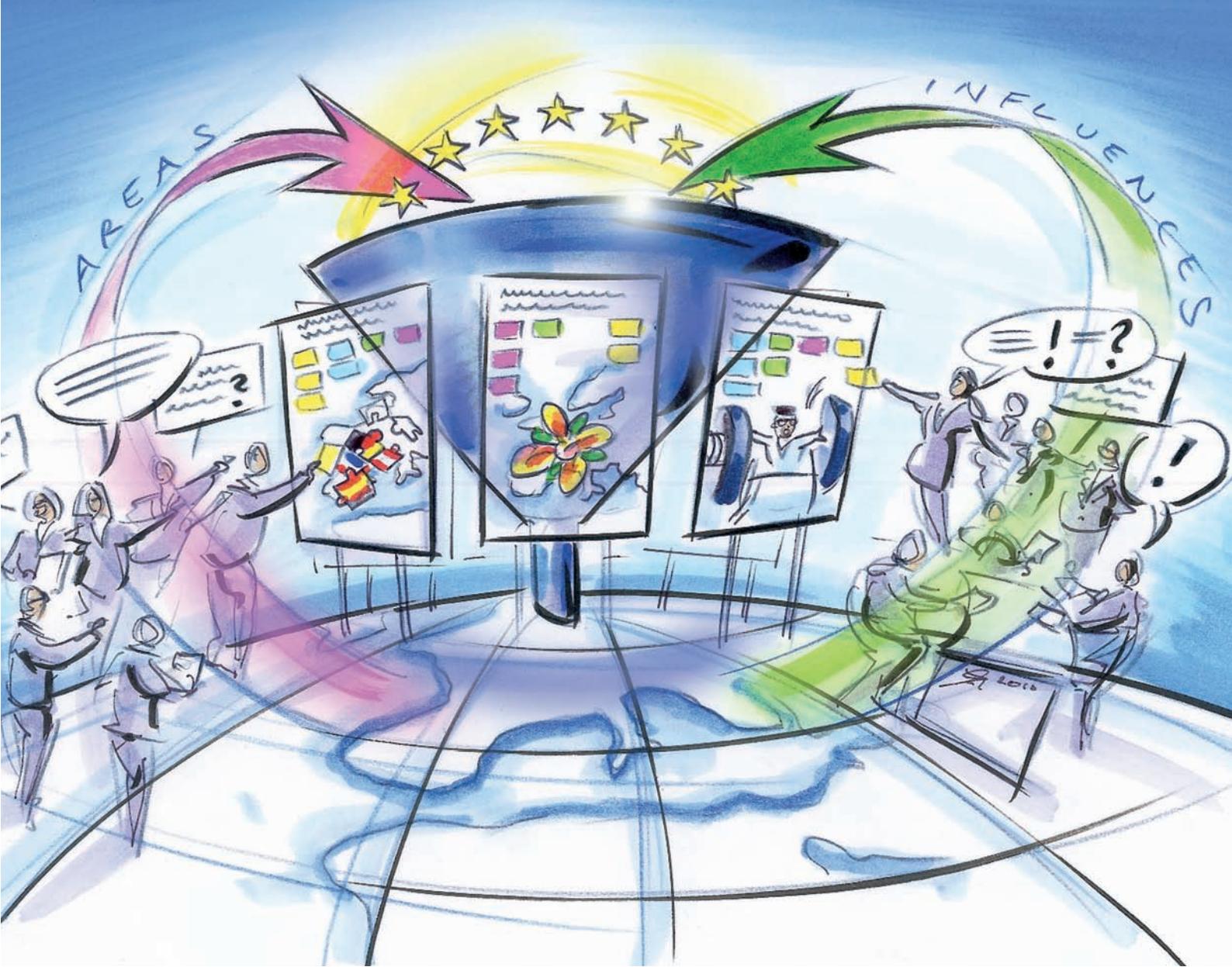




Fraunhofer

Envisioning future research horizons

Scenarios for the European research landscape 2025





Dear Readers,

We're more knowledgeable than any of the generations that came before us, and yet we find it more difficult to forge our path forward. This is one of the paradoxes of modern life: although we have a broader spectrum of strategic options open to us than ever before, we simultaneously face an equally wide assortment of associated uncertainties. The speed of change has accelerated to such an extent that we're unable to predict even the immediate future with 100 percent accuracy. Today, more than ever, economic development is characterized by increasing dynamism and growing complexity – and thus also by decreasing stability.

However, it's not true to say that we know nothing at all about future developments. Long-term trends naturally lend a certain shape to the future. And predictable demographic, political, economic, societal, scientific and technical developmental narratives can also be taken into account when evaluating and formulating possible alternative scenarios. Projecting different futures gives us the opportunity to discuss what future we'd actually like, and to create what is possible. That said, we must be aware of the multifaceted aspects of possible developments and generate appropriately varied potential courses of action. We cannot know the future – yet we must still prepare for it.

The European research landscape is packed with a multitude of players, from universities though publicly funded research establishments to commercial companies. It is constantly changing, and sometimes the changes are abrupt. The needs of the economy have a direct impact on the agendas of the various research institutions. The dynamism of the contract research market and the multiplicity of players in the European research landscape combine to create a very high degree of complexity, which we seek to reduce through the process of scenario development. Based on an intricate network of influential factors, scenarios are

simply a means of describing situations that might possibly arise in the future. Fraunhofer invited experts from various stakeholder groups to join us in a series of workshops in which we elaborated four different scenarios for the European research landscape in 2025 – they are presented in this brochure. Further workshops to develop scenarios for the future of the contract research market are currently underway.

Every reader will assess the likelihood of these scenarios becoming reality differently. This is not surprising, given that the scenarios are not objective appraisals, but rather the group-specific views of the respective scenario-building teams. And despite all efforts to the contrary, all the scenarios are inevitably tethered to the present, because even the best experts will never be able to predict the unknown or undiscovered. However, the quality of scenarios lies not in whether they actually materialize as envisaged, but whether they provide tangible support to the research community that will help to direct its activities on a realistic line of approach towards its future targets.

Since we cannot truly predict the future, all that remains is to work within the triangle of possible, probable and desirable developments. By publishing this brochure, Fraunhofer is seeking to raise awareness of this fact, to enrich the debate on the future European innovation and research area, and to open up new perspectives.

We look forward to stimulating and inspiring discussions with you all.

Yours sincerely,



Hans-Jörg Bullinger
President of the Fraunhofer-Gesellschaft

Envisioning future research horizons

Scenarios for the European research landscape 2025

1. Scenario methodology as a strategic planning tool	6
2. Four scenarios for the European research landscape	8
2.1 European Research Area: mission accomplished	8
2.2 The European puzzle: muddling through	14
2.3 Lessons learned: 'Glocal' Europe	19
2.4 Market-driven rules: research under pressure	24
3. Scenario team & moderation	29
4. Editorial notes	30

Scenario methodology as a strategic planning tool

Scenario methodology complements and extends conventional methods of forecasting. As a planning tool, it is particularly useful when strategic decisions need to be made within the context of specific societal, economic or political framework conditions and when developments in these spheres cannot be predicted over a lengthy period of time. Even though it is not possible to predict the future precisely, scenario methodology can be used to develop plausible and justifiable visions of the future, commonly referred to as scenarios.

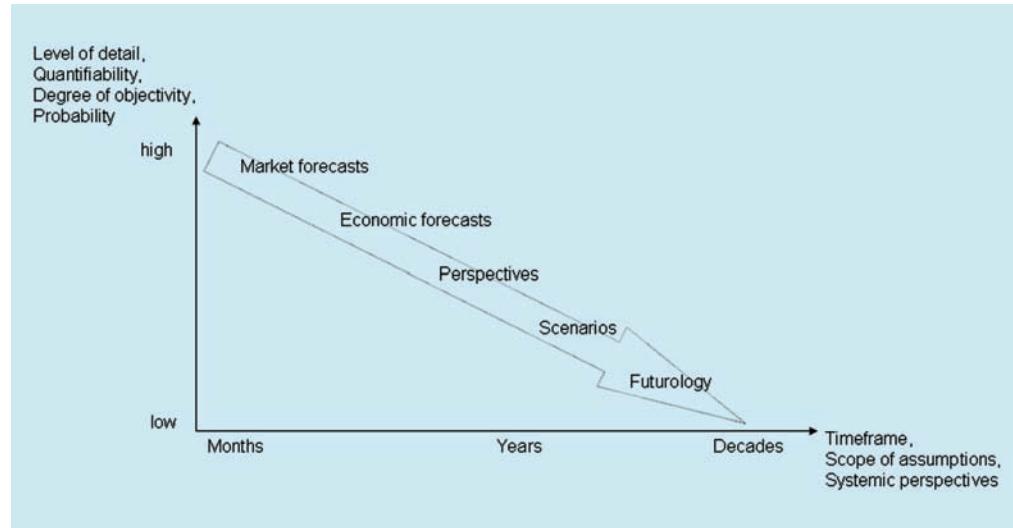
A scenario postulates a possible future situation, for example potential circumstances in which a company will be operating. It describes the framework conditions

below. Generally speaking, the sequence in which the various steps are performed is fairly flexible, so it is possible to jump back and forth between them.

Step 1: First, the problem is outlined. The boundaries of the field of study are set – thematically, spatially and temporally. The “as-is” situation – in this instance, the current “European research landscape” – is described, and the most important questions and problems are identified. The timeframe for consideration – in this case 2025 – is also stipulated.

Step 2: An environmental analysis is undertaken to identify and structure all the factors and/or areas that might influence the field of study, both at the present

time and in the future. Using the suggested factors and/ or areas as a starting point, and working with the workshop participants, an overall environmental structure is established. In the process, current influential factors and potential new areas of influence (e.g. globalization of research, key drivers such as energy and sustainability) are identified.



The future: Between prediction and hope – different methods of forecasting

and theorizes how the situation might progress. By considering a variety of alternative scenarios, the aim is to cover – as far as is possible – all the growing uncertainties and complexities in respect of a particular future point in time. All the scenarios that are constructed should be consistent in themselves and different from each other.

Taking the “European research landscape in 2025” scenario workshops by way of example, the step-by-step process involved in developing a scenario is detailed

Step 3: Workshop participants evaluate the identified influential factors. Those ranked highest are placed on a shortlist, scrutinized closely, and given more concrete form. (In the case in question, there are 14 influential factors.) Their as-is situation is described in detail, so the factors begin to take on a more tangible and readily understandable qualitative or quantitative character. All the conceivable ways in which these influential factors might develop are then discussed and formulated in the form of assumptions about the future. When reflecting on the “European research

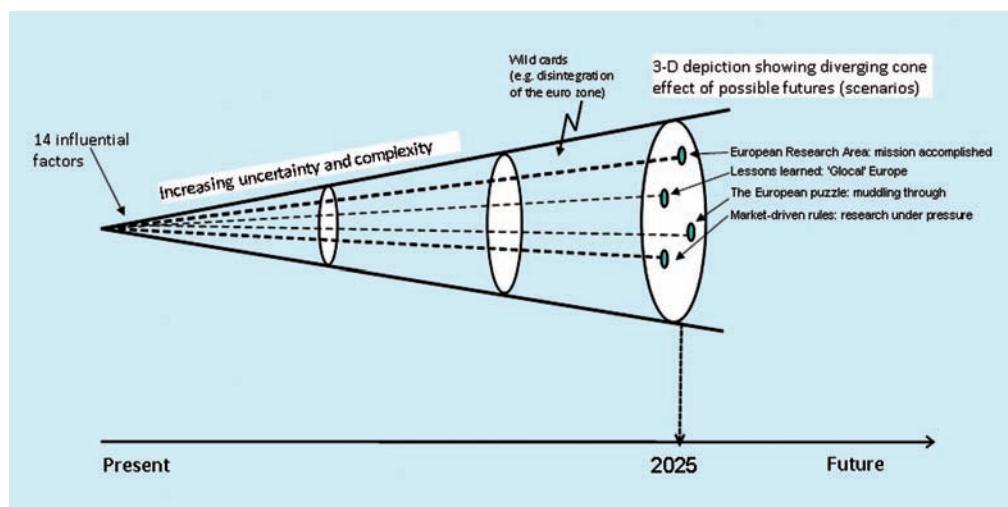
landscape in 2025”, this approach was used to generate two or three alternative assumptions for each influential factor.

Step 4: Consistency checks are carried out as part of the process of raw scenario development, their aim being to highlight any conflicts and synergies between the different assumptions. The resultant raw scenarios are thus comprised of specially selected, self-consistent sets of assumptions about the future. Four alternative raw

awareness of the possibility of unexpected setbacks – or indeed opportunities. When considering the European research landscape to 2025, a number of potential flash points and significant “what ifs” were discussed: the collapse of China, disintegration of the euro zone, and tipping points for climate change. However, these possibilities are not taken into account in the four scenarios put forward in this brochure.

Scenarios are useful for a number of different reasons:

- They enable planners in research institutions, companies and other organizations to develop an awareness of requirements that may emerge in a future world, thus helping them to identify potential new groups of customers and competitors.
- They can systematically reduce the complexity of a given field of study.
- In addition to deepening knowledge, they



Four alternative scenarios for the European research landscape in 2025

scenarios were crafted for the “European research landscape 2025”, and drawings were produced to illustrate visually the various development potentials associated with the different influential factors and raw scenarios.

Step 5: The raw scenarios are described in story form. The narrative should outline possible evolutions in the environment at the predefined point in time – the aim is to provide a clearer picture of how the different influential factors are interlinked, and to facilitate identification with each vision of the future through easy-to-understand stories.

Step 6: Wild card analysis is used to identify events that might occur without warning and completely transform the established environmental scenarios, either for good or for bad. Examples of past wild card events include the financial crisis in 2008, the terrorist attacks of September 11, 2001, and the fall of the Berlin Wall in 1989. Here, the aim is to promote

can also reveal the limits of current knowledge, i.e. by showing up gaps and ambiguities.

- They highlight future opportunities and risks. And every so often, they even draw attention to some that already exist but have not yet been recognized.
- They support internal communication processes.
- They provide a solid basis for reviewing strategies that have been adopted to date and simultaneously serve as a starting point for developing new strategies.



European Research Area: mission accomplished

The European Research and Innovation Area is continuing to develop, hand in hand with social cohesion in Europe. Well-coordinated, pan-European R&D activities have transformed it into a major player in priority areas set out by the Global Challenges, such as sustainable energy generation. This efficient networking of R&D activities has been facilitated by new, flexible framework structures. The publicly funded research sector cooperates closely with the wider economy to produce harmonized, integrated European developments, with the result that the European Economic Area is highly competitive internationally.

The financial and economic sector has been reformed in the wake of past economic crises. The old sectoral policies have been remodeled to produce structures that permit early identification of problems created by global interdependence. The principles of sustainable development are gradually gaining acceptance and are generating new markets around the world – markets which are being served primarily by Europe.

Economic situation and public finances

*The current global economic situation is characterized by a serious economic crisis. Government budgets have been severely depleted by measures to rescue the ailing financial sector. Future spending cuts are inevitable, and this will no doubt include the research sector. Compared with the rest of Europe, the German research landscape still enjoys a high level of national investment, because the country regards research and innovation as a possible – perhaps even essential – means of overcoming the economic crisis.**

Germany and the rest of Europe have recovered from the crisis (potentially also from subsequent crises) in 2025 and emerged stronger, not least because of reformed research structures and high levels of expenditure on research. The global markets are changing as the principles of sustainable development take hold; Europe is setting the trend in this regard, and profiting as a result.

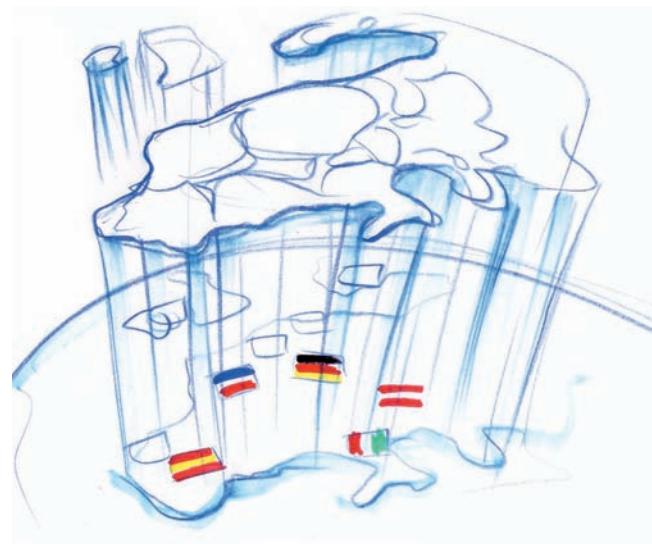
In the commercial sector, businesses are adapting to the global market by basing their choice of production and research locations on factors that give them a competitive advantage, an aspect of particular importance in times of economic recession. Decisions on where to site company research activities are governed by criteria such as markets and as well the locations of top-class university and extra-university research.

In 2025 such shifts and adjustments have resulted in companies bringing their R&D work (back) to Germany and other European countries. Even global players are once again including Europe in their considerations, viewing it as an increasingly attractive place to live and carry out research. Individual regions are specializing, forming clusters and seeking to establish networks by setting up global supply chains. The limited public funding that is available is being invested in trans-national European multiplayer structures, including new public-private partnership programs.

At present, know-how is generally poorly exploited, the result of strict patronage that impedes exploitation through a policy of protection.

In 2025 cooperation between EU member states has increased, even when it comes to protection mechanisms and models relating to commercial exploitation of

work and research findings. In recognition of the basic principle that the results of research funded by taxpayers' money should be freely accessible to all, an open access strategy has been adopted in sectors of particular social and economic importance. The open access strategy permits free access to scientific information on the Internet and encourages further



Europe is strengthened by cooperation.

development of research and development findings. The commercialization of research findings is additionally encouraged by the single EU-wide patent system.

Europe from the political and social perspective

In the year 2010, the EU is made up of 27 individual member states. Only in exceptional circumstances is concerted action taken within the various policy areas (economy, security, environment). The Treaty of Lisbon is making little headway in bringing the EU closer together and certain unsustainable economic policies are putting pressure on the Economic Monetary Union.

In 2025 the EU has emerged stronger from these crises, as members states have recognized that Europe must be tough and resilient if it is to compete effectively with the United States, China, Japan and Russia, not to mention other thriving, emerging countries such as India and Brazil. Jointly developed and implemented policy positions have been adopted, including a well-coordinated economic policy, common security interests and a uniform position on climate protection goals.

* The normal text is used for the scenario in 2025, while the italic text describes the year 2010.

Europe is leading the global climate change debate and setting clear and unconditional climate protection targets for the region. It has also coalesced socially – in other words, social cohesion has been achieved. The Structural Funds, for example, have ensured that less-prosperous regions no longer lag so far behind, and an integrated European economic and labor area has been created. As a result, there is a more widespread identification with Europe among the general population, and there is a greater tendency for people to feel more European than German, French or Greek.

"European culture" is currently expressed in a number of positive ways, including creativity arising from the interaction between different regions and peoples, very stable democracies, high social tolerance levels, strong social security systems and a widely held attachment to a healthy "work-life balance". However, these characteristics are not expressed uniformly throughout



Researchers have constant and lively exchanges with the whole of society.

the region, nor are they being utilized as competitive advantages, even where they are already enshrined. In 2025 Europe is recognized as being a significantly more attractive a place to live and work. A European "spirit" is developing, one that is felt by the common people, not just imposed from on high by policy makers and/or the EU Commission. In other parts of the world, Europe is increasingly being hailed as a good place to live because it is at the forefront of sustainable development, enjoys a stable political environment,

and boasts a great diversity of regions and a harmonized labor market.

Additionally, because of its geographical location, climate change is having less of an impact on Europe than on other areas of the world.

The European Research Area

In 2010 research is undertaken in a large number of isolated scientific communities and is generally fragmented. As a result, there is little dialog between different scientific disciplines (e.g. between social and natural sciences), and exchanges with society as a whole are sporadic at best. Society is currently regarded as nothing more than a consumer: companies plan a product, carry out R&D and launch what they deem to be appropriate consumables onto the market. Technology assessment studies are often carried out only as an afterthought, and open innovation approaches are rare. As things stand, the general population simply takes it on trust that investment in research (and education) is good and that the research sector is self-organizing and will proceed along the correct path.

The requirement for Europe to be both attractive and sustainable demands that research be conducted in more of a sociopolitical context in future. In 2025 the dialog between research and society as a whole has already greatly improved. Sustainable development, as both a driver and an objective of future research, is powered by social requirements, and results in a strong interaction between a range of players in society and interdisciplinary research teams (transdisciplinarity). The old legitimacy of the current age, namely that research is intrinsically good, no longer holds true. Instead, research is lent a new and essential significance, being fundamentally and directly oriented to society's needs. As a result, society's requirements and its need for research continue to grow.

The missions currently assigned to R&D organizations are often rather opaque, and there are sometimes significant areas of overlap within a single research system. Responding to pointers from third-party funding providers, research institutions that have traditionally focused on basic research are now increasingly turning their attention to application-oriented research.

Consequently, all these research structures now have very similar directions. Every one of them is promoting topical areas of research in an attempt to win third-party funding. And these days, society shows very little interest in the structure of the research landscape or the results of research undertaken.

In 2025 the demands made on the research sector in terms of efficiency and effectiveness have increased dramatically. This has resulted in more intensive (i.e.

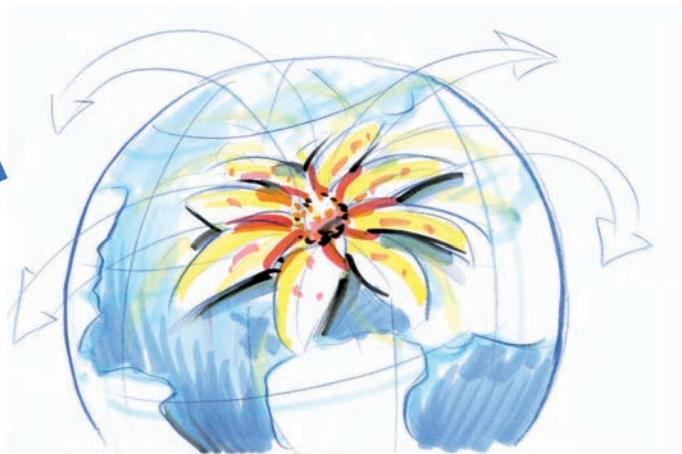


more comprehensive) evaluations not only of individual research projects and establishments, but also national situations and even the European research landscape as a whole. The upshot is that the majority of research institutions are strengthening their profiles and unique selling points. They are once again turning their attention to clearly defined areas of research with a definite strategic orientation, whether technological in nature (solar energy, surface treatment etc.) or more general, i.e. the specific direction of their research (basic, application-oriented, services etc.). A new order is emerging and the different national research landscapes are becoming more distinct. The old, historically rigid structures are no longer compatible with the requirements of an open research structure and are being abandoned in favor of a flexibly networked research landscape – in other words, the developing research structures in individual member states are being fashioned in such a way as to promote networking with other European institutions from the very start.

The general principle that underpins traditional universities in 2010 is the desire to amalgamate teaching, research and training for the next generation of

scientists under one roof, and the general trend is towards specialization in the sense of profile creation and/or functional integration. Both basic and application-oriented research feature strongly, as does cooperation with industry. These universities sometimes even go so far as to merge with extra-university research institutions – the Karlsruhe Research Center of Technology as a merger of Forschungszentrum Karlsruhe and Karlsruhe University is one such example of a merger. By contrast, universities of applied sciences have a much stronger practical focus.

In 2025 a more pronounced duality has emerged in the higher education system. Firstly, there are International Research Universities, which offer Masters and PhD



Europe is flourishing at every level: economic, political, societal, and also as a research location.

programs and are internationally attractive institutions for students and researchers alike. They have an unmistakable thematic profile. They run cooperation programs with international companies and extra-university research institutions and have a very pronounced research orientation. English has become the language of science. Secondly, there are (Local) Bachelor Schools (comparable to the Universities of Applied Sciences in Germany today) which have a very strong focus on teaching and application. They mainly offer Bachelor degrees. Their impact is predominantly regional, due largely to local spin-off projects, but they also seek international input in order to remain globally competitive.

As things stand in 2010, the research landscape in the European Union is still extremely fragmented, not only

between individual member states, but also between different research establishments within these states. Public funding is invested in a very wide spectrum of R&D work. And similar research is often carried out in all the member states. There are very few initiatives in which several member states share responsibility for a single research program. Instead, exclusive national programs tend to favor home-grown researchers. As yet there are no uniform transnational support structures or conditions, although initial ideas are being discussed (e.g. joint programming).

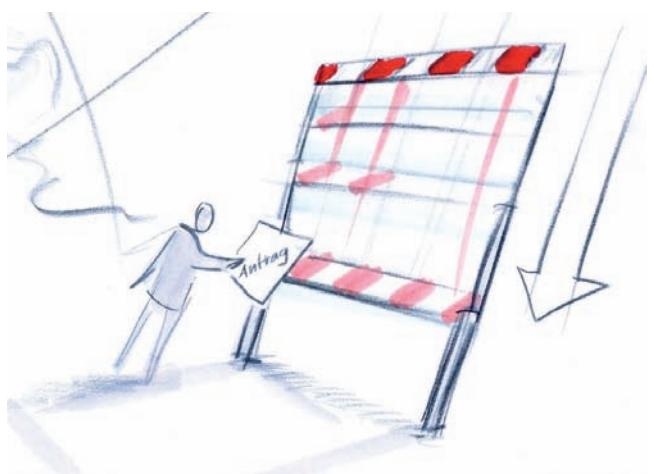


The creation of networks is strongly supported.

China and India have put pressure on Europe by increasing the intensity of their research effort. As a result, in 2025 Europe has developed internationally competitive R&D networks, which are initially oriented along the lines of the Grand Global Challenges. Both public and commercial R&D players are making a concerted effort to focus their work on those areas in which Europe wants to expand its technological leadership (e.g. the chemical industry, energy, the environment, the automobile industry, materials science and optical technologies). Energy has become vitally important by 2025, and there is now a European roadmap that outlines the desired orientation and long-term networking of the European research landscape. More and more research activities are being coordinated and funded at European level. The principle of transdisciplinarity is being observed – i.e. society at large is involved in this development process. Given the cultural diversity that exists in Europe, this presents a particularly tough challenge. Networking is, in general, supported by highly effective and efficient tools that have been set

up. Those tools ensure that European research funding not only encourages the initial creation of European R&D networks within a short period of time, but also provides a stable environment for their ongoing existence, even after the end of the EU project funding period. In this regard, the EU also plays greater role in the basic funding of R&D networks.

In 2025 the European research landscape has been harmonized. Support for both national and European research is better coordinated. Only a small portion of total R&D expenditure is still allocated to exclusively national projects via national budgets. Instead, various member states have banded together to set up joint support programs (e.g. coastal countries concerned with promoting offshore wind energy), and the EU has succeeded in achieving closer coordination between European states in respect of the Grand Global Challenges. The European R&D Framework Programme now has a bigger budget, while national expenditure on R&D has dropped accordingly. Although the Lisbon goal of investing 3% of the gross domestic product in R&D has not yet been achieved, comparison with other public budgets reveals a relatively large amount of funding is nonetheless being made available for this work. The European Research Council is being given a bigger slice of the pie. Establishments such as the European Institute of Technology are being subjected to effectiveness and efficiency criteria. And new administrative



The hurdles are falling when it comes to EU applications.

structures within the EU Commission have simplified the application and assessment procedures for funding

requests, previously so laborious and time-consuming. Europe is becoming stronger as a result of the reciprocal networking of German and European-wide research organizations, which is in turn supported by appropriate pan-European research programs and a focus on topics of greatest relevance to the region.

Thanks to the positive developments in European research and the fact that Europe is now regarded as an attractive destination, the problem of declining numbers of R&D professionals due to demographic changes is being solved. Europe is able to recruit researchers from elsewhere in the world by offering them desirable working and living conditions. Germany has played its part in this, not least by abolishing its collective wage agreement for the public sector and introducing a special tariff for scientists to ensure that top-quality

researchers can be remunerated appropriately and international recruitment drives prove successful.



Next-generation researchers from all over the world regard Europe as an attractive place to work.



The European puzzle: muddling through

As public resources decrease, competition for research funding increases, at both national and European level. No incentive exists for implementing structural changes or developing a stronger profile in the research landscape. The landscape is determined by large R&D structures, which are historically rooted and mostly uncoordinated. Coordinated action only takes place on a short-term, project-related basis. Owing to the fragmented nature of the European research landscape, its attractiveness for scientists from other regions of the world declines.

The world has largely recovered from the acute economic crisis, but no new structures have been created in the financial sector, and industry is still geared to unlimited growth. These systematic weaknesses impede development of the European Union. The process of integration stagnates and each member country attempts to optimize its own position in the global network in the short term. Without substantial reforms, Europe is stuck in its same old ways.

Economic situation and public finances

In 2010 Europe (and the rest of the world) remains afflicted by economic stagnation. It is an open question whether the crisis is a one-off event that can be overcome by means of short-term financial boosts from the government or system-inherent and requiring more fundamental structural measures (e.g. regulation of the financial sector). Despite limited resources, further economic growth is still the goal. These global crises also have an impact on the European Union, which now has to actively support a number of bankrupt member countries. Business is increasingly orienting itself to the global market and relevant location factors. Debates about the location of business and industry and appeals to companies to continue producing in their home



Sitting back and relaxing without due regard for the reality of the situation.

*country recede into the background. Production and R&D are therefore being relocated to those regions where the most attractive conditions for business currently prevail; decisive factors include taxation, access to low-cost labor and excellent research capacity.**

These trends continue through to 2025. While the economic crisis has been overcome in principle, business and technological activities have shifted across continents. Regional specialization has led to the formation of chains and networks of suppliers. Although 50% of the research conducted by German and European

companies takes place outside Europe, players in the European research landscape and in industry have succeeded in strengthening Europe's position as a business location by focusing on key subject areas, including chemistry, energy, environment, automotive, material sciences and optical technologies. Scarce public resources are used primarily to support transnational multi-player structures and clusters, consisting of companies, universities and research institutes. Clusters focusing on the key European subject areas receive priority funding. By contrast, development of the infrastructures used by the general public is restricted for years by the high levels of government debt. Balanced public-sector budgets have become a utopian dream for the member countries.

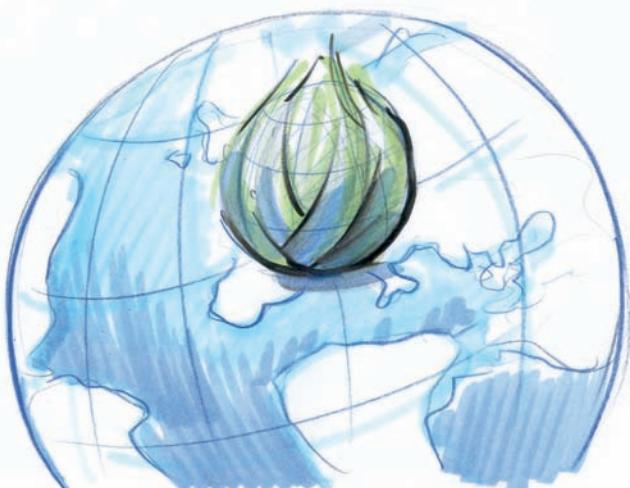
The decreasing attractiveness of Europe as a place to work and live is a problem with regard to the availability of qualified employees. While Europe can still offer many positive attractions as a location, including the stable democracies of the member countries, strong social security systems, high social tolerance and the importance attached to a work-life balance, these advantages are not exploited enough when trying to attract qualified employees. What is more, harmonization of employment conditions between the member countries (e.g. pension insurance) is making only very slow progress, which means that Europe is continuing to lose ground compared with other regions of the world which, even though they are still not regarded as very attractive, are definitely catching up. This decline in attractiveness is intensified by certain xenophobic trends in some member countries, resulting among other things from an increasing inflow of migrants from less developed regions.

Europe from the political and social perspective

In 2025 it has become clear that the pace of integration can no longer be maintained. The Lisbon Treaty, which was intended to give the Community new impetus, initially proved to be something of an obstacle to progress. Other problems, resulting from the indebtedness of individual member states, also afflict the EU as a whole. The citizens of the EU regard further European integration with skepticism. Direct personal advantages

* The normal text is used for the scenario in 2025, while the italic text describes the year 2010.

are not perceived and the increasing regulations from Brussels, which are required to be transferred into national law, are regarded as excessive interference. This Euroskepticism is also reflected in the fact that when elections are held in the member countries, Euroskeptic parties tend to get elected. Cooperation between the member countries only happens if the individual country gains direct advantages. Economic and external-policy cooperation at EU level is hindered by the importance the individual countries attach to overcoming their own specific problems. The unifying European ideal recedes into the background. The lacking willingness to cooperate seriously limits the EU's ability to take decisions.



Europe is not flourishing as it might.

The inadequate progress towards European integration is also reflected in national and European research funding. European R&D spending is coordinated only to a small extent through Brussels. The key expenditures are made through the national budgets for exclusively national funding. Although the European R&D budget is increasing slightly, this cannot exercise any long-term influence on cooperation between research bodies from the various member countries. The collaborations only last for as long as funding is provided. National R&D funding will remain restricted to national applicants. Efforts to strengthen Europe's competitiveness by increasing cross-border cooperation in the European Research Area are not proving successful. Outside the framework program international clusters are formed, triggered mainly by the innovation networks of globally active companies.

In 2010 patent regulations and a lack of different licensing models make it difficult to utilize the results of research. At the same time the exchange of scientific results is impeded by the high prices charged by publishing houses for research results.

Against the background of the trend towards sealing off acquired knowledge, research results are being increasingly protected in 2025. Copyrights and industrial property rights impede innovation by making it difficult to utilize research results. The tendency towards protection is also reflected in the publication of scientific articles. Scientific publishing houses are the eye of the needle through which research scientists have to squeeze in order to be able to publish. Access to research results therefore continues to be made difficult for industry and for research institutes by financial barriers and statutory regulations.



Society as a whole believes research is intrinsically good.

In the interests of maintaining the status quo, no questions are raised about the (in)efficiency of the research landscape. Research and education continue to be regarded as indispensable budgetary items in the public sector, and the effective and efficient use of available resources is not an issue. Although research requires more transparency, most people still see it as an ivory

tower, whose foundations should not be disturbed. The historically formed research structures are not questioned. The establishment of new transdisciplinary research activities, i.e. the exchange between the user perspective of society and the research community, which would be necessary to solve global problems, is slow. While sustainability is still a matter of topical interest, it continues to be neglected in actual practice and is not implemented in concrete terms.

The research landscape

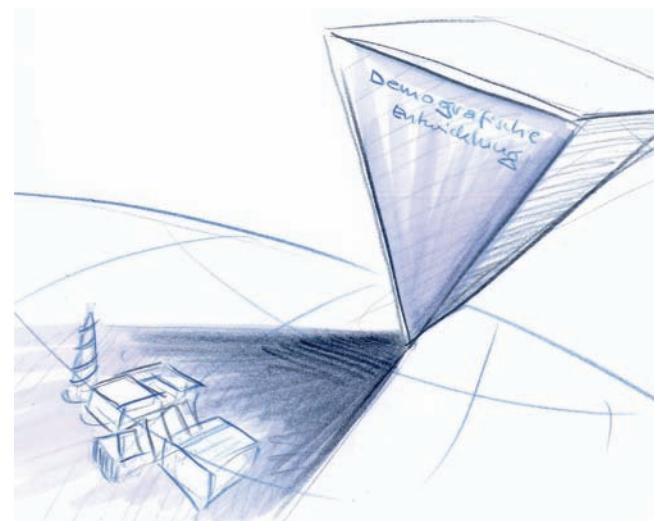
In 2010 the publicly-funded research institutes are already orienting themselves to the major technological subjects of key interest and are increasingly cooperating with industry in order to meet the requirements of the funding bodies for increased third-party financing. As a result, they are becoming increasingly similar to each other and pursue the same objectives. The research institutions which today primarily conduct basic research may in future also turn to application-oriented research.

In 2025 research institutes have come much closer together in their mission and profile, while the universities have been seeking a new profile. The teaching and research principle of the universities based on the Humboldt model is no longer adequate - in the stronger competition for students and funding the universities have to develop their own unique selling points. Cooperations are established for example with extra-university research institutes (e.g. Karlsruhe University and the Karlsruhe Research Center) to create a super-critical potential, both with regard to the education of students as well as the research work offered to companies. The universities are active on the contract research market, and this is reflected in a significant increase in industrial collaborations with universities. As a consequence, competition between universities and research institutes is increasing. At the same time available public resources are decreasing and so competition intensifies also for institutional funding and project funding from the federal and state governments.

As far as network building in the European research landscape is concerned, it can be stated that the current research policy with the European R&D framework

programs definitely stimulates collaborations, but these do not last for the long term if there is no funding.

In 2025 too, only short-term funding relationships without any sustained collaborative potential exist between the research institutes in the EU. The EU's funding mechanisms are still not suitable for stimulating long-term cooperation extending beyond the funding period, i.e. the number of collaborations will rise or fall depending on the funds provided for future R&D framework programs. There is hardly any joint cross-border funding of research in the member countries. Potential is pooled for major subjects of key importance, such as energy, by the mechanism of EU funding. European networks are created, but these are not particularly strong. As, however, EU research funding continues to rise while national R&D funding falls, important R&D work can be conducted by this route. Apart from specially created clusters and funded networks, the European research landscape remains heterogeneous and fragmented.



Demographic developments are casting ominous shadows.

In 2010 there is still enough young scientific talent coming through, but this is no longer certain to remain the case over the long term owing to the demographic trend and the decreasing attractiveness of Europe as a place of work, as well as the fragmentation of research activities.

In 2025 the lack of well-trained scientists in Europe is making itself felt strongly. One consequence, already



Europe's ability to compete on the international scene (India, China) is impaired.

mentioned, is the relocation of production and research sites by companies to regions outside of Europe which can provide the necessary personnel. This development in turn reduces the number of jobs in Europe by way of a reinforcement effect that gathers its own momentum. Increased spending on education and research by individual rich countries partially compensates for this. Europe remains competitive only in areas where R&D networks concentrate on European issues and have for a long time played a pioneering role. These are specifically funded and as a result are once again attractive for qualified personnel.



Lessons learned: ‘Glocal’ Europe

The economic crisis continues to dominate the global outlook for a long time to come. As a result, vigorous reforms are being initiated. A movement is evident towards the principles of sustainable development and away from the dogma of resource-intensive growth. Technology regions - or hotspots - are evolving, attracting companies and first class expertise. Whereas the European juggernaut is only slowly regaining speed, certain European regions are thus developing successfully and prospering.

Under the pressure of change, European research is emerging from the crisis structurally renewed. Only those research institutes which have concentrated specifically on their own strengths survive. New research structures exhibit high networking potential, both with industry and with society in general. By contrast, the controlling and shaping role of nations and supranational organizations such as the EU is diminishing, mainly because the high indebtedness of the member countries limits the funds available.

Economic situation and public finances

*In 2010 the economic crisis impacted on the real economy, leading to a weakening of business activity and a decline in industrial production. The effects on the labor market and the public finances are substantial.**

In 2025 the situation on the labor market remains difficult, while the conditions in the economic environment have changed. Production and development locations have moved as a result of the crisis. At the same time, stiffer competition and the sustainability debate have created new markets based on increasingly innovative products and technologies. As existing markets shift and new markets are created certain locations gain in strength and the differences between regions become more pronounced. Furthermore, competition between the European regions encourages them to develop attractive location factors. Technology regions which develop a successful combination of individual players such as companies, public institutions, research institutes and Non Governmental Organizations evolve into hotspots (Silicon Valley effect). In the form of a self-reinforcing effect companies increasingly prefer to be in these hotspots and thus further raising the attraction of the favored locations.



Regional hotspots are emerging in Europe.

The hotspots are characterized by attractive conditions for employees, companies and research institutes.

The inward location of important players creates mutual advantages. As regions exhibit a manageable size and complexity and can react very flexibly, they can break free from the cumbersome structures of the individual member country or the EU. Regions have thus gained completely new opportunities for quickly creating attractive conditions (e.g. infrastructures, resource availability and leisure activities). As a result, successful technology regions around the world are able to create hotspots and develop collaborations with leading players.

Compared to other parts of Europe, the German research landscape benefits today from high research funding, since research expenditure is regarded as an important engine of the economy.

In 2025 the public finances come under strong pressure owing to the high level of debt, and as a result R&D budgets are cut. The difficult financial situation faced by government is alleviated to a certain extent by the creation of new public-private partnerships. Efficient tools have been developed for cooperation between public- and private-sector players and interests. A decisive principle of success in this context is that state supervision remains in place even when public-sector activities are partially privatized.

Europe from the political and social perspective

After a number of serious crises (including within the currency union) the efforts to combine the EU member countries in a strong association of states run out of steam. By contrast, a "Europe of the Regions" is gathering momentum. This is a federalist concept which places emphasis on regional independence and therefore on better regional administration and a closer relationship with citizens. Political pressure increases at the level of the national states and the EU because such a growth in regional competence takes place to the detriment of national powers and responsibilities. In the long-lasting economic crisis this conflict is resolved in favor of the regions because the regions can react more flexibly and respond to the crisis with higher degrees of freedom than the EU combination of states with their sharply divergent interests.

As government R&D funding declines, the regions are jointly funded at national and European level. Within a new research program even less prosperous regions are encouraged to follow the example of the successful regions as part of a benchmark analysis. In 2025 European research funding increased less than national R&D funding. The research institutes of the successful regions in particular take part in the EU research



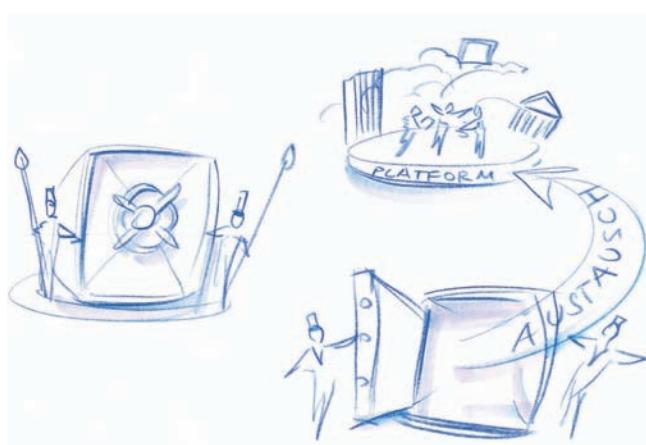
Society demands that research is efficient and effective.

programs in order to strengthen their networks. As a result, long-term links are established between regions and also individual institutions (e.g. between German Fraunhofer and French Carnot Institutes). Networks can, however, also be time-limited and with changing partners, so that they can react flexibly to changing circumstances. By contrast, attempts to implement joint programming, in which the member countries set up a common program for their research institutes to work on a particular subject, are successful only in isolated cases.

In 2010 research in Germany is regarded as important and hardly anyone questions the benefit it yields. In the political arena too, research is held in high esteem, but in the context of social policy plays only a subordinate role. As a rule, research and technology activities are conducted without any social discourse, in isolation within companies, until the results are implemented on the market. Discussions about technology assessment usually take place only after the technology has been introduced to the market.

In 2025 society's attitude to research has changed owing to the continuing difficult economic situation, i.e. the demands in respect of efficient and effective research have risen. Research now has to be target-oriented, although this does not mean that it has to be exclusively application-oriented. Prospering regions must have their own institutes conducting basic research, which can be expected to produce innovations and create a technological edge. Success also requires an interdisciplinary exchange, and a balance has to be sought between the humanities, the economic sciences and the engineering and natural sciences. Thanks to open networking structures that also include key social groups, the various players are able to engage in an intensive exchange. The interactions between society and research, especially in the

context of sustainable development, have intensified in both directions: society encourages research and obtains results. As a result, new transdisciplinary research activities come into being. What is more, society demands that the considerable funding approved in the European Framework Program is invested only in efficient and effective research. This is ensured by means of stringent evaluation of research projects and programs.



Knowledge and research findings are exchanged freely.

In 2010 strong protection continues to impede the utilization of research outcomes.

In 2025 knowledge has increasingly become a production factor. Knowledge as an intangible resource is largely protected by copyrights and industrial property rights, which have been harmonized at European level. While the development of technological innovations is encouraged by this protection, various different licensing models exist, some of them free of charge, which permit the rapid transfer of research and development results. In addition, an open access strategy is implemented in particularly relevant social and scientific sectors. An ongoing cycle of innovation is possible only if knowledge is utilized through free access or by way of various licensing routes. The better utilization of results then increases the benefit to the national economy.

The European research landscape

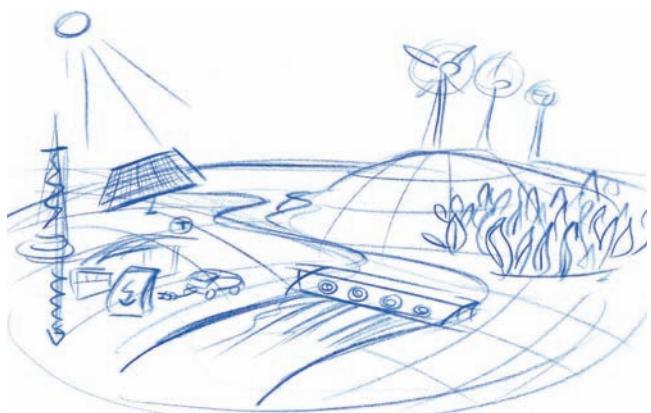
In the year 2010, the objectives pursued by the publicly-funded research institutes in Germany tend to overlap. Most establishments focus on application-oriented research and align their subject areas to broad key future technologies, such as man-machine interaction or renewable energies..



Research stakeholders must carve out a new niche in a restructured research landscape.

In 2025 a varied research landscape has evolved. Owing to the social pressure for efficient research funding, the research institutes are increasingly developing a stronger profile and have built up long-term networks. The

institutes cooperate strongly with the centers within their own regions or other regions, and themselves constitute such centers. This stronger profile will manifest itself in the return to a more pronounced separation of basic and applied research. Differentiations in subject area will also become more prominent. In order to survive, the R&D institutes have to build on their strengths. As a result, the research landscape becomes more efficient and more effective. This process is spreading throughout Europe in different forms.



Energy is a key driver behind networking the European research landscape.

The universities too are very much geared to their regions and the various clusters within them. The universities benefit from the attractiveness of their region and can also be a factor in increasing this attractiveness. The present universities of excellence and the merging of universities with public research institutes to form supercritical research clusters represent the start of this approach.

European research funding acts as a catalyst, encouraging European regions to network with each other. The instruments of the 9th R&D Framework Programme have been very well developed and induce long-term cooperation between equally strong partners (and do not accept any weak partners, e.g. for reasons of structural development). At the same time, the research institutes are now so well organized within their respective research landscapes, thanks to consolidation, that they are highly amenable to networking and cooperation. In general this leads to increased cooperation in research and innovation, irrespective of the amount of EU funding. Competition-relevant subjects of key

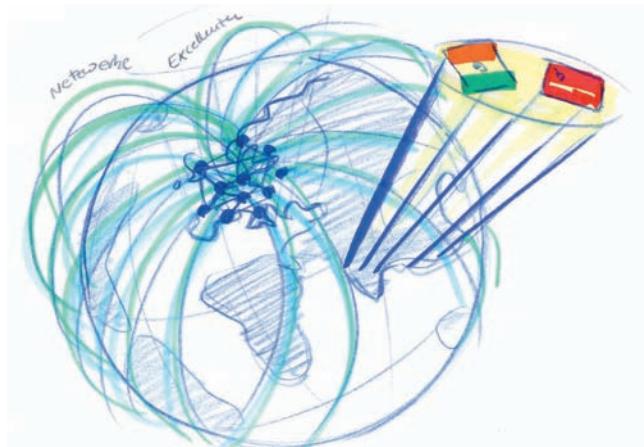
importance, such as energy and mobility, play a major role in the formation of these networks. English is established as the language of science for communication between the European regions. Less prospering regions cannot benefit from these positive developments and consequently represent a stark contrast to the successful regions of Europe.

This growing Europe of the Regions becomes increasingly attractive to both citizens and employees. The previously existing attractiveness, based on a multicultural approach and tolerance in society, is strengthened by further positive developments in Europe: These include the creation of excellent hotspots with clusters of research institutes and companies, the development towards a sustainable society and the completion of a harmonized labor market. As a result, Europe is competitive and can attract research scientists from all over the world, but only the particularly prosperous regions really succeed in attracting labor and thus closing the demographic gap.

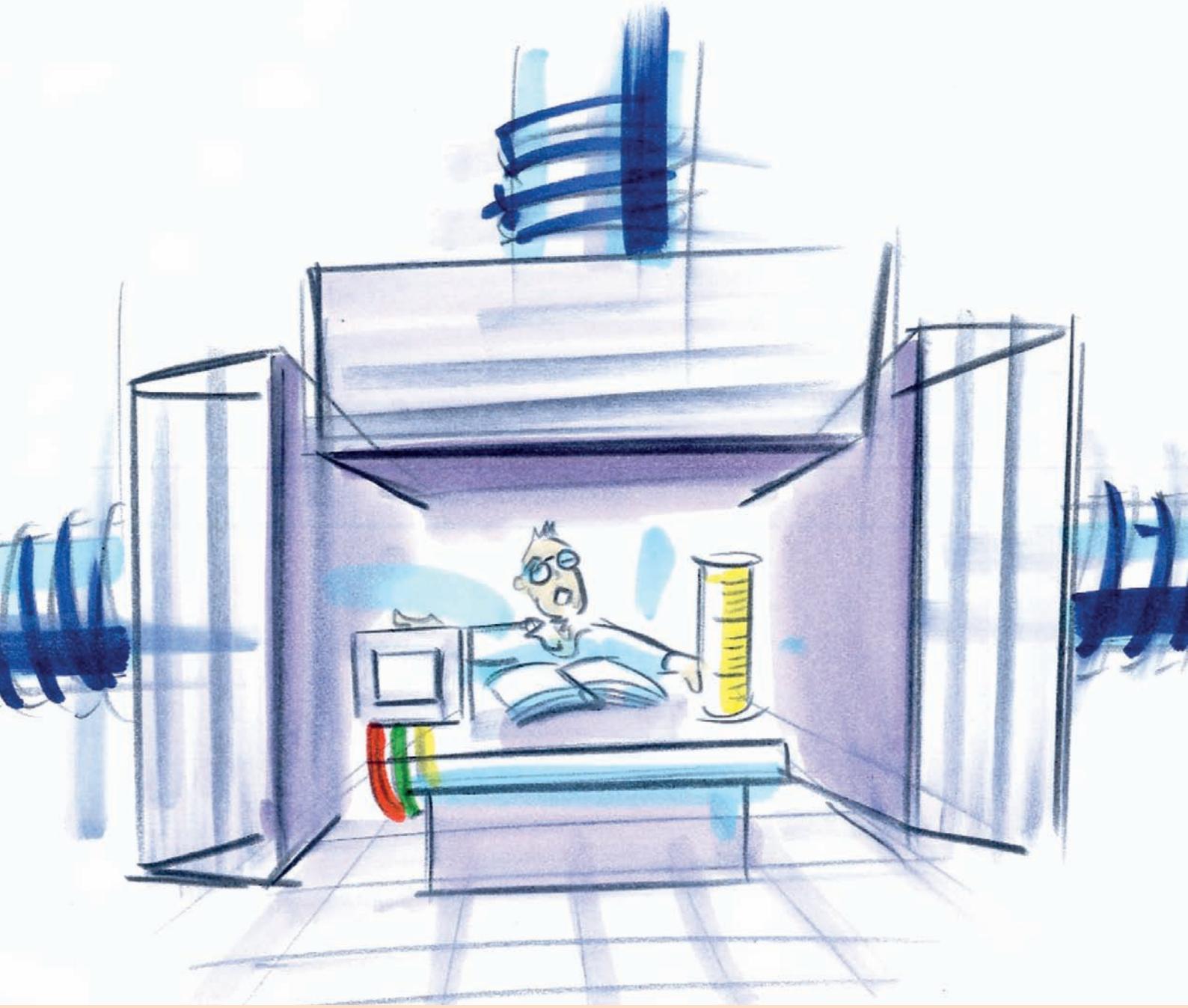
The attractiveness of Germany for research scientists is increased by the introduction of various measures, including discontinuation of the fixed public-service salary rates for research workers. The responsibility of the federal states for their own education systems is further reinforced, which means that even stronger

differences can be expected to emerge between the state school systems.

The European Research Area has been set up on a competitive footing. This was achieved thanks to the successful restructuring of the research institutes in the member countries, the ability of the regions with their worldwide links to react flexibly and a European system of research funding which effectively combines the best research work in Europe. In the face of rising R&D spending in Japan and the USA, as well as in the up-and-coming technology nations such as China, Brazil and India, the structural advantages of a Europe of the Regions are fully exploited.



Competitive networks which also cooperate internationally are developing within Europe.



Market-driven rules: research under pressure

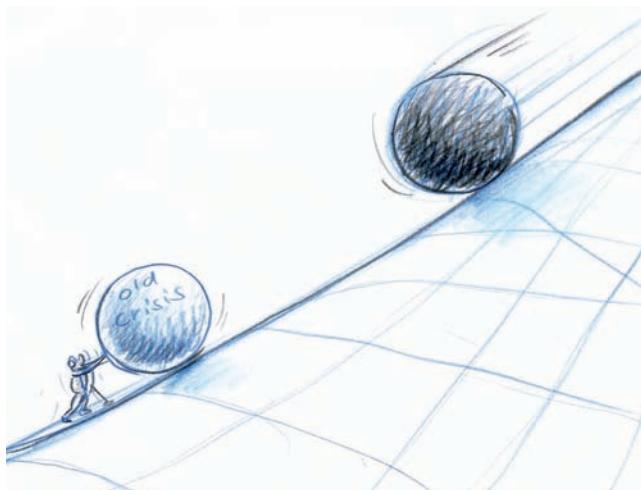
Research institutes are having to come to terms with shrinking public funding, triggered by the prolonged economic crisis and the resulting growth in public debt. This is why the scope of research is being scaled back to what is of direct relevance to industry. The dominant multinational companies are setting the agenda for future research and laying down the conditions for partnerships. All in all, globally operating enterprises are gaining more influence at the expense of national governments as the latter are doing little in the way of coordination within larger international networks, e.g. within the EU. There is still no consensus as regards Corporate Social Responsibility at an international level.

Research institutes have little scope to shape things as they would like to, either in terms of their R&D portfolios or their organizational set-up. While strong networks are developing with companies, interaction with society is suffering as a result. European research partnerships will come about primarily against the backdrop of dwindling EU funding.

Economic situation and public finances

*Although the global financial and economic crisis in progress since 2008 has reached new dimensions, it is still being combated with the same old tools. This is the reason governments have been piling up long-term debt. The debt burden is even driving some EU countries to the brink of bankruptcy.**

In the period up to 2025, the economy has been fluctuating between modest growth and minor slumps at a relatively low level, the reason being that the root causes of the original crisis remain unaddressed. To this extent, one can speak of a permanent state of crisis or an ongoing series of minor crisis cycles. The world community has failed to agree on fundamental reforms and new structures that could pave the way for an economic system based on sustainability. Sustainable development includes not just the sparing use of resources, but also the containment of highly speculative behavior in the financial markets. The resulting risks are being palmed off on the public authorities.



As one crisis passes, another looms.

Companies select their locations solely on the basis of market requirements. They no longer feel any obligation to their countries of origin, and global mergers tend to blur their origins anyway. In times of fierce international competition, companies are at the mercy of market forces beyond the control of the state, and are increasingly oriented towards short-term results and returns. This is why the decisions they make pay so little heed to sustainable development, and to their responsibility towards the environment or their workers.

Production and research facilities can be set up or closed down at will. Depending on the conditions prevailing at a given location – such as tax breaks,



The crisis puts pressure on the economy and public finances.

legislation, availability of personnel and training opportunities – either a country may profit from the companies it attracts or it may lose them. New players in the global science and innovation competition – countries such as South Korea, India, Taiwan, Indonesia and China, who are in the process of catching up industrially – are making their presence felt.

As government regulation of markets diminishes, companies with global operations are gaining a high degree of freedom to mold their own production and working conditions. Governments with a high level of debt do not have the funds they need to remain in control: they become powerless. Against this backdrop, legislation aimed at ensuring minimum wages, restricting research (e.g. genetic engineering) or maintaining high environmental standards is more or less doomed to failure – unless the few remaining companies are to be driven away as well. Given that the international community was unable to agree on a binding climate protection treaty, companies need fear no restrictions in this area.

There are a number of prosperous regions around the world which, thanks to the self-energizing „Silicon Valley“ effect, have not lost the ability to attract companies. The same effect applies in reverse to regions with weak infrastructure: they cannot attract

* The normal text is used for the scenario in 2025, while the italic text describes the year 2010.

new companies as they do not already have an attractive environment to use as bait. The potential for governments to offer attractive conditions in the form of tax concessions are all but exhausted. The differences in economic strength between the individual regions of the world are becoming more accentuated.



Research follows companies abroad.

Research, too, is a major factor in attracting companies to a location. And, again, a self-reinforcing effect is observable in this field. By necessity, research follows the markets. This means that, ultimately, 50% of the research carried out by German and European companies is done outside Europe. The consequence is that German research institutes are following the „German“ companies abroad. Since there are hardly any cases of companies – and thus research institutes – being repatriated to Europe, the Continent as a location for industry is suffering massively because of this.

This trend correlates with the need to find qualified R&D staff. In Germany as in the rest of Europe, it is becoming increasingly difficult to recruit such personnel. The shortage of qualified staff in Europe is due to demographic trends and the continent's waning attraction as a place to work – although individual regions are a positive exception to the rule here. Europe's earlier, more positive image as a haven of political stability offering a variety of cultures and regions has lost its attraction, not least because companies are leaving in droves to set up shop in other locations. Owing to the high level of unemployment worldwide, the practice of paying less than the minimum wage has become acceptable. The shortage of qualified researchers and the falling number of companies setting up business in Europe are triggering a self-reinforcing negative spiral.

Europe - society and politics

In 2010 Europe is on the way to becoming integrated community. But the speed of integration has slowed down. The EU has grown to encompass 27 member states, and finding a consensus between them is getting ever harder. The intention of the Lisbon Treaty was to create new structures commensurate with this larger EU, but even the implementation of the treaty is fraught with difficulties. In the same way, the EU – and, above all, the monetary union – is being faced with huge challenges because of the failure of individual members, e.g. the specter of a nation going bankrupt. Even as early as the economic crisis of 2008/2009 it was apparent that the member states preferred national solutions, rather than pursuing a coordinated European strategy.

In 2025 in the face of the prolonged economic crisis, both the EU members and the other nations of the world are focusing primarily on optimizing their own national economies. Supranational organizations limit themselves to a joint security and foreign policy. EU integration has ground to a halt. With unemployment



The young, internationally mobile scientists of tomorrow are passing Europe by, because it is simply not attractive enough.

on the rise, the achievements of the Single European Market, i.e. the free movement of goods, services and workers, are being called into question. Here and there, discontent is developing into a mood of xenophobia, even within the EU.

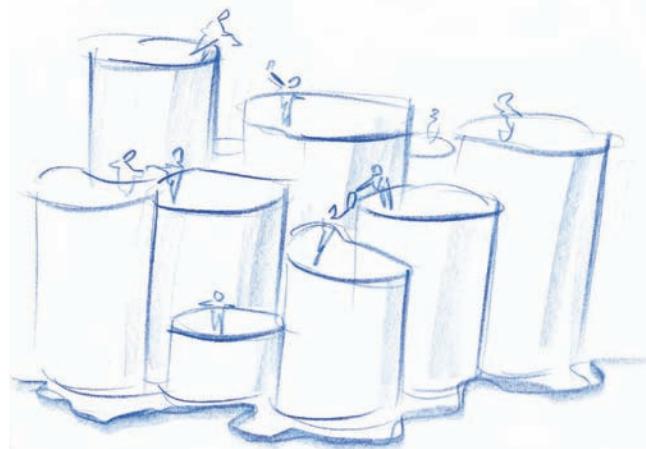
There is less cooperation and more competition between the countries of the EU, and this is also reflected in the growing trend towards preventing the dissemination and use of research results. Scientific publications are sold at high prices by a limited number of publishing companies, while patent regulations and a lack of licensing models are hindering the commercial utilization of R&D results. Given that knowledge, and thus innovation, are key factors in economic growth and increasing affluence, the dwindling utilization of the results of research represents a negative trend. It puts paid to the innovation cycle that could arise with free access to scientific literature and the availability of suitable patent licensing schemes.

Although society's high regard for research and technology remains unaffected by this trend, research is now being evaluated in terms of its utility. With less public funding for pre-competitive research and strong global competition, the effectiveness and efficiency of research are coming under close scrutiny. All research institutes are now more strongly oriented towards third-party funding, mainly from industry. The result is a conflict of cultures between the different research disciplines. What is more, after an initial boom triggered by the sustainability debate, the humanities are being pared back as their utility is called into question. The move to include society more in the dialog on future research topics is also marking time because tomorrow's research agenda is inevitably being set by market demand. As enterprises – are compelled to – seek short-term success and profits, any talk of sustainable development is generally silenced.

The European research landscape

Dwindling public funding for research and the growing influence of companies are causing research institutes to shift their focus more towards application-oriented topics. Publicly funded institutes, which previously concentrated on „global challenges“ by carrying out medium-term precautionary research, are now realigning themselves with the short-term contract-research market. Even those institutes that mainly focused on basic research are now becoming involved in application-oriented research. With the missions

of these different types of research institute converging, the danger of inefficiency is growing: everyone is pursuing similar goals and there is a lack of differentiation between the institutes. The much needed institutional restructuring of the research landscape is not taking place because interaction with society is on the decline (the latter has hardly any contact with the world of research anymore), and there is very little constructive intervention on the part of politicians. The research institutes are all busy competing for third-party funding; there is no room for a discussion of long-term structures. The companies, a potential source of influence, have little interest in a holistic realignment because they cooperate worldwide only with those research institutes



Cooperation and understanding between EU member states is difficult to achieve.

that they consider suitable. The focus of corporate interests is naturally on short-term returns, and this is even more true in times of crisis.

Although the public coffers are under much strain in 2010 because of the economic downturn, German research institutes are still profiting from high research spending in comparison with their European peers.

Although expenditure on research in 2025 is lower in both Germany and the EU, it is still relatively high when compared with other budget items. The reduction in funding has exacerbated competition between the individual research institutes. In particular, the allocation of institutional funding for institutes is up for discussion. These trends are affecting the tertiary education landscape too, with universities shifting their focus much

more strongly towards application-oriented areas. Within this trend, however, universities have become more and more specialized and integrated in the companies' innovation networks. The close cooperation between enterprises and universities has continued to move in a positive direction, as evidenced by the large number of university chairs found by foundations.



Universities (HS) are moving into areas of application-oriented research previously the domain of the Fraunhofer-Gesellschaft (FhG).

EU funding for research continues to rise under the 9th R&D Framework Programme – though only modestly – mainly because the European funds has been allocated mainly as a structural fund to stabilize certain regions or countries within the EU. As regards R&D expenditure,

the EU cannot keep pace with countries such as China, Japan and India. The envisaged 3% goal now seems beyond reach. In terms of the focus of research, there is little overlap between the funding programs of the EU and those of the national governments. Difficult public finances, coupled with the focus on national interests, are cementing the separation between research interests at national and EU level. At European level, funding for key topics of market relevance – such as security, energy and mobility – is strong, with the result that European research networks are being forged in these areas. However, these networks tend to collapse at the end of the funding period, with their members returning again to their national structures. In general, joint research programs involving several EU members are the exception, and long-term partnerships hardly exist at all. The EU Commission has failed to establish mechanisms to safeguard long-term partnerships within Europe, and companies searching for new locations hardly consider the existing temporary networks to be a factor in Europe's favor.

Partnerships between individual research institutes are restricted, too, as the institutes are locked into the innovation networks of different competing companies. All this makes for a fragmented and heterogeneous research landscape in which only few long-term networks can be established.

Scenario team & moderation

Scenario team (in alphabetical order)

Dr. Lothar Behlau, Department Head Strategy and Programs, Fraunhofer-Gesellschaft

Axel Bauer, Marketing and Communication, Fraunhofer Institute for Laser Technology (ILT)

Dr. Guenter Clar, Director Regional Strategies and Innovation, Steinbeis-Europa-Zentrum (SEZ)

Dr. Kerstin Cuhls, Coordinator of Business Unit Futures Research and Foresight, Fraunhofer Institute for Systems and Innovation Research (ISI)

Prof. Dr. Carsten Dreher, Director of the Center for Cluster Development (CCD) at the Free University of Berlin

Dr. C.L. Kees Ekkers, Director Strategy and Research Planning, Netherlands Organisation for Applied Scientific Research (TNO)

Miriam Hufnagel, Competence Center Policy and Regions, Fraunhofer Institute for Systems and Innovation Research (ISI)

Dr. Simone Kimpeler, Competence Center Emerging Technologies, Fraunhofer Institute for Systems and Innovation Research (ISI)

Undersecretary Wilfried Kraus, Head of Cultural, Earth System and Environmental Research at the German Federal Ministry for Education and Research (BMBF)

Prof. Dr. Stefan Kuhlmann, Chair of Departement of Science, Technology, & Policy Studies (STePS), University of Twente

Andrea Kulas, Department of Strategy and Programs, Fraunhofer-Gesellschaft

Dr. Berthold Neizert, Head of International Relations, Max Planck Society

Dr. Margit Noll, Assistant to the Director of the Austrian Institute of Technology GmbH (AIT)

Dr. Frank Martin Petrat, Senior Consultant to the innovation agency Evonik Degussa GmbH

Dr. Georg Rosenfeld, Division Director Corporate Development, Fraunhofer-Gesellschaft

Dr. Thomas Stahlecker, Competence Center Policy and Regions, Fraunhofer Institute for Systems and Innovation Research (ISI)

Dr. Roland Strauss, Director Brussels Office, BITKOM e.V.

Illustrations & Artworks

Heyko Stöber

Moderation

Dr. Ewa Dönitz, Competence Center Innovation and Technology Management and Foresight, Fraunhofer Institute for Systems and Innovation Research (ISI)

Elna Schirrmeister, Deputy Head Competence Center Innovation and Technology Management and Foresight, Fraunhofer Institute for Systems and Innovation Research (ISI)



Editorial Notes

Editorial team:

Dr. Lothar Behlau
Andrea Kulas

Authors:

Dr. Lothar Behlau, Headquarters of the Fraunhofer-Gesellschaft
Andrea Kulas, Headquarters of the Fraunhofer-Gesellschaft
Dr. Ewa Dönitz, Fraunhofer Institute for Systems and Innovation Research ISI
Elna Schirrmeister, Fraunhofer Institute for Systems and Innovation Research ISI

Layout: Johanna Angermeier

Illustrations and Cover Picture: Heyko Stöber

Translation:

Burton, Van Iersel & Whitney GmbH München

No reproduction without prior consent of the editorial team.

Contact:

Fraunhofer-Gesellschaft
Andrea Kulas
Hansastraße 27 c
80686 München
Germany
Telephone: +49 89 1205-1222
andrea.kulas@zv.fraunhofer.de

www.fraunhofer.de

© Fraunhofer-Gesellschaft, München 2010

The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft was founded in 1949 and currently maintains more than 80 research units, including 59 Fraunhofer Institutes. Its 17,000 employees share an annual research budget of 1.6 billion euros. Subsidiaries, affiliated research centers and representative offices in Europe, the United States and Asia provide contact with the regions of greatest importance to present and future scientific progress and economic development.

Fraunhofer's services are requested by customers and partners in industry, the service sector and public administration. With their focus on technology and systems-oriented innovation, the institutes strengthen their clients' ability to compete effectively on the international scene. But that's not all. The outcomes

of their applied research extend well beyond the immediate benefits to these customers: the research and development work undertaken by Fraunhofer Institutes also enhances the competitiveness of their local regions, of Germany, and of Europe as a whole. They develop technical and organizational solutions that can be employed in real life, and they work in almost every area of technology:

- Information and communications technology
- Life sciences
- Light & surfaces
- Microelectronics
- Production
- Materials, components

