RESEARCH AND INNOVATION IN SWITZERLAND 2022 INTERIM REPORT

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Remarks for English-speaking readers

The present report is a shorter version of the 2022 Interim Report entitled, 'Research and Innovation in Switzerland'.

The full 2022 Interim Report contains a description of the Swiss research and innovation system (Part A) as well as a comparison of various countries and innovation metropoles (Part B). This report has been published in German and French.[1]

The abridged version in English includes an introduction, a management summary (of the entire 2022 Interim Report) and Part A. Part B is not available in English. Whenever Part B is mentioned in this English version, what is being referred to is Part B in the full German or French version of the 2022 Interim Report.

[1] www.sbfi.admin.ch/fi-bericht

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INTRODUCTION

As part of the National Action Plan on Digitisation, the Federal Department of Economic Affairs, Education and Research (EAER) has decided to support a network of technology transfer centres to help Swiss SMEs overcome the challenges associated with modern manufacturing technologies. One of these federally supported centres is ANAXAM, which offers industries access to advanced analytical methods using neutron and synchrotron radiation (X-rays). This photo shows the neutron source at the Paul Scherrer Institute, which ANAXAM uses for its work.
Photo: Oliver Oettli

Context and purpose of this report

Research and innovation are crucial for sustainable social, environmental and economic development in Switzerland. Strong research and innovation performance also ensures that our country is able to hold its own in the face of international competition. The Federal Council therefore attaches great importance to education, research and innovation policy, which is reflected in the considerable amount of funding allocated to this policy area.

Monitoring and impact assessment tools are used to observe the impact of investments. The present report, ‚Research and Innovation in Switzerland' (R&I Report) by the State Secretariat for Education, Research and Innovation (SERI), is one example of this. This report shows the performance of the Swiss research and innovation system (R&I system) and is intended to help readers to better understand the Swiss R&I landscape. The findings of the R&I Report also serve as a basis for the preparation of the Federal Council's dispatches on the promotion of education, research and innovation (ERI dispatches), which are submitted to the Swiss Parliament every four years.

The R&I report was first published in 2016 and a second time in 2020.[1] The present document is an interim report. As such, it is significantly shorter than the long versions from 2016 and 2020. After publication of this report, the concept and content of future R&I reporting will be analysed and adjusted. This report will be analysed with a view to redesigning the concept and content of future R&I reporting.

The 2022 Interim R&I Report describes the Swiss R&I system and compares it with benchmark countries and innovation metropoles. This report is intended for a readership comprised of policymakers and government officials responsible for strategic management of the Swiss ERI system. The target readership also includes R&I funding institutions, education institutions as well as interested persons, organisations and businesses in Switzerland and other countries.

Structure and content of the 2022 Interim R&I Report
This report is subdivided into two parts:

Part A describes the framework conditions, stakeholders, responsibilities, R&I funding and the main national and international R&I funding instruments.

Part B examines Swiss research and innovation performance on the basis of indicators. The comparison focuses on selected countries and European metropoles that are heavily geared towards research and innovation.

[1] in addition, Part B ‚International comparison of Swiss research and innovation activities' was updated in 2018.

Because this is an interim report, a smaller number of indicators are used compared to the previous full reports from 2016 and 2020; in addition, Part C (studies on crucial overarching or cross-cutting issues affecting the Swiss R&I system) has been omitted.

Key sources of statements on Swiss R&I performance include the ‚Research and Development in Switzerland' statistics (R&D statistics) produced by the Federal Statistical Office (FSO) as well as on the innovation survey conducted on SERI's behalf of the KOF Swiss Economic Institute (ETH Zürich). The most recent data from these surveys, which were available when this report was being prepared, relate to the reference year 2019 in the FSO's R&D statistics and to the reference period 2016 to 2018[2] in the KOF Innovation Survey. Both periods reflect the situation just prior to the Covid 19 outbreak. For this reason, the impact of the Covid-19 period on Swiss research and innovation is not discussed.[3] The report does, however, make individual references to the Covid 19 issue (e.g. in relation to specific R&I funding programmes).

A broad view of research and innovation
The present report examines research and innovation from a broad angle, which includes technological, economic and social aspects and considers the interaction of several stakeholders and institutions along with the resulting feedback effects and synergies. The report implies, among other things, that basic research, applied research and innovation do not necessarily follow a linear sequence. Applied research can certainly lead to questions that can be fed back into basic research. Likewise, basic research can directly give rise to various applications and innovations. And often innovations arise without any prior research and development (R&D) whatsoever.

Definition of research and innovation
Each stakeholder has its own definition of research and innovation, depending on their perspective (e.g. researchers, academic institutions, business enterprise sector).

Research and Innovation as defined in the Federal Research and Innovation Promotion Act (RIPA)[4]
According to the Federal Research and Innovation Promotion Act (Art. 2), scientific research is defined as a methodically guided search for new knowledge. It includes basic research, which is primarily intended to acquire new knowledge as well as applied research, where the aim is mainly to find practical solutions to existing problems.

[2] Exception: In Part A, Chapter 2.1, the proportion of enterprises pursuing R&I activities was determined using data from the reference period 2018-2020.

[3] For an international overview of the potential impact of Covid-19 on research and innovation, see (1) Times of Crisis and Opportunity (OECD, 2021) and (2) What future for science, technology and innovation after COVID-19? (Paunov & Planes, 2021).

[4] SR **420.1**

Focus of the two main institutions supporting R&I in Switzerland

The **Swiss National Science Foundation (SNSF)** mainly supports research that is intended to expand knowledge in general (basic research). It also supports research where scientific knowledge is expanded with the aim of finding practical solutions (use-inspired basic research). In the field of medicine, the latter is referred to as translational research.

The **Swiss Innovation Agency (Innosuisse)** supports science-based innovations in businesses and organisations as well as the transfer of knowledge and technology between research and implementation partners. It encourages innovation in all scientific disciplines and fields of innovation that can benefit the economy and society. Support comes in the form of financial contributions, consulting and reinforcement of networks.

Science-based innovation means the development of new products, methods, processes and services in industry and society through research, particularly applied research and the exploitation of its results.

Definitions of research and innovation may differ from country to country. In order to include all scientific and technological activities and to ensure international comparability of data, this report refers to the internationally accepted definitions contained in the Frascati Manual (OECD, 2015) and the Oslo Manual (OECD & Eurostat, 2018), unless explicitly stated otherwise.

Research and development as defined in the Frascati Manual
The Frascati Manual draws a distinction between three types of research and development activities (R&D activities):

- **Basic research** is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.
- **Applied research** is original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective.
- **Experimental development** is systematic work, drawing on knowledge gained from research and practical experience and producing additional knowledge, which is directed to producing new products or processes or to improving existing products or processes (OECD, 2015: p. 45).

Innovation as defined in the Oslo Manual
The 4th edition of the Oslo Manual, which was published in 2018, defines innovation as follows: 'a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).' (OECD & Eurostat, 2018: p. 20)

This definition includes all forms of innovation,[5] i.e. innovation in business, in government, in the arts as well as in the social sphere. Innovations can serve both economic and social objectives (OECD & Eurostat, 2018: Chapter 1, § 1.1; Chapter 2, § 2.2).

Use of the terms 'research and development' and 'research and innovation'
The Oslo Manual identifies eight types of activities that are typically associated with business innovation.[6] 'Research and development (R&D) is one of these. In this report, the term ‚research and development' is used mainly when making statements based on official statistics, where measurement of R&D activities is the primary focus (e.g. R&D expenditure and personnel). However, when discussing other research and innovation activities and aspects that do not relate exclusively to research and development (e.g. policy decisions or intellectual property), the term ‚research and innovation' is used instead.

[5] The focus of the 2018 edition of the Oslo Manual is on business innovation.

[6] (1) R&D activities; (2) Engineering, design and other creative work activities; (3) Marketing and branding equity activities; (4) Intellectual property (IP) related activities; (5) Employee training activities; (6) Software development and database activities; (7) Activities relating to the acquisition or lease of tangible assets; (8) Innovation management activities (OECD & Eurostat, 2018: p. 34–35).

MANAGEMENT SUMMARY

The Swiss company dhp technology AG from Zizers developed the ‚HORIZON' solar folding roof to enable the multifunctional use of infrastructures such as car parks and sewage treatment plants. The solar folding roof is deployed directly above the infrastructure using cable car technology (photo: Glarnerland sewage treatment plant). It can be folded up like an accordion to facilitate such things as crane-based servicing and maintenance work. The EU provided funding for this project under the 8th Framework Programme for Research and Innovation (Horizon 2020). The participation of Swiss R&I stakeholders in these EU programmes brings multiple benefits to Switzerland and is an important pillar of Swiss research and innovation policy.
Photo: Oliver Oettli

Part A: Swiss research and innovation system

Part A provides an overview of the Swiss research and innovation system (R&I system). It describes the framework conditions, the stakeholders, the role of government and the corresponding legal basis. It also explains how research and innovation activities are funded, describes the main national and international funding instruments used to support research and innovation, and discusses knowledge and technology transfer.

Framework conditions

The framework conditions for research and innovation are considered very advantageous in Switzerland. Political stability, safety and quality of life are outstanding compared to other countries. The well-developed, constantly modernised infrastructure, the efficiency of state institutions, strong digital competitiveness and the high quality and permeability of the education system are all worth mentioning. That said, Switzerland compares less favourably with other countries when it comes to online government services.

The markets for labour, capital, goods and services are largely competition-driven. Access to international markets is made possible thanks to various multilateral and bilateral agreements, which confer a high degree of flexibility to the economy. Switzerland also boasts favourable taxation conditions.

Within the specific context of research and innovation, framework conditions include both academic freedom and a high-quality education system. The Swiss education is jointly managed by the Confederation and the cantons, each in their own respective area of authority. It offers a complementary range of vocational and academic pathways and boundaries between the two remain permeable. This enables highly skilled professionals and managers to pursue education and training in very different areas of business, science and public administration. This is a key factor in Switzerland's R&I performance. Switzerland also has solid R&I funding mechanisms in place and clear rules to protect intellectual property.

Stakeholders

The most important driver of Switzerland's innovative strength is the business enterprise sector. Around two-thirds of all research and development (R&D) activities in Switzerland are funded and carried out by large companies, but also by small and medium-sized enterprises. These companies, which often also operate internationally, primarily engage in applied R&D activities with the aim of transforming knowledge into marketable innovations. In this area, they often work with higher education institutions, especially universities of applied sciences.

The Swiss higher education landscape offers a wide range of study and research opportunities through three types of higher education institution: universities, universities of applied sciences (UAS) and universities of teacher education (UTEs). The first type includes cantonal universities and Switzerland's two federal institutes of technology (FITs; ETH Zurich and EPFL in Lausanne). Swiss higher education institutions have achieved internationally recognised performance. The mandate includes teaching (incl. undergraduate programmes, graduate programmes and continuing education), research and development (R&D), knowledge and technology transfer (KTT) and the provision of services to third parties. Swiss TUs mainly conduct basic research and teaching content is research-based. In contrast, Swiss universities of applied sciences focus on applied research and development. Swiss higher education institutions maintain international networks, which is important for Swiss research and innovation.

A number of independent federally funded research institutes also contribute scientific added value. Another R&I stakeholder is the federal administration, which pursues federal policy research. This is scientific research conducted in the public interest. Policy research provides information and data that are needed by the federal administration to perform its tasks. The various federal offices conduct policy research themselves or outsource it to universities and private businesses.

Role of the government sector

Public R&I funding is largely the responsibility of the federal government, specifically the Federal Department of Economic Affairs, Education and Research (EAER) and its State Secretariat for Education, Research and Innovation (SERI).

The Federal Research and Innovation Promotion Act (RIPA) stipulates the purpose and structure of federal R&I funding. In addition to national funding, RIPA also describes the Confederation's role in international funding and specifies the tasks, procedures and responsibilities of federal funding bodies. Under the Higher Education Act (HEdA), the Confederation and the cantons must work together to coordinate their activities and ensure the quality and competitiveness of the Swiss higher education sector. This is important as research activities pursued within the higher education sector greatly contribute to downstream innovation activities.

As responsible bodies of universities, universities of applied sciences and universities of teacher education, cantonal governments play an important role in encouraging R&I. They also support start-ups and regional networks, doing so either on their own or in conjunction with other cantons. In addition, municipal and communal governments support innovation by creating technology and innovation parks, for instance.

Finances

In terms of Swiss gross domestic expenditure on R&D (GERD), Swiss R&D performance reached 22.9 billion in 2019, or 3.15% of gross domestic product (FSO, 2021a). Switzerland thus compares favourably with other benchmark countries and is well above the OECD average (2.51%).[1]

The business enterprise sector drives most of this expenditure, accounting for around two-thirds of both R&D funding and performance. The government sector (Confederation and the cantons) funds roughly one-fourth of R&D activities. Most of this government sector funding goes to the ETH Domain, cantonal universities and universities of applied sciences.

Swiss controlled affiliates abroad also have high levels of R&D expenditure. In 2019, their R&D expenditure (CHF 15.8 billion) was even slightly higher than Switzerland's business enterprise sector expenditure on R&D (CHF 15.5 billion).

National, regional and cantonal support

The Confederation provides R&I funding primarily through two main funding bodies: the Swiss National Science Foundation (SNSF) and Swiss Innovation Promotion Agency (Innosuisse). Both review and select projects submitted to them in competitive calls for proposals. The SNSF is the most important Swiss institution responsible for funding scientific research. It gives special attention to supporting the next generation of scientists. For its part, Innosuisse is the federal funding agency responsible for science-based innovation. It encourages the transfer of knowledge between public research institutes and industry. Among other things, Innosuisse supports science-based start-ups. In addition, the Swiss Academies of Arts and Sciences is an organisation that seeks to intensify cooperation within and between researchers from different scientific disciplines and strives to anchor science in society.

Through the federal government's New Regional Policy (NRP), the State Secretariat for Economic Affairs (SECO) seeks to improve the competitiveness of Swiss regions by supporting local entrepreneurial initiatives and innovation. The cantons also play a role in fostering innovation and economic development, partly thanks to federal subsidies paid to them within the framework of SECO's NRP. Finally, a number of foundations also work to encourage research and innovation.

International cooperation

Cross-border cooperation provides Swiss researchers with access to international networks and brings scientific and economic benefits to Switzerland.

Switzerland's participation in EU framework programmes for research and innovation are very important. Researchers in Switzerland have been taking part in these programmes since 1987.

Switzerland is a member and partner of other international programmes, research infrastructures, research infrastructure networks and initiatives, all of which facilitate international R&I cooperation. This includes membership with the European Space Agency (ESA) as well as Switzerland's status as a host country and member of the European Organization for Nuclear Research (CERN) in Geneva. These memberships allow Swiss R&I stakeholders to conduct their experiments in cost-intensive research infrastructures and gain access to scientific data and a wide range of knowledge.

The Confederation pursues bilateral funding programmes to facilitate cooperation with non-European priority countries and maintains a global network of science offices and counsellors at Swiss missions abroad.

Knowledge and technology transfer

Knowledge and technology transfer (KTT) between universities, research institutes, companies and government agencies has become increasingly important in ensuring successful innovation. The aim of KTT is to initiate, improve and drive innovation processes. Here, emphasis is placed on the practical and/or economic use of existing and jointly generated knowledge.

KTT is one of the tasks of the ETH Domain, cantonal universities and universities of applied sciences. Since these institutions traditionally focus on teaching and research, KTT takes place primarily via graduates who work in companies (‚transfer via heads'). KTT also results, for example, from Switzerland's participation in various international programmes (e.g. EU framework programmes for research and innovation), research infrastructures (e.g. CERN) and international R&I cooperation platforms (e.g. Eureka). In addition, most cantons and larger towns maintain technology parks that serve as fertile ground for KTT.

The Swiss Innovation Park, which links science and business, is a key location for KTT. Under the umbrella brand of ‚Switzerland Innovation', the park is currently comprised of six main sites, situated near Switzerland's two federal institutes of technology (ETH Zurich and EPFL in Lausanne), in Aargau, northwestern Switzerland, Biel and eastern Switzerland. Other regional sites are connected to these main sites.

Technology transfer or KTT offices have been established to encourage and support KTT. These offices vary in terms of institutional structure and content. In addition, Innosuisse instruments are also designed to intensify KTT between researchers and businesses.

[1] See Part B, Figure B 4.3.

Part B: International comparison of Swiss research and innovation

Part B explores Switzerland's international standing in the area of research and innovation and draws a comparison with selected countries[1] and leading European innovation metropoles.[2]

Overall, analysis shows that Switzerland is well positioned in terms of research and innovation. Switzerland is far ahead in many indicators. However, the differences between countries considered in the comparison are tending to narrow. The economies of countries like Singapore and South Korea are developing rapidly. Moreover, comparison with six innovation metropoles of similar size to Switzerland in four European countries (Germany, Italy, France, United Kingdom) confirms Switzerland's good overall position. However, Switzerland performs less well with innovation metropoles than with the respective four countries where they are located. In order to retain its leading internationally competitive position in the future, Switzerland must pay particular attention to the areas where it can improve and areas where it may potentially lose ground.

Framework conditions for research and innovation

Good framework conditions are an essential prerequisite for a country's success in the area of research and innovation. Alongside Singapore, Switzerland is a global leader in this respect: the high level of political stability, efficient state institutions, low corporate taxes, a flexible labour market and very competitive digital technology make Switzerland a particularly appealing location for research and innovation.

In terms of the performance of infrastructures and logistics systems, Switzerland ranks in the middle, with most countries in the comparison performing similarly. In terms of the quality and scope of online government services, Switzerland was ranked third to last.

Education and skills

Switzerland benefits from the high quality of its education system, which offers both academic and vocational pathways. In addition, the Swiss population as a whole is highly educated, which provides a key basis for research and innovation activities. In 2020, 53% of the Swiss population between the ages of 25 and 34 held a tertiary-level qualification, with PhD holders accounting for 2.2% of this total.

Among the benchmark countries, only South Korea and the United Kingdom reported a higher proportion of holders of tertiary-level qualifications. Switzerland came out on top in terms of PhD holders

With regard to study programmes in STEM fields, Switzerland was not among the top countries, which had higher proportions of new entrants at Bachelor's or comparable level. However, Switzerland's proportion of new entrants in these disciplines has risen steadily in recent years, both at Swiss universities of applied sciences and at universities (FITs and cantonal universities), with most of the new entrants being women: Between 2009 and 2020, new female entrants into STEM degree programmes increased by 65%.

Tertiary education in Switzerland is very internationally oriented. Together with the United Kingdom and Austria, Switzerland was considered to be one of the most appealing countries for foreign students at tertiary level in 2019. This is particularly true at PhD level, where over half of PhD students came from other countries.

Research and innovation staff

In Switzerland, 42% of the labour force was employed in the field of science and technology in 2020. Compared with the benchmark countries, a relatively high proportion of the Swiss workforce is involved in the production, dissemination and application of scientific and/or technological knowledge. However, in terms of the share of researchers in total employment, Switzerland is positioned at the lower middle range of benchmark countries.

The recruitment of foreign workers by companies and universities is also very important in the R&D sector. In 2019, 43% of the R&D staff at universities and 41% of the R&D staff in companies were foreign workers. A comparison with the year 2000 shows a sharp increase in the proportion of foreigners, which has nevertheless levelled out in recent years.

The proportion of female researchers working in Switzerland stands at 36%. Even though Switzerland compares very favourably with benchmark countries, the ‚leaky pipeline' phenomenon persists: While in 2020, 54% of holders of a Bachelor's degree and 53% of holders of a Master's degree were women, the proportion of women among recent PhD holders was still 47% and among appointed professors and senior researchers only 26%.

[1] The countries considered in this comparison are: China, Germany, France, Israel, Italy, Netherlands, Austria, Sweden, Singapore, South Korea, USA, United Kingdom.

[2] The innovation metropoles considered in this comparison are: the two German federal states of Baden-Württemberg and Bavaria; the Italian region of Lombardy-Piedmont; the two French regions of Rhônes-Alpes and Île-de-France (Greater Paris), and Greater London.

R&D funding and performance

R&D funding indicators show which sectors provide the funding used to perform R&D activities in individual countries. R&D performance indicators, on the other hand, show which sectors performed R&D activities in individual countries and how much funding they used for these activities. Depending on R&D transfer flows (i.e. the flow of capital from sources of funding to R&D performers), the respective shares attributed to each sector may vary.

With regard to R&D funding, we find that, as in most of the benchmark countries, the business enterprise sector was the main source of funding in Switzerland in 2019, accounting for 65% of Swiss R&D funding. The government sector was the second-largest source of R&D funding for most of the benchmark countries and in Switzerland, where the Confederation and the cantons accounted for 27% of Swiss R&D funding.

With regard to R&D performance, we find that, as in most of the benchmark countries, the business enterprise sector also had the largest share of total R&D expenditure (68%) in Switzerland.[3] Swiss higher education institutions were also key R&D performers, accounting for nearly the remaining third (29%) of R&D expenditure. Singapore and the Netherlands had similarly high figures as Switzerland. In contrast, the Swiss government sector's share amounted to only 1% of total R&D expenditure. China and Germany were among the benchmark countries with large government sector shares of total R&D expenditure. Overall, total Swiss R&D expenditure stood at 3.15% of GDP. This places Switzerland above the OECD average, but below the group with highest R&D intensity, which includes Israel, South Korea and Sweden.

In 2020, Switzerland had a similar level of venture capital investment as a share of GDP (0.08%) as most of the benchmark countries. However, venture capital investment as a share of GDP was significantly higher in the USA (0.63%) and South Korea (0.16%) in particular.

Participation in EU framework programmes for research and innovation, particularly in Horizon 2020

Switzerland's participation in EU framework programmes (FPs) is crucial for Swiss research and innovation. It gives institutions, companies and researchers the opportunity to work with partners from other countries, to share knowledge and use infrastructures. Switzerland has been involved in FPs in various ways since 1987.

Analysis of the data from FP3 up to and including FP8 (Horizon 2020, 2014-2020) shows that the number of instances of Swiss participation and the corresponding funding flows to R&I performers in Switzerland have steadily increased since 1992.

The focus of analysis is on Horizon 2020. Switzerland was partially associated with Horizon 2020 from 2014 to 2016 and then fully associated from 2017 to 2020. The data basis for FP9 (Horizon Europe, 2021-2027) does not yet provide sufficient information (as of August 2022). From 2021 to 2022, Switzerland took part in Horizon Europe as a non-associated third country. The form in which it will take part in the future is still uncertain (as of August 2022).

In Horizon 2020 (2014-2020), Switzerland ranked second among the benchmark countries in terms of the number of instances of project participation per million inhabitants, falling just behind the Netherlands. In terms of total funding flows to R&I performers, Switzerland ranked behind Germany, the United Kingdom, France, Italy and the Netherlands. In terms of average contribution per instance of participation, Switzerland ranked second behind Israel. In terms of the success rate[4] of project proposals, Switzerland ranked third, falling slightly behind France and Austria. In terms of the grants awarded by the European Research Council to individual researchers from all disciplines for promising research projects, Switzerland was behind the United Kingdom, Germany, France and the Netherlands.

Research publications

Switzerland produced more scientific publications per capita in the period from 2016 to 2020 than any other country. The largest proportion of these were published in the research fields of ‚clinical medicine', ‚life sciences' and ‚physics, chemistry and earth sciences'.

Despite increasing competition from countries such as China and Singapore, Switzerland continued to produce a respectable volume of high-impact scientific publications relative to its small size. The largest share of this research output related to the following research fields: ‚Agriculture, Biology and Environmental Sciences', ‚Technical and Engineering Sciences, Computer Science' and ‚Physics, Chemistry and Earth Sciences'. Switzerland's success in research, and especially in scientific publications, is partly due to its strong international network and partly to the fact that researchers in Switzerland often work with foreign institutions. In the period from 2016 to 2020, 84% of Swiss research output resulted from international cooperation.

[3] The small difference of three percentage points between the business enterprise sector's share of total contributions to R&D funding (65%) and the share of funding that the business enterprise sector received from various sources for R&D performance (68%) is the result of the corresponding R&D funding flows (see Part A, Figure A 4.1 and Table A 4.2)..

[4] The success rate is calculated by dividing the total number of incoming project proposals by the number of approved projects.

Patents

Patent applications provide useful information about a country's inventions. They indicate how the knowledge gained from a country's R&D activities can be used for technological and commercial purposes. In relation to the number of inhabitants, Switzerland has a particularly high number of PCT[5] patent filings, followed by Sweden and South Korea. Switzerland's strong international network is also worth mentioning: in 2018, it was at the top of the list of benchmark countries in terms of the proportion of PCT patent applications filed with at least one foreign co-inventor (39%). In addition, 28% of patent applications filed under the name of an inventor established in Switzerland were owned by foreign companies. This shows Switzerland's strong appeal as an R&I location.

With regard to ICT and environmental technologies, Switzerland lagged far behind benchmark countries in 2018, with 11% of the total number of PCT applications relating to ICT and 7.5% relating to environmental technologies. China led the world in terms of patent filings for ICT, while Austria led in terms of patent filings for environmental technologies.

Innovation activities of businesses

IIn Switzerland, the share of companies with product innovations fell from 59.7% to 39.9% in the industrial sector and from 55.3% to 32.1% in the services sector between the periods 2002-2004 and 2014-2016. In the period 2016-2018[6], this share began increasing again slightly for the first time: by 0.4 percentage points to 40.3% in the industrial sector and by 0.7 percentage points to 32.8% in the services sector. While these two indicators were the highest among the benchmark countries in the early 2000s, Switzerland continued to lag behind Germany and Sweden in the industrial sector and behind Sweden, Germany and Austria in the services sector.

In terms of the share of innovative products in the total turnover of industrial companies with product innovations, Switzerland ranked second to last among the benchmark countries in 2018. Italy, Germany and Austria were at the top. In the services sector, however, Switzerland's share was the highest among the benchmark countries.

Taking company size into account, large Swiss companies (250 employees and more) had the second-lowest share of turnover in innovative products in the industrial sector but the highest share of turnover in innovative products in the services sector when compared with benchmark countries in 2018. In the industrial sector, both the smaller (10 to 49 employees) and the larger Swiss SMEs (50 to 249 employees) had the highest share of turnover in innovative products among the benchmark countries. In the services sector, the smaller and larger SMEs ranked third among the benchmark countries.

In terms of the distribution of market innovations, Swiss companies ranked last in the industrial sector and second to last in the services sector among the benchmark countries in 2018. In Switzerland, only a few companies launched products or services may be considered as new-to-market innovations. Swiss businesses fared better in terms of the share of new-to-firm innovations: They ranked fourth in the industrial sector and first in the services sector among the benchmark countries.

In Switzerland, knowledge and technology transfer (KTT) is a factor ensuring the success of research and innovation, as it allows knowledge to be shared between universities and private businesses. European surveys assessing the level of cooperation between innovative businesses and universities focus on innovation activities in the broader sense. In contrast, the Swiss survey focuses exclusively on R&D activities. As a result, Switzerland tends to show lower values for this indicator. Despite this, Switzerland ranked third among the benchmark countries, positioned behind Austria and Germany.

Comparison of Switzerland with other innovation metropoles in Europe

The comparison with six similarly sized innovation metropoles[7] in large European countries (Germany, Italy, France, United Kingdom) confirms Switzerland's strong overall position. However, it performed less well in the metropole comparison than in the comparison with the four countries where these metropoles are located.

For example, the northern neighbouring metropole of Baden-Württemberg had an R&D intensity (R&D expenditure in relation to GDP) that was almost twice as high as Switzerland's in 2019.

In terms of scientific output (period 2018-2020) and the number of patents (period 2017-2020) per capita, Switzerland came out on top of all of the innovation metropoles considered in the comparison. In 2018, for example, Switzerland had the highest proportion of companies with product and process innovations in the group. Although Switzerland had a higher share of turnover from product innovations, its share of turnover derived from market innovations was lower than the proportions observed in nearly all

[5] PCT = Patent Cooperation Treaty. Mit dem Vertrag über die Zusammenarbeit auf dem Gebiet des Patentwesens (PCT) kann mit nur einer Anmeldung Schutz in einer grossen Anzahl Länder erzielt werden.

[6] In Teil A, Kapitel 2.1, werden bezüglich Anteil Unternehmen mit F&E- und Innovationsaktivitäten Daten mit Referenzperiode 2018–2020 verwendet. Ein internationaler Vergleich anhand dieser neusten Daten ist derzeit (Stand August 2022) noch nicht möglich.

[7] See footnote 2 for the list of benchmark countries.
As in the previous R&I reports (2016 and 2020 reports as well as the 2018 interim update), the present chapter on the metropole comparison was written by Dr. C. Rammer of the Leibniz Centre for European Economic Research (ZEW) in Mannheim (Germany).

of the metropoles considered. In addition, the proportion of employment in research- and knowledge-intensive industries in 2018 was also noticeably lower in Switzerland than in the two German innovation metropoles of Baden-Württemberg and Bavaria, and slightly below the proportion observed in the Paris and London metropolitan areas.

PART A: THE SWISS RESEARCH AND INNOVATION SYSTEM

The Idiap Research Institute pursues basic research, teaching and technology transfer in the field of theoretical and applied artificial intelligence. Its research areas include speech and image recognition, robotics and machine learning. In the photo, a researcher collects data to calibrate a prototype that can identify people based on vein patterns of the hand without the need for physical contact. This is useful in sterile environments, such as hospitals. Idiap receives federal funding as a research facility of national importance under Article 15 of the Research and Innovation Promotion Act.
Photo: Oliver Oettli

Part A[1] provides an overview of the Swiss research and innovation (R&I) system.[2] It describes the framework conditions, stakeholders, role of government and legal basis. It also explains research and innovation funding, the main national and international funding instruments used to support research and innovation, and knowledge and technology transfer.

1 Framework conditions

Favourable framework conditions are a key prerequisite for strong R&I performance and the successful positioning of Switzerland amid international competition.

The framework conditions for research and innovation in Switzerland are considered to be very good.[3] In terms of political stability, safety and quality of life, Switzerland is in an excellent position. It also has a well-developed, continuously modernised infrastructure by international standards, good quality state institutions, a high level of digital competitiveness as well as a high-quality and permeable education system. In the long term, this creates a favourable environment for the performance of successful R&I activities and the establishment of innovative companies. The aforementioned framework conditions are also key to attracting talented people from abroad. In contrast, Switzerland compares less favourably with other countries when it comes to online government services.

The markets for labour, capital, goods and services are largely competition-driven. Access to international markets is assured by bilateral and multilateral agreements. This allows the economy to react flexibly, to absorb innovations quickly and to drive them forward. In addition, Switzerland offers good general tax conditions.

The framework conditions specifically relating to research and innovation include, among others, academic freedom, which is enshrined in the Federal Constitution (Art. 20 Cst.).[4] However, the Federal Constitution also requires lawmakers to set research boundaries. For example, human beings and their environment must be protected against the misuse of gene technology (Art. 120 Cst.). Switzerland's highly differentiated education system is another bedrock for Swiss research and innovation. This system includes top-notch universities as well as solid real-world skills development opportunities in the form of upper-secondary level vocational education and training (VET), tertiary-level professional education and continuing education and training (CET) woven throughout.

New developments in taxation

With entry into force of the Federal Act on Tax Reform and AHV Financing (TRAF) on 1 January 2020, the special cantonal tax privileges given to certain companies were abolished. In return, TRAF introduced new tax incentives for research and development as well as innovation. Since then, income derived from patents and comparable intellectual property rights are taxed at a reduced rate at cantonal level. Moreover, the cantons may grant additional tax deductions for R&D expenditures.

In addition, the OECD/G20 project on taxation of the digital economy will affect Swiss corporate tax law. Various adjustments to applicable principles for the taxation of multinational companies will need to be made.[5] Possible effects on the general conditions for R&D activities in Switzerland were formulated in two studies conducted by the auditing and consulting firm KPMG.[6]

Swiss education system

The Confederation and the cantons share responsibility for ensuring that the Swiss education system offers a complementary range of vocational and academic pathways, which are considered ‚equivalent but different'. The underlying notion underpinning this system is that each person should be free to choose the path that corresponds to his or her inclinations and abilities.

At the same time, the Swiss education system offers a high degree of vertical and horizontal permeability between vocational and academic pathways. This is reflected in the principle of ‚no dead-end qualifications', which is also a prerequisite for lifelong learning.

The Swiss education system produces highly skilled professionals and managers who are able to work in a wide range of different fields relating to business, research and government. This is a key factor in Switzerland's R&I performance.

1 Part A is based on a text written by Prof. em. Beat Hotz-Hart (University of Zurich) for the 2016 R&I Report. This text was revised and updated for the 2020 report as well as for the present 2022 interim report.

2 The introduction to this report explains the distinction drawn between ‚research and innovation (R&I)' and ‚research and development (R&D)'.

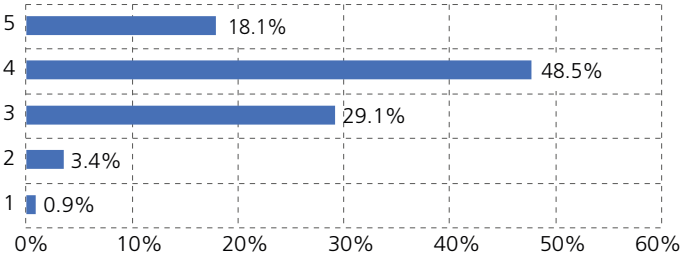
3 For an international comparison of the various indicators relating to framework conditions, see Part B, Chapter 1.

4 Federal Constitution of the Swiss Confederation of 18 April 1999 (BV, SR **101**).

5 With a view to implementation in Switzerland, the Federal Council adopted a corresponding dispatch in June 2022: Federal Council Dispatch of 22 June 2022 on the Federal Decree on Special Taxation of Large Corporate Groups (Implementation of the OECD/G20 project on taxation of the digital economy), BBl 2022 1700.

6 1) 1) Tax incentives for R&D in Switzerland'. Competitiveness of tax incentives for R&D in Switzerland (KPMG, 2021);
2) Steuerliche Förderung von F&E in ausgewählten Ländern im Lichte der OECD Steuerreform. This is a follow-up study to the previous report entitled, 'Tax incentives for R&D in Switzerland' (KPMG, 2022).

Figure A 1.1: Swiss public confidence in science in general, 2020



Scale from 5 'very high' to 1 'very low'
Rounding differences possible
Source: Covid-19 edition of Science Barometer Switzerland survey (2020; n=1,065), adapted by SERI

In addition, Switzerland has time-tested R&I funding instruments (see Chapter 5) and clear rules to protect intellectual property. The success of research and innovation also depends on how it is perceived and evaluated by the Swiss population. On the whole, Swiss inhabitants are aware of the importance of science. In the first year of the Covid 19 pandemic, the population's trust in science and research actually increased.[7] For example, at the end of November 2020, 67% of the resident population said their trust in science was ‚high' to ‚very high'. In 2019 and 2016, the figures were 56% and 57% respectively (Figure A 1.1).

2 Stakeholders

The main research and innovation stakeholders in Switzerland include the business enterprise sector, the higher education sector (comprised of two federal institutes of technology, cantonal universities, universities of applied sciences and universities of teacher education), research facilities of national importance[8] and the government sector (federal and cantonal levels). VPET system and its stakeholders also play an important role in innovation.

The government sector establishes suitable framework conditions for research and innovation and the business enterprise sector focuses mostly on R&D funding and performance.

2.1 Business enterprise sector

The business enterprise sector plays a central role in Swiss research and innovation. It devotes itself primarily to the pursuit of applied research and development and looks for ways to transform knowledge into marketable innovations. Some large companies also conduct basic research.

Definition of SMEs and large companies

SMEs are companies with 1 to 249 employees, large companies are those with 250 employees and more. SMEs are divided into the categories of micro-enterprises (1 to 9 employees), small-sized (10 to 49 employees) and medium-sized enterprises (50 to 249 employees). Accordingly, over 99% of companies in Switzerland are SMEs and less than one percent are large companies. This definition is used by the Federal Statistical Office (FSO) and Eurostat, among others.[9]

Specific populations in the various surveys

FSO's R&D statistics

SMEs are small- (10 to 49 employees) and medium-sized companies (50 to 99 employees), while large companies are those with 100 or more employees. The only exception to this rule is the ‚research and development' economic sector, which has a high R&D intensity and therefore receive full survey coverage. This means that companies with 1 to 9 employees are also surveyed in this economic sector.[10] The population of companies pursuing R&D activities in Switzerland is relatively small. In order to be able to publish different breakdowns of the results without compromising the quality and confidentiality of data (minimum number of companies per category), the FSO had to lower the threshold for large companies down to 100 employees.

Innovation survey conducted by the KOF Swiss Economic Institute (ETH Zurich)

SMEs are small- (5 to 49 employees) and medium-sized companies (50 to 249 employees). Large companies are those with 250 or more employees (Spescha & Wörter, 2020).

Eurostat's Community Innovation Survey (CIS)

SMEs are small- (10 to 49 employees) and medium-sized companies (50 to 249 employees), while large companies are those with 250 or more employees.[11]

[7] The Swiss Science Barometer conducted an online survey in November 2020, asking a representative sample of the Swiss resident population about their perceptions and use of information during the Covid 19 pandemic.

[8] Research facilities of national importance help to generate scientific added value in the fields concerned and complement the research activities carried out by cantonal universities, universities of applied sciences and the ETH Domain.

[9] www.bfs.admin.ch > Statistiken finden > Industrie, Dienstleistungen > Unternehmen und Beschäftigte > Wirtschaftsstruktur: Unternehmen > Kleine und mittlere Unternehmen; ec.europa.eu/eurostat > Strukturelle Unternehmensstatistiken > Kleine und mittlere Unternehmen (KMU)

[10] www.bfs.admin.ch > Statistiken finden > Bildung und Wissenschaft > Wissenschaft und Technologie > Indikatorensystem Wissenschaft und Technologie > Zugang zu den Indikatoren > W+T Input > F&E-Aufwendungen der Privatwirtschaft > Methodologie > Populationen

[11] wwww.ec.europa.eu/eurostat/ > Data > Database > Database by themes > Science, technology, digital society > Science and technology (scitech) > Community innovation survey (inn) > Community innovation survey 2018 (CIS2018) (inn_cis11) information note > CIS Metadata
In Part B, Chapter 8 'Innovation activities of the business sector' and Chapter 9 'Comparison of Switzerland with other innovation metropoles in Europe' Data on large companies and SMEs are based on the European Innovation Survey and refer to the corresponding population.

Two-thirds of R&D activities in Switzerland are funded and carried out by the business enterprise sector. In 2019, large companies accounted for 81% and small- and medium-sized enterprises (SMEs)[12] for 19% of the business enterprise sector's R&D expenditure (FSO, 2021b).[13] Large companies that fund and carry out R&D activities are mainly active in the pharmaceuticals, chemicals, food and machinery sectors. In terms of R&D expenditure, Roche is the eighth most R&D-intensive company in the world at EUR 11.2 billion and Novartis comes in 18th at EUR 7.1 billion (European Union, 2021).

An important innovation factor is cooperation between companies as well as between companies and universities.[14] Cooperation between SMEs and large companies is also important: as suppliers, SMEs often provide large companies with highly specialised components. For this reason, the R&D activities of SMEs form a key part of the value chains of large companies.

Proportion of companies pursuing R&D and innovation activities

According to the 2020 Innovation Survey, the proportion of companies in Switzerland pursuing R&D activities in the period 2018-2020[15] increased from 12.5% to 16.2%. Compared to the year 2000, however, this proportion has nearly halved overall. One important reason for this is the fact that the R&D activities of SMEs[16] between the year 2000 and 2018 declined steadily. Between 2018 and 2020, the share of R&D-performing SMEs once again rose for the first time, from 12.2% to 16.1%. This increase constitutes a departure from the long-term trend.[17]

In contrast, the R&D commitment of large companies has remained relatively stable between around 40% and 50% since 2003. Between 2016 and 2020, the proportion of large companies pursuing R&D activities declined from 45% to 38.9%.[18] Despite this decline, it is still more than twice as high as the proportion of Swiss companies pursuing R&D activities among all companies in Switzerland.

Switzerland also has more innovative businesses again. Already in 2016-2018, the proportion of innovative companies at national level rose from 31.2% to 34.4% in all areas of innovation. In the period 2018-2020, this proportion even increased from 33.4% to 41.8%. (Spescha & Wörter, 2022).

Start-up companies[19]

According to the Swiss Startup Radar, at least 500 new start-up companies are founded in Switzerland each year. Generally, more start-ups are founded in urban areas than in rural areas.[20] The regional distribution also suggests that there is a correlation between start-up locations and proximity to universities. In terms of the number of start-ups founded between 2014 and 2018, the most important centres are the cantons of Zurich (331), Vaud (163), Zug (76), Geneva (58), Bern (44), Basel-Stadt (40), Lucerne (33), Valais (27), Aargau (25), St. Gallen (25) and Schwyz (23).[21]

Compared to other countries, Switzerland has a disproportionately high number of start-ups in the medical technology, machinery, electrical and metal industry (MEM), energy and cleantech, biotechnology and financial services sectors. The share of start-ups focusing on e-commerce and internet marketplaces, on the other hand, is lower than in other countries (startupticker.ch, 2018, 2019, 2021).

Start-ups play an important role in the development and application of new technological innovations. They thus contribute significantly to the use of knowledge gained from research and thus help to tap innovation potential.

[12] The data for large companies and SMEs are based on the FSO's R&D Statistics for the corresponding population.

[13] More explanations can be found in Part A, Chapter 4 'Finances'.

[14] See Part A, Chapter 7 'Knowledge and technology transfer (KTT)'.

[15] The periods mentioned correspond to the data collection periods of the Innovation Survey, which is conducted every two years by ETH Zurich's Swiss Economic Institute (KOF) on behalf of SERI.

[16] The data on SMEs and large companies are based on the KOF Innovation Survey for the corresponding population.

[17] The 2022 Innovation Survey (period 2020-2022) will show whether and to what extent this pattern becomes consolidated. The results of this survey will be published in 2024.

[18] The main obstacles to innovation are: high costs, lack of equity and third-party capital, long amortisation period, lack of skilled labour (R&D, IT), high market risk, building regulations, technical risk, easy copying of innovations (Spescha & Wörter, 2022).

[19] In Switzerland, there is no uniform definition of the term ‚start-up company' or ‚start-up'. According to the Swiss Startup Radar 2020/2021, the following six criteria identify a start-up: science and technology-based approach, focus on innovation, scaleable business model, ambitious growth plans, international sales markets and returns-oriented investors (startupticker.ch, 2021).

[20] In total, Switzerland counted around 556 574 companies in 2018. Of these, 39 608 had been founded in the same year and around 90% in the tertiary sector. In 2017, 39,303 companies had been newly founded. 82.7% of these start-ups were still active one year later (FSO, 2022a).

[21] According to the Swiss Technology Transfer Association (swiTT), 65 start-up companies were created in 2020 in the ETH Domain, 21 in the university sector and 4 in the UAS sector. The summary only includes the data from the institutions that agreed to have their data rendered public. (swiTT, 2021).

Start-up ecosystem

According to a study on the start-up ecosystem in Switzerland, our country is well positioned overall. Nevertheless, there is room for improvement in several areas (BAK Economics AG, 2021). Following this study, the Federal Council commissioned the Federal Department of Economic Affairs, Education and Research (EAER) in August 2021 to find ways to accelerate the use of research findings generated within the start-up ecosystem.

In June 2022, the State Secretariat for Education, Research and Innovation (SERI) published a report identifying areas of potential improvement (SERI, 2022). More effective technology transfer can help to strengthen the start-up ecosystem. Examples include guidelines to ensure transparent handling of intellectual property rights at universities; helping universities to build expertise in patent filing and the provision of start-up funding to cover patent costs. Support could also be provided to enable universities to offer entrepreneurial training. In terms of implementation, each university should be free to decide which measures to put in place.

The measures to reinforce Switzerland position as a location for start-up activities also include the recently adopted revision of the Federal Research and Innovation Promotion Act (RIPA), which from 2023 onwards will enable Innosuisse to directly provide funding for innovation projects by start-ups seeking to prepare for their market debut (see also Chapter 5.2).[22]

The Federal Council also adopted a policy decision on the creation of a sector-neutral Swiss Innovation Fund to provide seed capital to start-ups, especially during the growth phase and in particular for activities relating decarbonisation and digitalisation. The specific parameters will be set by early 2023.[23]

[22] www.sbfi.admin.ch > News > Press Releases > Greater support for knowledge and technology transfer needed for start-ups

[23] www.admin.ch > Startseite > Dokumentation > Medienmitteilungen > Bundesrat trifft Richtungsentscheid für einen Schweizer Innovationsfonds

2.2 Higher education sector

Switzerland's higher education landscape includes universities, universities of applied sciences (UAS), universities of teacher education (UTEs) and other accredited institutions.[24] Universities include Switzerland's two federal institutes of technology (ETHZ and EPFL) and cantonal universities (Figure A 2.1). These higher education institutions offer a comprehensive and diverse range of studies and research and enjoy a solid international reputation[25] and make a decisive contribution to research and innovation.

According to the Higher Education Council Ordinance of 29 November 2019 on the Coordination of Teaching at Swiss Universities[26], the Bologna model with Bachelor's, Master's and PhD levels is used as a frame of reference. Only universities (FITs and cantonal universities) that are primarily engaged in basic research and research-based teaching are authorised to award PhDs. However, UAS and UTEs have the option of offering PhD programmes in cooperation with a university (FIT or cantonal university). In contrast, universities of applied sciences are more geared towards applied R&D activities. UTE degree programmes also focus on teaching and research designed for practical application.

Swiss higher education institutions, which are well networked internationally, have a performance mandate that includes teaching (incl. continuing education), research and development, knowledge and technology transfer (KTT) and the provision of services for third parties.

Federal Institutes of Technology Domain (ETH Domain)
In 2021/2022, ETH Zurich and EPFL had a total of around 36 000 students, including around 6 800 PhD students (FSO, 2022b). The ETH Domain[27] is formed by these two institutions, together with the four research institutes Paul Scherrer Institute (PSI), Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), Swiss Federal Laboratories for Materials Testing and Research (Empa) and the Swiss Federal Institute of Aquatic Science and Technology (Eawag). The ETH Board is the strategic management and supervisory body of the ETH Domain.

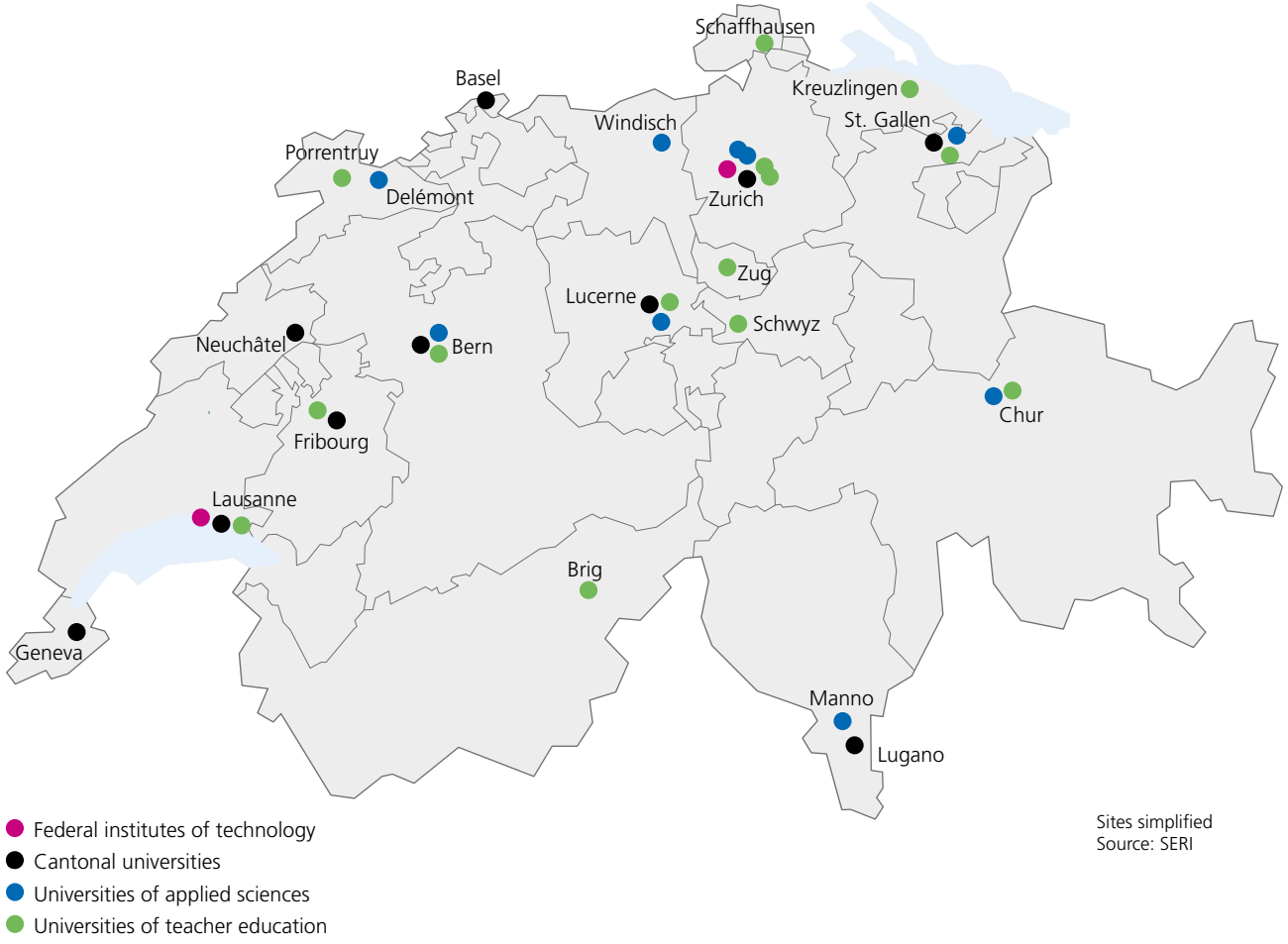
[24] The Swiss higher education landscape includes not only the higher education institutions recognised by the Confederation as eligible for funding, but also those that are institutionally accredited by the Swiss Accreditation Council (www.akkreditierungsrat.ch), e.g.UAS Kalaidos, Swiss Business School and others. A list of recognised and accredited Swiss higher education institutions can be found at: www.swissuniversities.ch > Themen > Studium > Akkreditierte Schweizer Hochschulen

[25] Five cantonal universities (Basel, Bern, Geneva, Lausanne, Zurich) as well as two federal institutes of technology (ETHZ and EPFL) have featured among the world's top 200 universities in major university ranking lists (Shanghai, QS, Times and Leiden) for several years in a row.

[26] SR **414.205.1**

[27] ETH Zurich was established in 1855; when the Confederation took over the University of Lausanne's polytechnical college in 1969, Switzerland's second federal institute of technology emerged: the Ecole polytechnique fédérale de Lausanne (EPFL). Over time, four research institutes (PSI, WSL, Empa and Eawag) were then created. The legal basis for the ETH Domain is the Federal Act of 4 October 1991 on the Federal Institutes of Technology (SR **414.110**).

Figure A 2.1: Swiss higher education landscape



ETH Zurich and EPFL are universities specialised in engineering and natural sciences. The focus of their study programmes and research activities is on natural and engineering sciences, life sciences, mathematics and architecture.

Research institutes within the ETH Domain focus both on basic and applied research. In addition, they provide scientific and technical services and contribute to teaching and research activities at ETH Zurich and EPFL.

Cantonal universities

In 2021/2022, cantonal universities had a total of around 129 000 students, roughly 20 000 of whom were PhD students (FSO, 2022b).[28]

Cantonal universities have faculties and institutes specialised in the humanities and social sciences, law, mathematics, natural sciences, economics and medicine.

Some cantonal universities have a specific profile and focus on selected areas; for example, the University of St. Gallen is one of the leading business universities in Europe. Unlike the two federal institutes of technology, cantonal universities do not offer any degree programmes in engineering.

Universities of applied sciences

In 2021/2022, a total of around 93 000 people studied at public universities of applied sciences and the private UAS Kalaidos (FSO, 2022b). UAS were created in the mid-1990s when professional and technical colleges were converted and merged together.

UAS are strongly rooted in the local community and are important cooperation partners for SMEs. Over half of the projects funded by Innosuisse (see Chapter 5) are carried out with UAS as research partners.

UAS offer Bachelor's and Master's degrees that are geared towards the specific needs of the labour market. In this way, they play a key role in transferring knowledge into marketable innovations.

[28] Founded in 1460, the University of Basel is by far the oldest in Switzerland.

Role of Swiss vocational and professional education and training systemin innovation

Switzerland has a comprehensive system of upper-secondary level vocational education and training and tertiary-level professional education, which is referred to collectively as the Swiss VPET system. Around two-thirds of all young people completing compulsory education enrol in an upper-secondary level VET programme. The Swiss VPET system ensures that the Swiss economy has an adequate number of highly skilled professionals and managers. Each year, around 70,000 upper-secondary level vocational qualifications and 26,000 tertiary-level professional qualifications are awarded. Holders of vocational and professional qualifications are as crucial to the competitiveness and innovative capacity of businesses as holders of university degrees.

The Swiss VPET system is highly correlated with the specific needs of the labour market: Professional organisations decide on the content of training programmes and review and update this content at regular intervals. This ensures that training programmes remain forward-looking and sustain innovation. In addition, training programmes reflect the type of knowledge and skills that are currently in demand on the labour market. Finally, a combination of classroom instruction (theory) and workplace training (practice) allows learners to flexibly adapt and develop a wide range of knowledge, skills and know-how. This improves their ability and willingness to contribute to and drive innovations forward.

Fairly recent analysis (Backes-Gellner & Pfister, 2020) shows that decisive factors for innovative capacity include a well-functioning collaborative partnership and a high degree of permeability within the education system as a whole and the VPET system in particular. In this collaborative partnership, the Confederation, the cantons and professional organisations (and their member companies) all work together. The innovative impact of the Swiss VET sector is made possible by the fact that the training plan of each VET programme is systematically and continuously checked and updated as part of a cyclical review and revision process. The involvement of companies in this process is crucial as they are familiar with the latest developments in their field. The second crucial factor at system level is the permeability built into the Swiss education system and VPET system. The high degree of horizontal and vertical permeability enables workers to more effectively adapt over the course of their educational and professional careers to changing requirements resulting, among other things, from innovation.

According to analysis at company level, the broad participation of companies and a diverse mix of skills within companies are two important factors sustaining the innovation effects of the Swiss VPET system. The participation of different types of companies in training programmes encourages the spread of innovative knowledge.

Analysis of responses obtained from surveys of individuals shows 'favourable employment and career prospects' to be an important factor encouraging young achievers to pursue vocational education and training and to enrol in tertiary-level education (e.g. professional education) later on. This factor is therefore very important in ensuring the innovative capacity of the VPET system. Another factor is the wide range of options for tertiary-level education and lifelong learning.

To sum up, the Swiss VPET system trains a broad spectrum of professionals and managers, providing them with versatile and future-oriented skills. In this way, the Swiss VPET system greatly contributes to innovation.

Geared to the needs of professionals, the Bachelor's degree is the usual qualification obtained at a UAS. UAS offer a broad range of study programmes that vary from one UAS to another: engineering and information technologies, architecture, construction and planning, chemistry and life sciences, agriculture and forestry, business and services, design, health, social work, music, theatre and other arts, as well as applied psychology, applied linguistics and sport.

Universities of teacher education

In 2021/2022, a total of 24 000 people were enrolled at a Swiss university of teacher education (FSO, 2022b). UTEs offer teaching programmes (incl. continuing education) for aspiring teachers and pedagogical specialists for all levels within the Swiss education system. Training programmes are also available for school directors and other education system stakeholders. UTEs pursue education/school research as well as research and development relating to specific occupational and professional fields. UTEs also provide corresponding services to education stakeholders.

2.3 Research facilities of national importance

Over thirty federally funded research facilities of national importance help to bring scientific added value in a wide range of subject areas and disciplines. They complement the research activities and infrastructure of higher education institutions and the ETH Domain. Public authorities and higher education institutions, and in some cases private individuals, contribute to the core funding of these institutions. Federal funding is provided on a subsidiary basis and goes to three types of institution, namely:[29]

[29] EA list of all institutions supported in the four-year period 2021-2024 can be found at: www.sbfi.admin.ch > Forschung und Innovation > Förderinstrumente > Forschungseinrichtungen von nationaler Bedeutung

– Research infrastructures such as the Swiss Social Archives (SSA) in Zurich, which support scientific activities by providing services such as collecting, processing, analysing and preparing scientific information and documentation.
– Research institutions such as the Swiss Institute of Allergy and Asthma Research (SIAF) in Davos, which work in highly specialised fields, usually in close partnerships with cantonal universities or institutions within the ETH Domain.
– Centres of technological excellence such as the Centre suisse d'éléctronique et de microtechnique (CSEM) in Neuchâtel, which focus in particular on knowledge and technology transfer. They also work with higher education institutions and pursue innovation projects with partners from industry.

2.4 Federal administration

Competent handling of government activities as well as complex policy issues and challenges require evidence-based knowledge. One of the means used to gather this knowledge is through research conducted either by the federal agencies themselves or outsourced to higher education institutions, companies and non-profit institutions (see Chapter 5.4). The term ‚federal policy research' is used to refer to this type of research conducted by the federal government.

3. Role of the government sector

State institutions at three political levels - federal, cantonal and communal - provide fertile ground for both privately and publicly funded stakeholders to engage in research and innovation activities. Among other things, these three political levels are responsible for ensuring the quality of education and training throughout the entire education system. They also provide public infrastructure and strive to maintain a reliable political and legal environment.

3.1 Federal government

At the federal level, the Federal Department of Economic Affairs, Education and Research (EAER) and its State Secretariat for Education, Research and Innovation (SERI) are primarily responsible for the ERI sector and for implementation of corresponding legislation (Figure A 3.1). The Federal Act of 14 December 2012 on the Promotion of Research and Innovation (RIPA)[30] establishes the conditions for: the competitive awarding of research funding; for innovation funding; and for international cooperation in research and innovation. Under the Higher Education Act of 30 September 2011 (HEdA)[31], the Confederation and the cantons must work together through the Swiss Conference of Higher Education Institutions to ensure the coordination, quality and competitiveness of the higher education sector. The Confederation also provides basic contributions under HEdA to cantonal universities and UAS, but not to the UTEs. The Federal government also manages and funds the ETH Domain, which in turn is strategically managed and supervised by the ETH Board (see Chapter 2.2).[32]

The federal government's research and innovation funding bodies are the Swiss National Science Foundation (SNSF), Innosuisse and the Swiss Academies of Arts and Sciences (see Chapter 5). The Swiss Science Council (SSC) serves as an advisory body to the Federal Council for all matters pertaining to R&I policy. Other federal offices within the EAER are also involved in research and innovation. These include, for example, the State Secretariat for Economic Affairs (SECO) with its new National Regional Policy (NRP) (see Chapter 5.5) and Agroscope as the federal competence centre for agricultural research.

In addition to the EAER, other federal departments are directly or indirectly involved in supporting the performance of research and innovation, for example through federal policy research (see Chapter 2.4 and 5.4).[33]

Federal Council Dispatch on the Promotion of Education, Research and Innovation
Every four years, the Federal Council submits a Dispatch on the Promotion of Education, Research and Innovation (ERI Dispatch) to Parliament. In it, the Federal Council takes stock of the current funding period and lays out the objectives and measures for the next four-year period. Each ERI Dispatch includes the federal government's budget requests for the ERI system as well as proposed legislative changes relating to budget allocations. Financial decisions mainly relate to the Confederation's national measures for the Swiss VPET system, higher education sector, continuing education and training sector (CET) and support for research and innovation.

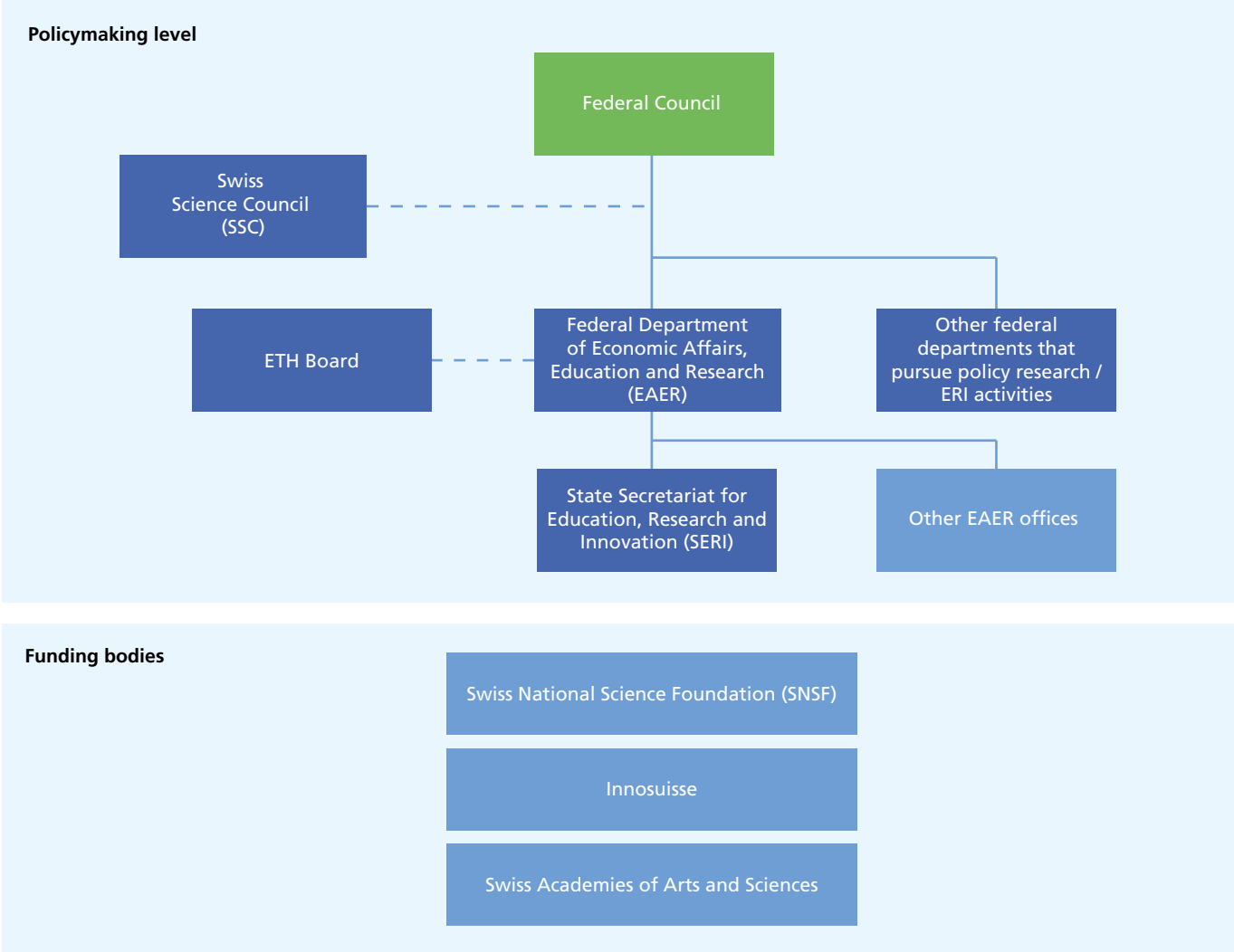
3.2 Cantonal, municipal and communal governments

Generally speaking, the cantons are responsible for all areas that are not explicitly assigned to the Confederation under the Federal Constitution. The cantons are also largely responsible for the implementation of federal legislation.

The cantons are the responsible bodies of cantonal universities, UAS and UTEs on their territory. Through the provision of core funding, they greatly contribute to the research activities of cantonal universities.

[30] SR **420.1**
[31] SR **414.20**.
[32] The ETH Domain is assigned to the EAER under Art. 4 para. 1 of the ETH Act.
[33] The Swiss Federal Institute of Intellectual Property (IPI) and several commissions also play a key role in research and innovation. For example, the extra-parliamentary Federal Energy Research Commission (CORE) helps to coordinate energy research.

Figure A 3.1: Federal institutions responsible for research and innovation



Source: SERI

Intercantonal financing agreements are in place to offset some of the costs incurred by the subsidising cantons. Cantonal universities, UAS and UTEs are largely autonomous: They plan, regulate and conduct their affairs within the framework of both cantonal legislation and the Higher Education Act (HEdA).

The Swiss Conference of Cantonal Ministers of Education (EDK) and the Conference of Cantonal Directors of Economic Affairs (VDK) coordinate research and innovation activities at intercantonal level and play an active role at interface points.

Towns and communes also support innovation, for example by establishing and operating technology and innovation parks.

Joint federal-cantonal bodies

The Confederation and the cantons ensure the coordination, quality and competitiveness of the Swiss higher education sector through three joint policymaking bodies: the Swiss Conference of Higher Education Institutions, which is chaired by the Confederation,[34] the Swiss Conference of Rectors of Higher Education Institutions (swissuniversities)[35] and the Swiss Accreditation Council.[36] In the area of education (especially outside the higher education sector), there is a steering committee that coordinates federal-cantonal cooperation in education.[37] The members of this body regularly meet to share information in order to jointly ensure the high quality and permeability in the Swiss education system within their respective areas of authority.

[34] www.shk.ch
[35] www.swissuniversities.ch
[36] www.akkreditierungsrat.ch
[37] www.edk.ch > Kooperationen

Federal legislation

Federal Constitution (FC)[38]

According to Article 64 paragraph 1 of the Federal Constitution, the Confederation is responsible for supporting scientific research and innovation. It may establish and operate research institutes by virtue of Article 64 paragraph 3 of the Federal Constitution. Under Article 63a paragraph 3 of the Federal Constitution, the Confederation and the cantons are jointly responsible for the co-ordination and work together to ensure the quality in Swiss higher education. Under Article 63a paragraph 1 of the Federal Constitution, the Confederation manages Swiss federal institutes of technology and under paragraph 2, it supports cantonal universities. Under Article 63 of the Federal Constitution, the Confederation issues regulations on vocational and professional education and training (VPET) and encourages a diverse and accessible range of upper-secondary and tertiary-level training options.

Federal Research Promotion and Innovation Act (RIPA)[39]

RIPA provides a general legislative framework describing the tasks and structure of federal government funding of R&I. RIPA establishes the tasks, procedures and responsibilities of the funding bodies specified in RIPA, namely the Swiss National Science Foundation (SNSF), Innosuisse and the Swiss Academies of Arts and Sciences. It also establishes the conditions for international research cooperation. RIPA stipulates the subsidiarity of federal contributions to research facilities of national importance and contains provisions on the planning, coordination and quality assurance of federal policy research. Finally, RIPA provides the legal basis for supporting the Swiss Innovation Park on a subsidiary basis.

Higher Education Act (HEdA)[40]

Under the HEdA, the Confederation and the cantons work together to coordinate their activities and ensure the quality and competitiveness of the higher education sector. The HEdA forms the legal basis for the creation of joint federal and cantonal bodies, quality assurance and accreditation, uniform funding of higher education institutions and other institutions within the higher education sector. It also describes the division of responsibilities in particularly cost-intensive areas. However, contributions under the HEdA apply exclusively to cantonal universities and UAS, not to federal institutes of technology and UTEs. Nevertheless, Swiss UTEs are eligible for federal project contributions under the HEdA just like cantonal universities and UAS.

Swiss Federal Institutes of Technology Act (ETH Act)[41]

The ETH Act establishes the tasks and organisational structure of the ETH Domain (for more information about research institutes within the ETH Domain see Chapter 2.2).

Federal Vocational and Professional Education and Training Act (VPETA)[42]

VPETA supports the performance of the Swiss innovation system. It serves as the basis for the modernisation of training programmes for upper-secondary level vocational and tertiary-level professional qualifications and takes into account the significant changes affecting the labour market. VPETA provides for differentiated upper-secondary and tertiary level training pathways and establishes permeability as a key trait of the Swiss education system, which includes both vocational and academic pathways. Finally, VPETA serves as the legal basis for federal contributions to the Swiss VPET system

[38] SR **101**
[39] SR **420.1**
[40] SR **414.20**
[41] SR **414.110**
[42] SR **412.10**

Legal basis for coordination between the Confederation and the cantons

On the federal side, HEdA forms the legal basis for coordination of the Swiss higher education sector. On the cantonal side, the legal basis is the Intercantonal Agreement of 20 June 2013 on Cooperation in Higher Education[43]. All cantons have acceded to this agreement. In addition, the Confederation and the cantons signed the Federal-Cantonal Agreement of 26 February 2015 on Cooperation in Higher Education[44]. With this agreement, the corresponding competences have been transferred to joint federal-cantonal higher education policymaking bodies.

Higher education matters are regulated by corresponding cantonal legislation. Cantonal legislation on universities of applied sciences forms the basis for supervision of UAS. As a rule, cantonal legislation covers matters pertaining to cooperation with other cantons and with the Confederation. There is also cantonal legislation for universities of teacher education (UTEs).

In addition to this, the Confederation and the cantons entered into an education cooperation agreement45 in order to fulfil their constitutional obligation to work together and coordinate their activities within the Swiss education system. On the federal side, the legal basis for this agreement was the Cooperation in Education Act[46] and on the cantonal side it was the Intercantonal Agreement on Compulsory Education.

VPETA assigns the cantons the task of ensuring an adequate supply of training programmes for upper-secondary level vocational education and training, tertiary level professional education and job-related continuing education and training (CET). VPETA also gives the cantons authority over vocational, educational and career guidance. Cantonal legislation on vocational and professional education and training serves as implementing legislation for the mandate given to the cantons under VPETA. Cantonal funding of innovation is usually based on special legislation.[47]

4. Finances

The business enterprise sector, the government sector, the higher education sector and foreign stakeholders are both sources of R&D funding and R&D performers.[48]

4.1 Funding flows from source to R&D performer

Figure A 4.1 provides an overview of funding flows between the individual sectors in 2019. This includes all R&D funding flows within Switzerland as well as funding flows in and outside of Switzerland. The left-hand side of the chart (Source of funding) lists the sectors that provide funding for Swiss R&D activities, while the right-hand column (R&D performer) shows the four sectors that carry out R&D activities in Switzerland using those funds. The 'Rest of the world (ROW)' category is added on both sides.

Table A 4.2 provides a more detailed breakdown of the information presented in Figure A 4.1, showing funding flows from source to R&D performer.

[43] www.edk.ch > Dokumentation > Rechtstexte und Beschlüsse > Rechtssammlung

[44] SR **414.205**

[45] SR **410.21**

[46] SR **410.2**

[47] Examples include the Canton of Bern's Economic Promotion Act, the Canton of Aargau's Location Promotion Act and the Canton of Fribourg's Economic Promotion Act.

[48] This chapter is based on the FSO's R&D Statistics for Switzerland (FSO, 2021a; FSO, 2021b). For an international comparison of different data on R&D funding and performance, see Part B, Chapter 4.

4.2 R&D performance[49]

In terms of Swiss gross domestic expenditure on R&D (GERD), Swiss R&D performance reached 22.9 billion in 2019, or 3.15% of gross domestic product (GDP). Switzerland thus compares favourably with other benchmark countries and is well above the OECD average (2.51%; see Part B, Figure B 4.3). The business enterprise sector drives most of this expenditure, accounting for around two-thirds of both R&D funding and performance.

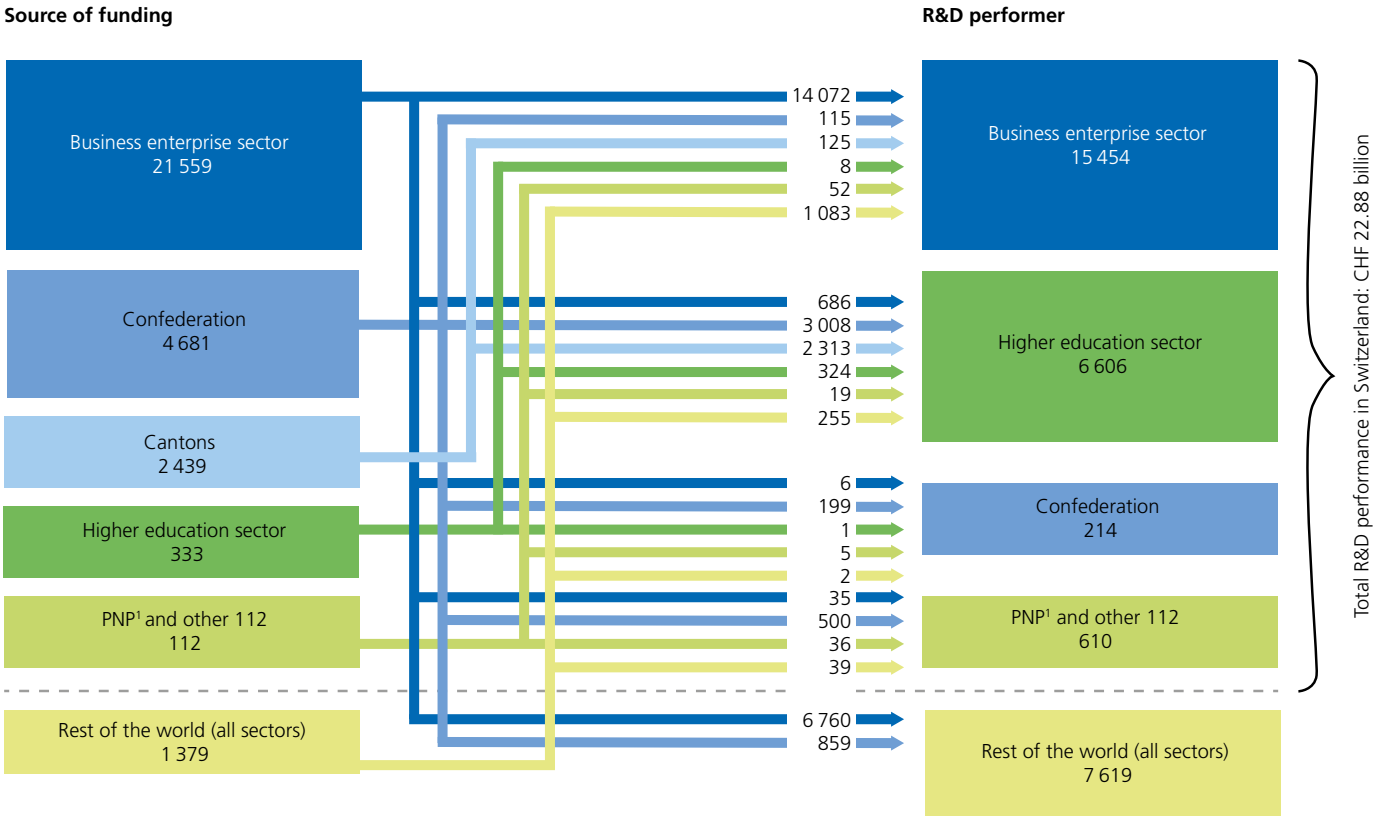
The ETH Domain, cantonal universities and universities of applied sciences are the main recipients of R&D funding. Unlike the business enterprise sector, where companies tend to fund and perform nearly all R&D activities themselves, most of the funding for R&D performance in the higher education sector comes from the Confederation and the cantons.

The business enterprise sector and the federal government also fund R&D activities outside of Switzerland. At the same time, there are stakeholders from abroad that fund R&D projects in Switzerland.

The other stakeholders (private non-profit institutions such as foundations and others) play a comparatively minor role in Switzerland, both in in terms of R&D funding and performance.

[49] The term ‚expenditure' used in the R&I Report matches the term used in FSO statistics. The OECD uses the term ‚outlays', which is defined in the Frascati Manual as follows: Outlays (used interchangeably with ‚expenditure' in terms of spending) represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated or obligated (when referring to government funds) (OECD, 2015, p. 377).

Figure A 4.1: Overview of R&D funding and performance in Switzerland by sector, in CHF million, 2019 (excl. Swiss controlled affiliates abroad)



[1] Private non-profit
Source: FSO

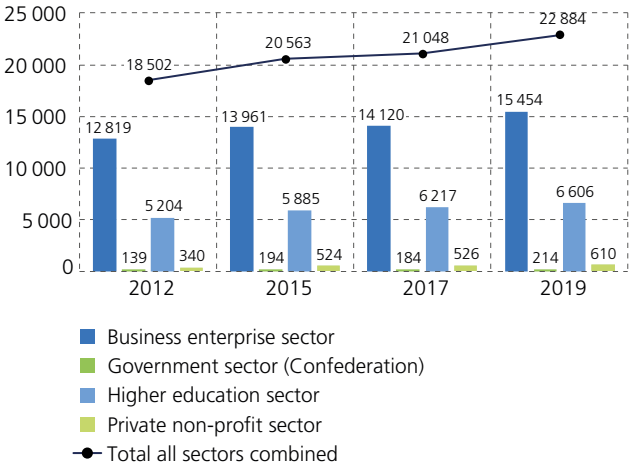
Table A 4.2: Swiss R&D funding and performance by sector, in CHF million, 2019[1] (excl. Swiss controlled affiliates abroad)

2019	R&D performer							
Source of funding	**Business enterprise sector**	**Gov. sector**	**Higher education sector**	**PNP sector[2] and other**	**Total (excl. ROW)**	**Rest of world**	**Total R&D funding in Switzerland and ROW**	**Total funded by**
Business enterprise sector	14 072	6	686	35	14 799	6 760	21 559	… Business enterprise sector
Confederation	115	199	3 008	500	3 822	859	4 681	… Confederation
Cantons	125	< 1	2 313		2 439		2 439	… Cantons
Higher education sector	8	1	324		333		333	… Higher education sector
Private non-profit sector and other	52	5	19	36	112		112	… Private non-profit sector and other
Rest of the world	1 083	2	255	39	1 379		1 379	… Rest of the world
Total intra-mural R&D expenditures in Switzerland	**15 454**	**214**	**6 606**	**610**	**22 884**	**7 619**	**30 503**	
					Total intra-mural R&D expenditures in Switzerland			

[1)] Revised data
[2)] Private non-profit institutions

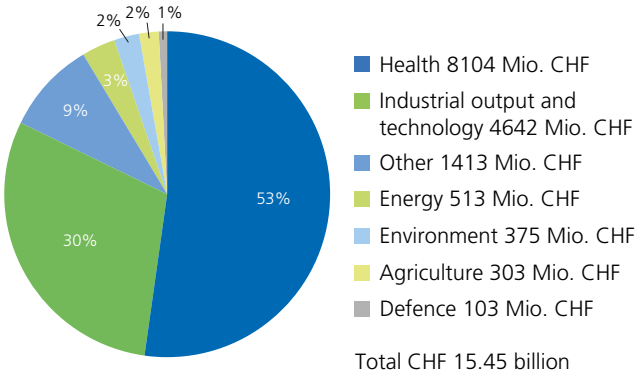
Source: FSO

Figure A 4.3: Intramural R&D expenditures in Switzerland by sector, in CHF million, at current prices, 2012-2019



Source: FSO, adapted by SERI

Figure A 4.4: Business enterprise expenditure on R&D in Switzerland by objective, in % and in CHF million, at current prices, 2019



Source: FSO, adapted by SERI

Development of intramural R&D expenditures in Switzerland

Intramural R&D expenditures are outlays for R&D activities conducted in Switzerland. In 2019, Swiss intramural R&D expenditures for all sectors combined (GERD) stood at CHF 22.9 billion. Compared to the figures for 2017[50], this corresponds to an increase of CHF 1.8 billion or an average annual increase of 4.3%.[51] This annual increase in GERD is significantly higher than the increase observed between 2015 and 2017 (+1,2%).

In 2019, business enterprise expenditure on R&D (BERD) stood at CHF 15.5 billion, which amounts to over two-thirds (68%) of GERD (Figure A 4.3). BERD growth (+4.6%) was slightly higher than the national average, after remaining fairly constant between 2015 and 2017 (+0.6%). Due to its size and dynamism, the business enterprise sector was responsible for a large part of the increase in GERD between 2017 and 2019.

The second largest sector was higher education, which accounted for 29% of GERD, or CHF 6.6 billion. Compared to 2017, higher education expenditure on R&D (HERD) rose by nearly CHF 400 million. This corresponds to an average annual increase of 3.1%, which is roughly in line with the average trend observed for HERD in the most recent surveys (2012-2015: +4,2%; 2015-2017: +2,8%).

The federal government and private non-profit (PNP) sector play a marginal role in R&D performance. Together they accounted for 4% of Swiss GERD (Confederation: CHF 214 million or +7.7%; PNP: CHF 610 million or +7.7%).

Business enterprise expenditure on R&D by objective

In 2019, 52% of BERD went to ‚Health' and 30% were used for projects relating to ‚Industrial output and technology'. Thus, over three-fourths (82%) of intramural R&D expenditures were allocated to these two objectives. Only a small amount of available funding was used for other objectives such as ‚Energy' (3%) and ‚Environment' (2%) (Figure A 4.4). However, these areas in particular showed high average annual growth rates in the period 2017 to 2019: ‚Energy' +6.9% and ‚Environment' +14.9%.

R&D expenditures of Swiss controlled affiliates abroad

Generally, it is large global enterprises that invest heavily in R&D. This can be seen in the R&D expenditures of Swiss controlled affiliates abroad (Figure A 4.5). We find that virtually all such expenditures are made by a handful of large global enterprises.

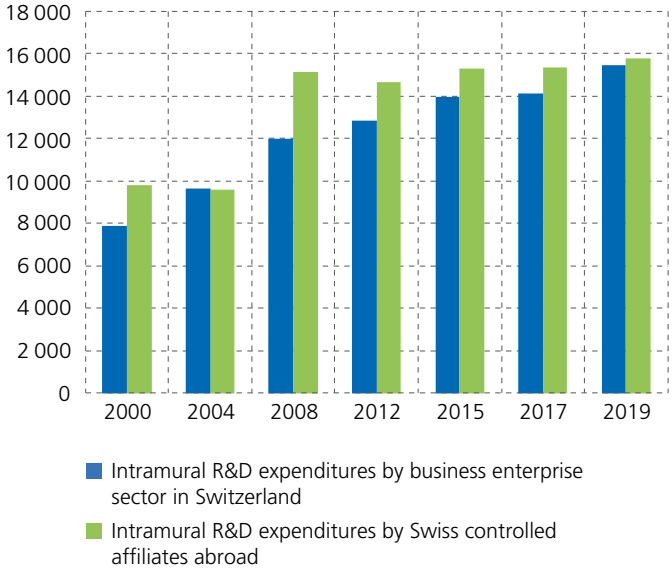
In 2019, the R&D expenditures of Swiss controlled affiliates abroad amounted to CHF 15.8 billion.[52] This amount is slightly higher than the CHF 15.5 billion spent on R&D by the business enterprise sector in Switzerland in the same year.

[50] Since the reference year 2015, the FSO has been compiling R&D statistics at two-year intervals.

[51] The amounts shown are at current prices, i.e. not adjusted for inflation.

[52] It is worth mentioning that R&D expenditures by Swiss controlled affiliates abroad are made in foreign currencies. This implies strong exchange rate fluctuations resulting from conversion into Swiss francs, especially in recent years. This must be factored in when interpreting developments over time.

Figure A 4.5: Development of intramural R&D expenditure, business enterprise sector in Switzerland and Swiss controlled affiliates abroad, in CHF million



Since some of the respondents corrected the replies given in previous surveys, the data for 2012, 2015 and 2017 had to be revised.

Source: FSO, adapted by SERI

5. National, regional and cantonal support

The Confederation is the principal driver of government sector R&I support. Its main instruments are the Swiss National Science Foundation (SNSF), which supports scientific research, and Innosuisse, which supports science-based innovation. Both institutions review and select projects submitted to them in competitive calls for project proposals. In addition, the Swiss Academies of Arts and Sciences is committed to strengthening cooperation within and between scientific disciplines. This organisation also seeks to anchor science in society.

5.1 Swiss National Science Foundation

Founded in 1952, the Swiss National Science Foundation (SNSF) is the most important institution supporting scientific research and young researchers in Switzerland. To ensure that research remains independent, the SNSF is structured as a foundation under private law. Adapting itself to the financial decisions of the Federal Assembly, SERI signs four-year performance agreements with the SNSF. Researchers from all scientific disciplines have access to SNSF funding.

The SNSF has an annual budget of around CHF 1.2 billion. Each year it receives several thousand funding applications, which it assesses through a peer review process. The SNSF's National Research Council awards funding on the basis of assessments carried out by national and international review panels. The NRC is comprised of around 100 researchers, most of whom work at Swiss universities. The NRC is also backed by 90 evaluation committees totalling over 700 members.

The SNSF has a wide range of research funding instruments at its disposal. Project support is essential, accounting for around half of approved federal funding. Here, researchers are free to determine the topic and scope of their projects. Thus, the SNSF creates the necessary freedom for innovative ideas.

Other funding instruments are the National Centres of Competence in Research (NCCRs) and the National Research Programmes (NRPs):

– NCCRs are a federal funding instrument conducted by the SNSF on behalf of the Confederation. Running for a period of around ten years, they help to shape the Swiss research landscape by acting as centres of expertise in key fields such as life sciences, migration and language research, materials technology and quantum science.

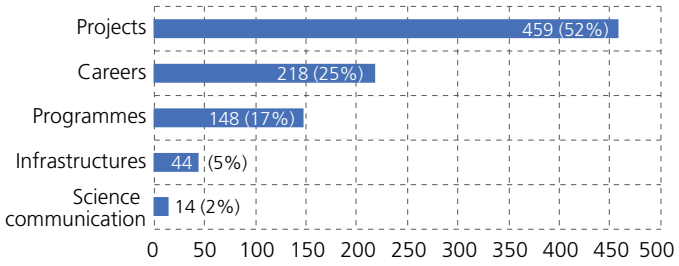
– NRPs allow the Confederation to support scientific research on current and urgent challenges of national importance. Because NRPs aim to solve problems, practical applications and interdisciplinary approaches are important. The main emphasis is on knowledge and technology transfer. Topics are set by the Federal Council in a selection process open to all academic fields; the SNSF is responsible for implementing them. For example, research projects relating to NRP 77 ‚Digital Transformation' have been running since 2020. In addition, NRP 78 ‚Covid-19', NRP 79 ‚Advancing 3R – Research, Animals and Society' and NRP 80 ‚Covid-19 in Society' were all launched in 2020 and 2021.

A further key focus of the SNSF is promoting the careers of young scientists and academics via a range of instruments and across all disciplines. The SNSF supports the careers of young, highly qualified researchers from their doctorate thesis through to their position as assistant professor, for example by providing grants for working abroad or for projects conducted independently.

Funding is also appointed to infrastructures. For example, the SNSF provides funding for high-quality and innovative equipment through the R'Equip programme. It also funds editing projects in the humanities.[53] In addition, the SNSF supports science communication among researchers as well as between researchers and the general public.

[53] Editing projects compile historical documents and make them accessible for further research.

Figure A 5.1: SNSF commitments by funding category, in CHF million, 2021



Total excl. overhead: CHF 881.8 million
Total (incl. overhead of 117.3 million): CHF 999.1 million
Source: SNSF, adapted by SERI

The SNSF also has a wide range of instruments at its disposal to encourage international cooperation, e.g. through federal bilateral programmes. These help to facilitate cooperation between research groups across national borders.

Figure A 5.1 shows the funding commitments approved by the SNSF by funding category in 2021.[54]

5.2 Innosuisse

The Swiss Innovation Agency (Innosuisse) supports science-based innovations that benefit the economy and society. Innosuisse was created in 2018 following restructuring of the Commission for Technology and Innovation (CTI). Innosuisse is a federal institution under public law with its own legal personality and budget. Strategic guidelines are set by the seven-member Innosuisse Board, which reports to the Federal Council. The Management Team, which is supported by the Innosuisse Secretariat, is responsible for operational management.

In 2021, Innosuisse had a funding budget of around CHF 330 million. The Innovation Council, Innosuisse's specialist body, reviews project applications and monitors project implementation from both a scientific and innovation-based perspective. It relies on experts to assess project applications.

Innosuisse instruments help to improve knowledge and technology transfer (KTT) between research and practice.

One of Innosuisse's core tasks is to support innovation projects. Funding is available for all scientific disciplines and fields of innovation. Emphasis is placed on the development of new products, processes, services and business models. The aim is to use research findings to develop marketable solutions that bring economic and social benefits. Innovation projects are normally implemented with the help of implementation partners who work closely with research institutes. Funding criteria include innovation potential and scientific merit. Special emphasis is placed on the anticipated application of research findings on the market. Funding is provided to research institutes and is largely used to cover the salaries of research staff. Implementation partners must make their own contribution covering at least half of total project costs and this usually includes a cash contribution amounting to at least 10% of total project costs.

Innosuisse also supports innovation projects pursued by research institutes without implementation partners, taking into account the future implementation potential on the market and in society. SMEs can also commission smaller preliminary studies from research partners through Innosuisse in the form of innovation cheques.

Moreover, Innosuisse supports international cooperation projects of businesses through the intergovernmental initiative Eureka,[55] as well as through European programmes and bilateral agreements with partner countries. This international project support is intended to improve the competitiveness of Swiss businesses, integrate them in global value chains and lead to solutions to global challenges. The Enterprise Europe Network (EEN)[56] helps businesses to network internationally, both in pursuit of cooperation projects and to find markets abroad for innovative technologies and services. Innosuisse also fosters cooperation and information sharing in international networks as well as with foreign funding agencies (e.g. through TAFTIE).[57]

Innosuisse launched the Flagship Initiative[58] at the end of 2020. This programme focuses on specific but broadly defined thematic fields. Project partners work together in larger project consortia, adopting a systemic and transdisciplinary approach to challenges that have a major social and economic impact.

[54] The term ‚overhead' refers to indirect research costs (e.g. costs for rent, electricity, administrative tasks, etc.).

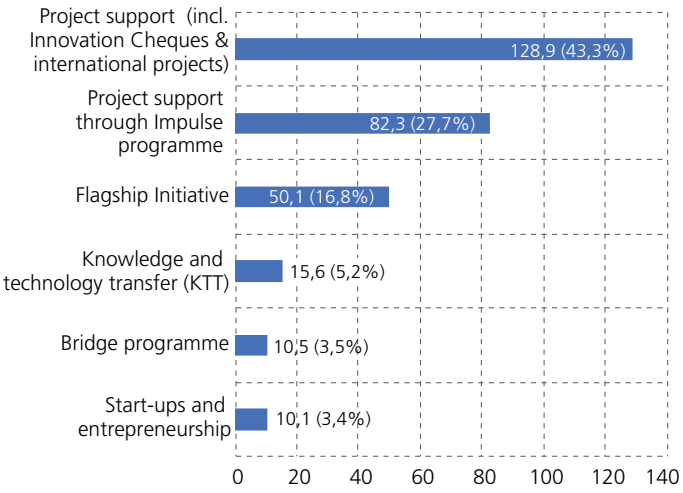
[55] A brief description Eureka can be found in Chapter 6.3 and the Annex.

[56] The EEN seeks to support cooperation, KTT and strategic partnerships for SMEs. 600 regional focal points in over sixty countries provide support. Switzerland takes part in the EEN using its own funds.

[57] TAFTIE is a European network of funding agencies (www.taftie.eu).

[58] www.innosuisse.ch > Funding for national projects > Flagship Initiative

Figure A 5.2: Innosuisse commitments by funding category, in CHF million, 2021



Total excl. overhead: CHF 297.5 million
Total (incl. overhead of CHF 32.2 million): CHF 329.7 million
Bridge programme: Innosuisse share
Source: Innosuisse, adapted by SERI

This new programme complements the bottom-up approach used for established innovation project funding. The thematic focus of the first flagship call was (1) addressing the digital transformation induced by Covid-19 and (2) improving resilience and sustainability while at the same time closing vulnerability gaps in society, infrastructure and processes.

The NTN Innovation Booster[59] is a KTT tool used by Innosuisse to help launch new innovative ideas. To this end, interested parties from research, business and society are brought together in selected thematic areas. New ideas are developed through an open culture of innovation, which can provide fertile ground for radical innovations. Innovation mentoring is another KTT tool that allows Innosuisse to provide SMEs with advice on how to submit funding applications.

Innosuisse's other activities include support for science-based start-ups. Innosuisse offers modular coaching services tailored to the individual needs of entrepreneurs. Innosuisse also helps start-up entrepreneurs to develop their international market presence through trade fair exhibits and stays abroad (internationalisation camps). Additional start-up support services include awareness-raising activities and training modules for prospective entrepreneurs from the higher education sector.

Innosuisse also has specific funding initiatives, such as the ‚Innovationskraft Schweiz' stimulus programme launched by the Federal Council in 2020 in response to the Covid 19 pandemic. This programme was launched to encourage innovation activities, sustain innovation and secure the long-term competitiveness of SMEs in Switzerland within the context of the Covid 19 pandemic. The programme ran from January 2021 to the end of 2022.

In 2021[60] the Swiss Parliament adopted revised legislation that will allow for more flexible handling of the implementation partner's own contributions in national innovation projects starting from 2023. In addition, it will be possible to provide start-ups with direct project funding before they enter the market. The same applies to businesses involved in international projects.

Figure A 5.2 shows Innosuisse commitments in 2021 by funding category.

Cooperation between SNSF and Innosuisse

While the SNSF's funding activities are mainly intended to acquire scientific knowledge, the focus of Innosuisse funding is on developing innovations that can be implemented on the market for economic and social gain. Both institutions thus have a clear profile with their own focus and complement each other perfectly.

This results in numerous areas of cooperation, such as the Bridge programme, which is supported by both organisations and is aimed at projects at the interface between basic research and science-based innovation. The Bridge programme offers two types of support: Proof of concept support is intended for younger researchers seeking to develop practical applications for their research findings either by establishing their own start-up or by partnering with the business enterprise or government sector. Discovery support is intended for more experienced researchers who wish to identify and tap the innovation potential of their research findings for future implementation of specific innovations.

5.3 Swiss Academies of Arts and Sciences

As a federal funding body, the Swiss Academies of Arts and Sciences seeks to foster cooperation in and between all academic disciplines and help to root science in society. They work to ensure and encourage timely recognition of socially relevant topics pertaining to education, research and innovation. They are also committed to upholding ethics in research and teaching. Finally, they shape the dialogue between science and society in order to build mutual understanding.

The individual academies coordinate their funding activities through the umbrella organisation Swiss Academies of Arts and Sciences. They advise policymakers, government officials and the general public on issues of relevance to science and society. They play a key role in the interdisciplinary networking of the research community.

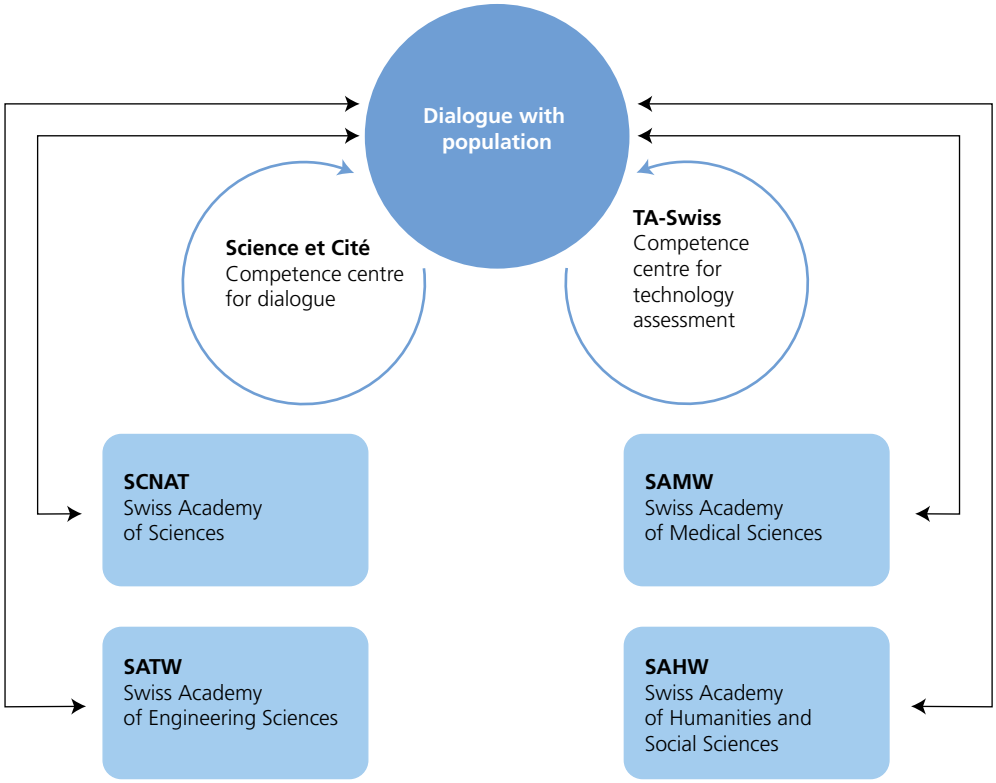
Working on behalf of the Confederation, they develop stimulus and coordination initiatives and work with other ERI stakeholders to implement them.[61] They are committed to representing Swit-

[59] NTN = National Thematic Networks.

[60] www.innosuisse.ch > Media and Events > Newsroom > Parliament gives Innosuisse more leeway for innovation promotion

[61] Examples include the programme to support young researchers in science, technology, engineering, and mathematics (STEM) or the national funding initiative to support personalised medicine (Swiss Personalized Health Network, SPHN).

Figure A 5.3: Swiss Academies of Arts and Sciences



Source: Swiss Academies of Arts and Sciences, adapted by SERI

zerland in international scientific organisations and umbrella associations of academies. This helps to reinforce Switzerland's position as a location for science and research.

Firmly rooted in the scientific community, the Swiss Academies of Arts and Sciences have access to the expertise and excellence of around 110 000 people, making it the largest scientific network in Switzerland organised on a militia basis. It uses this network to address overarching issues, for example relating to scientific culture, sustainable development or changing healthcare needs. It also brings scientific expertise to discussions on policy issues and seeks to encourage a greater understanding of science in society. The federal government provides around CHF 49 million per year to the Swiss Academies of Arts and Sciences under the terms of a performance agreement.

The association is comprised of the Swiss Academy of Sciences (SCNAT), the Swiss Academy of Medical Sciences (SAMS), the Swiss Academy of Engineering Sciences (SATW) and the Swiss Academy of Humanities and Social Sciences (SAHS). The two competence centres TA-SWISS (which conducts technological impact assessments) and Science et Cité (which is responsible for nurturing dialogue between science and society) are also part of this association (Figure A 5.3).

5.4 Federal policy research

The Federal Administration initiates and supports scientific research - referred to as policy research - to obtain the knowledge that it needs carry out its tasks (see Chapter 2.4). Policy research takes place in the context of government action in the public interest. It can encompass practically all forms of scientific research, namely basic and applied research as well as market-oriented development, which includes pilot and demonstration plants for engineering projects.

The Confederation may establish federal research institutes (under Art. 17 RIPA) and thus become a performer of R&D activities (i.e. intramural R&D). Examples of federally owned research institutes include Agroscope, which conducts agricultural research on behalf of the Federal Office for Agriculture; the Swiss Federal Institute for NBC Protection (Spiez Laboratory), which is part of the Federal Office for Civil Protection (FOCP).

In addition, the Confederation provides research funding to third-parties and awards research contracts. It may also launch its own research programmes in cooperation with higher education institutions, the SNSF, the Swiss Academies of Arts and Sciences and Innosuisse. Research contracts are mainly awarded for expert opinions and reports or for accompanying research aimed at assessing the impact of policy measures and/or developing policy.

Over 30 federal agencies are involved in policy research. The Federal Council has defined eleven policy areas. Research in these policy areas is coordinated by an interdepartmental coordination committee headed by SERI. In 2021, the Confederation spent around CHF 362 million on policy research.

5.5 Regional, cantonal and communal support for R&I

Regional, cantonal and communal support for R&I is also important for Swiss research and innovation. The key features of this support are presented in the following national overview below.

Individual regions within a given country often differ in terms of competitiveness and innovative capacity. For this reason, sub-national levels are playing an increasingly important role in innovation promotion, both in Switzerland and abroad (OECD, 2011).

The federal government's New Regional Policy (NRP), which is managed by SECO, has taken this reality into account since 2008. Under the NRP, subsidies are channelled to mountain regions, rural areas and border zones. This funding is intended to improve the innovative capacity and competitiveness of these regions and strengthen cohesion between urban and rural areas (SECO, 2022). The aim of regional innovation systems (RIS) is to improve the coordination of existing support measures (e.g. clusters, innovation coaching, events, joint cooperation projects involving several businesses). RIS help SMEs to adapt to regional specificities (SECO, 2018), enabling them to tap regional potential more effectively and improve overall innovation dynamics in the targeted regions. The cantons have a certain amount of leeway in shaping RIS programmes, which has an impact on the range of services offered in each region. If innovation support in a science- or research-based context is needed, then economic partners can fall back on Innosuisse funding instruments. Coordination and cooperation between the RIS and Innosuisse are therefore very important.

The cantons contribute greatly to the promotion of research and innovation by funding cantonal universities, universities of applied sciences and universities of teacher education. In addition, most cantons, partly thanks to NRP subsidies, encourage innovation and business activities. The range of services includes, for example, support for business start-ups, fostering regional networks or clusters through close contact with businesses, and the provision of coaching services. The cantons have their own business promotion agencies, which operate either on their own or in conjunction with other cantons. These agencies provide businesses with information about the advantages of their canton as a business location and maintain contacts with investors. They also provide information on business location opportunities, arrange for investor support and provide on-site services to clients. In addition, many cantons offer tax concessions and use their education institutions to promote regional development.[62]

Like other banks, cantonal banks and some regional banks offer financing for start-ups. Cantonal banks frequently take part in competitions and funding prizes for particularly innovative businesses. In addition, several cantonal banks provide guidebooks and templates for start-ups.

Municipal and communal governments encourage innovation through various means such as business incubators or technology parks. Such initiatives are mostly privately funded, but in some cases also include cooperation with the government sector. A typical example might be as follows: a real estate company purchases an office building and assigns a company to manage the property. This property management company then selects innovation-oriented businesses to use the premises. These businesses then receive support services from the property management company.

5.6 Foundations

Foundations also support research and innovation. In 2021, there were around 13 500 active non-profit foundations in Switzerland contributing to cultural, social and scientific life. Of these, around 20% pursue activities in the area of education and research (von Orelli and al., 2022).[63] Examples include the Gebert Rüf Foundation,[64] the Swiss Cancer Research Foundation[65] and the Hasler Foundation.[66]

Since these foundations provide funding for a wide range of R&I projects and apply different eligibility criteria, they play an important role in diversifying R&I funding.

[62] Examples of cantonal agencies or regional networks for business promotion are the High-tech Aargau initiative, the Canton of Ticino's Agenzia per l'innovazione regionale or platinn in western Switzerland.

[63] Other foundation purposes include culture and leisure, social services, health care, environmental protection and religion.

[64] The Gebert Rüf Foundation encourages innovation that benefits the Swiss economy and society. Support is given to projects by up-and-coming entrepreneurial talent. Selection criteria include relevance, scientific quality, originality, effectiveness, transfer potential and interdisciplinarity.

[65] The Swiss Cancer Research Foundation funds all areas of cancer research (basic research as well as clinical, epidemiological and psychosocial research). Particular attention is paid to supporting patient-oriented research.

[66] The purpose of the Hasler Foundation is to encourage the development of information and communication technology (ICT) to enhance Switzerland's appeal as a location for research and production.

6. International cooperation

International cooperation is intended to consolidate and reinforce Switzerland's position as one of the world's most competitive ERI locations. With this aim in mind, international R&I funding instruments complement national ones and enable Swiss stakeholders to gain access to international networks.[67]

6.1 EU framework programmes for research and innovation

EU framework programmes for research and innovation (FPs) are particularly important for international cooperation in research and innovation. The most recent one, Horizon Europe (FP9), runs from 2021 to 2027 and is the successor to Horizon 2020 (FP8), which ran from 2014-2020. Horizon Europe is the most ambitious FP in the history of the EU and is the world's largest research and innovation funding programme. It is intended to boost science and technology production in the EU by increasing investment in highly skilled workers and cutting-edge research. At the same time, Horizon Europe is also intended to help advance the EU's strategic priorities. These include, for example, strengthening a resilient, inclusive and democratic European society so that it is prepared for and able to respond to threats and disasters. At the same time, the aim is to restore and safeguard Europe's ecosystems and biodiversity. Horizon Europe is thus expected to contribute to the green and digital transformation and consolidate the European Research Area.

Switzerland has been participating in the EU framework programmes in various forms since 1987:
1987-2003, FP1-6: non-associated third country
2004-2013, FP6 and FP7: fully associated
2014-2016, Horizon 2020 (FP8): partially associated
2017-2020, Horizon 2020 (FP8): fully associated
2021-2022, Horizon Europe (FP9): non-associated third country
2023-2027, Horizon Europe (FP9): form of participation yet to be determined

The form in which Switzerland will participate in the future is still uncertain at present (as of August 2022). The Federal Council's stated objective is to secure fully associated status for Switzerland in Horizon Europe and related programmes and initiatives (Euratom, ITER, Digital Europe Programme) as soon as possible. In order to reduce the impact of Switzerland's current non-associated third-country status in a targeted and efficient manner, the Federal Council adopted a series of transitional measures using the funds that Switzerland would have contributed to the EU had it held associated country status. The amount of funding set aside for these transitional measures in 2021 and 2022 amounted to over CHF 1.2 billion. SERI is therefore able to directly fund project participants in Switzerland wishing work on joint projects, which they are still eligible to take part in. SERI has requested the Swiss National Science Foundation (SNSF), Innosuisse, the European Space Agency (ESA) and other stakeholders to take additional transitional measures to cover inaccessible parts of Horizon Europe.

The participation of Swiss R&I stakeholders in FP brings Switzerland multiple benefits. Researchers and innovators in Switzerland work in transnational projects mostly with researchers from Europe, but also with project participants from all over the world. The numerous beneficial scientific, technological and economic effects are particularly important (SERI, 2019). Compared to their colleagues in other European countries, Swiss researchers have been particularly effective in securing project funding for their project proposals (see Part B, Figure B 5.6). That said, Swiss participation in FPs temporarily declined for the first time as a result of the partial association with Horizon 2020 (SERI, 2018).[68] A more precise assessment is expected in 2023.

6.2 EU education programmes

Switzerland's cooperation with the EU in the area of education has been a tried and tested part of the Confederation's international support policy for over thirty years. Participation in the EU's pluri-annual education programmes - whether it be solely on a project-by-project basis or through association - encourages individual learning mobility and cooperation between Swiss and European institutions and stakeholders.

EU programme advisory services for Swiss stakeholders

Acting under a SERI mandate, Euresearch provides information and guidance to research and innovation stakeholders in Switzerland who wish to take part in FP projects. The Euresearch network has advisory offices at over ten university locations in Switzerland in addition to its main office in Bern.

The Confederation supports the Swiss Contact Office for European Research, Innovation and Education (SwissCore) through SERI, SNSF and Innosuisse. The liaison office for Swiss researchers and students is located in Brussels. SwissCore helps Swiss ERI stakeholders to network locally.

[67] The Federal Council updated its international strategy for education, research and innovation in 2018 (Federal Council, 2018).

[68] Indications of this include the relative decline in Swiss participation compared to other countries, the marked decrease in the number of instances of Swiss project coordination and the reduction in EU contributions to Swiss research institutions as a proportion of total EU funding for Horizon 2020 projects.

The latest Erasmus+ education programme runs from 2021 to 2027. Switzerland currently holds third-country status and has adopted a 'Swiss solution' to facilitate Swiss participation.[69] It is still uncertain at present (as of August 2022) in what form Switzerland will participate in the future.

In 2021, the Confederation's 'Swiss solution' enabled roughly 14800 participants from Switzerland and Europe to round off their education with a stay abroad. Movetia is the national agency responsible for promoting exchanges and mobility in education. It is supported by the Confederation and the cantons.

6.3 Other programmes, research infrastructures, research infrastructure networks and initiatives

In addition to EU framework programmes, there are other programmes, research infrastructures, research infrastructure networks and international R&I cooperation initiatives that are very important for Swiss research and innovation.[70] Among other things, participation provides Swiss R&I stakeholders with access to cost-intensive research facilities for experiments as well as to a wide range of knowledge. It also allows nationally organised research infrastructures to be part of international research infrastructure networks.

Switzerland is a founding member of the European Space Agency (ESA). By participating in ESA programmes, Swiss R&I stakeholders gain access to scientific data and compete with R&I stakeholders in other countries for industrial contracts and research project funding. Since the ESA was founded in 1975, it has given rise to an effective, innovative Swiss space ecosystem based on research excellence and high value creation.

Switzerland's membership of CERN is another important asset. CERN is an intergovernmental organisation devoted to basic research in physics. The CERN laboratory is the world's top research facility in the field of particle physics. Based in the Canton of Geneva and with sites in both France and Switzerland, CERN has remained one of the world's largest international research infrastructures since it was founded in 1954. Switzerland derives scientific, industrial and economic benefits from CERN. As a result, the Federal Council decided to improve Swiss government planning support for CERN projects on 10 December 2021.[71]

Switzerland also takes part in the projects of ten international research infrastructures where experiments are carried out and cutting-edge research is conducted worldwide in the respective scientific fields.

In addition, the Federal Council decided on 13 April 2022[72] that Switzerland would increase its participation in international research infrastructure networks in order to link nationally organised research infrastructures with those abroad and to coordinate their activities. In this way, the synergy potential of these infrastructures can be better exploited.

In the area of international support for innovation, Switzerland is a member of the intergovernmental Eureka Initiative, which specifically exists for the purpose of encouraging cross-border cooperation projects in market-oriented research and development. It is particularly interesting for SMEs, which account for over half of project partners.

6.4 Bilateral R&I cooperation and Swissnex

Since 2008, the Confederation has funded bilateral support programmes for research and innovation cooperation in selected regions where there is significant potential for scientific and technological development. The aim is to diversify international partnerships and establish tailor-made cooperation instruments. This should facilitate the emergence of new mutually beneficial partnerships of excellence. At the same time, Swiss ERI stakeholders receive assistance in their independent efforts to internationalise their activities.

These bilateral programmes consist of two complementary instruments:

– Joint Research Projects: On behalf of SERI, the SNSF has teamed up with funding agencies in various partner countries to support ambitious three- to four-year research projects that focus on specific scientific issues. Joint calls for proposals also strengthen institutional cooperation between funding agencies. In 2020, for example, a lead agency agreement was signed between South Africa and Switzerland.[73] Thanks to the direct cooperation between the SNSF and the South African National Research Foundation, scientists from Switzerland and South Africa are now able to submit joint project proposals to only one of the agencies at any time and in any subject area.

[69] As part of the ‚Swiss solution', SERI mainly facilitates the indirect participation of Swiss institutions in mobility and cooperation projects under the Erasmus+ programme, complemented by corresponding accompanying measures. Following a complete overhaul of the legal basis (SR 414.51) in April 2022, the strategic scope of action was expanded so that funding can also be provided for the worldwide exchange and mobility activities that are not directly related to Erasmus+.

[70] A non-exhaustive overview of Swiss participation in international programmes, research infrastructures, research infrastructure networks and initiatives can be found in the Annex of Part A.

[71] www.admin.ch > Documentation > Press releases > Federal Council intends to increase Swiss support for CERN projects

[72] www.admin.ch > Documentation > Press releases > Federal Council wants Switzerland to join six European research infrastructures

[73] www.admin.ch > Documentation > Press releases > Milestone in scientific cooperation between Switzerland and South Africa

Figure 6.1: Swissnex

- Main Swissnex locations
- Science counsellors at Swiss missions abroad

Source: SERI

– Leading House pilot activities: SERI has mandated selected higher education institutions[74] to develop small-scale support mechanisms (e.g. initial funding and innovative pilot projects) to encourage bilateral cooperation in their assigned regions. These Leading House instruments have acted as a catalyst for new bilateral research and innovation projects and have led to the testing of new bilateral R&I cooperation instruments.

IIn May 2022, the Federal Council announced its intention to diversify and intensify the international focus of Swiss research and innovation activities in areas where Switzerland currently excels: the focus will be on bilateral and multilateral research partnerships with countries in and outside Europe in research areas of strategic importance to Switzerland.

In 2021, SERI teamed up with its partners[75] and Swissnex to create the Research.swiss[76] platform for the purpose of standardising communication on Swiss bilateral funding programmes. The Research.swiss website features current calls for proposals for bilateral funding programmes and provides a comprehensive overview of Swiss international R&I funding instruments.

Swissnex, the worldwide Swiss network for education, research and innovation, is another initiative of the Confederation to encourage international cooperation. Swissnex helps its partners to establish international contacts and contributes to the global exchange of knowledge, ideas and talent. The six main Swissnex sites are located in the world's most innovative metropoles. Together with the twenty or so science sections and science counsellors at Swiss missions abroad, Swissnex strengthens Switzerland's image as an innovation hotspot (Figure A 6.1).

[74] In consultation with the Swiss Conference of Rectors of Higher Education Institutions (swissuniversities), the following Leading Houses are responsible for regional implementation of smaller pilot projects for the period 2021-2024: University of Applied Sciences of Western Switzerland will cover North Africa and the Middle East; the Swiss Tropical and Public Health Institute (Swiss TPH) in cooperation with the University of Basel will cover Sub-Saharan Africa; the University of St. Gallen will focus on Latin America; ETH Zurich will focus on East and Southeast Asia; the *Zürcher Hochschule für Angewandte Wissenschaften* (ZHAW) will cover South Asia and Iran.

[75] The Swiss Agency for Development and Cooperation (SDC), the ETH Board, Euresearch, Innosuisse, Leading Houses, SNSF, Swissnex, swissuniversities, and Switzerland Innovation.

[76] www.research.swiss

KTT frequency, forms, motivations and obstacles in Switzerland

As shown by an analysis of KTT from both the company side (Beck et al., 2020) and research institute side (Barjak et al., 2020), around 25% of businesses and around 80% of research institutes in Switzerland engaged in KTT during the observation period 2012 to 2017. Most of these instances of KTT occurred through informal, personal contacts. The main motivations on the company side for KTT were the search for specific skills to complement internal know-how and the desire to hire graduates. For research institutes, the motivation was to bolster scientific research and solve practical problems for business, society and technology. However, KTT often failed to materialise or develop due to a lack of interest (which both sides expected), insufficient resources and difficulties securing the necessary funding. Companies engaged in KTT pointed out that they lacked specific contact persons for KTT at research institutions

7. Knowledge and technology transfer (KTT)

Knowledge and technology transfer (KTT) involves the sharing, provision and transfer of information, skills and R&D findings between higher education institutions, research institutes, businesses and government agencies. The aim is to initiate and improve innovation processes and thereby encourage innovation. Emphasis is placed on the practical and/or economic use of existing and jointly acquired knowledge.

The provision of services and KTT are included in the remit of the ETH Domain, cantonal universities and universities of applied sciences. Since their focus is traditionally on teaching and research, KTT takes place primarily via graduates who are employed by businesses (‚transfer via minds'). Other forms of KTT include, for example, research cooperation or consultancy work.

In addition, KTT takes place through Switzerland's participation in international programmes (e.g. FPs), research infrastructures (e.g. CERN) and initiatives (e.g. Eureka) for international R&I cooperation (see Chapter 6.3 and Annex). In the area of space technology, the Confederation also pursues a KTT policy through its participation in the ESA, which includes in particular the transfer of institutional R&D programmes to the business sphere. In addition, KTT in space technologies is encouraged through national space activities (Ordinance of 17 December 2021 on the Promotion of National Activities in the Space Sector (NASO).[77] Innosuisse's instruments also help to reinforce the transfer of knowledge and technology between research and practice (see Chapter 5.2). Finally, most cantons and many larger towns also maintain technology parks where KTT occurs.

KTT can be found primarily in the technical and natural sciences as well as in medicine. However, importance is also given to the transfer of knowledge in the fields of health, social sciences and the arts as well in the humanities and social sciences. Here, KTT takes the form of consulting, assessment, analysis and problem-solving with innovative approaches to improving society as a whole.

7.1 Centres of technological excellence

The centres of technological excellence (Art. 15 para. 3 let. c RIPA, see Chapter 2.3)[78] offer a possible framework for cooperation in the area of KTT. These are national research institutes outside the higher education sector that work with universities and the business enterprise sector. They act as legally independent entities, receiving their funding from the business enterprise sector and the government sector. Examples include the Centre Suisse d'Electronique et de Microtechnique (CSEM) in Neuchâtel, inspire AG in Zurich and St. Gallen, which is active in the field of mechatronic production systems and manufacturing technology, and the Swiss Institute for Translational and Entrepreneurial Medicine (sitem-insel) in Bern. Other examples of centres of technological excellence include the Swiss m4m Center and ANAXAM, which the Confederation has been funding since 2021 as part of the AM-TTC initiative (Advanced Manufacturing Technology Transfer Centers). These centres are coordinated by the ETH Domain and provide guidance and support to SMEs in particular on how to implement modern manufacturing technologies.

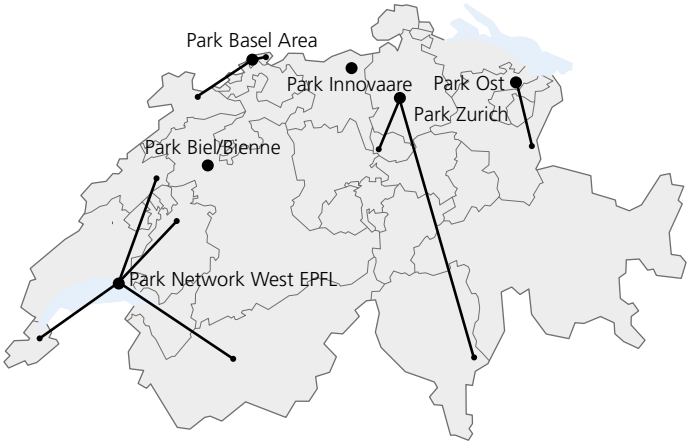
7.2 Swiss Innovation Park

The Swiss Innovation Park is an initiative of national importance run by the Confederation and the cantons, the research community and the business enterprise sector. It plays an important role in KTT by encouraging researchers and businesses to work together. The Swiss Innovation Park thus makes a substantial contribution to Switzerland's appeal as a competitive location for research and innovation.

[77] SR **410.125**

[78] A list of all the centres of technological excellence that received funding in the four-year period 2021-2024 can be found at: https://www.sbfi.admin.ch > Forschung und Innovation > Förderinstrumente > Forschungseinrichtungen von nationaler Bedeutung

Figure A 7.1: Swiss Innovation Park sites



Source: Switzerland Innovation

Under the umbrella brand of 'Switzerland Innovation', the Swiss Innovation Park is currently comprised of six locations in the vicinity of Switzerland's two federal institutes of technology, i.e. ETH Zurich and EPFL Lausanne. There are also sites in Aargau, in the northwestern part of Switzerland, in Biel and in the eastern part of Switzerland. Other regional locations are linked to these main sites (Figure A 7.1).

The Swiss Innovation Park is intended to boost private investment in research and development and to supplement established funding instruments in a targeted manner. The aim is to make Switzerland an appealing location for international research and development activities by providing fully developed plots of land and floor space near higher education institutions and businesses. These plots of land will provide sufficient room for settlement and expansion.

Funding is provided by the cantons and private investors. This includes funding to cover operating costs and maintenance as well as preparation of land where businesses will carry out their activities. The various sites generate rental and service income and thus become economically self-sustaining in the medium term.

The Confederation's involvement is restricted to providing guarantees for earmarked and fixed-term loans for the various site operators. These loans are used to finance the construction of research infrastructures at the various locations. The federal government can also grant building rights on land that it owns (Art. 33 RIPA).

7.3 Technology transfer offices

Technology transfer offices have been set up to encourage and support knowledge and technology transfer (KTT). These offices differ in terms of how they are institutionally embedded and the content covered. Publicly funded, technology transfer offices provide researchers with skilled partners for R&D projects both within and outside their institutions. They identify and evaluate research findings with economic potential, define a valorisation strategy with the researchers (e.g. how best to obtain patents and licences) and work with researchers, companies and other partners to implement this strategy.

There are three different types of technology transfer offices in Switzerland:

– The office is an administrative unit fully integrated into a higher education institution and is centrally managed. This is the case in the majority of cantonal universities and the federal institutes of technology; for example, the ETH Transfer office at ETH Zurich.

– The office is integrated into a higher education institution but most of its activities are decentralised, taking place in departments and faculties with KTT tasks outsourced. This organisational model is the one preferred by the universities of applied sciences.

– Several universities coordinate their KTT activities: a jointly owned company serves as an external KTT office guiding and driving transfer processes. This is the approach adopted by the universities of Zurich, Bern and Basel in cooperation with the company Unitectra AG.

Swiss Technology Transfer Association

The Swiss Technology Transfer Association (swiTT) brings together experts specialised in technology transfer between the business enterprise sector and public research and education institutions, hospitals and other non-profit research institutions. swiTT facilitates KTT between these institutions and the business enterprise sector. Members and others involved in KTT in science and business receive professional support and training as well as a wide range of services.

Overview: International programmes, research infrastructures, research infrastructure networks and initiatives

An overview of the examples mentioned in Chapter 6.3 as well as further examples of Swiss participation in international R&I programmes, research infrastructures, research infrastructure networks and R&I initiatives can be found in the following, non-exhaustive list.

Name	Function
International research and innovation programme	
European Union framework programmes	The EU's main instrument used to support research and innovation. The Horizon Europe programme will run from 2021 to 2027. Switzerland is currently (as of August 2022) not associated with Horizon Europe. The predecessor programme Horizon 2020 (with which Switzerland was fully associated from 2017 onwards) ended in 2020, although some projects are still ongoing.
Institutionalised partnerships under Horizon Europe: – Global Health EDCTP3 – Innovative Health Initiative – Key Digital Technologies – Europe's Rail – Circular Bio-based Europe – Clean Hydrogen – Clean Aviation – EuroHPC – Single European Sky ATM Research 3 – Smart Networks and Services – European Partnership on Metrology	Institutionalised partnerships complement the existing Horizon Europe framework by addressing global challenges and priorities that require a certain critical mass and long-term vision. They involve public and private stakeholders working together at EU and national level. Legal entities established in Switzerland are also eligible to take part in most of these partnerships by virtue of Switzerland's non-associated third country status. Funding for this can be obtained directly from SERI under the transitional measures adopted.
Euratom (European Atomic Energy Community), which includes EUROfusion (European Consortium for the Development of Fusion)	The aim of the Euratom programme is to continuously support efforts to improve nuclear safety and radiation protection through nuclear research and education activities. EUROfusion coordinates national research activities across national borders that focus on the peaceful use of nuclear energy. Switzerland is currently not associated with the Euratom programme (as of August 2022).
DEP, Digital Europe Programme	The Digital Europe Programme is a new EU support programme that runs parallel to Horizon Europe and complements it. Its purpose is to make digital technologies accessible to businesses, citizens and government bodies. Switzerland is currently (as of August 2022) not associated with the DEP.
EMBC, European Molecular Biology Conference	Promotes molecular biology research in Europe and supports training and information sharing between European researchers.
International research infrastructures	
CERN, European Laboratory for Particle Physics, Geneva (Switzerland)	Ensures the exclusively peaceful cooperation of European states in the field of nuclear and particle physics and promotes high-energy physics research with its accelerator facilities.

Name	Function
International research and innovation programme	
ESO, European Southern Observatory, Garching (Germany) and various locations in Chile	Constructs and operates astronomical observatories in the southern hemisphere and promotes European cooperation in the field of astronomical research.
SKAO, Square Kilometer Array Observatory, Jodrell Bank (UK) and sites in South Africa and Australia	Builds and operates radio telescopes located in the southern hemisphere and encourages global cooperation in specific areas relating to astronomical research.
EMBL, European Molecular Biology Laboratory, Heidelberg (Germany) and five other sites in Europe	Promotes European cooperation in basic research in molecular biology, provides the necessary infrastructure and participates in the development of cutting-edge instruments for biology.
ESRF, European Synchrotron Radiation Facility, Grenoble (France)	Provides X-rays with high energy, intensity and accuracy, necessary for structural analysis in solid state physics, molecular biology, materials science, for diagnosis and therapy in medicine, and for special experiments in radiobiology, fundamental physics and physical chemistry. ESRF is complementary to the Swiss Light Source at the Paul Scherrer Institute (PSI).
European XFEL, European X-Ray Free-Electron Laser Facility, Schenefeld (Germany)	Creates short X-ray laser flashes with very high luminosity. This allows, for example, the recording of atomic details of viruses, of the molecular composition of cells, of elements of the nanocosmos and of physio-chemical and biological reactions. European XFEL is complementary to SwissFEL at the Paul Scherrer Institute (PSI).
ESS, European Spallation Source ERIC, Lund (Sweden)	Is building the world's most powerful neutron source. Unlike ILL, ESS will not use a nuclear reactor to produce neutrons. Switzerland has contributed to construction of the ESS and will also be involved in operating the facility. ESS is complementary to the Swiss Neutron Spallation Source (PSI) and is expected to replace ILL's capacity after its expected closure in 2033.
ILL, Institut Max von Laue – Paul Langevin, Grenoble (France)	Expected to provide nuclear reactor-based power until at least 2033. The ILL offers a high-performance neutron source for research and studies in material science, solid state physics, chemistry, crystallography, molecular biology, nuclear physics and fundamental physics. The ILL complements the Swiss Neutron Spallation Source at the (PSI).
ITER Organization, International Thermonuclear Experimental Reactor, Cadarache (France)	Is building the world's largest experimental reactor to generate energy by means of nuclear fusion. While Switzerland is not a member of ITER, it participates indirectly via EU representation. ITER is complementary to the Swiss Plasma Center (EPFL).
CTAO, Cherenkov Telescope Array Observatory ERIC,[79] Bologna (Italien) und Standorte in Deutschland, Spanien und Chile	Once built, CTAO will be the world's largest Earth-based observatory for ultrahigh-energy gamma astronomy on both hemispheres and encourages global collaboration in this field of research, which straddles astronomy and particle physics.

[79] The international research infrastructure CTAO will adopt the legal form of the ERIC sometime in 2023.

Name	Function
International research and innovation programme[80]	
BBMRI, Biobanking and Biomolecular Resources Research Infrastructure ERIC	Provides a central platform providing access to national biobanks and molecular biology resources.
CESSDA, Consortium of European Social Science Data Archives ERIC	Helps to link together social science archives.
DARIAH, Digital Research Infrastructure for the Arts and Humanities ERIC	Seeks to link up digital infrastructures for humanities research and provide tools that facilitate the interpretation of sources.
ECRIN, European Clinical Research Infrastructure Network ERIC	Conducts international clinical trials to improve medical practice and treatment.
EPOS, European Plate Observing System ERIC	Connects infrastructures and enables networked data collected from Earth crust readings, from laboratory experiments or from computer simulations to be used more readily and to a greater extent.
ELIXIR, European Life-Science Infrastructure for Biological Information	Encourages the sharing of life sciences research data by creating a common infrastructure for national bioinformatics centres and services.
ESSurvey, European Social Survey ERIC	This survey is updated every two years and covers social attitudes and behaviours.
ICOS, Integrated Carbon Observation System ERIC	Observes the carbon and greenhouse gas cycle of the atmosphere, oceans and ecosystems.
SHARE, Survey of Health, Ageing and Retirement in Europe ERIC	Multidisciplinary survey of people over 50 on the topic of health and ageing.
Space sector	
ESA, European Space Agency, Paris (France) and Locations in the Netherlands, Italy, Germany, Spain, the United Kingdom, Belgium and French Guyana	Fosters cooperation between European countries in the areas of space research and technology to generate scientific knowledge, to develop applications such as navigation systems, telecommunications or weather satellites, and to ensure independent access to space.
International R&I initiatives	
COST, European Cooperation in Science and Technology, Brussels (Belgium)	Brings together researchers from research institutions, universities and the business enterprise sector and offers them the opportunity to become involved in European research networks and pursue a wide range of R&D activities.
Eureka, Initiative pursued as part of European technological research cooperation, Brussels (Belgium)	Instrument designed to encourage innovation as a means of boosting the competitiveness of member countries. Innovative products, processes and services reach the market as a result of transnational cooperation between businesses, research centres and universities. The initiative is particularly interesting for SMEs, which account for over half of the project partners.

[80] In the case of research infrastructure networks, Switzerland is already a member of ELIXIR. Switzerland also holds observer status in eight research infrastructure networks organised under the legal form of the European Research Infrastructure Consortium (ERIC). In April 2022, the Federal Council applied to Parliament to join six of these ERIC networks, namely BBMRI ERIC, CESSDA ERIC, DARIAH ERIC, ECRIN ERIC, EPOS ERIC and ICOS ERIC. Further Swiss participation in such networks can be reviewed under established procedures. Switzerland is currently involved in individual research infrastructure networks that are in the process of being established (as of August 2022).

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Abbreviations

CHF	Swiss francs
CIS	Community Innovation Survey
Cst.	Federal Constitution
EAER	Federal Department of Economic Affairs, Education and Research
EPFL	École polytechnique fédérale de Lausanne / Swiss Federal Institute of Technology Lausanne
ERI	Education, research and innovation
ETH Zurich	Eidgenössische Technische Hochschule Zürich / Swiss Federal Institute of Technology Zurich
EU	European Union
FIT	Federal institute of technology (there are two in Switzerland: ETH Zurich and EPFL)
FP	EU framework programme for research and innovation
FSO	Federal Statistical Office
GDP	Gross domestic product
HEdA	Swiss Higher Education Act
ICT	Information and communication technologies
KOF	KOF Swiss Economic Institute (ETH Zurich)
KTT	Knowledge and technology transfer
Mio.	Million
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
R&I	Research and Innovation
R&D	Research and development
RIPA	Swiss Research and Innovation Promotion Act
SECO	State Secretariat for Economic Affairs
SERI	State Secretariat for Education, Research and Innovation
SME	Small and medium-sized enterprises
SNSF	Swiss National Science Foundation
STEM	Science, technology, engineering and mathematics
UAS	University of applied sciences
UTE	University of teacher education

This list is by no means exhaustive and contains only the most frequently encountered abbreviations.