

A 1 Commentary on current research and innovation policy

High-Tech Strategy 2025

In its High-Tech Strategy 2025 (HTS 2025), the Federal Government formulated inter-departmental targets and areas of focus for R&I policy in the current legislative period.¹ The HTS 2025 was adopted by the German Federal Cabinet on 5 September 2018.² It heralds the fourth phase of the strategic process in the field of R&I policy initiated in 2006.³

The primary focus of the HTS 2025 lies in three fields of action: “Societal Challenges”, “Germany’s Future Competencies” and “An Open Culture of Innovation and Entrepreneurship” (cf. figure A 1-1).

Societal challenges

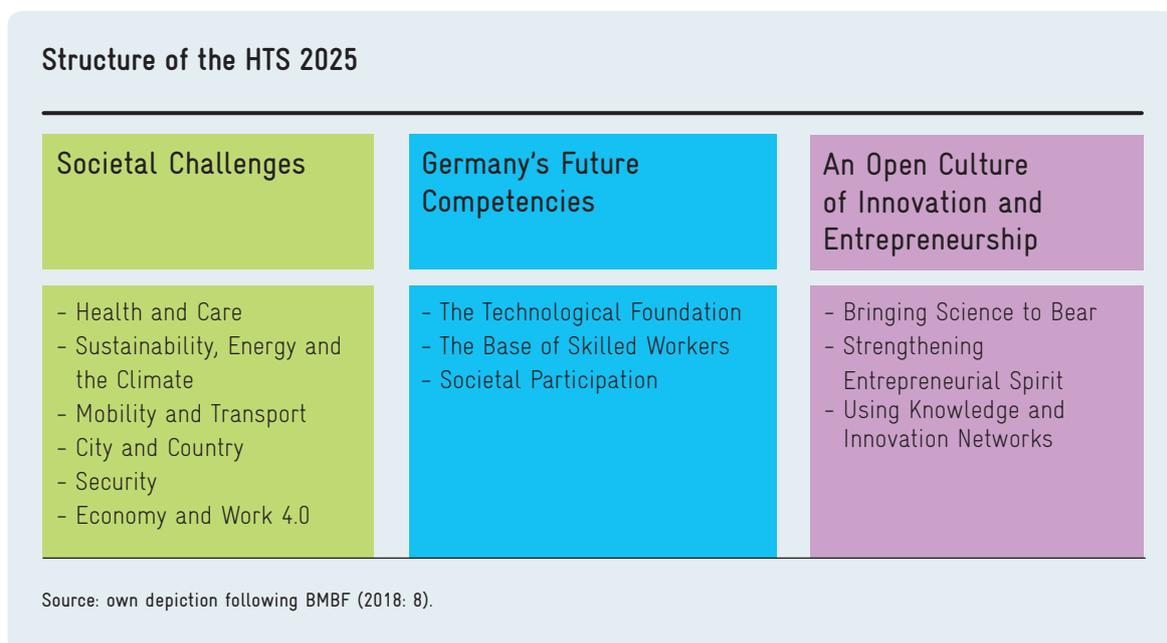
The Federal Government has stated its aim to put people at the heart of R&I policy and provide targeted support in response to societal needs.⁴ The HTS 2025

specifies six societal challenges (cf. figure A 1-1) which require qualitative leaps forward “that make a visible and tangible difference to people’s day-to-day lives”.⁵

The major societal challenges outlined in the HTS 2025 tie in closely with the priority challenges identified in the third phase of the HTS.⁶ However, a new emphasis is set in the HTS 2025 by assigning the topic “City and Country” to the societal challenges. In this regard, the aim is “to develop all regions, both urban and rural, into sustainable and future-ready locations in which to live and work”.⁷ The HTS 2025 details, for instance, plans to reinforce the innovative power of structurally weak regions, promote sustainable urban development within the meaning of the 2030 Agenda for Sustainable Development, and create more resilient regional economic structures and infrastructure. The Commission of Experts welcomes the intention to enhance the innovative power of rural regions. It warns, however, that considerations

Fig. A 1-1

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of structural development should not dominate the Federal Government's R&I policy.

Germany's Future Competencies

The Federal Government's view is that, in order to combat the specified societal challenges, competencies must be developed in order to further establish Germany as a location for science, research and innovation.⁸ In the HTS 2025, the "Germany's Future Competencies" field of action comprises three components (cf. figure A 1-1):

- The first component, the "Technological Foundation", aims to promote skills in relation to central key technologies that make it possible to realize wide-ranging – and also disruptive – innovation potential.⁹ The Commission of Experts welcomes the explicit inclusion of technologies with cross-sectional character in the HTS 2025.
- Skilled workers with a good level of suitable qualifications are a central basis for Germany's ability to innovate and be competitive.¹⁰ The "Base of Skilled Workers" is therefore an important topic area in the HTS 2025. The Commission of Experts welcomes the high importance assigned to digital education in the HTS 2025.
- The third component of the HTS 2025, "Societal Participation", links with the core element of "Transparency and Participation" from the third phase of the HTS. The Commission of Experts has already advocated the systematic implementation of approaches to enable citizens and groups of players from civil society to play a greater role in the development of R&I policy.¹¹ Ultimately, however, taking decisions on state innovation policy remains the duty of representatives democratically elected by the people.¹² Increased public participation should be accompanied by intensive communications work by the BMBF to introduce issues from the field of research and innovation into general societal discourse. In doing so, it may be prudent to intensify collaborative endeavours in scientific communication with academies, tertiary education institutions and non-university research institutions (außeruniversitäre Forschungseinrichtungen, AUFs). The Commission of Experts deems the support for accompanying research in social sciences and the humanities outlined in HTS 2025 to be appropriate.

An Open Culture of Innovation and Entrepreneurship

Global innovation and value-creation chains are becoming increasingly complex as innovation cycles become ever shorter. In light of this, the Federal Government aims to establish an open and agile culture of innovation.¹³ "An Open Culture of Innovation and Entrepreneurship" is a field of action comprising three topics (cf. figure A 1-1):

- In "Bringing Science to Bear", the Federal Government intends to intensify the transfer research findings into practice.¹⁴ The Federal Government's plans in this regard include promoting new transfer methods and structures and developing new, highly innovative clusters emerging from basic research. Furthermore, it operates a transfer initiative to identify barriers "on the path from the concept to market" and develop solutions to overcome them.¹⁵ An entirely novel aspect of the HTS 2025 is the creation and use of disruptive innovations. This will comprise two distinct approaches (see below). In a joint initiative of the BMBF and the BMWi, the Agency for Disruptive Innovations will be established to promote disruptive innovations for application in civil society. In parallel, the BMI and BMVg will collaborate to found the Agency for Innovation in Cybersecurity.¹⁶ In the HTS 2025, the Federal Government also announces that the state will take its role as a driver of innovation into account in public sector procurement, e-government and in the field of open data. The Commission of Experts shares the view that these areas harbour immense potential for innovation and that the public purse must at last make significant progress in this regard. In view of the considerable volume of orders placed, public procurement can play an important role in the formation and development of innovation-oriented markets.¹⁷ e-government should enhance the quality of public authorities' services for both citizens and private companies.¹⁸ Making authorities' databases accessible can enable start-ups and established companies to realize new value-creation potential.¹⁹ It would be advisable to conduct a systematic investigation in this regard to examine whether legal regulations would obstruct such access and whether they could be amended without impairing privacy protections.

- In the topic area of “Strengthening Entrepreneurial Spirit”, the HTS 2025 includes measures aimed at supporting small and medium-sized enterprises.²⁰ The intention is for universities and AUFs to function increasingly as research and innovation partners of SMEs; it also aims to promote the internationalization of SMEs and to maintain and enhance the competitiveness and innovative power of SMEs.²¹ The strategy advocates promoting start-up funding, in particular in the world of science, further developing the range of instruments to finance the foundation and growth of young companies, and reinforcing start-up ecosystems (cf. chapter B 1 on funding for start-ups).²² Furthermore, the HTS 2025 refers to the introduction of tax-based R&D funding, in particular for SMEs. The Commission of Experts – which has argued in favour of tax-based R&D funding for several years,²³ considers it very important that the Federal Government finally pushes ahead with such an instrument. The Commission presented potential courses of action and recommendations in its 2017 report.²⁴
- In the topic area of “Using Knowledge and Innovation Networks”, collaboration at both national and international level is the centre of attention in the HTS 2025. Among other aspects, the strategy includes support for structural measures such as clusters, networks, competence centres and innovation labs. There are also plans to fund the development of a national infrastructure for research data. Germany’s inclusion in global knowledge flows and value-creation chains is to be further reinforced, as is educational and research cooperation at the European level.

Cross-cutting issues

The HTS 2025 is characterized by a series of cross-cutting issues.

- In the past, the Commission of Experts has on numerous occasions called for digitalization to be incorporated more closely in R&I policy and to be considered in all areas of support. The Commission is therefore pleased to note that the topic of digitalization is a common theme in all areas of the HTS 2025.
 - In contrast to the third phase of the HTS, framework conditions are not considered a topic
- area in their own right in the HTS 2025; instead, these conditions are addressed in the context of the individual fields of action. In this context, the Commission of Experts regrets that the overarching significance of framework conditions is not afforded sufficient consideration.
- The HTS 2025 features a new aspect: so-called missions are formulated in all fields of action.²⁵ Examples of these missions are “Fighting Cancer”, “Sustainable Economic Activity in Cycles”, “Bringing Artificial Intelligence to Bear” and “New Sources for New Knowledge”. These missions will be pursued as part of a systematic approach in the fields of action, within which it will only be possible to find solutions to major challenges with the cooperation of all participations and which will involve several departments.²⁶ The Commission of Experts welcome the fact that a new approach has been ventured with the outlined missions.
 - Unlike the third phase of the HTS, the HTS 2025 includes rough schedules for research and innovation policy initiatives. The Commission of Experts welcomes this commitment to timely implementation by the Federal Government.

Implementation of High-Tech Strategy 2025

Coordination across departments and policy areas has been a characteristic element of HTS from the outset.²⁷ The establishment of a round-table of state secretaries should further advance this coordination in the current legislative period.²⁸ The Commission of Experts praises the efforts to strengthen inter-departmental coordination compared to the third phase of the HTS. The stated missions of the HTS 2025 also represent starting points for intensified inter-departmental cooperation.

As in the last three phases of the HTS, an advisory body is again included in the HTS 2025.²⁹ The High-Tech Forum, as it is known, includes representatives from the worlds of science and business as well as from civil society.³⁰ Its role is to analyse important topics and provide impetus for the round-table of state secretaries in respect of the implementation and further development of the HTS 2025. As was the case in the third phase of the HTS, there is little more than two years in the current legislative period for the advisory body to conduct active work.³¹

It plans to undertake work to develop the HTS for the next legislative period before the current period has run its course.³² The Commission of Experts considers this a positive move, as valuable time was lost at the start of this legislative period – and the one before it – before the HTS advisory body was able to begin its work. The Commission also recommends conducting an evaluation into what was achieved in previous phases of the HTS measured against objectives set in each case. The results of this evaluation should be presented in time for the new legislative period, so that they can be incorporated in future work.

The Commission of Experts specifically welcomes the recent announcement of evaluations for all major support measures and work to continually develop evaluation praxis.³³ The Commission refers to its past statements on the structure of evaluations.³⁴ Despite some progress, however, the Federal Government's R&I policy remains a far cry from systematically evidence-based evaluation praxis.

The 3.5 percent target

In 2017, Germany achieved its target of investing 3 percent of GDP in R&D.³⁵ In the HTS 2025, the Federal Government has set a new target of stepping up investment for R&D to 3.5 percent of GDP by 2025. The Commission of Experts welcomes the fact that this takes up one of its recommendations from 2013.³⁶ However, the Commission urges the Federal Government to increase significantly the financial resources set aside in the budget for R&D in order to achieve this target. In the coalition agreement forged between the CDU, CSU and SPD, it was agreed that a total of €2 billion would be provided from 2018 to 2021 in order to achieve the 3.5 percent target incrementally.³⁷ Yet even in the event that GDP fails to increase in nominal terms in this period, the Federal Government will have to make cumulated additional expenditure of around €3.3 billion between 2018 and 2021 in order to reach the 3.5 percent target incrementally.³⁸ In the event of nominal economic growth of 1.5 percent per year, this sum would almost double.

Promoting disruptive innovations

While the German innovation system features effective support for evolutionary innovation processes, there are no funding structures in place at present

that are explicitly focused on engendering disruptive innovations. Disruptive innovations are new creations that entail wide-reaching transformations in markets, organizations and societies and which harbour significant added-value potential. The HTS 2025 is the Federal Government's first innovation strategy which aims to develop and exploit disruptive innovations by means of specifically designed approaches (see above). On 29 August 2018, the Federal Cabinet agreed to establish the Agency for Disruptive Innovations (Agentur zur Förderung von Sprunginnovationen) for civil applications as well as the Agency for Innovation in Cybersecurity (Agentur für Innovationen in der Cybersicherheit) (cf. box A 1-2). The Commission of Experts emphatically welcomes the move to promote disruptive innovations outside of established funding structures.

It is the view of the Commission of Experts that the Agency for Disruptive Innovations is fundamentally capable of advancing disruptive innovations by means of innovation competitions and high-profile projects (cf. box A 1-2). These instruments have already proven their worth in the USA when used by the Defense Advanced Research Projects Agency (DARPA) (cf. box A 1-3). Crucial factors in the new agency's success will be the independence the organization is afforded, as well as its ability to attract entrepreneurially minded figures with excellent technical and scientific qualifications to serve in leading roles. As the agency will promote projects which, despite harbouring considerable potential, are also characterized by a high degree of risk, an inherent aspect of this concept is that many of its projects will fail. The Commission of Experts notes at this juncture that such failures will not be indicative of a failure of the Agency for Disruptive Innovations. In addition, the institution will not be an overnight success; a sufficiently high number of projects will need to be initiated to achieve success. Measured against these requirements, the budget that the Federal Government has so far set aside for the Agency for Disruptive Innovations is too limited.

The Agency for Disruptive Innovations is focused on civil applications. The Agency for Innovation in Cybersecurity, on the other hand, aims to source new cybertechnologies. The Commission of Experts therefore considers it sensible that the two institutions are to be kept separate in organizational terms.

Approaches pursued by the Federal Government to promote disruptive innovations

The Federal Government is pursuing two approaches to promote disruptive innovations.

Agency for Disruptive Innovations for civil applications

According to the Federal Government, the purpose of the Agency for Disruptive Innovations is to promote research ideas with the potential to produce disruptive innovations to solve specific problems of relevance for civic society and potential users.³⁹ It should lead to highly innovative products, processes and services being created with the potential to transform entire markets, create added value and benefit society.⁴⁰ The agency should serve three primary purposes: it should act as an idea scout for topics with disruptive potential, promote R&D, and act as a transfer hub.⁴¹ It will be jointly established by the BMBF and the BMWi in the legal form of a private limited company (Gesellschaft mit beschränkter Haftung, GmbH) and is set to be afforded a high level of independence.⁴²

A central feature of the Agency for Disruptive Innovations, promoting innovations for civil application, is a person-oriented, entrepreneurial approach – unlike classic support instruments. In this context, fixed-term innovation managers will play a prominent role: possessing exceptional technological and market knowledge, they must be afforded sufficient independence when handling projects.⁴³ The agency will promote disruptive innovations on the basis of two instruments:⁴⁴ Firstly, innovation competitions will compare the methods used by participating teams to solve pre-determined challenges. Secondly, high-profile projects will revolve around a specific user-related problem. This will create a corresponding R&D project, providing support for three to five years with the aim of bringing the solution to market once the funding term ends. Innovation competitions and high-profile projects are instruments that have already proven their worth in the USA when used by the Defense Advanced Research Projects Agency (DARPA) (cf. box A 1-3).

The Federal Government has set aside €151 million as the budget for the agency's launch phase.⁴⁵ It estimates funding requirements of a further €1 billion for the ten-year period from 2019.⁴⁶

Agency for Innovation in Cybersecurity

By establishing the Agency for Innovation in Cybersecurity, the Federal Government hopes to initiate projects in the field of cybersecurity.⁴⁷ The aim is to retain security technologies in Germany and to achieve speed advantages in comparison to previous procurement processes. The Agency for Innovation in Cybersecurity is to be founded as an in-house private limited company (GmbH), owned by the Federal Government and jointly overseen by the BMI and BMVg. Around €215 million has been made available to the agency for the period 2018-2022 – an amount in the region of €40-50 million per year.

Science policy

The decision to fund the excellence clusters promoted as part of the Excellence Strategy was taken in September 2018.⁴⁸ At 57, the number of funding cases is considerably higher than the 45 to 50 cases envisaged in the Federal-Länder agreement on the Excellence Strategy.⁴⁹ The Commission of Experts is critical of the retrospective decision to deviate from important assessment parameters and the fact that the number of funding cases was increased due

to political considerations. As the funding was not increased, the number of funding cases limited to financial support available to exceptional excellence cluster projects.

The Federal-Länder agreements on the Pact for Research and Innovation (Pakt für Forschung und Innovation) and the Higher Education Pact (Hochschulpakt) expire in 2019. The Joint Scientific Conference (Gemeinsame Wissenschaftskonferenz, GWK) plans to conclude its deliberations on

Box A 1-3

DARPA as a role model for a disruptive innovation agency

The Advanced Research Projects Agency (ARPA) – later renamed the Defense Advanced Research Projects Agency (DARPA) – was established in the USA in 1968 as a response to the ‘Sputnik Shock’.⁵⁰ At present, DARPA has a budget of over USD 3 billion and employs around 100 programme managers. DARPA organizes innovation competitions and promotes high-profile projects. Examples of its work include the innovation competitions for autonomous vehicles and the development of ARPANET:

- In 2004, 2005 and 2007, DARPA organized innovation competitions centred around autonomous vehicles. The Grand Challenges set in 2004 and 2005 involved vehicles navigated a predefined route in the desert, avoiding obstacles in doing so.⁵¹ The aim of the subsequent DARPA Urban Challenge in 2007 was to develop vehicles capable of navigating an urban environment. The innovation competitions demonstrated that autonomous driving is fundamentally possible. They accelerated the development of technologies in this field.⁵² German innovator Sebastian Thrun – who won the 2005 Grand Challenge with his Stanford Racing Team and finished second in the 2007 Urban Challenge – was entrusted with Google’s self-driving car project.⁵³ DARPA innovation competitions are also closely linked to the foundation of start-ups, such as the sensor manufacturer Velodyne LiDAR.⁵⁴
- Starting in the 1960s, DARPA (and its predecessor, ARPA) supported the development of ARPANET, a network to enable geographically separate computers to share resources.⁵⁵ ARPANET was the precursor to the modern Internet, which of course opened up entirely new added-value potential – and continues to do so to this day.

successor agreements for these pacts in Spring 2019. It will present its findings to the Federal and Länder Governments in its June 2019 session.⁵⁶

- The Commission of Experts supports the continuation of the Pact for Research and Innovation as it provides the planning security that scientific organizations urgently need. In the past, the Commission has spoken out in favour of updating the research policy objectives to be implemented by AUFs to include a greater emphasis on the transfer of knowledge and technology.⁵⁷ Individual AUFs should develop and systematically implement a strategy to this end.
- Current plans foresee stabilizing the Higher Education Pact on the basis of the recently passed Article 91b of the German Constitution (Grundgesetz).⁵⁸ The Commission of Experts welcomes the fact that the Federal Government will provide the Länder with long-term support in funding teaching and that the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) programme allowance will continue to be financed. The Commission of Experts is in favour of increasing federal funding for teaching in order to facilitate quality improvements. This must not, however, lead to a situation in which the Länder reduce their contributions to science funding in other areas. Tertiary education institutions need substantial improvements to their basic funding. In terms of allocating funds from the Higher Education Pact to tertiary education institutions, the Commission of Experts considers it sensible to use both capacity-related and quality-related indicators.⁵⁹

The Commission of Experts has repeatedly referred to the central importance of suitable mentoring relationships in providing high-quality teaching, and has therefore called for curricular standard values to be raised.⁶⁰ Adjusting the teaching workload of staff can also free up time in which staff could develop and implement innovative teaching formats.

Recommendations

High-Tech Strategy 2025

- The Commission of Experts calls on the Federal Government to make sufficient funding available in the current legislative period as a contribution to reaching the 3.5 percent target incrementally.
- In the HTS, the Federal Government announced that the state will take its role as a driver of innovation into account in public sector procurement, e-government and in the field of open data. This must be implemented without undue delay.
- The Commission of Experts also proposes evaluating the measures taken to date in the field of public procurement. This could lead to successful approaches being identified and subsequently intensified.
- The tax-based R&D funding activities discussed in the HTS must be introduced in the near future, with a focus on SMEs. Whether this funding should then be gradually extended to include large companies can then be examined once further experience has been gathered.⁶¹ The Commission of Experts advocates implementing tax incentives for R&D activities as a tax credit for R&D personnel expenses offset against payroll tax. A reasonable alternative to this would be a tax credit for all R&D expenses, offset against companies' income tax. In the latter case, the tax credit should be converted to a subsidy if a company has no tax liabilities.
- The missions and measures pursued in the HTS 2025 should be underpinned with milestones; progress in reaching these milestones should also be clearly documented. The missions pursued in the field of action entitled "Societal Challenges" should be approached in a technology-agnostic manner.
- Against the backdrop of rapid technological development, the legal framework conditions must come under greater political focus than is made clear in the HTS 2025. In the short term, the Federal Government should identify fields in which technological developments necessitate changes to legal framework conditions.
- The Commission of Experts therefore considers it necessary to examine issues of security and liability in relation to AI applications and

questions of data protection in the field of Industry 4.0 (cf. chapter B 1).

- The Commission of Experts once again calls for more agile federal R&I policy so that new developments can be picked up at an early stage.

Agency for Disruptive Innovations

- The Agency for Disruptive Innovations to promote innovations with civil applications should be afforded considered freedom and be able to go about its day-to-day operations with the maximum possible independence from political control. Another pressing matter is the recruitment of entrepreneurially minded and highly qualified figures from the worlds of industry and science to serve in leading roles. The agency's budget should be expanded in the medium term.

Science policy

- In terms of updates to the research policy targets to be implemented by AUFs, greater emphasis must be placed on the transfer of knowledge and technology. Individual AUFs should draw up and subsequently implement a strategy to this end.
- The successor agreement to the Higher Education Pact should include increased federal funding for teaching, such as for the purpose of digitizing teaching in universities. In addition to capacity-related indicators, quality-related indicators should also be considered in the allocation of funding.
- To improve teaching quality, the Commission recommends raising curricular standard values and adjusting teaching workloads.
- In recent years, the Federal Government has invested considerable sums in higher education – such as through the Excellence Initiative, the Higher Education Pact, the Teaching Quality Pact and by undertaking all costs incurred by the Federal Training Assistance Act (Bundesausbildungsförderungsgesetz, BAföG). The Commission of Experts encourages the Federal Government to examine how this compares to the financial commitments made by the Länder in relation to higher education.