has a significance that extends far beyond the universities themselves. Beyond the design of digital teaching and learning opportunities in academic initial and continuing education, universities need a strategic approach to digitalisation in all performance areas, as well as in cross-university processes. We will support universities and university associations in the development and implementation of digitalisation strategies.

The Federal Government and the Länder have set the long-term course for universities with their resolution on the Programme for Women Professors III, designed to retain more women in the science system after they have completed their doctorates. By 2023, the Federal Government alone has earmarked more than 20 billion euros for additional first-year students under the Higher Education Pact. Through the Quality Pact for Teaching, the Federal Government will provide an additional two billion euros for improved study conditions and greater quality in teaching by 2020. In order to ensure high-quality teaching against the background of the persistently high demand for studies, we will continue to provide Federal funding on the basis of the newly created Article 91b of the Basic Law (Grundgesetz, GG). We want to continue with and further develop the Quality Pact for Teaching.

Strengthening vocational education and training

With a modern dual-sector vocational training system and close links between training and modern company practice, the Federal Government is contributing to ensuring that we will continue to have competent employees in German companies in a future shaped by digital technologies. We want to promote permeability and synergies between vocational and academic education in both directions in order to improve training and make more efficient use of training periods.

Promoting international exchange

We are advancing European networking in all education sectors and supporting the development of innovative and sustainable European and international higher education networks. We want to expand the mobility of trainees and apprentices, especially in SMEs. In addition, Germany supports numerous partner states in Europe and worldwide in their vocational education and training endeavours.

We also want to ensure that Germany continues to be an attractive place to work and live for specialists from outside of Germany. With an improved strategy for the targeted recruitment of skilled workers from third countries and increased marketing, we are counter-acting shortages of skilled workers, as well as increasing the competitiveness of the German economy and the dynamics of innovation.

New research and innovation policy initiatives 2018–2021

Together with our social partners and the Länder, we want to develop a **National Strategy for Continuing Education**. The aim of this is, in particular, to strengthen the skilled workforce, to bundle the continuing education programmes of the Federal and State Governments and to establish a new continuing education culture.

With the **Vocational Education and Training Pact**, we are committed to providing future-proof, attractive and competitive vocational training in an increasingly digitalised and networked world.

With the new **Mobility Programme for Training Worldwide** as part of the Vocational Education and Training Pact, we are supporting companies in sending their prospective specialists, managers and training personnel abroad.

The **MINT Action Plan** is bundling STEM (science, technology, engineering and mathematics) education activities. Our aim is to inspire young people, women in particular, to take an interest in STEM professions.

2018–2023

We are further developing our **Educational Campaign for the Digital Knowledge Society**. This campaign promotes the development of digital competence and learning with digital media.

from 2018

In the new **Framework Programme for the Promotion of Empirical Educational Research**, the research priority 'Digitalisation in Education' provides scientific support for the implementation of the Educational Campaign for the Digital Knowledge Society. The funding measures for the implementation of the framework programme will start from 2018.

2017–2022

With the **Digital Pact for Schools**, the Federal and State Governments want to provide schools with better digital equipment. School students should be able to use digital media confidently and autonomously.

2019–2023

The **Initiative Klischeefrei (Cliché-free Initiative)** also offers selected information for the STEM area on career and study choices free of gender stereotypes via the Internet portal klischee-frei.de. Since 2018, annual conferences have supplemented the programme.

ongoing since 2016

As part of the **National School Competition Protectors of Earth**, school students will develop ideas on environmental protection with the participation of German ESA astronaut Alexander Gerst. The aim is to encourage young people's interest in STEM subjects.

2018–2020

The **Touring Exhibition INNOspaceEXPO "ALL.täglich!"** vividly communicates the transfer of knowledge from space travel to everyday applications and promotes STEM subjects.

2018–2021

We want to maintain the momentum triggered by the joint **Federal Government-Länder Competition Advancement through Education: Open Universities**. SMEs in knowledge-intensive sectors benefit particularly from this.

ongoing until 2020



Societal participation

Digital technologies are changing the way we inform ourselves, communicate, learn, work and spend our free time. Digital literacy is essential for all citizens of our modern knowledge society. This makes it all the more important to involve users at an early stage in technology development and to take advantage of opportunities to impart digital skills. With the development of technological innovations, we must also examine the accompanying social processes. Beyond technological developments, we must also exploit the potential of social innovations.

We want to promote openness to new social developments, arouse curiosity for digital technologies, and create confidence in dealing with them. The education system plays a central role in this. Only education that is oriented to the requirements of social and technological developments can enable active participation and self-confident handling of new technologies. We want to promote, enhance and broaden innovative approaches, especially in non-formal and informal education. That is why we are funding educational research projects with the aim of contributing to the development of a reflexive approach to new developments.

We will trial new forms of citizen participation in science and research. We will continue to advance Citizen Science in order to make the knowledge of the many usable. Within the Science Years framework, for example, we will lead and expand open dialogue between various stakeholders from science, society and politics on issues of the future.

We will intensify the discourse with society on selected fields of technology such as AI, the application of big data methods or the interaction between humans and technology. To this end, we are using public platforms, for instance the Plattform Lernende Systeme – Germany's Platform, for Artificial Intelligence, and the Competence Centre Public IT for the generally comprehensible interdisciplinary treatment and political discussion of socially relevant technology topics. In addition, we are setting up a Data Ethics Commission to propose a development framework for data policy, the handling of algorithms, artificial intelligence and digital innovation within the next year.

Using the potential of the social sciences

Successful forward-looking innovation policy requires evaluation skills – we need to understand change processes in order to actively shape them. Together with the promotion of key enabling technologies, we will therefore support research in the social sciences and humanities – for example, to better understand digitalisation and its consequences for the economy, society, the environment and politics, to harness it for the benefit of society, and to stimulate scientifically sound debate. We will strengthen the science-based consideration of ethical, legal, social and gender-specific aspects of research and innovation and work towards an opportunity-oriented and responsible handling of scientific and technological progress. In addition, we will create spaces for critical reflection on technological as well as social changes.

The humanities and social sciences play a key role in the successful shaping of our future. We will further strengthen their potential in order to contribute their knowledge to overcoming societal challenges and solving pressing socio-political problems, thus contributing to the development of an open, innovative and sustainable society.

In promoting the humanities and social sciences as well as empirical educational research, the focus will be on migration, integration and social cohesion, gender issues, democracy and European integration, welfare state research, radicalisation processes, causes of conflict, and coping strategies.

With regard to topics such as welfare state research, it is particularly important to strengthen the dissemination of interdisciplinary approaches. The Funding Network Interdisciplinary Social Policy Research (FIS) supports social policy and social law research in Germany in the disciplines of law, economics, history, social ethics, political science and sociology. Independent and efficient social policy research is of great importance for the welfare state of Germany. Independent and theoretically sound research on the various aspects of social security and social participation can create important foundations for public discourse on the role and function of the welfare state. We will therefore systematically strengthen the social policy research infrastructure and counteract the decline in social policy research in the various disciplines.



New research and innovation policy initiatives 2018–2021

With a new **Framework Programme for Shaping the Future**, we are strengthening research in the humanities and social sciences and its practical relevance for investigating and addressing societal challenges.

from 2019

Via **Citizen Science**, people interested in science can participate directly in the research process – either by collecting and evaluating valuable data or, in certain cases, by formulating research questions.

ongoing until 2019

The Federal Government is strengthening the measures for strategic foresight and is launching, among other things, a new **Foresight Process** to identify new topics of high strategic relevance for education, research and innovation policy.

from 2019

Innovation and Technology Analysis (ITA) is an important instrument of strategic foresight. It has the task of analysing the challenges, opportunities and risks of future developments with a medium-term time horizon.

2018–2020

We are establishing a decentralised, multi-disciplinary **Institute for Social Cohesion**.

from end of 2018

The **Weizenbaum Institute for the Networked Society – The German Internet Institute** examines the conditions and requirements for social autonomy in key areas such as self-determined work, digital sovereignty, digital citizenship, participation and democracy.

first construction phase until 2020

The **ELSI Network for Human-machine-interaction** will address the ethical, legal and social aspects of technology research.

from 2018

The **Funding Network Interdisciplinary Social Policy Research (FIS)** supports welfare state research in Germany by funding professorships, junior research groups and projects. By developing new dialogue formats, FIS contributes to the better transfer of knowledge.

2nd funding round from 2018

A **Data Ethics Commission** will address the challenges and possible solutions arising from the areas of algorithms, data protection and the right to informational self-determination, data policy, digital innovation and artificial intelligence.

from September 2018

The **Centre of Competence Public IT** at the Fraunhofer Institute FOKUS analyses socially relevant technology and digitalisation trends and presents topics in a generally understandable way, opening them up for political discussion. Topics for the 2018–2019 funding period are foresight processes and trends, digital governance, infrastructure and services, security and trust, the digital society, the digital state, and data policy.

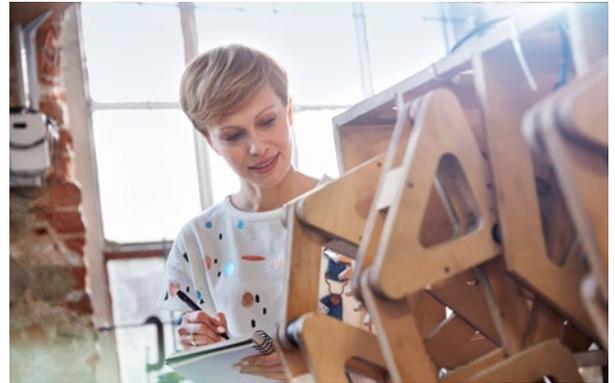
ongoing

Examples of future competencies of Germany as an innovation location



Raising data treasure – putting AI into practical application

Our life and business worlds are becoming more and more data-driven. The development of skills, instruments and methods to generate, store and analyse large amounts of data and to gain new insights and decision-making tools from this is becoming a key competence. With the latest developments in digitalisation, the importance of data will increase even further. Driven by rapid advances in AI knowledge, networked machines and systems are becoming increasingly autonomous, learning independently, and making their own decisions. Our goal is to use data to generate knowledge and additional value creation in Germany. We want to design technology in such a way that data use is made possible while at the same time maintaining the high and globally respected data protection standards of Europe and Germany. This also means examining the ethical questions that arise in the process. This requires the development of technologies for secure data spaces and intelligent data use. Researchers and specialists must acquire the necessary skills to process, analyse and store data securely. At the same time, social dialogue must be promoted, for example on how data and AI should be freely used. Data protection and the data sovereignty of citizens must be guaranteed.



Intelligent design of materials

New materials form the basis for a multitude of innovations, be they new storage technologies for electromobility, new materials technologies in the field of sensor technology, electronics and IT communication for digital networking or new materials for lightweight construction and 3D printing. Materials research lays the foundation for operationally safe, durable, cost-effective, low-emission and recyclable products. In order to meet these requirements, traditional approaches to materials research must increasingly be combined with data-based methods. Advanced materials, longer-life materials and more reliable components are made possible more frequently, faster, and in better quality through digital modelling and simulation approaches. Material developments can thus be initiated more quickly and examined promptly for possible effects on humans and the environment, and high costs for time-consuming experiments avoided. We want to develop the technologies and standards necessary for this, bring together materials researchers and engineers, and lay the foundations for their training.



Designing and producing complex systems

Today, a feature of technological innovations is their increasing complexity. What is required are innovative systems that combine different technologies and are tailored to their relevant application. AI systems such as autonomous production robots or vehicles combine high-precision, generally microelectronic sensor technology with precisely fitting hardware and software for data evaluation and sensitive actuator technology that enables direct interaction with people. The interaction of different systems such as these is often required for applications in the field of mobility or space travel, for example. The ability to design and produce complex systems thus becomes a key competence. This requires not only the further development and combination of different technologies, often across disciplinary boundaries, but also specialists who combine the relevant diverse expertise. Dialogue with society must also be intensified in order to discuss issues such as usability and user autonomy and thus create the conditions for increasing confidence in the functioning of complex systems.



Mastering complex products and services

Today, products and services are increasingly the result of complex processes that bring together different technologies, combine intelligent data evaluation with intensive customer involvement, and require a wide range of expertise. Products and services merge to form hybrid value-added bundles or product-service systems. We want to research, develop and test the technological and individual skills necessary for this, and to spread them across the broad spectrum of business and society.



Using resources efficiently

In view of climate change and a growing world population, it is becoming increasingly important to deal with raw materials, land and energy in a responsible way. We are combining sustainability and competitiveness through intelligent solutions for an efficient circular economy and a secure, flexible and integrated energy supply for all sectors. Insights from the life sciences play a special role here. We are pioneers of new forms of cross-industry and cross-sector cooperation in which the intelligent linking of processes and applications results in an optimised use of resources. In this way, we are making energy- and material-intensive core industries fit for the future and opening up new technologies and markets.



'New space' – promoting space travel as an international growth market

New business models are emerging at the interface to the digital world through the private space flight industry known as 'new space'. The 'new space economy' is building its business models primarily on marketing services. Be it global private access to the Internet via satellite networks or access to Earth observation data for agriculture and forestry, trade or insurance cover, new space applications offer other industries broad fields of application. In the industrial Internet of Things, new space companies can supply new customer groups with more secure communication, monitoring and navigation systems, especially for safety-critical applications. In addition, government space programmes such as Galileo and Copernicus are generating free data. These can be used to establish a flourishing space applications sector in Germany. New commercial business models also open up new perspectives for the coverage of government space requirements. The strengthening of the National Programme for Space and Innovation and its clear focus on commercial applications will give Germany the opportunity to develop this growth market.

III. Establishing an open innovation and venture culture

Germany is globally networked and benefits from open markets, international exchange of knowledge and free trade, as well as from a barrier-free EU. With increasing globalisation, there are also advances in the international division of labour. Global innovation and value chains are becoming more complex, and innovation cycles are becoming ever shorter. With our research and innovation policy in Germany our aim is to benefit from this dynamism and establish an innovation culture in Germany that is characterised by openness, agility and foresight.

We will strengthen national and global knowledge and innovation networks, as well as the effectiveness and efficiency of individual stakeholders. Where it decisively improves Germany's or Europe's competitiveness, we will develop overarching infrastructures and provide structural impulses. With new initiatives to promote the transfer of ideas, knowledge and technology, we aim to support the transition of innovations into the market. This is because a declining innovator ratio indicates a need for action.

Our promotion of innovation is:

1. **OPEN:** We are convinced that a modern innovation system must provide more freedom and space for experimentation to test new technologies and to explore new models of entrepreneurship, as well as new forms of learning, working and living together.
2. **SYSTEMIC:** Our understanding of innovation is a systemic one that sees it as the result of cooperation and interaction among a variety of different actors.
3. **TECHNOLOGY-OPEN:** Being completely technology-open in research funding is an important basic principle of our research and innovation policy so as it can benefit from the diversity of ideas in industry and society.
4. **APPLICATION-ORIENTED:** Our concept of innovation builds bridges from basic research to market launch.
5. **FUTURE-ORIENTED:** We want to promote the development of breakthrough innovations so as to remain internationally competitive in the long term.
6. **COMPREHENSIVE:** We aim to achieve technological and social innovations that also help to reduce risks to people and the environment.

Putting knowledge into effect: Transfer into practical application

Scientists and innovators, but also (potential) users, work hand in hand throughout the entire innovation process – from knowledge to value creation – putting research results into practice for the citizens of our country. We will strengthen transfer and innovation as the 'third mission' of higher education – in addition to research and teaching – to further shape the strategic role and profile of higher education institutions in the regional innovation system. We will continue to drive cultural change in universities and research institutions towards a more effective transfer of their research results for the benefit of business and society and support them in fulfilling their role in the regional innovation system. At the same time, the authorities responsible for the regulatory framework shall be encouraged to be more involved at an early stage.

On the one hand, we will ensure that existing knowledge and available research results are widely applied, especially by SMEs. On the other hand, we will pave the way to transforming cutting-edge research into innovative products and business ideas. To do this, we use both horizontal measures – such as the promotion of early validation, as well as of clusters and research campuses – and specific transfer approaches in the specialist programmes.



Addressing the challenges in the transfer process

We will launch a transfer initiative to help companies translate scientific research results into products and processes. Together with the innovation stakeholders, we will identify and clearly specify the bottlenecks and obstacles on the path from idea to market. This will form the basis for attending to the concrete challenges in the transfer process. To this end, we will tackle problems in a variety of areas, such as regulation, financing and support. We are combining our forces to find solutions. We also want to encourage researchers at higher education and research institutions to take the plunge into self-employment.

Supporting an open innovation culture

New forms of collaboration, such as idea competitions, digital platforms, cloud-based collaboration environments, and the open source and open data movement, are gaining ground in many areas. Digital technologies make it possible to retrieve and share large amounts of knowledge in the shortest possible time. They show new ways to translate knowledge into added value. And they make it possible for previously uninvolved parties to participate in the innovation process.

The Federal Government will support an open innovation and venture culture that specifically promotes creative ideas and mobilises unused innovative potential in Germany. We will support the opening of knowledge and innovation processes with a broad-based initiative – in business, science and society. To do this, we will further intensify the funding of innovative networks and take an open-topic approach to supporting young, highly innovative excellence clusters. We want to break down thematic lock-ins, promote cross-industry approaches and develop future technologies. We will support new forms of cooperation between science, business and society, between different disciplines, between users, suppliers and producers, between large and small stakeholders, and civil society structures.

Open forms of innovation hold great economic and social potential, but they also require suitable framework conditions and cultural change. For many companies, it will continue to be important to protect their specific knowledge advantages and core competencies. We will therefore create additional spaces in which companies can interact openly with their partners and test new protection and exploitation strategies. New campus models, demonstration projects, innovation laboratories, real-world laboratories and communal experimental spaces are intended to offer science and the public and private sectors the experimental environment to open up to new ways of disseminating and exchanging knowledge and involve new stakeholders in innovation processes.

Open access and the disclosure of research data contribute to the transparency and reproducibility of research results and promote quality assurance in the research process. We want to support the willingness to disclose knowledge and will continue to work towards establishing open access as the standard of scientific publishing with a national Open Access Strategy. In our funding, we will work intensively to ensure that the FAIR Data Principles for research (findable, accessible, interoperable and reusable data) are implemented. We will also advocate a 'culture of data sharing' and quality-assured, standardised data collection and evaluation. In Germany and in Europe, we will continue to advocate an education- and science-friendly copyright law – we achieved a major milestone with the Law for Copyright Protection in the Knowledge Society in June 2017.

Promoting social innovation

Our understanding of innovation is based on a comprehensive innovation concept that takes equal account of technological and social innovations and includes society as the key stakeholder. New business models, trailblazing creative economic solutions, organisational practices or new forms of learning, working and living together can have a greater impact than individual technologies. And often they mutually give rise to each other. This is why we will increasingly open research funding for social innovations and focus it on important societal goals. Innovators and potential users will come together in experimental spaces for social innovations so as to test, for instance, new forms of the sharing economy, new financing models and forms of exploitation, the inclusion of civic involvement, or new specialist, management and organisational knowledge and to transfer these into practical application. In order to cope with change, we aim to achieve an even greater degree of openness to new ideas and new target groups in project funding. This enables the creation of social innovations that add value to individuals, specific target groups, different sectors of the economy and society as a whole through new practices, organisations or business models.

Promoting the creation and exploitation of breakthrough innovations

The German innovation system is very well positioned to produce evolutionary innovations based on existing technologies, products and services. Compared internationally, however, there is a need to catch up in the development and economic exploitation of breakthrough innovations, i.e. innovations that are characterised by radical technological novelty and/or disruptive market changes. Therefore, in order to strengthen our innovation and business location, we want to introduce new instruments that are adapted to the German innovation system so as to promote research ideas with breakthrough innovation potential from science to market maturity. In response to this challenge, the goal of state support for breakthrough innovations has been enshrined in the Coalition Agreement. The funding is intended to enable new value creation in Germany and to achieve huge social benefits.

Our mission: Finding new sources for new knowledge

New ways of finding common ideas and new ways of acquiring and sharing knowledge make it possible to redesign and open up innovation processes. We will work together with science, industry and society to ensure that the opportunities offered by open access, open science, open data and open innovation are exploited more comprehensively. In this way, we want to develop more effective solutions to social and technological challenges and also give our companies faster access to the latest scientific findings. To this end, we will significantly increase the proportion of open access publications in the scientific community and, with increased funding, significantly increase the number of new, more open forms of cooperation between companies, civil society stakeholders and scientific institutions. We want to make success stories accessible for the general public. Our goal is to contribute to the development of knowledge and good ideas in our country through intelligent networking.

The Federal Government is pursuing two approaches to the promotion of breakthrough innovations. One approach, pursued in the establishment of an Agency for Breakthrough Innovations, is open to topics, disciplines and technologies that are oriented towards the grand challenges formulated in HTS 2025. The other approach, pursued in setting up the Agency for Innovation in Cybersecurity, focuses on future cybersecurity needs in the area of national security provision, as well as on achieving and preserving technological sovereignty in this area. Although the two approaches are pursued in parallel and in separate institutions, they are also coordinated beneficially in order to leverage synergy effects. The aspect of exploitation is a key driver in both initiatives. The approaches are designed in such a way that they are open to international cooperation (e.g. with France) and complementary to European approaches.



The State as a driver of innovation

The Federal Government itself will fulfil its role as an innovation driver. Public procurement, for example, with its high volume of more than 350 billion euros per year, can provide important incentives for more innovation in the economy. We therefore want to make even better use of the leverage effect of innovation-oriented public procurement and thus give innovative companies the decisive impetus for successful market penetration.

We will intensively promote the further development of a modern, user-friendly e-government. Open data is an essential contribution of the administration on our way to a digital society. Numerous examples already show how innovative services and products can be developed by linking open administrative data with other data. At the same time, open administrative data helps to make decision-making processes more transparent and to increase trust in the administration. Never before has so much data been provided by the administration as today. Where the State has open administrative data, it will provide structured access to this data.

A strong research and innovation location also requires a regulatory environment that includes openness to innovation in planned impact assessments. This is where the innovation principle comes in. It implies that the potential impact on research and innovation will always be sufficiently taken into account when drafting and reviewing legislation in all areas.

New research and innovation policy initiatives 2018–2021

With the **Transfer Initiative**, we will support companies in translating the results of scientific research into products and processes and address the concrete challenges of the transfer process. from 2018

The establishment of an **Agency for Breakthrough Innovations** is intended to support the development and exploitation of radically new or market-changing innovations in Germany. The agency is to fund innovation competitions and cutting-edge projects to solve concrete societal challenges through research ideas with breakthrough innovation potential so as to create new added value in Germany. end of 2018

The **Agency for Innovation in Cybersecurity** is pursuing a demand-oriented, institutionalised and predominantly disruptive cybersecurity research methodology in order to realise medium- and long-term strategic and tactical advantages in this area of internal and external State security at the highest level. from Q3 2018

The **Concept of an Open Innovation Culture** bundles the promotion of innovative transfer structures and methods, contributing to the opening of innovation processes and transferring research results faster into economic, societal and social innovations. from 2019

With the **Pilot Funding of Non-technical Innovation Projects and Innovation Networks** we are opening up the innovation system more to ideas from target groups such as the digital start-up scene, the cultural and creative industries, and the field of social innovation. expected from 2019

With the **Next Generation Cluster Initiative**, new, innovative clusters are being developed from basic research in Germany. call for proposals 2019

The joint **Federal Government-Länder Initiative Innovative Hochschule (innovative higher education institution)** is intended in particular to strengthen universities of applied sciences and small and medium-sized universities in the research-based transfer of ideas, knowledge and technology. call for proposals 2nd selection round 2021

The **INNOspace Initiative** promotes cross-industry innovation transfer. The ideas and innovation competition INNOspace Masters with partners from aerospace and mobility generates new, sometimes disruptive technologies and business models. from autumn 2018



Strengthening entrepreneurial spirit: Upswing for SMEs

Companies are central players in the innovation process. They contribute significantly to the fact that the German economy features such a strong focus on innovation in international comparison. However, the innovator ratio – which describes the proportion of companies that have brought innovations to market in the last three years – has been falling for years in Germany. Although there was a slight increase again in 2016, this development must be taken seriously in the face of growing adjustment pressure from new technologies, business models and services.

Boosting the innovative strength of SMEs

SMEs in particular are important drivers of the innovative strength of our country. Through their specialisation, strong customer loyalty, cooperation with large companies and scientific institutions, and regional roots, they make a decisive contribution to Germany's innovative capacity. SMEs introduce new ideas into markets and play an important role in transferring research into practical application. We will support entrepreneurial diversity and help

SMEs and start-ups to innovate even more intensively by offering stronger support services that are technology-based and topics and that pick up impulses from the economy according to the bottom-up principle.

In order for more SMEs to participate in the innovation process again, we will expand the opportunities for higher education and public research institutions to act as central research and innovation partners for SMEs. With their application-oriented research and practical training, the universities of applied sciences in particular play an important role, for example as initiators of regional research and cooperation networks with the research-intensive economy. We will therefore successively expand the promotion of research at universities of applied sciences. In order to strengthen the access of research-based SMEs to global knowledge flows and value chains, we will further expand our support for the internationalisation of SME innovation activities. With market- and application-oriented funding offers, SMEs will be specifically supported in maintaining and strengthening their competitiveness and innovative strength.

We have set ourselves the ambitious goal of investing 3.5 per cent of GDP in R&D by the year 2025 together with the Federal States and industry. The Coalition Agreement provides for tax incentives for research, in particular for SMEs, to cover personnel and contract costs for research and development. The German government is currently working on tax incentives for research in line with the provisions of the Coalition Agreement.



A new entrepreneurial age for a strong innovation base

Start-ups are important drivers of innovation in all areas of life and the economy. They bring new technologies to the markets and contribute to economic dynamism and structural change. It can often be observed that new competitors give established companies the decisive incentive to rethink their strategies, products and business models and thus intensify their innovation efforts. The promotion of start-ups often helps to form new industrial growth centres and is therefore also a central component of a new industrial policy.

Excellent research can be a cornerstone for the emergence and success of innovative business ideas. The focus is therefore on promoting start-ups through research and on imparting entrepreneurial skills. We want to contribute to a stronger start-up and exploitation culture in science.

In the coming years, it will be crucial to bring new ideas from application-oriented basic research into practical application more than before and thus also to broaden our economic basis.

With targeted start-up support, we want to meet the complex requirements of the various development phases of young, innovative companies and offer complementary instruments that seamlessly intermesh with each other. This includes the continuation and further development of existing instruments for financing the establishment and growth of young companies and the addition of new instruments. That is why we want to assess the introduction of tax incentives to mobilise private venture capital beyond the existing measures. In addition, we will lower the access hurdles to our funding programmes, especially for very young innovative companies.

Potential entrepreneurs with good ideas often lack access to the necessary technical equipment, to the established industry, and to the appropriate networks. Essential components of our technology support are therefore the strengthening of start-up ecosystems through the funding of start-up incubators, the creation of experimental rooms and test laboratories, and the development of technology building blocks for low-threshold entry. In this way, we also want to strengthen the maker movement and increase its potential for innovation.

At the same time, we want to improve compliance with sustainability requirements for start-ups and support programmes. By anchoring sustainability in newly founded companies at an early stage, climate protection and issues such as resource efficiency, contributions to biodiversity conservation, and other sustainability concerns can be integrated into the strategic orientation of young companies and pursued throughout their entire existence. This can accelerate the transformation towards a sustainable development of the economy. Innovative technology and knowledge-based start-ups in particular have great climate protection potential thanks to their scalable and growth-based business models.

New research and innovation policy initiatives 2018–2021

The Federal Government is currently working on **Tax Incentives for R&D** in line with the requirements of the Coalition Agreement in order to provide incentives for private R&D investments and to contribute to achieving the 3.5 per cent target.

ongoing

Thousands of innovation projects are launched every year through the **Central Innovation Programme for SMEs (ZIM)**. In the case of technology-open, bottom-up funding, the companies themselves determine the direction of innovation. The programme will be continued, modernised and further intensified.

new directive 2020

With the **10-point programme Priority for SMEs** we are contributing to networking SMEs with other stakeholders and to making knowledge and research results more usable for SMEs.

ongoing, update in 2019

The **Research at Universities of Applied Sciences Programme** will be continued on the basis of a new, yet to be concluded Federal Government-Länder agreement. This programme promotes application-oriented research at universities of applied sciences – particularly in the engineering, natural, and economic sciences and in the social and health sciences – and innovation-oriented cooperation between the universities of applied sciences and industry.

expected end of 2018

The **Industrial Collective Research (IGF)** activity focuses on technology transfer and the implementation of research results. A new focal point is the PLUS funding model with its focus on carrying out collective projects. For example, the German Federation of Industrial Research Associations (AiF) can cooperate with the DFG (German Research Foundation) on basic research.

since 2018

The **Innovation Competence Funding Programme INNO-KOM** supports the innovative performance of non-profit, external, industrial research institutions in structurally weak regions in order to strengthen the innovative strength of these regions in the long term.

new directive 2022

The next call for proposals under the **Innovation Programme Future Building** is intended to provide even more R&D support to SMEs. The knowledge transfer of research results from applied building research is being expanded.

release 2019

Within the **Conceptual Framework Five Points for a New Entrepreneurial Age**, we are sensitising doctoral students to the option of starting their own businesses through the Young Entrepreneurs in Science programme.

pilot phase launch in September 2018

By strengthening the **Funding Initiative EXIST – University-based Business Start-ups**, we are laying the foundations for new companies based on technology and innovation growth. We will strengthen the existing network of academic start-up grants and set new impulses with the revamp of EXIST – Culture of Entrepreneurship.

expected end of 2018

The **Tech Growth Fund** is intended to provide fast-growing start-ups with venture debt financing (loans with equity-related elements).

programme launch planned for 2018

The **Digital Hub Initiative** is driving the development and support of twelve hub ecosystems. The Hubs bring young entrepreneurs together with established businesses and academia to work collectively on digital innovation.

ongoing until 2020

The **Innovation Forums Mid-size Sector** will create new interdisciplinary networks in which SMEs, together with universities, research institutions and other partners, will develop creative products and services to improve their innovative capacity.

ongoing, renewal expected in 2019

With the **Establishment of an Independent KfW Venture Capital Firm**, KfW's commitment in the area of venture, equity and mezzanine finance is being expanded both qualitatively and quantitatively.

expected in 2018

In order to strengthen the access of research-based SMEs to global knowledge flows and value chains, we will further develop the 2+2 approach within the framework of the **SME International Initiative**.

from 2018

This approach refers to research and development projects involving two countries. One research institution and one company are funded per country.

The **ESA Business Incubation Centres** model, which supports aerospace-related start-ups in the launch phase, will be expanded to include new locations.

2018–2021

Using knowledge and innovation networks: National and international cooperation

The basis for good ideas ‘made in Germany’ is our strong science system with its leading-edge universities and non-university research institutions, as well as a competitive, innovative economy. Through the Pact for Research and Innovation, the Federal Government and the Länder provide science organisations with planning security through annual increases in institutional funding – the agreed growth rate of 3 per cent per year will be borne by the Federal Government alone until 2020. At the same time, the Pact partners commit themselves to objectives that they wish to drive forward (e.g., taking up new thematic fields, attracting the best minds for science and research, providing excellent infrastructures, rapidly and comprehensively transferring ideas, knowledge and technology, or specifically approaching excellent creative minds both in science and in industry).

We will also continue to develop other major Federal Government-Länder programmes in collaboration with the Länder in the coming years. Important examples range from the follow-up to the Higher Education Pact 2020 and the Quality Pact for Teaching to the recruitment and development of personnel at universities of applied sciences, and the promotion of both the research facilities at universities and the national supercomputing system. In addition, there is the Excellence Strategy, through which the Federal Government and the Länder are linking up with the successful Excellence Initiative and, for the first time, are strengthening universities long-term through the promotion of scientific excellence, profile building and cooperation within the science system.



We are driving forward the dynamism in science, research and development with the strategic and content-related linkage of institutional and project funding and cooperation with industry within the framework of needs-based research contracts. Collaborative projects are central instruments of our research funding when it comes to translating research results into new added value and improving quality of life. Through cooperation projects between science, industry and society, we are bringing innovations more effectively and efficiently to the market and to the people – the participation of universities and applied science institutions at the same time fills the need for outstanding talent in innovative research and economic sectors. We will promote the interaction of the stakeholders in the innovation process with their specific strengths and profiles and further strengthen this through structural initiatives such as clusters, networks, competence centres and innovation laboratories.

Creating the basis for cooperation in innovative networks

Digitalisation and globalisation are changing the nature and speed of research and innovation, communication and cooperation. It is becoming increasingly important for individual researchers and entrepreneurs to define and maintain their position in complex, global knowledge and value-creation networks. Regional, trust-based relationships on the one hand and global networking and division of labour on the other are two sides of the same coin – today, innovation is a joint effort.

In the digitally networked world, the controlled exchange of data, information and knowledge is a basic prerequisite for scientific work. The comprehensive use of research data makes it possible to answer new, even multidisciplinary, scientific questions. Internationally compatible solutions must be found for the use of data. In order to secure our competitiveness in a data-driven science and economy, we supplement our funding with overarching infrastructure approaches such as the establishment of a National Research Data Infrastructure and the European Open Science Cloud.

Access to research infrastructures and technologies is one of the central prerequisites for excellent basic research, technological progress and the development of

the latest research areas. With sustainable, networked infrastructures, we will ensure cross-institutional access to computing capacity, large research infrastructures and the latest technologies. In this way, we also want to contribute to quality assurance, standardisation and the training of young scientists. The involvement of users in the further development of research infrastructures, in particular universities along with industrial and commercial enterprises, promotes the optimum use of infrastructures, offers an excellent framework for highly qualified education and further training, and guarantees innovative instrumentation and methodology. Using the instrument of the national roadmap process for prioritising research infrastructures we will cooperate internationally to enable the establishment of complex and cost-intensive research infrastructures for all scientific fields. Our standards for this are a high level of scientific quality, economically viable planning and major societal significance.

It is also important for the broad spectrum of German innovators to receive technology-open and open-topic support for networks in a variety of self-defined fields of innovation. Not only do we want to offer this successful approach across the boundaries of industries and specialist areas, but we also aim to strengthen it across national borders.





Our commitment to European and international innovation partnerships

As a research and innovation location, it is essential for Germany to be integrated into global knowledge flows and value chains. Successful international networking means a direct competitive advantage. The Federal Government is actively shaping this path with its Strategy for the Internationalisation of Education, Science and Research. With the internationalisation of the High-Tech Strategy 2025, the Federal Government is promoting excellence through global cooperation, strengthening Germany's innovative capability and addressing global challenges. An important element here is the creation of interdepartmental synergy projects that are being developed within the framework of the Federal Government's round table on 'Internationalisation of Education, Science and Research'. The German Centres for Research and Innovation (DWIH) also make an important contribution to the international networking of Germany as a high-tech location.

In Europe, we will work to link education and research cooperation more closely so as to strengthen the basis for living together in a peaceful and efficient European Union. We will set new priorities for the European Research Area and the Innovation Union and support the establishment of a European Innovation Council. Together, we want to advance research topics with European added value. We will develop new instruments to reduce the differences in the innovative strength of the European Member States and to prepare (potential) EU candidate countries for the European Research Area. Here, we are focusing above all on expanding scientific excellence and strengthening cooperation between science and industry. In this way, we want to increase the cohesion, competitiveness and willingness to reform of Europe's research and innovation systems. Germany is in favour of an EU financial framework whose task structure is geared even more strongly to current priorities, future topics such as education, research and innovation, and European added value. In addition, together with innovation leaders and strong partners in Europe, such as Scandinavia, France and the Netherlands, we want to advance forward-thinking topics, especially in the area of digitalisation and key technologies.

We are assuming our global responsibility through knowledge and innovation partnerships with leading scientific nations and international organisations in order to further develop creative potential for our mutual benefit. We are strengthening research into global health, in both developing and industrialised countries. We are expanding international research into sustainable land use and climate protection so as to improve living conditions in different regions of the world together. The root causes of forced displacement of people must be combated on the ground. We are supporting the development of modern vocational training and science systems, especially in African countries. Together with our partners in developing countries, we will increasingly promote knowledge transfer and innovation at the interface of science, industry and society, and expand network and cluster initiatives. We are engaging in space travel in sustainable international cooperation, above all through our great commitment to the European Space Agency ESA, but also in bilateral cooperations. With the help of these international cooperations, we are bundling our resources and are thus able to realise projects that neither we nor our partners would be able to implement on our own. Aerospace projects such as the International Space Station (ISS) are also instruments for a foreign policy aimed at peaceful coexistence.

Germany will promote international initiatives and participate in these to an appropriate extent. We will keep the cooperation interests of international partners as well as the work opportunities and interests of German companies and civil society actors in an appropriate balance.

New research and innovation policy initiatives 2018–2021

A new Strategy for International Cooperation in Vocational Education and Training is intended to support vocational education and training reforms in partner countries and German initial and continuing vocational education and training providers.	from start of 2019
Further development of the Strategy for Cooperation in Education, Research and Innovation with African Countries .	November 2018
The Action Plan ErUM-Pro promotes the involvement of universities in the further development of large-scale physics research facilities and thus serves to increase scientific performance and networking at international research institutions.	from end of 2018
With the GO FAIR Initiative , we are creating the conditions for cross-border access to research data at scientific institutions of all research disciplines.	from October 2020
Pilot Project for the Promotion of International Innovation Networks according to the technology-open, bottom-up principle to supplement national network funding in the Central Innovation Programme for SMEs (ZIM).	from 2018
With International Future Labs , we will create competence centres in Germany in which renowned scientists from all over the world will work together on strategically important topics.	from start of 2019
In the second cycle of the Federal Government’s Round Table on Internationalisation of Education, Science and Research , we are developing international synergy projects in the field of ‘Seas and Oceans’.	from June 2018
The Merlin Satellite Mission intends to launch a Franco-German research satellite into the Earth’s orbit to study climate change. Merlin is to detect where the greenhouse gas methane enters the atmosphere.	launch 2019



IMPLEMENTATION





Our research and innovation policy goals can only be achieved through the joint efforts of a variety of players. The prerequisites for success are a shared awareness of the problems, a clear distribution of tasks, transparent participation processes and functioning coordination committees. We will further develop and implement our strategy in dialogue with the stakeholders in the innovation process and with the citizens of our society.

A coordinated research and innovation policy

Strengthening interdepartmental cooperation in programme development and implementation is a key element of HTS 2025. Many of our goals can only be achieved through close cooperation between different policy areas. A round table of State Secretaries will be set up for coordination within the Federal Government. Their task will be to define, steer and shape innovation policy agendas along the priorities of the HTS 2025. Joint missions, new initiatives in priority fields of action and new themes can be defined and anchored. In order to increase the integration capability of research results, the needs and requirements of research and innovation policy should be discussed from the perspective of the various policy fields. Interfaces between the departments are to be addressed and measures defined to improve interaction at these interfaces. In this way, solution strategies can be coordinated and possible deficits in the existing innovation approaches can be eliminated jointly, taking the departmental principle into account.

An adaptive research and innovation strategy

With HTS 2025, we are setting ourselves ambitious goals – for Germany as an innovation location and in the individual fields of research and application. The cooperation of all actors responsible for innovation policy is of particular importance for the success of the strategy. The Federal Government will expand the continuous, strategic dialogue between politics, science, industry and society.

The implementation and further development of HTS 2025 is supported in terms of content and strategy by an advisory body made up of representatives from science, industry and civil society. Complementary to existing advisory bodies, it is intended to analyse the important issues for the future viability of Germany as a location for research and innovation and to develop impulses for the implementation and further development of the strategy. If necessary, adaptations to current technological or social developments can be made and new topics and missions proposed in the sense of an 'adaptive strategy'. The round table of State Secretaries can pick up on the body's impulses in terms of content and, if necessary, initiate implementation in the departmental group as well as feed thematic suggestions into their deliberations.

The Federal Government has set itself the goal of achieving the greatest possible transparency regarding the objectives, implementation and impact of HTS 2025. The social importance of science and research and the public funding of research and innovation oblige communication and dialogue. For this purpose, we will develop a communication concept for HTS 2025 that will provide comprehensive information and also address new target groups. The website www.hightech-strategie.de provides an overview of current funding programmes and initiatives of the Federal Government under the umbrella of HTS 2025.

Evaluation and outlook

Evaluations are an important instrument of our research and innovation policy. They contribute to performance monitoring with the dimensions of goal achievement, impact and cost-effectiveness and enable a scientifically sound assessment of the need for action. They thus help in the design of efficient programmes, instruments and procedures to promote research and innovation and to optimise existing programmes, instruments and procedures. The Federal Government will evaluate all major funding initiatives of HTS 2025 and continuously expand development of evaluation practice (especially with regard to impact analysis). The implementation and further development of HTS 2025 will be reported on at regular intervals.

Instruments of strategic foresight can provide impetus as to which future technologies and innovation fields can be particularly relevant for the competitiveness of the German economy and how they are developing. On this basis, the competencies required can be anticipated and strategically developed. We will also launch a new foresight process on future topics in science, business and society. It is intended to identify future technological and social developments with a long time horizon and thus provide the Federal Government with important impulses for education, research and innovation policy in good time. The innovation and technology analysis examines and evaluates new interdisciplinary topics of social relevance with regard to their challenges, risks and benefits. We see analyses in the area of tension between technological possibilities, social values and economic requirements as an important part of the State's provision for the future. The Federal Government will strengthen the competencies and capacities of the strategic foresight departments in order to better identify the risks and benefits of medium- and long-term developments.

Science communication and participation

The Federal Government will strengthen the involvement of society in the implementation and further development of HTS 2025. In addition to the innovation-driving activities of science and industry, innovations are increasingly emerging from within society and with the involvement of citizens. The opportunities for participation have grown considerably through digital applications. The Federal Government will contribute to the broad dissemination of science and research and to promoting the participation of citizens and organised civil society in order to make use of their contribution to innovation.

Our Science Years initiative focuses on topical themes such as Working Worlds of the Future. Numerous events take place in the course of a Science Year – from exhibitions and competitions to a wide variety of dialogue formats. Science communication itself is undergoing profound change as a result of new technologies. Our activities in this field have become more intensive and varied in recent years.

We remain true to the tradition of dialogue and are expanding it with new, participative formats: from the involvement of civil society in agenda-setting and dialogue formats to independent research activities and projects from civil society. Through the Future Forums, we will continue the strategic exchange with citizens on overarching, topical, political issues. Where appropriate, we will supplement the conception of funding programmes with agenda-setting processes. Finally, we will continue to promote scientific research on the prerequisites and success factors of participation. To prepare the research and innovation strategy of the 20th legislative period, the Federal Government will initiate a broad participation process during this electoral term.



Published by

Bundesministerium für Bildung und Forschung/
Federal Ministry of Education and Research (BMBF)
Division for Innovation and Transfer Policy Issues;
Coordination
11055 Berlin, Germany

Orders

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18132 Rostock, Germany
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September 2018**Edited by**

BMBF

Layout

familie redlich AG Agentur für Marken und Kommunikation
KOMPAKT MEDIEN Agentur für Kommunikation GmbH

Printed by

BMBF

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