Schweizerische Eidgenossenschaft
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Research and Innovation in Switzerland

Management Summary

Swiss Universities — A Wide Range of High-Quality Options

With its cantonal universities and federal institutes of technology (ETH/EPF), its universities of applied sciences and universities of teacher education, the Swiss higher learning landscape offers a wide diversity of options.

Degree courses are structured according to the international model, with Bachelor and Master levels. Universities and ETHs also offer the possibility of achieving a doctorate degree. All universities are involved not only in teaching but also in research and continuing education and training and provide services to third parties.

Swiss universities are internationally recognised for their achievements and make a significant contribution to the economic, cultural and social development of the country.

Approximately a quarter of all students and over 40% of researchers at Swiss universities are foreign nationals. Various universities place well or even very well in international rankings.

International ranking of swiss universities

	EPFL	ETHZ	Basel	Bern	Fribourg	Geneva	Lausanne	Lugano	Neuchâtel	St.Gallen	Zürich
Shanghai Ranking 2019	78	19	87	101–150	401-500	58	151-200	501-600			61
QS Ranking 2020	18	6	151	123	581-590	110	153			398	76
Times Ranking 2020	38	13	94	113	301-350	144	198	301–350	500-600	401–500	90
Leiden Ranking 2019	16	14	53	181		71	116				60

Source: www.universityrankings.ch

Well-Coordinated Cooperation Between the Private and Public Sectors

A division of tasks between the private and public sectors has evolved over time, where basic research is conducted mainly in ETH and cantonal universities, and applied research and development (R&D) and the development of marketable products take place primarily in the private sector and at universities of applied sciences.

The federal government funds research and innovation through the Swiss National Science Foundation (SNSF) and the Suisse Innovation Agency Innosuisse. It also funds the ETH Domain and the Swiss Academies of Arts and Sciences, and supports almost 30 research facilities of national importance. The cantons support primarily their own cantonal universities and universities of applied sciences. The confederation supplements the cantonal funding with its subsidies.

Around two thirds of all R&D in Switzerland is funded by the private sector and takes place mainly within a relatively small group of very research-intensive multinational companies and particularly innovative SMEs.

Established Principles in Research and Innovation Promotion

Public research promotion primarily relies on openness, the researchers' own initiative, the principle of competition, qualitative assessment criteria and international cooperation.

- Openness: there are few specifications established by the government for research topics and programme funding. Universities enjoy a high degree of autonomy. All disciplines are eligible for funding.
- Bottom-up principle: individual research teams or companies are proactive in their research and innovation activities. They take responsibility and accept risks.
- Competitiveness and excellence: funding is awarded in a competitive proposal process; proposals are evaluated according to their standard of excellence.
- International cooperation: Switzerland actively contributes to international research organisations and programmes.

Both the government and the private sector invest large amounts in maintaining and developing Switzerland as a research location. Investment in research and innovation makes up around 3.4% of Swiss GDP – a figure much higher than the OECD average.

Active Cooperation in International Research and Innovation

Switzerland's main involvement in the European Research Framework Programmes is a major stake.

Switzerland is active in key European research and innovation initiatives such as EUREKA. Furthermore, it is a member of several international research organisations such as the European Space Agency (ESA) and CERN, the world's largest laboratory for elementary physics, based in Geneva.

Foreign science policy is an integral part of Swiss foreign policy. Switzerland works bilaterally with select partner countries, and is present in an official capacity all over the world, with its science and technology councillors at Swiss embassies and through the Swissnex network.

Optimal Framework for Innovation-Intensive Companies

A competitive market with a strong focus on private initiative and comparatively little state regulation and intervention are the key features of the system in Switzerland.

Switzerland has particularly clear regulations to protect intellectual property. The fiscal environment is generally favourable. The processes and requirements for setting up a new company in Switzerland are favourable compared to many other countries. Funding for start-ups is also facilitated.

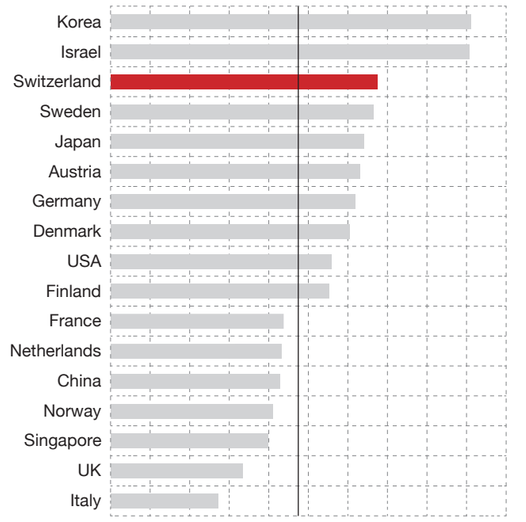
Switzerland is a leader with regard to PCT patents. Measured against the country's population, the number of patent applications is particularly high.

Qualified Specialists Along the Entire Value Chain

Switzerland has a highly developed education system. Young people and adults can pursue either a vocational or an academic education path, depending on their strengths and talents. The education system has high permeability, allowing transfers both within and between the vocational and academic areas of education.

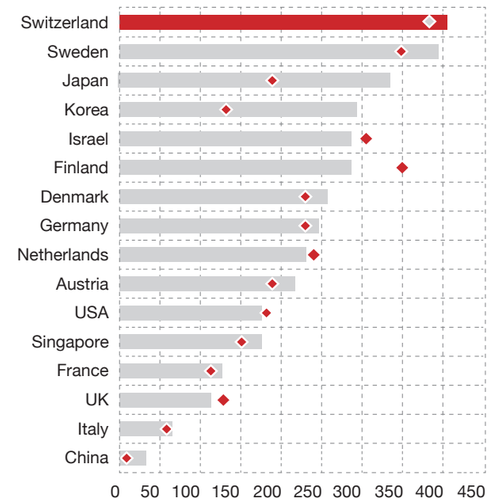
Companies in Switzerland benefit from highly qualified specialists and executives along the entire value chain. Unemployment is low.

R&D expenditure as a percentage of GDP, 2017



ECD 2.4%. Exceptions to reference year 2017: Singapore (2014), EU member countries (2018)
Source: OECD

PCT patent applications per million inhabitants, 2016



◇ 2006 According to the residence place of the inventors.

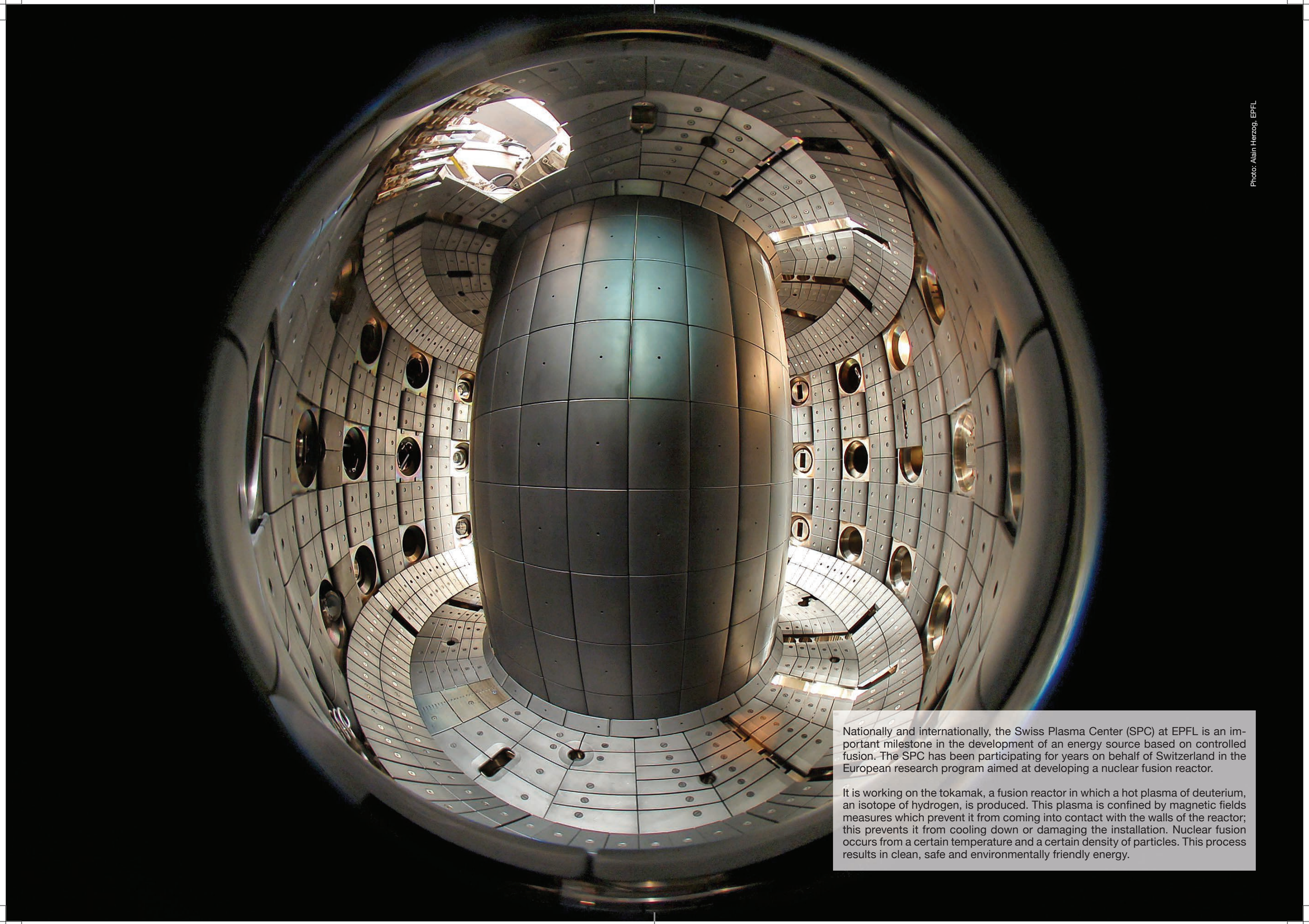


Photo: Alain Herzog, EPFL

Nationally and internationally, the Swiss Plasma Center (SPC) at EPFL is an important milestone in the development of an energy source based on controlled fusion. The SPC has been participating for years on behalf of Switzerland in the European research program aimed at developing a nuclear fusion reactor.

It is working on the tokamak, a fusion reactor in which a hot plasma of deuterium, an isotope of hydrogen, is produced. This plasma is confined by magnetic fields measures which prevent it from coming into contact with the walls of the reactor; this prevents it from cooling down or damaging the installation. Nuclear fusion occurs from a certain temperature and a certain density of particles. This process results in clean, safe and environmentally friendly energy.

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Foreword

In 2020, for the 10th year in a row, the World Intellectual Property Organization's Global Innovation Index ranked Switzerland as the world's most innovative country. What is our recipe for this success? Three main ingredients stand out: competition, education, adaptability.

Switzerland attaches great importance to research and innovation policy, which is based on the principle of competition. Public funding for research and innovation is allocated on the basis of excellence, incentivizing researchers and companies to pursue new ideas at their own initiative. The private sector also works closely with universities and public research institutions to ensure that emerging research is rapidly translated into marketable solutions.

Switzerland's longstanding investments in education system, which includes world-class universities alongside rigorous vocational training programmes is another key factor in the country's innovation success. The flexibility within and between the vocational and academic career paths ensures a pipeline of highly-skilled workforce – with both technical and conceptual skillsets – and maintains the innovative capacity of economy as a whole.

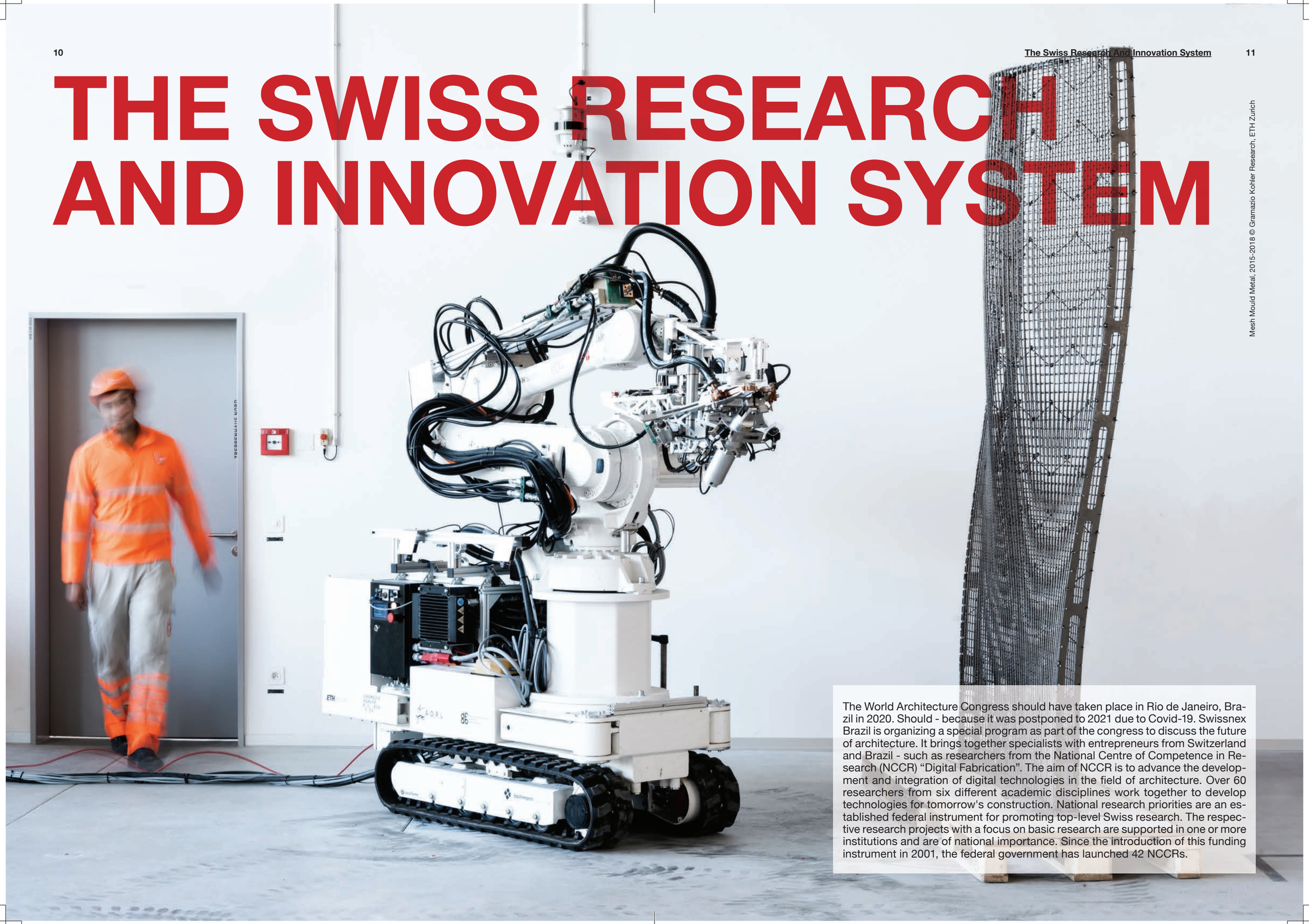
Adaptiveness is the third ingredient in Switzerland's innovation recipe. In a fast-changing world, responsiveness to emerging challenges gives the first-mover advantage to those that are able to adapt.

This brochure provides an overview of research and innovation in Switzerland. It describes the frameworks set by government, the role of the involved stakeholders as well as available funding mechanisms. It also provides country and regional comparisons with quantitative and qualitative indicators.

Today's global challenges require the development of innovative solutions at an unprecedented scale and pace. It is my hope that Switzerland's recipe for innovation success may inspire many local solutions around the world.

Bernardino Regazzoni
Ambassador of Switzerland to China

THE SWISS RESEARCH AND INNOVATION SYSTEM



Mesh Mould Metal, 2015-2018 © Gramazio Kohler Research, ETH Zurich

The World Architecture Congress should have taken place in Rio de Janeiro, Brazil in 2020. Should - because it was postponed to 2021 due to Covid-19. Swissnex Brazil is organizing a special program as part of the congress to discuss the future of architecture. It brings together specialists with entrepreneurs from Switzerland and Brazil - such as researchers from the National Centre of Competence in Research (NCCR) “Digital Fabrication”. The aim of NCCR is to advance the development and integration of digital technologies in the field of architecture. Over 60 researchers from six different academic disciplines work together to develop technologies for tomorrow's construction. National research priorities are an established federal instrument for promoting top-level Swiss research. The respective research projects with a focus on basic research are supported in one or more institutions and are of national importance. Since the introduction of this funding instrument in 2001, the federal government has launched 42 NCCRs.

1 Framework Conditions

The Swiss Research and Innovation (R&I) system needs favourable conditions in order to thrive and maintain a successful position in face of international competition.

In Switzerland, these conditions include political stability, security and quality of life. These positively viewed elements provide a favourable environment for successful R&I activities with a long timescale and for encouraging innovative companies to become established here. They are also important in attracting talents from abroad. This is particularly vital for Switzerland, a small country with limited personnel resources.

Characteristic for Switzerland are a competition-driven market and the primacy of private initiative, with little state regulation and intervention compared with other countries. The various markets for labour, capital, goods and services are largely competitiondriven. Access to international markets is free and open thanks to bilateral and multilateral agreements. This allows the economy to react flexibly, absorb new developments rapidly and be open to innovations.

Switzerland's infrastructure is well-developed compared to other countries', and it is continuously modernised. Moreover, the fiscal environment is relatively good.

Academic freedom is also a major element in the favourable conditions for research and innovation in Switzerland. The Federal Constitution (FC) guarantees freedom of research for individuals and institutions. However, it also requires legislators to set limits on research. For example, Art. 120 FC states that human beings and their environment shall be protected against the misuse of gene technology.

The differentiated education system with its first-class higher education institutions and well-developed, practice-oriented vocational education and training system is a further key success factor for Swiss research and innovation.

Furthermore, Switzerland has well-established R&I funding instruments (see Section 5) and clear rules on the protection of intellectual property.

The success of research and innovation also depends on the perception and evaluation of the Swiss public. People in Switzerland are aware of the value of science and have considerable trust in it (Figure A 1.1).

Whereas the private sector funds and conducts around two thirds of R&D activities, the public sector ensures optimum conditions to promote research and innovation.

Recent Developments in the Fiscal Sector

In Switzerland, until now there have been fewer fiscal incentives for research and innovation than in other countries. Since 1 January 2020, yields from patents and similar rights may be taxed at favourable rates by the cantons. The cantons can also grant additional tax deductions for expenditure on research and development.

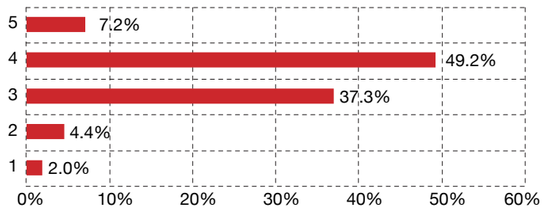
The Swiss Education System

The cantons and the Confederation operate an education system in which the vocational and academic paths complement each other. These two educational paths are seen as 'equal, but different'. Each individual chooses the path that corresponds to their preferences and abilities.

The Swiss education system also has a high degree of vertical and horizontal permeability, allowing learners to switch from the vocational to the academic path and vice versa. All qualifications lead to new study or employment possibilities, the prerequisite for life-long learning.

The overarching objective of the Swiss education system is to produce a well-qualified workforce to meet the needs of the entire value creation chain; this is vital to the success of R&I in Switzerland.

Figure A 1.1: Swiss public confidence in the science community in general, 2019



Scale from 5 'very high' to 1 'very low'
Rounding differences possible
Source: Science Barometer survey (2019; n=1043), Adapted by SERI

2 Players

In Switzerland, the main players in research and innovation are the private sector, the higher education sector (the two Federal Institutes of Technology as well as the cantonal universities, universities of applied sciences and universities of teacher education), research institutions of national importance as well as the federal government and the cantons. The VET/VPET sector and its players also have an important role in innovation.

2.1 Private Sector

The private sector plays a central role in Swiss research and innovation. It is primarily engaged in applied research and development (R&D) and in translating knowledge into marketable innovations. It often works with universities and other publicly funded institutions.

Some large corporations also carry out basic research. Two thirds of R&D activities are funded and conducted by the private sector. In 2017, large corporations accounted for 84% of private-sector R&D expenditure and SMEs for 16%.[1] However, R&D expenditure is not the only driver of innovation. Partnerships and the involvement of clients and higher education institutions are also factors in innovation.

Nonetheless, the number of companies engaged in R&D in Switzerland has almost halved in recent years; the number of SMEs conducting R&D has been steadily declining since 2000.[2] Large corporations, meanwhile, have been increasing their R&D activities since 2009 and their expenditure is now well above the average for the overall economy.

Although the number of companies conducting R&D has decreased, there has been a steady rise in R&D expenditure as a proportion of gross turnover. This means that a smaller number of companies are investing more in R&D, with the result that these businesses have a greater impact on the innovative strength of the economy as a whole.

Large corporations that fund and conduct R&D are primarily found in the pharmaceutical industry, the food industry and the machine engineering sector.

The number of SMEs conducting R&D has been declining since the early 2000s, yet these businesses continue to play an important role in Switzerland's innovative performance. In a European comparison, they enjoy top rankings in a number of areas, in particular in the introduction of marketing and organisational innovations. Their cooperation with large corporations in research and innovation is significant; as suppliers of highly specialised components, they integrate their R&D activities into the value creation chains of large corporations, and in this way can occupy niche markets. Founding innovative companies is an effective way of spreading new knowledge and new technologies on the market.

Their importance to the economy lies less in the number of jobs created than in the economic dynamism they trigger.

Young businesses rarely have sufficient funds themselves and are therefore reliant on access to venture capital. In terms of investments in venture capital as a proportion of GDP, Switzerland lies far behind the OECD leaders, the US and Israel.

Start-up Companies

According to the Swiss Startup Radar, currently around 300 start-ups are founded each year in Switzerland, four times more than 15 years ago. There are start-ups in all of the cantons. The main hubs are the canton of Zurich, where around a third of all start-ups are located; Vaud with around 15%, Geneva with 7%, Zug with 5% and Basel-Landschaft and Basel-Stadt, which together account for 9%. In an international comparison, Switzerland has a high proportion of start-ups in the fields of medtech; mechanical and electrical engineering; energy and cleantech, biotechnology; and financial services. The share of start-ups in e-commerce and internet marketplaces is, however, smaller than in other countries.

However, Switzerland offers favourable conditions for those wishing to set up a new company. There is a well-developed, soundly financed and thus competitive system of education and research, which provides fertile ground for future innovations and raises awareness of entrepreneurial activity. Entrepreneurship benefits from factors such as streamlined procedures for setting up a company, innovation-friendly corporate and bankruptcy laws, an attractive fiscal system and simple laws on the protection of intellectual property and licences.

[1] SMEs are small (1–49 employees) and medium-sized (50–249 employees) enterprises; corporations are companies which employ 250 or more (OECD, Eurostat). Over 99% of businesses in Switzerland are SMEs and fewer than one per cent are corporations.

[2] One reason for this may be that R&D-driven innovation activities have become too expensive and too risky for many companies in recent years.

2.2 Higher Education Institutions

Swiss higher education institutions – the Federal Institutes of Technology (ETH Zurich and EPF Lausanne), the cantonal universities, the universities of applied sciences (UASs) and the universities of teacher education (UTEs) – offer a wide range of study and research opportunities. They perform strongly in international rankings and make a considerable contribution to research and innovation.

The curricula follow the Bologna model, with the three degree levels: bachelor's, master's, PhD. Only the cantonal universities and the two Federal Institutes of Technology (FITs), which primarily engage in basic research and research-based teaching, are authorised to award doctoral degrees. The UASs can, however, offer doctoral degree courses in cooperation with a cantonal university or FIT. The UASs' specialisation is applied research and development (aR&D). Degree courses at the universities of teacher education (UTEs) also involve practical research and innovation.

Most of the Swiss higher education institutions have excellent international connections. They are required to engage in teaching (incl. in continuing education), research and development, knowledge and technology transfer (KTT) and services for third parties.

Domain of the Swiss Federal Institutes of Technology (ETH Domain)

There were around 35 000 students enrolled at the ETH Zurich and the EPF Lausanne (EPFL) in 2020, of which 6 600 were doctoral students (FSO, 2019). These two institutions belong to the ETH Domain, along with four research institutes: the Paul Scherrer Institute (PSI), Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), the Swiss Federal Laboratories for Materials Science and Technology (Empa) and the Swiss Federal Institute of Aquatic Science and Technology (Eawag). The ETH Board is the strategic governing and supervisory body of the ETH Domain. The ETH Zurich and the EPFL are tertiary-level institutes of technology. Their study programmes and research activities focus on natural sciences and engineering, life sciences, mathematics and architecture.

The ETH Domain research institutes focus both on basic and applied research. They also provide scientific and technical services and are involved in teaching and research at the ETH Zurich and the EPFL.

Strategic Objectives of the Federal Council for the ETH Domain

The Federal Council has set the following main objectives for the ETH Domain: maintaining its leading international position in research and offering first-class, research-based teaching that students find appealing. There are also other objectives derived from the central role that the ETH Domain plays within the Swiss education, research and innovation system: operating and expanding research infrastructure and making it available to the entire research community; strengthening cooperation with cantonal universities, universities of applied sciences and private research partners; and supporting the entrepreneurial efforts of its members. On an international level, the ETH Domain further expand cooperation and networking with the world's best institutions and maintain its appeal for the best students and researchers. In addition to these objectives, which fall within the ETH Domain's core remit, the Federal Council has also established objectives relating to finance and real estate as well as to human resource and pension policy.

Responsibility for implementing the strategic goals rests with the ETH Board. It signs performance mandates with the two Federal Institutes of Technology and four research institutes and allocates federal funding.

The Federal Council will report annually to Parliament and the public on progress towards achieving the objectives established for the ETH Domain.

Figure A 2.1: The organisation of ETH Domain

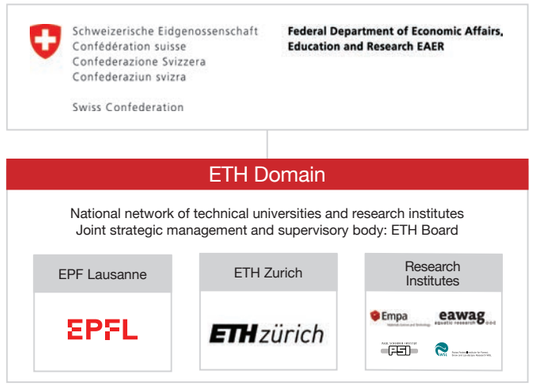


Table A 2.4: Knowledge and technology transfer (KTT)

	2019	2020
Invention disclosures	329	310
Software notifications[1]	40	32
Patents	224	217
Licences	324	338
Spin-offs	59	66

*Open Source Software not included

With numerous patents, new cooperation agreements and another record number of spin-offs in 2020, the institutions of the ETH Domain also contributed to the transfer of knowledge and technology and thus to Switzerland's innovative strength.

Source: ETH Domain

Figure A 2.3: ETH Domain institute locations

Source: ETH Domain

Figure A 2.2: Organisation of ETH Domain

ETH Board
11 members
Staff: 56 employees (staff, Internal Audit, Internal Appeals Commission)

Federal Institutes of Technology

ETH Zurich	EPFL
23 422 students and doctoral students 12 855 employees*	11 813 students and doctoral students 6 358 employees*

Research Institutes

PSI	WSL	Empa	Eawag
2 097 employees*	564 employees*	1 022 employees*	522 employees*

* employment contracts including doctoral students, as of 31 December 2020

Source: ETH Domain

ETH BOARD

The ETH Board is the strategic management and supervisory body. Basing itself on the strategic objectives set by the Federal Council as well as on its own strategic planning, the ETH Board establishes objectives for each of the institutions and allocates federal funding accordingly. With this aim, it signs four-year target agreements with the two Federal Institutes of Technology and four research institutes. It supervises these institutions and is responsible for preparing and implementing legislation governing the ETH Domain.

ETH zürich

Founded back in 1855, ETH Zurich is regularly rated as one of the world's best universities in international rankings. Around 560 professors teach and conduct research at ETH Zurich in the fields of engineering, architecture, mathematics, natural sciences, system-oriented sciences, management and social sciences. 21 Nobel laureates have studied, taught or done their research at ETH Zurich. Each year, the Confederation pays nearly CHF 1.3 billion (2020) in support of this federal institute.

The innovations of the university flow into the most forward-looking sectors, from computer science to micro- and nanotechnology, even high-tech medical equipment. In 2020, 34 spin-offs were founded.

EPFL

EPFL was initially founded in 1853 as École Spéciale de Lausanne. It was renamed École polytechnique fédérale de Lausanne (EPFL) when it joined the ETH Domain in 1969. More than 370 laboratories conduct leading research in areas such as renewable energy, medical technology, materials science and information technology at the campus in Lausanne. Each year, the Confederation pays nearly CHF 700 million (2020) in support of this federal institute. EPFL Innovation Park is one of the first innovation parks in Switzerland and is home to more than 200 start-ups and research centres. 25 spin-offs were founded in 2020.

PAUL SCHERRER INSTITUT PSI

PSI is the largest research institute for natural sciences and engineering in Switzerland. It receives roughly CHF 300 million (2020) from the Confederation. The institute's own research focuses on the fields of matter and materials, energy and the environment, as well as humanity and health. In addition to its research, the PSI operates the only installation in Switzerland for the treatment of specific types of cancer using protons (Center for Proton Therapy, CPT).

WSL Swiss Federal Institute for Forest, Snow and Landscape Research WSL

WSL is present at various locations in Switzerland where research is focussed on forest, snow and landscape. The WSL receives CHF 60 million (2020) from the Confederation each year. It monitors the condition and development of forests, landscape, biodiversity, natural hazards and snow and ice, and develops sustainable solutions for socially relevant problems – in collaboration with its partners from academia and society. Disciplinary research is the foundation of WSL. In order to be able to answer society's pressing questions, time-limited research programmes that cut across disciplines complement WSL's portfolio.

Empa Materials Science and Technology

Empa is an interdisciplinary research institute and service provider specialised in materials science and technology. It creates a scientific basis for the sustainable development of society and finds solutions for industry and society in the fields of nanoscale materials, energy and sustainable building technologies, novel production technologies as well as bio- and medical technologies.

The Empa receives around CHF 100 million (2020) from the Confederation each year. Working with industry partners and via spin-offs, Empa transforms its research results into marketable innovations, helping to make the Swiss economy more innovative and more competitive.

eawag aquatic research

Eawag is one of the world's top water research institutes. It receives around CHF 60 million (2020) from the Confederation each year. Its success is based on the combination of research, teaching and continuous education and advice that it has provided for over 80 years. The combination of natural sciences, engineering and social sciences enables comprehensive research of water in relatively untouched rivers and lakes, right through to fully automated wastewater management systems.

EPFL Rolex Learning Center. Photo: Alain Herzog, EPFL

The Role of VPET in Innovation

Vocational and professional education and training (VPET) is not an innovation player in a strict sense. But because of its importance for innovation, it is nonetheless mentioned here. Two thirds of young people in Switzerland begin their professional career by doing an apprenticeship (at upper secondary level). Annually, 69 000 people complete an apprenticeship and 26 700 obtain a qualification in (tertiary-level) professional education and training, providing a pool of highly skilled workers and professionals for the private sector and public authorities. These people play just as much of an important role as university graduates in boosting businesses' competitiveness and innovative strength.

The Swiss VPET system is strongly linked to the needs of the labour market. The professional organisations define and update the content of courses, ensuring that they continue to meet the precise needs of the workplace and generate the innovative skills companies require. Those following the VPET path obtain a flexible and broad theoretical education and practical training, and this increases their ability and willingness to be involved in and drive forward the innovative process. There are many opportunities in the VPET system to obtain higher qualifications or to switch direction, a mark of diversity that is also a major asset to innovation in Switzerland.

To summarise, the Swiss VPET system trains a broad spectrum of skilled workers and managers with wide-ranging skills, and so plays an important role in innovation.

Cantonal Universities

Around 120 000 students were enrolled at the ten cantonal universities in 2019, of which 19 000 were post-graduates (FSO, 2019). The cantonal universities have varying combinations of faculties and institutes in law and social sciences, mathematics and natural sciences, humanities, economics and medicine. Some of the universities have a specific profile and focus on particular fields: for example, the University of St. Gallen is one of Europe's leading universities for business administration and economics. Unlike the two FITs, the cantonal universities do not offer programmes in engineering sciences.

Universities of Applied Sciences

Almost 78 500 students were enrolled at the seven public universities of applied sciences (UASs) and at the private Kalaidos UAS in 2019 (FSO, 2019). The UASs were set up in the 1990s through mergers of professional education institutions. An eighth public UAS was created on 1 January 2020. The universities of applied sciences have a strong regional character and are important cooperation partners for local SMEs. More than half of the projects promoted by Innosuisse (see Section 5) are conducted with research partners from the UASs.

The UASs offer bachelor's and master's degrees tailored to the needs of the labour market. They make a major contribution to the application of knowledge in marketable innovations. The practice-oriented bachelor's degree is the usual qualification obtained at a UAS. These universities offer a wide range of degree courses and each establishment offers a different combination of subjects: technology and information technology, architecture,construction and planning, chemistry and life sciences, agriculture and forestry, economics and services, design, health, social work, music, drama and other arts, applied psychology, applied linguistics and sport.

ETH Zürich | Photo: Gian Marco Castelberg, ETH Zürich

Universities of Teacher Education

Around 21 000 students were enrolled at the universities of teacher education (UTEs) in 2019 (FSO, 2019). There are 14 UTEs in Switzerland; four further teacher training institutions that are integrated into another type of university; and two federal teacher training institutions. The UTEs train teachers and other educational specialists at all levels. They conduct educational and school research and occupational research and development, and provide services in this field for schools and other educational institutions.

2.3 Research Institutions of National Importance

There are around thirty research institutions of national importance, and these make a major contribution to generating scientific added value in all specialist areas and disciplines. They complement the research activities and research infrastructures at universities and in the ETH Domain. These facilities are both publicly and privately funded, with federal funding being subsidiary in character. Three types of institution may receive federal funding:

- research infrastructures such as the Swiss Centre of Expertise in the Social Sciences (FORS) in Lausanne which collect, process, analyse and make available scientific information and documentation as a basis for further research.
- research institutions such as the Swiss Institute for Allergies and Asthma Research (SIAF) in Davos which focus on a highly specialised topic and generally work closely with cantonal universities or institutions in the ETH Domain.
- centres of technological excellence such as the Centre Suisse d'électronique et de microtechnique (CSEM) in Neuchâtel which focus in particular on knowledge and technology transfer. They cooperate with institutions in the ETH Domain, the cantonal universities and the UASs; they also engage in innovation projects with the private sector.

2.4 Federal Administration

Specialist skills and knowledge are required to deal with public sector tasks and complex political processes. Federal Government Research is one area in which this acquired. This is research conducted by the federal entities themselves or by universities and private companies on behalf of the Federal Administration.

Figure A 2.5: Swiss higher education landscape

- Federal institutes of technology
- Cantonal universities
- Universities of applied sciences
- Universities of teacher education

Sites simplified
Source: SERI

Photo: Zooey Braun, Stuttgart

NEST is the modular research and innovation building of the Swiss Federal Laboratories for Materials Science and Technology (Empa) and the Swiss Federal Institute of Aquatic Science and Technology (Eawag), two institutions of the ETH Domain, which itself reports to the Confederation. The building was designed by Gramazio Kohler Architects. NEST accelerates the innovation process in the construction industry. Here, new technologies and construction concepts are tested, refined and demonstrated under real-world conditions. Close cooperation between partners from research, industry and the public sector enables innovative technologies in construction and energy to be brought to the market more quickly.

3 State Responsibilities

State institutions at all three political levels – Confederation, cantons and communes – are responsible for ensuring that there is fertile ground for both private and publicly funded players in research and innovation. They guarantee the quality of education and training at all levels, make available the public infrastructure and create a stable political and legal environment.

3.1 Confederation

At federal level, the State Secretariat of Education, Research and Innovation (SERI), which is part of the Federal Department of Economic Affairs, Education and Research (EAER), is, as its name suggests, the principal body responsible for the ERI sector and for the implementation of related legislation. The Research and Innovation Promotion Act (RIPA) regulates competitive research funding and international cooperation in R&I.

The Higher Education Act (HEdA) states that the Confederation along with the cantons is responsible for ensuring the coordination, quality and competitiveness of higher education, under the umbrella of the Swiss Conference of Higher Education Institutions. The HEdA also states that the Confederation is responsible for co-funding cantonal universities and universities of applied sciences, but not universities of teacher education.

The Confederation is also responsible for the ETH Domain, whose governing body is the ETH Board (see also Section 2.2). The federal R&I funding bodies are the Swiss National Science Foundation (SNSF), Innosuisse and the Swiss Academies of Arts and Sciences (see Section 5). The Swiss Science Council (SSC) advises the government on R&I policy. Some other units in the EAER also deal with research and innovation, for example Agroscope, the federal centre of expertise for agricultural research.

Other departments besides the EAER also promote or commission research and innovation, for example as Federal Government Research (see Sections 2.4 and 5.4).

Dispatch on the Promotion of Education, Research and Innovation

Every four years the Federal Council presents a dispatch on the Promotion of Education, Research and Innovation (ERI Dispatch) to Parliament, in which it draws an assessment of the current funding period and sets out the objectives and measures for the one to come. The ERI Dispatch contains the federal ERI budget for the coming legislative period and any amendments to the law optimising the legal basis. The funding decisions include all national federal measures in VPET, higher education and continuing education, and for the promotion or research and innovation.

3.2 Cantons, Cities and Communes

Apart from the cases in which the Confederation is specifically mentioned in the Federal Constitution, it is the cantons that are responsible for the education system. They bear the main financial burden of education, research and innovation.

The cantons are responsible for the cantonal universities, the universities of applied sciences and the universities of teacher education. They provide core funding which covers a large proportion of the research activities at the cantonal universities. Some of their costs are met via inter-cantonal funding agreements. The cantonal universities, UASs and UTEs are largely autonomous: they plan, regulate and manage their own affairs under cantonal laws based on the Constitution and on the HEdA.

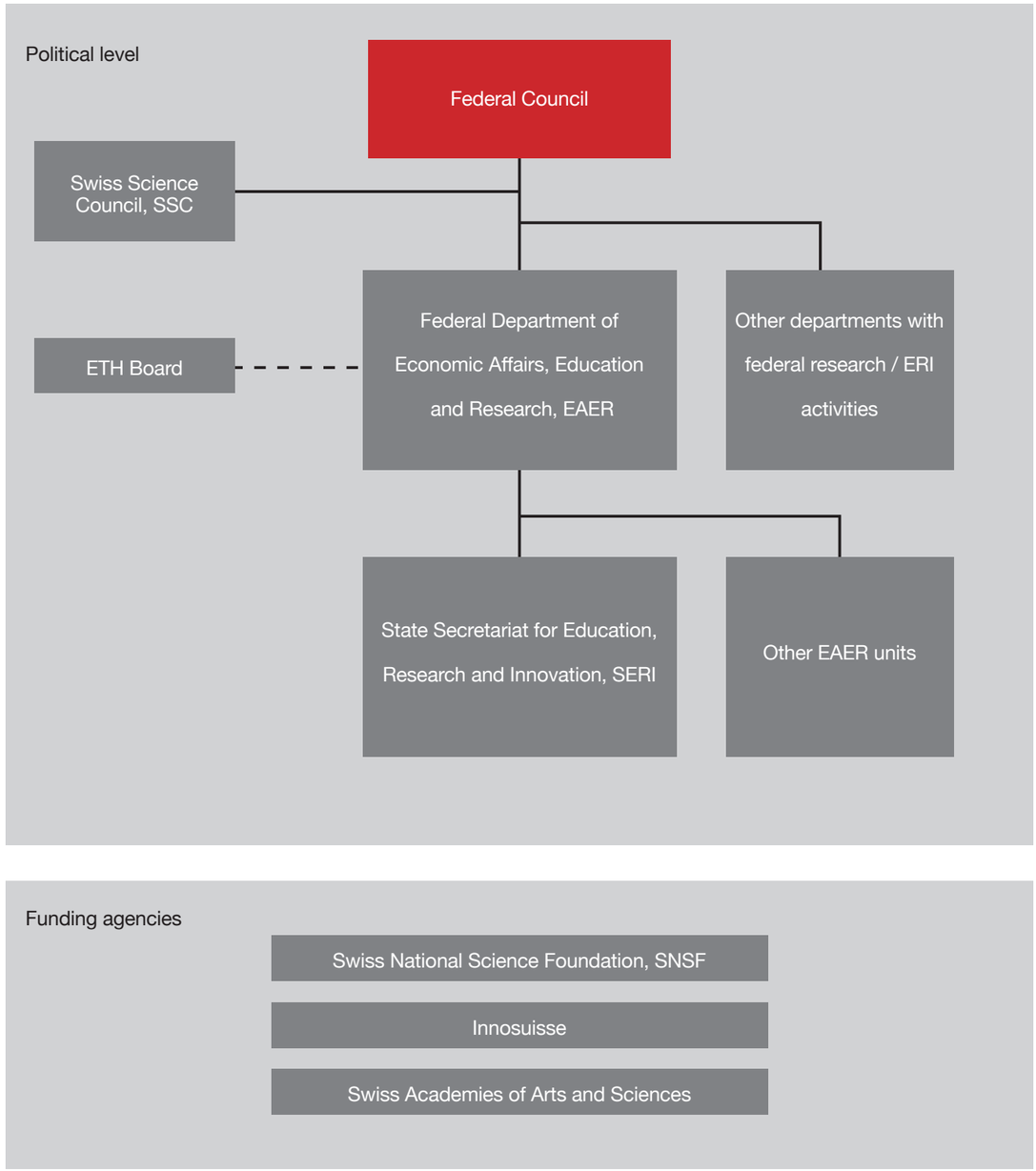
The Swiss Conference of Cantonal Ministers of Education (EDK) and the Conference of Cantonal Directors of Economic Affairs (VDK) play an inter-cantonal coordinating role in the field of research and innovation and at its interfaces with other sectors.

The cities and communes are also involved in innovation promotion, for example in setting up and running technology and innovation parks.

Joint Federal-Cantonal Bodies

There are three joint bodies in which the Confederation and the cantons ensure the coordination, quality and competitiveness of the higher education sector: the Swiss Conference of Higher Education Institutions (SHK), the Swiss Conference of Rectors of Higher Education (swissuniversities) and the Swiss Accreditation Council.

Figure A 3.1: Federal institutions responsible for research and innovation



Source: SERI

Federal Statutory Basis

The Federal Constitution

The Federal Constitution (Art. 64 FC) states that the Confederation shall promote scientific research and innovation.

It also states (Art. 63a FC) that the Confederation and cantons are jointly responsible for the coordination of and guarantee of quality in higher education. The Confederation is responsible for the federal institutes of technology and supports the cantonal universities financially. It encourages the provision of a diverse and accessible range of courses in vocational and professional education and training (Art. 63 FC).

Federal Act on the Promotion of Research and Innovation

The Federal Act on the Promotion of Research and Innovation (RIPA) is a framework law on the tasks and organisation of federal R&I promotion. RIPA regulates the tasks, procedures and responsibilities of the funding agencies legally established in RIPA – the Swiss National Science Foundation, Innosuisse and the Swiss Academies of Arts and Sciences – and of international cooperation in science. Moreover, it sets out the subsidiary participation of the Confederation in research institutions of national importance and the planning, coordination and quality assurance of federal research policy. It also contains the basis for funding of the Swiss Innovation Park.

Federal Act on the Funding and Coordination of the Higher Education Sector (HEdA)

The Higher Education Act states that the Confederation and the cantons are responsible for the coordination, quality and competitiveness of the higher education sector. The HEdA provides a basis for the establishment of joint federal and cantonal bodies, quality assurance and accreditation, uniform funding of the universities and other institutions in the higher education sector and the distribution of tasks in particularly cost-intensive fields. The provisions on funding in the HEdA apply only to the cantonal universities and the UASs, not to the FITs and UTEs. However, the latter, like the former, may receive project-linked funding.

Federal Act on the Federal Institutes of Technology

The Federal Act on the Federal Institutes of Technology (ETH Act) regulates the tasks and organisation of the ETH Domain (for institutions in the ETH Domain see Section 2.2).

Federal Act on Vocational and Professional Education and Training

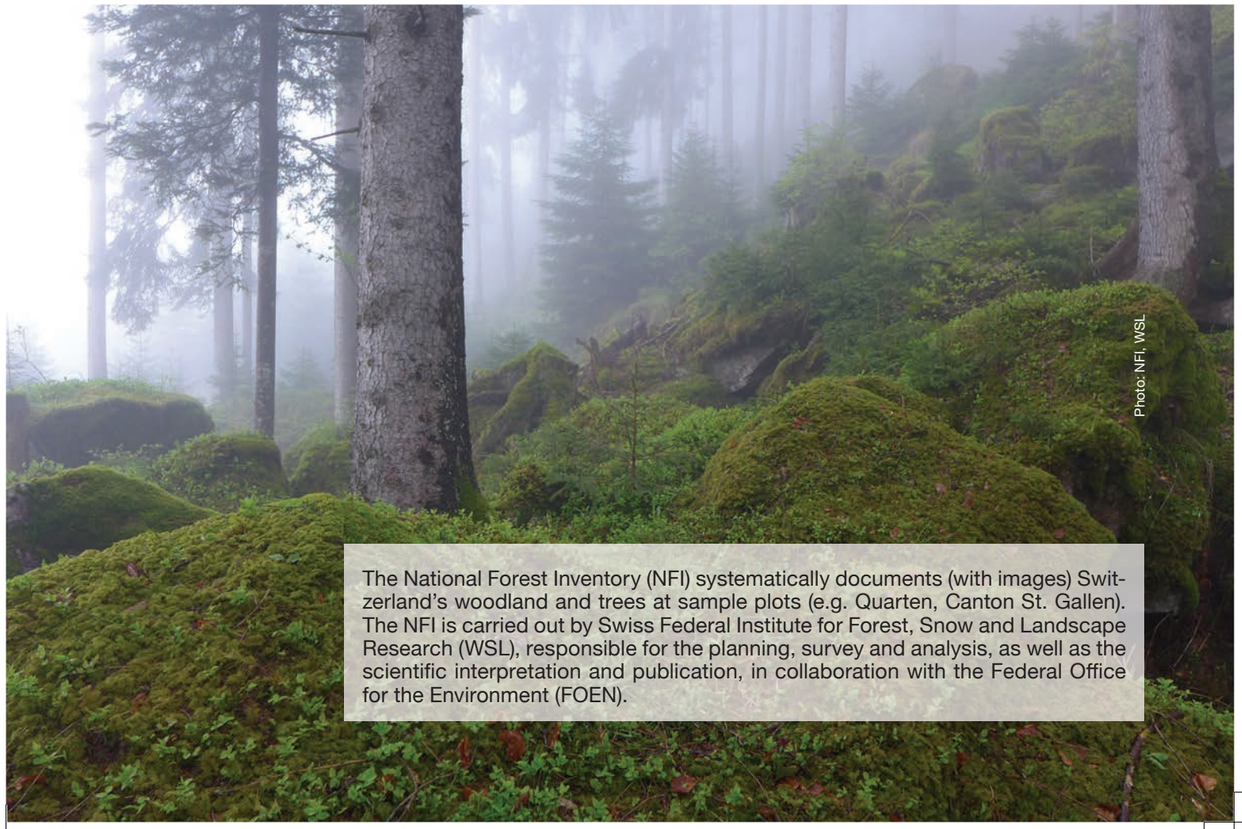
The Federal Act on Vocational and Professional Education and Training (VPET Act) provides a basis for the success of the Swiss innovation system. As a driver of modernisation in the VPET system, it keeps abreast of the rapid changes in the labour market, and allows for differentiated and flexible paths in the education system. The VPET Act also provides the legal basis for the Swiss Federal Institute for Vocational Education and Training (SFIVET) and defines the Confederation's financial participation in VPET.

Legal Basis for the Cantons

The HEdA provides the legal basis for coordination in the Swiss higher education sector at federal level. The legal framework for the cantons' role, meanwhile, is set out in the Intercantonal Agreement of 20 June 2013 on Cooperation in Higher Education. All of the cantons are party to this agreement.

Each canton hosting its own university has a cantonal law pertaining to it. The cantonal laws on universities of applied sciences provide the basis for the running of a UAS; generally, these laws address cooperation with other cantons and the Confederation. There are also cantonal laws relating to the universities of teacher education.

The Federal Vocational and Professional Education and Training Act (VPETA) assigns the cantons the task of ensuring adequate possibilities for vocational education and training, professional education and training, vocational continuing education and career and study guidance. The cantonal VPET laws provide implementing legislation to meet this task. Innovation promotion as part of cantonal economic development is generally based on specific laws in the individual cantons.



The National Forest Inventory (NFI) systematically documents (with images) Switzerland's woodland and trees at sample plots (e.g. Quarten, Canton St. Gallen). The NFI is carried out by Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), responsible for the planning, survey and analysis, as well as the scientific interpretation and publication, in collaboration with the Federal Office for the Environment (FOEN).

Established in 2016, the Swiss Innovation Park plays an important role in science and technology transfer. It provides a link between the science community and the business world at sites near each of the federal institutes of technology and at three other locations. The Switzerland Innovation Park Basel Area focuses on the healthcare and medtech fields. In the Miracle project, researchers at the University of Basel are seeking ways to conduct minimally invasive surgery using laser technology and robotics. They are also developing new navigation techniques with which the robot-guided laser system can be precisely controlled during the surgical operation.

4 Finances

4.1 Finance Flows

The private sector, public sector, universities and entities abroad all conduct and fund R&D activities.

Figure A 4.1 provides an overview of the finance flows between individual sectors in 2017. It shows all the R&D finance flows in Switzerland and the funds coming from or going abroad. The left-hand side of the graphic shows the funding sources for Swiss R&D and funds from abroad, the right-hand side the four sectors in which R&D is conducted in Switzerland and the amount spent on R&D conducted abroad.

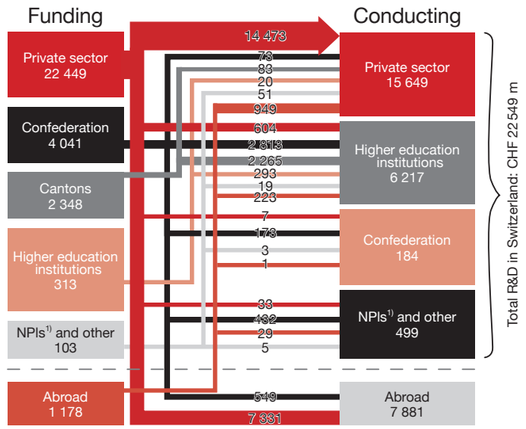
In 2017, CHF 22.5 billion was invested in R&D in Switzerland – about 3.4% of GDP. This puts Switzerland among the top group of OECD countries. The lion's share was invested by the private sector, which funds and conducts around two thirds of R&D activities.

In the private sector, businesses fund and conduct almost all the R&D activities themselves. The ETH Domain, the cantonal universities and the universities of applied sciences are the main receivers of funding. They are primarily funded by the Confederation and the cantons.

The private sector and the Confederation also fund R&D activities abroad, and entities abroad fund R&D projects in Switzerland.

Other entities (non-profit institutions, foundations etc.) play a comparatively minor role both in funding and in conducting R&D in Switzerland.

Figure A 4.1: Entities engaged in funding and conducting R&D in Switzerland by sector, in CHF million, 2017 (not including branches of Swiss companies abroad)



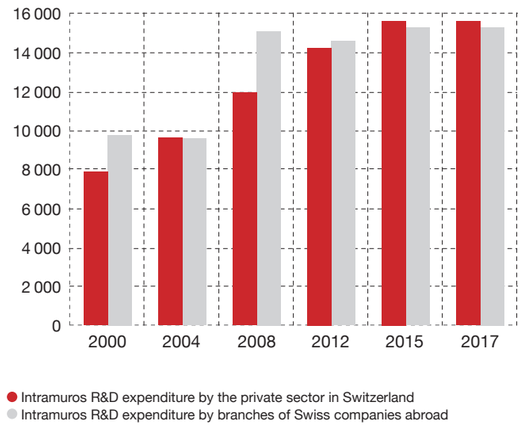
1) Non-profit institutions

Source: FSO

4.2 R&D Expenditure by Branches of Swiss Companies Abroad

The private-sector companies that invest heavily in R&D tend to operate internationally. This can be seen from the expenditure on research by branches of Swiss companies abroad (Figure A 4.2), accounted for by just a small number of internationally active corporations. In 2017 R&D expenditure by branches of Swiss companies abroad amounted to CHF 15.3 billion, just slightly less than the CHF 15.6 billion spent by the private sector on R&D in Switzerland in the same year.

Figure A 4.2: Development of intramuros R&D expenditure by the private sector in Switzerland and by company branches abroad, in CHF million



Intramuros R&D expenditure is expenditure on R&D activities conductedby companies on their own premises: 'within their own walls'.

Source: FSO, Adapted by SERI

5 National, Regional and Cantonal Promotion

The Confederation is primarily responsible for public-sector R&I funding. Its main instruments are the Swiss National Science Foundation (SNSF) for the funding of basic research, and Innosuisse for the promotion of science-based innovation. A further player is the association of Swiss Academies of Arts and Sciences, which foster cooperation in and between the science disciplines and promote the place of science in society.

Main Principles of R&I Funding

- Public R&I funding functions according to the bottom-up principle – on the individual initiative of researchers and businesses.
- Project applications receive public funding on a competitive basis.
- In an international comparison, Switzerland is not strong on the top-down setting of areas and programmes that are eligible for funding.
- Generally, no funding is awarded directly to private businesses.

5.1 Swiss National Science Foundation

Founded in 1952, the Swiss National Science Foundation (SNSF) is the main institution funding scientific research and promoting young academics. In order to ensure that research remains independent, the SNSF is set up as a private foundation. SERI concludes four-year performance agreements with the SNSF in accordance with the budget set by the Parliament. All scientific disciplines have access to SNSF funding.

The SNSF has CHF 1.2 billion at its disposal annually, which it awards in a competitive process. Several thousand project applications are assessed in a peer-reviewed process. The SNSF's National Research Council, comprising around 100 academics from Swiss higher education institutions, selects applications on the basis of expert reports from 90 evaluation bodies with over 700 members.

The SNSF has a broad range of funding instruments (Figure A 5.1). The principal instrument is project funding, which accounts for around half of all approved funding. Here the researchers select the topic and nature of their projects; the SNSF thus provides the necessary freedom for innovative ideas.

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

- The NCCRs are a federal funding instrument and are conducted by the SNSF on behalf of the Confederation. Running for a period of ten years, they contribute to improving the structuring of the Swiss research landscape by acting as centres of expertise in major fields such as robotics, quantum science, neuroscience andmigration.
- The NRPs are a federal instrument to promote scientific research into urgent issues of national importance. Designed to address and solve specific problems, they are application-oriented and transdisciplinary. Knowledge and technology transfer is a primary element in the NRPs. Topics are set by the Federal Council in a selection process open to all academic fields; the SNSF is responsible for imple menting them. For example, research projects run from 2020 in NRP 77 'Digital Transformation'.

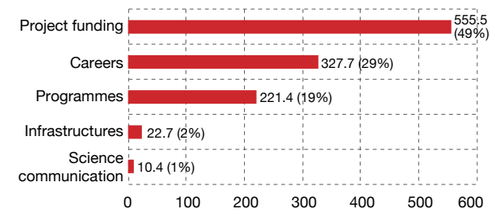
A further key focus of the SNSF is promoting the careers of young scientists and academics via a range of instruments and across all disciplines. The SNSF supports the careers of young, highly qualified researchers from their doctorate thesis through to their position as lecturer/assistant professor,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

Funding is also apportioned to infrastructures. The SNSF funds high quality and innovative apparatus under the R'Equip scheme, and publication projects in the humanities. Furthermore, it fosters communication on scientific issues among researchers and between researchers and the general public.

The SNSF also has many instruments to promote international cooperation e.g. under federal bilateral programmes. These facilitate cooperation between research groups in different countries.

Figure A 5.1 shows the funds approved in 2018 by the SNSF by funding category.

Figure A 5.1: Funding awarded by SNSF funding category, in CHF million, 2018



Total without overhead: CHF 1137.6 million
Total with overhead: CHF 1248.3 million

Source: SNSF

Photo: Kellenberger Kaminski, ETH Board

The Swiss Light Source (SLS) at the Paul Scherrer Institut (PSI) is more than 130 metres in diameter. Concrete slabs shield the particle accelerator. Inside, billions upon billions of electrons complete a million laps per second. In the storage ring of the SLS 2.0 upgrade, the brilliance of the synchrotron light produced will be greatly improved by a new, finely graduated magnet arrangement.

5.2 Innosuisse

Innosuisse, the Swiss Innovation Agency, supports science-based innovation in the interests of the economy and society. Until the end of 2017 it was known as the Commission for Technology and Innovation CTI. Support for knowledge and technology transfer has existed in this form since 1944. Whereas the CTI was an executive commission with decision-making powers, Innosuisse is now an institution under public law with its own budget. The Innosuisse Board, which reports to the Federal Council, is the agency's strategic body, the management team its operational body.

Innosuisse has an annual funding budget of around CHF 200 million. The Innovation Council, its specialist body, selects project applications and provides advice on scientific and innovation issues during the course of projects, with support from a range of experts.

Innosuisse's key activity is funding projects in all scientific disciplines and areas of innovation. Its focus lies on applied research into the development of new products, processes and services for the economy and society and on the valorisation of the research findings on the market.

Innosuisse's main funding instrument focuses on innovation projects run jointly by research institutions and implementation partners from the private sector. The projects thus contribute directly to KTT. To qualify for funding, projects must demonstrate innovation potential and scientific content, as well as promise to produce marketable results. Funding is awarded exclusively to research institutions, largely in the form of salaries for those working on the projects. The private-sector implementation partners provide matching funds in the form of own funds (working hours, apparatus etc.) and are usually required to make a cash contribution of at least 10% of the project costs. No direct payments are made to companies in research and innovation promotion in Switzerland in general and by Innosuisse in particular.

Innosuisse also promotes innovation projects which do not have an implementation partner, for feasibility studies, prototypes and pilot facilities. In addition, its 'innovation cheques' provide SMEs with the funding necessary to conduct small-scale preliminary studies with research partners.

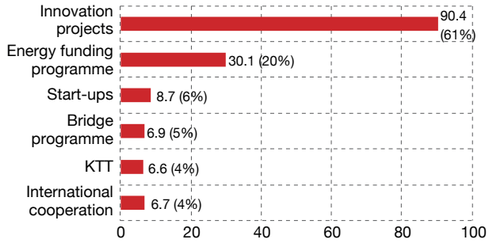
Innosuisse also funds science-based start-ups, which are offered coaching tailored to their individual needs and help in developing their international market presence in the form of trade fair appearances and internationalisation camps. Awareness-raising and training modules are also offered for people from the higher education sector who are interested in setting up a business. Furthermore, it has SME-specific measures such as the National Thematic Networks (NTN), thematic specialist events, innovation mentoring and the Enterprise Europe Network (EEN), which serve to foster KTT.

Innosuisse also funds and steers the eight Swiss Competence Centres for Energy Research (SCCERs), as part of the 'Coordinated Energy Research in Switzerland (2013–2020)' action plan. The centres focus on research into efficient and renewable energies in a range of action areas.

Furthermore, the agency promotes international cooperation in the private sector in order to boost companies' competitiveness in global value creation chains. To this end, it participates in several international initiatives and fosters contacts with innovation funding agencies and other partner organisations around the world.

Figure A 5.2 shows the funds awarded by Innosuisse in 2018 by funding category.

Figure A 5.2: Funding awarded by Innosuisse by funding category, in CHF million, 2018



Total (incl. overhead of CHF 11.6 million): CHF 149.4 million
Bridge programme: Innosuisse share
Source: Innosuisse, Adapted by SERI

Cooperation Between the SNSF and Innosuisse

The SNSF's funding activities focus on the acquisition of scientific knowledge. The focus of Innosuisse funding, meanwhile, is on innovation with the goal of market implementation. 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.

5.3 Swiss Academies of Arts and Sciences

The Swiss Academies of Arts and Sciences promote dialogue with the public and advise politicians, the administration and the public on scientific and societal issues. They represent the arts and sciences and make an important contribution to transdisciplinary networking. On behalf of the Confederation they design stimulus and coordination initiatives, which they implement jointly with other ERI players. They promote Switzerland's representation in international specialist organisations and academies, thereby promoting Switzerland as a science location.

Anchored in the scientific community, the Academies network has access to the expertise and excellence of some 110 000 people. It uses this expertise to address overarching issues such as the science culture and infrastructure planning, to provide specialist advice on policy issues, and to promote scientific understanding in society. The Academies are funded by the federal government via a service level agreement to the tune of around CHF 43 million annually.

The association comprises the Swiss Academy of Sciences (SCNAT), the Swiss Academy of Humanities and Social Sciences (SAHS), the Swiss Academy of Medical Sciences (SAMS) and the Swiss Academy of Engineering Sciences (SATW). The competence centres TA-SWISS (Foundation for Technology Assessment) and Science et Cité (which promotes dialogue between the sciences and the public) are also part of the association.

5.4 Federal Government Research

The federal government initiates what is known as Federal Government Research, because the findings are used in executing federal tasks (see Section 2.4). Federal Government Research involves both basic and applied research as well as market-oriented development in fields such as engineering, in pilot and demonstration facilities.

The Confederation runs a number of its own research institutes, in which it also conducts R&D. These include Agroscope, affiliated to the Federal Office for Agriculture, and the Spiez Laboratory, affiliated to the Federal Office for Civil Protection. The federal government also conducts its own research programmes in conjunction with higher education institutions, the SNSF, the Academies and Innosuisse.

Furthermore, the Confederation awards grants to third parties and commissions research, which primarily involves expert reports and assessments or accompanying research for evaluating the impact of policy measures.

Over 30 federal agencies are involved in Federal Government Research. SERI coordinates these in eleven policy areas selected by the Federal Council. In 2018 the federal government invested around CHF 308 million in Federal Government Research.

5.5 Regional, Cantonal and Communal Promotion

The individual regions of a country often have varying degrees of competition and innovative power. In Switzerland as abroad, the regions are playing an increasingly significant role in innovation funding.

The Confederation's New Regional Policy, anchored in the State Secretariat for Economic Affairs SECO, was introduced in 2008 to address this situation. The policy supports rural areas and cantons with mountainous regions by funding local entrepreneurship and innovation in order to boost competitiveness. The aim of these regional innovation systems (RISs) is to improve coordination between existing funding mechanisms (e.g. clusters, innovation coaching, events, cooperation projects between economic branches) to the benefit of local SMEs, and to tailor these mechanisms to regional circumstances. Regional potential can be better exploited as a result, and a boost given to innovation dynamics in the regions. The cantons have a large degree of flexibility in the design of these RIS programmes, and so there is considerable variation between them.

The cantons make an important contribution to research and innovation promotion via their funding of the cantonal universities, universities of applied sciences and universities of teacher education. Most cantons also have their own innovation and business promotion, in part supported by regional policy mechanisms. This takes the form of support for new businesses, coaching or the funding of regional networks or clusters in close cooperation with businesses. The cantons have their own economic development agencies individually or in association with other cantons. These agencies inform businesses about the advantages of setting up in the given canton, and they draw up concrete offers for interested parties, maintain contacts with investors and put businesses in contact with them, and are responsible for client care. Some cantons offer tax advantages, or promote regional development via their educational institutions.

Like other financial institutions, the cantonal banks and regional banks offer financial help for start-ups. They frequently put up prize money for competitions and awards for particularly innovative businesses. Some of the cantonal banks also provide help for start-ups in the form of advice and business model templates. The cities and communes also promote innovation in the form of business start-up centres or technology parks. These are primarily funded by the private sector – as is the Zurich Technopark – but sometimes in partnership with the public purse. A real estate company provides the buildings, and the operating company invites innovation-oriented businesses to use the premises, while providing them with the necessary services.

5.6 Foundations

There also a large number of foundations that fund research and innovation. In 2018 around 13 000 charitable foundations in Switzerland enriched the cultural, social and economic life of the country.

Around 20% of these are active in the field of education and research. Examples are the Gebert Rüf Foundation, Cancer Research Switzerland and the Hasler Foundation.

Since the foundations fund a wide range of R&I undertakings and apply varying funding criteria, they play an important role in bringing diversity to R&I funding.

Digital Bamboo, 2016 - Photo: Digital Building Technologies, ETH Zurich

The Digital Bamboo pavilion explores the innovative combination of a naturally grown material with digital fabrication. Bamboo is an excellent sustainable building material, because of its rapid growth and very low weight-to-strength ratio. Customized computational tools were developed to design the ultra-lightweight structure, whose bespoke connections were manufactured using 3D printing technology. The structure covers more than 40 sqm with a total weight of only 200 kgs. The Digital Bamboo pavilion showcases a filigree and engaging architecture that surpasses the standardized space frame vocabulary.

6 International Cooperation

Switzerland engages in international cooperation in order to consolidate and further strengthen its position as one of the world's most competitive centres in terms of ERI. International F&I funding mechanisms complement national instruments and give Swiss players access to international networks.

6.1 EU Framework Programmes for Research and Innovation

The European Union's Framework Programmes for Research and Innovation (FPs) are of particular importance in Switzerland's international cooperation activities. The 8th programme generation, Horizon 2020, runs from 2014 to 2020 and the 9th, Horizon Europe, from 2021 to 2027.

Switzerland's status in the FPs has varied over the years:		
1987–2003	FPs 1–6	Third country
2004–2013	FPs 6 and 7	Full association
2014–2016	Horizon 2020 (FP 8)	Partial association
2017–2020	Horizon 2020 (FP 8)	Full association

At the current time (late 2019) it is still not known what form Switzerland's participation in Horizon Europe will take.

F&I researchers' participation in the FPs creates many benefits for Switzerland. Researchers from Switzerland cooperate in international projects with colleagues in Europe and around the world. The positive scientific, technological and economic impacts of Switzerland's participation are particularly significant. The success rate of project applications with Swiss participation is excellent in a European comparison, although for the first time Swiss participation in the FPs declined slightly at times during Horizon 2020 as a result of only partial association. A definitive assessment of the benefits of participation can only be made once Horizon 2020 has concluded.

6.2 EU Education and Mobility Programmes

Switzerland's cooperation with the EU in the field of education has been an established element of the Confederation's international promotion policy for over 20 years. Participation in the EU's multi-annual education programmes – either on a project basis or in the form of association – creates opportunities for mobility and cooperation between Swiss and EU educational institutions and individuals.

The present EU education programme Erasmus+ runs from 2014 to 2020. Switzerland currently participates with third country status. In 2019 almost 12 700 persons from Switzerland and Europe were able to spend time abroad and thus enrich their educational experience under the programme. In Switzerland, the foundation Movetia, funded by the Confederation and the cantons, organises educational exchanges and mobility. The federal government is currently in discussions with the European Commission over Switzerland's possible association to the Erasmus+ successor programme (2021–2027).

Advisory Services for Swiss Researchers Participating in EU Programmes

Euresearch is mandated by SERI to inform and advise research and innovation players in Switzerland who are interested in participating in an FP project. The Euresearch network has advisory points at ten higher education institution locations and is headquartered in Bern.

The Confederation helps to fund SwissCore (Swiss Contact Office for European Research, Innovation and Education, funded jointly by SERI, the SNSF and Innosuisse). The liaison office for Swiss researchers and students, located in Brussels, helps Swiss ERI players to network locally.

6.3 Programmes, Infrastructures and Initiatives for International Research and Innovation Cooperation

Switzerland does not only take part in the EU Framework Programmes, it is also a member of and partner in other international R&I programmes, infrastructures and initiatives. These give Swiss R&I players access to major international networks and thus to cost-intensive research facilities for conducting experiments and to a broad range of knowledge.

For example, Switzerland is a founder member of the European Space Agency (ESA). Thanks to its participation in the ESA programmes, Swiss R&I players have access to scientific data and can compete at an international level for research project funding and for contracts. Since ESA was founded in 1975, an effective, innovative Swiss space related ecosystem has developed based on top quality research and value creation.

Switzerland also participates in CERN, the research facility for basic physical research and the world's largest research centre for particle physics. Set up in 1964 in Geneva and with locations in Switzerland and France, CERN is one of the world's largest international research infrastructures. It plays a major role in the Swiss research and innovation landscape.

Switzerland also participates in EUREKA, an international initiative promoting innovation cooperation for SMEs in particular.

6.4 Bilateral Research and Innovation Cooperation and the Swissnex Network

The Confederation funds bilateral programmes for research and innovation cooperation with selected countries such as China, India, Russia, South Africa, Japan, South Korea and Brazil. These programmes aim to promote the diversification of international partnerships and provide instruments for cooperation in order to facilitate the emergence of new partnerships of excellence with scientifically promising countries or regions. They also support Swiss ERI players in their autonomous internationalisation efforts.

The Swissnex network is a further government-based instrument for promoting international cooperation. It fosters international networking of Swiss higher education institutions, scientists and research-related companies. The network includes around 20 science counsellors based at Swiss embassies around the world and at the five Swissnex locations in Bangalore, Boston, Rio de Janeiro, San Francisco and Shanghai.

Figure A 6.1: Swissnex network

Source: SERI

Photo: Martin Proksch

Alpine glaciers and polar regions are acutely affected by global warming. The Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) and the WSL Institute for Snow and Avalanche Research (SLF) study these regions in order to anticipate future developments.

7 Knowledge and Technology Transfer

Successful innovation relies to an ever greater extent on cooperation among companies and between companies and universities. Businesses make use of the skills and services of their respective partners to boost their own innovation potential.

Knowledge and technology transfer (KTT) involves the exchange, provision and transfer of information, skills and R&D findings between universities and research institutions on the one hand and between companies and publicly funded players on the other. The aim is to initiate and improve innovation processes and thereby promote innovation. There is a focus on gaining economic benefit from existing and jointly created knowledge.

The ETH Domain and higher education institutions are also required to provide services and KTT. Since they traditionally focus on teaching and research, KTT is carried out primarily via the graduates who go to work in the private sector. Other forms of KTT include research cooperations and consulting.

KTT also takes place via Switzerland's participation in international F&I cooperation programmes (e.g. the FPs), infrastructures (e.g. CERN) and initiatives (e.g. EUREKA) (see Section 6.3). With Switzerland's participation in the European Space Agency, the Confederation also pursues a KTT policy, from institutional R&D programmes to commercial markets. KTT in space technology is also promoted via a range of complementary national measures.

Of equal importance is the transfer of knowledge from the fields of health, social affairs and arts as well as from the humanities and social sciences. This takes the form of advice, situation analysis and solutions with innovative perspectives for the social field.

Swiss Technology Transfer Association

The Swiss Technology Transfer Association (swiTT) brings together persons who are primarily engaged in technology transfer in their professional lives and who deal with cooperation between public and private research institutes, hospitals and other not-for-profit research institutions. The association connects KTT between the research institutes and the private sector. Members and other persons involved in KTT in the Academies and private sector benefit from the specialist support and continuing education opportunities and from a wide range of services.

7.1 Technology Transfer Offices

Technology transfer offices and KTT offices in publicly financed research and education institutions provide researchers with skilled partners for R&D projects both within and outside their institutions. These offices 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 and industry to implement this strategy.

In Switzerland there are three main types of KTT office:

- 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 at the FITs; for example, the KTT office ETH Transfer at the 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 pool their KTT activities, perhaps jointly owning an externally run KTT office which promotes transfer processes on their behalf. This is the approach adopted by the universities of Zurich, Bern and Basel in cooperation with the company Unitectra AG.

7.2 Public-Private Partnerships and Centres of Technological Excellence

Public-private partnerships (PPPs) between higher education and the private sector create enormous potential for KTT. This is the case, for example, with Empa, a research institution in the ETH Domain, which transforms its research findings into marketable innovations in cooperation with industry partners and via spin-offs. Private and public co-financed research institutes (e.g. Disney Lab Zurich and Nestlé Institute of Health Sciences) and privately funded university chairs play an important role in KTT. In addition, institutions such as the European Space Agency (ESA) are increasingly implementing programmes as PPPs, with Swiss companies involved.

The centres of technological excellence (Art. 15 RIPA) are conceived of as PPPs and as transferers of knowledge. These are autonomous research institutions of national importance outside of the university sector which work with higher education institutions and the private sector. Examples of such centres include the Centre Suisse d'Electronique et de Microtechnique (CSEM) in Neuchâtel, the Geneva Biotech Campus and Inspire AG, based in Zurich and St. Gallen, whose focus is mechatronic production systems and manufacturing techniques.

7.3 Swiss Innovation Park

The Swiss Innovation Park is a public-private partnership of national importance run by the Confederation and cantons, the science community and the private sector. Under the umbrella brand 'Switzerland Innovation', the park currently comprises six principal site operators: Switzerland Innovation Park (SIP) Basel Area, SIP Biel / Bienne, SIP Innovaare, SIP Ost, SIP West EPFL and SIP Zurich. Several smaller sites are affiliated to these main ones.

The activities focus on enabling R&D cooperations between businesses, the higher education sector and research partners; on attracting companies and research groups; R&D investments by private investors; KTT and creating attractive conditions for start-ups.

Switzerland Innovation is facilitating collaborations for companies, startups, and universities to find solutions to some of the world's most pressing challenges. Together with its numerous and diverse partners, among them the Federal Institutes of Technology, ETH Zurich and EPFL, Switzerland Innovation creates an ecosystem for universities and research-based companies, accelerating the transformation of research results into marketable products and services.

A recently signed collaboration agreement (MoU) between Switzerland Innovation and China's Torch Center (Ministry for Science and Technology) will help attract new and exciting Chinese R&D projects and research teams to Switzerland Innovation from the high-tech development zones. At the same time, these zones will be the ideal opportunity for Swiss companies located in one of Switzerland Innovation's innovation parks to gain a foothold in the Chinese market. The MoU is the first step toward implementing a collaboration between Switzerland and China in research and development as part of the Federal Council's China Strategy 2021–2024.

The Park is funded by the cantons and private investors. The Confederation's involvement is restricted to providing guarantees for ring-fenced and fixed-term loans for the various site operators, primarily to finance research infrastructures, e.g. labs or facilities. The Confederation can also lease federally owned land with building rights to the site operators (under Art. 33 RIPA). The Innovation Park adds considerably to Switzerland's attractiveness as a location for research and innovation.

Figure A 7.1: Swiss innovation park sites

Source: SERI

INTERNATIONAL COMPARISON OF SWISS RESEARCH AND INNOVATION

Photo: Astronomical Institute, University of Bern

The ZIMLAT telescope at the Zimmerwald Observatory uses a laser to measure the distance to satellites. At the same time, it serves as an astronomical telescope: with digital cameras, the position and brightness of objects close to the earth are determined. The observatory, which has existed since 1955, is affiliated with the Astronomical Institute of the University of Bern.

This chapter examines how well research and innovation in Switzerland compares to that of other industrialised and emerging countries.

Overall, the analysis shows that Switzerland is well-positioned at international level. Most of the indicators measuring investment, synergies and performance of the research and innovation system place Switzerland in pole position.

Gaps between the countries considered in the comparison, however, are generally closing. At the same time, countries that have established themselves as research and innovation leaders in recent years (including Switzerland) now have to compete with countries such as China, Israel, Singapore and South Korea. Particular attention should therefore be paid to areas where Switzerland could potentially gain or lose ground.

Framework Conditions

Favourable framework conditions are an essential prerequisite for a country's success in research and innovation. Together with Singapore and Denmark, Switzerland offers some of the best conditions: a high level of political stability, top-notch infrastructure and public services, as well as good living standards in economic hubs. All of these conditions make Switzerland a particularly appealing location for research activities. Low corporate taxation and a flexible labour market are also important considerations for innovative companies.

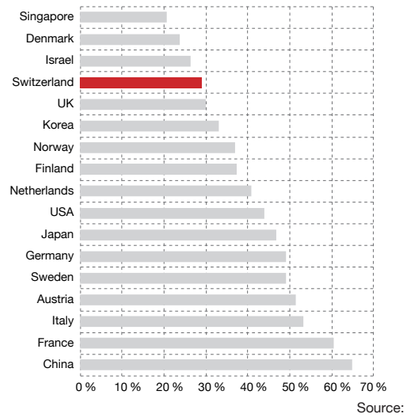
In terms of e-government, however, Switzerland trailed the other countries: in an international comparison, neither the availability, nor the quality of public online services were found to be convincing.

Table B 1.5: Quality of life according to city ranking (top 10), 2019

Rank	City	Country
1	Vienna	Austria
2	Zurich	Switzerland
3	Vancouver	Canada
4	Munich	Germany
5	Auckland	New Zealand
6	Düsseldorf	Germany
7	Frankfurt	Germany
8	Copenhagen	Denmark
9	Geneva	Switzerland
10	Basel	Switzerland

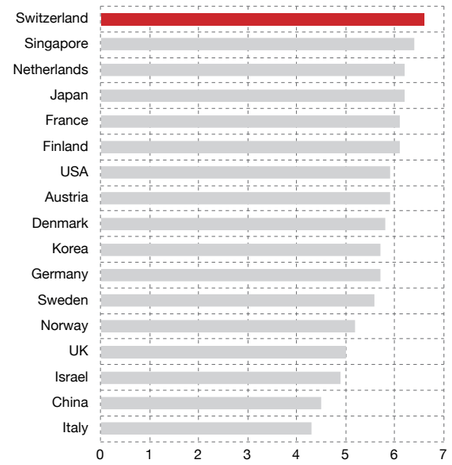
Source: Mercer

Figure B 1.6: Total corporate tax rate as a percentage of profit, 2019



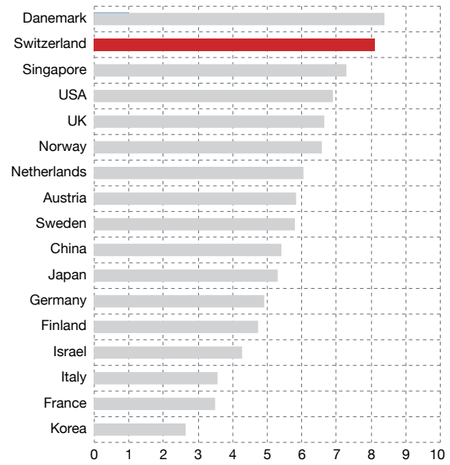
Source: World Bank

Figure B 1.2: Quality of the infrastructure, 2017-2018



1 = severely underdeveloped, among the worst in the world
7 = extensive and efficient, among the best in the world
Source: World Economic Forum

Figure B 1.7: Labour market flexibility, 2019



0 = less flexible or strongly regulated labour market,
10 - very flexible or scarcely regulated labour market
Source: IMD

Education and Skills

Swiss research and innovation activities are sustained by Switzerland's high quality education system, which in addition to academic pathways also gives considerable importance to vocational pathways at both upper-secondary and tertiary level. The Swiss population in general is highly educated: in 2018, over half of the population between the ages of 25 and 34 held a tertiary-level qualification. Only South Korea and Japan report even higher proportions. Among those holding a tertiary-level qualification, a noticeable shift in trend was observed among young women and men in Switzerland over the past 15 years: while in 2005 only 25% of women aged 25-34 held a tertiary-level qualification (37% of men), that share has now risen to 54% (49% of men).

Tertiary level education in Switzerland is highly internationalised. Together with the UK and Austria, Switzerland is one of the most desirable destination countries for foreign students pursuing tertiary-level education. This is particularly true of PhD students: over half of PhD students are foreign and over three-quarters of those are from the European Union.

Table B 2.9: Swiss higher education graduates among migration, 2014

%	Master HEU	Doctorate HEU
Nationality at the time of acquisition of the certificate of access to graduate studies		
European	71.3	78.2
Distribution by field of study		
Humanities	6.7	2.8
Social sciences and education	13.0	3.7
Law	9.7	1.0
Economics	11.7	2.8
Natural sciences	31.8	45.0
Health	4.2	16.0
Technical sciences	22.8	28.7
Emigration rate after graduation (2015)		
Total	34.8	33.0
Humanities	21.7	48.3
Social sciences and education	40.7	47.5
Law	25.5	m
Economics	46.0	48.3
Natural sciences	33.2	33.7
Health	37.2	20.2
Technical sciences	32.6	27.6
Proportion of those who live abroad and work in Switzerland (2015)		
Total	21.9	9.5

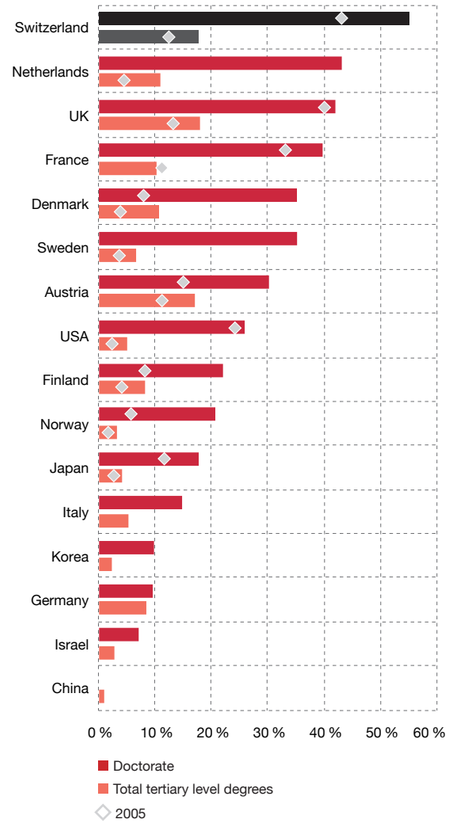
m: less than 25 cases
Source: FSO

Research and Innovation Staff

Switzerland has outstanding human capital: over 40% of the Swiss working population is involved in the creation, dissemination and application of scientific and technological knowledge. In terms of the share of R&D staff in total employment, however, Switzerland is only average among peer countries and, in particular, has a relatively low proportion of researchers. For these indicators, Nordic countries clearly come out on top.

Recruiting foreign researchers, technicians and R&D support staff by private companies and higher education institutions is essential for the development of research and innovation activities in Switzerland. Between 2000 and 2017, the number of foreign R&D staff working at higher education institutions and companies doubled. In 2017, foreign R&D staff accounted for 43% of total university R&D staff (28% in 2000) and 42% of R&D staff in private companies (32% in 2000). In addition, over half of researchers working at higher education institutions (52%) and in the private sector (51%) were foreign nationals.

Figure B 2.8: Share of foreign students in all tertiary level students, 2017



Data not available: Singapore 2005 data not available: Germany, China, South Korea, Israel, Italy, Netherlands (doctorates), Sweden (doctorates)
Source: OECD

Photo: Inspire AG

Technology competence centres are not-for-profit research institutions of national importance. Working with partners from the private sector and cooperating closely with higher education institutions, they conduct innovation projects in the pre-competitive phase. Inspire AG in Zurich, which conducts research into mechatronic production systems and manufacturing technologies, is one of the technology competence centres funded by the Confederation. As a strategic partner of the ETH Zurich, it is involved in the knowledge and technology transfer in the field of production technology to the mechanical, electrical and metal industries. The photograph shows the surface analysis of a component produced with a 3D printer.

Women account for 35% of researchers working in Switzerland, which is a high figure compared to the other countries considered in the comparison. However, the 'leaky pipeline' phenomenon is still apparent: Although 53% of master's degree students are women, only 23% of all professorships and senior research positions are held by women. In Switzerland, the proportion of female professors and senior researchers in the medical sciences, health and natural sciences is lower than in the European Union.

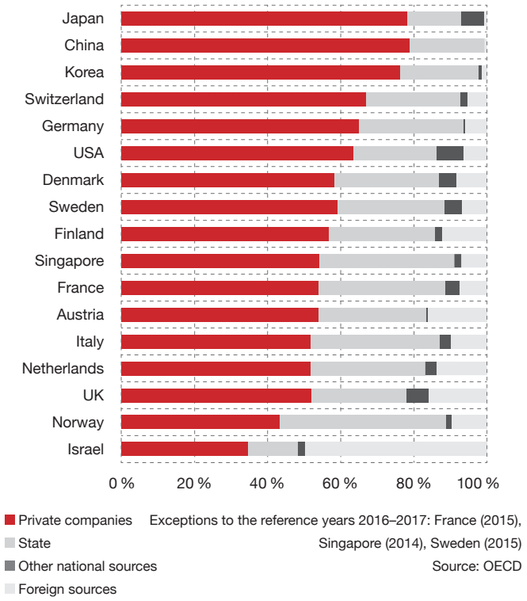
R&D Expenditure and Funding

Switzerland remains one of the countries with the highest level of R&D expenditure in relation to GDP, behind South Korea and Israel. In Switzerland, as in most peer countries, private companies account for over 60% of the total expenditure concerned. Swiss higher education institutions also play an important role, accounting for nearly a third of total R&D expenditure.

For the first time since 2000, growth in total intramuros R&D expenditure (i.e. expenditure on R&D activities in Switzerland) slowed down significantly in 2017. Sector-by-sector analysis reveals for the first time that companies with at least 100 employees did not increase their R&D expenditure.

As in most of the countries considered in this comparison, the private sector was the main source of R&D funding in Switzerland. Despite this, top priority is given to public sector funding of intramuros R&D expenditure in Switzerland. Within the space of ten years, the increase in public sector funding of R&D expenditure (Confederation and cantons) – measured in terms of the ratio of total public funding to GDP – in Switzerland has been higher than in peer countries.

Figure B 4.1: R&D funding by sector of activity, 2016-2017



Participation in EU Framework Programmes

Participation in the EU research framework programmes is a priority of Swiss research and innovation policy. By taking part in the FPs, institutions, companies and researchers in Switzerland are able to work with leading foreign partners, exchange knowledge and share access to world-class infrastructure.

Since 1992, the number of instances of Swiss participation in the FPs has increased six-fold. Such participation is particularly important for research projects carried out by ETH Domain institutions and cantonal universities. Since 1992, ETH Domain institutions have secured a total of CHF 2.3 billion in EU funding and Swiss cantonal universities have secured CHF 1.7 billion. Moreover, the FPs are the main source of public funding of research and innovation activities of Swiss SMEs (CHF 820 million since 1992) and industrial companies (CHF 638 million since 1992).

Due to the adoption of the popular initiative against mass immigration in 2014, Switzerland was less active in FP8 Horizon 2020 (2014–2020) than in FP7 (2007–2013). However, if we consider the number of instances of Swiss participation in Horizon 2020 and the total amount of funding awarded to Swiss institutions, Switzerland is the most important non-EU partner for EU research activities. Moreover, the high success rate of Swiss project proposals in FPs confirms the high quality of Swiss research.

Scientific Publications

Switzerland and Denmark have the highest volume of publications per capita. Despite increasing competition from countries such as China and Singapore, Switzerland continues to produce a considerable volume of high-impact research publications relative to its small size.

In terms of the number of publications output and their impact, it can be said that research in Switzerland tends to focus mainly on 'Clinical Medicine', 'Life Sciences' and 'Physics, Chemistry and Earth Sciences'. In addition, Swiss publications in the field of 'Technical and Engineering Sciences, Information Technology' have a high impact at international level despite their small share as a proportion of the total number of publications.

Switzerland's success in research activities and research output is partly due to the fact that it maintains strong international networking ties and works extensively with foreign institutions. Between 2014 and 2018, 85% of Swiss research output was the result of international cooperation.

Patents

Patent applications provide an insight into the extent of technological and commercial use of research findings in a given country. Relative to the number of inhabitants, Switzerland has the highest number of international patent applications, followed by Japan and Sweden. As far as

Figure B 6.3: Impact of publications, average 2014-2018

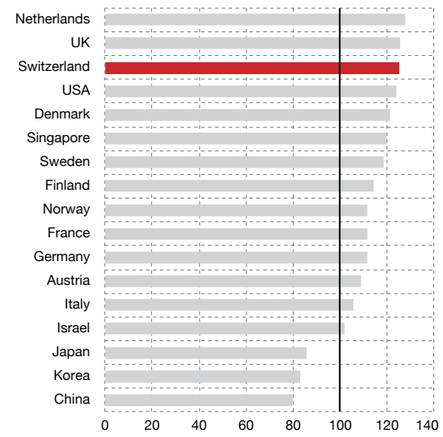
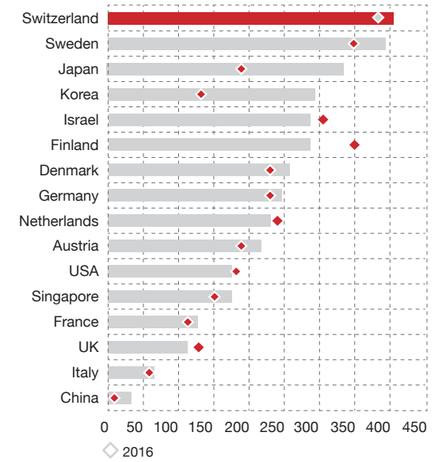


Figure B 7.1: PCT patent applications per million inhabitants, 2016



patents are concerned, Switzerland is the country that works the most intensively with foreign countries: 42% of internationally patented inventions are the result of international cooperation, with 30% being from cooperation with researchers from the European Union.

The knowledge gained in Switzerland is also used by foreign companies: around a third of all international patent applications filed by researchers working in Switzerland are owned by foreign companies. Switzerland is therefore one of the five most preferred countries in terms of foreign investment in research. In the technology sectors, Switzerland is particularly specialised in health and biotechnology. However, its specific areas of specialisation do not include environmental technologies (in which Japan is the leader), nanotechnologies (dominated by Singapore) and information and communication technologies (where China is the leader).

Knowledge and Technology Transfer

In Switzerland, close ties between higher education institutions and companies are a success factor for research and innovation. Knowledge and technology transfer (KTT) ensures that knowledge flows between these two partners. Such KTT activities are a prerequisite for creating the cooperation networks that give rise to innovation, enable the economic potential of research findings to be tapped and bring real-world knowledge to academic research. About one in four Swiss companies is involved in KTT activities. These activities are mostly informal in nature (e.g. attending conferences or reading scientific publications) and also take place through direct contact between companies and higher education institutions (students, graduates or researchers). Companies mainly take part in KTT activities to recruit human capital and – to a lesser extent – to gain access to research findings. In Switzerland, universities of applied sciences and federal institutes of technology are the main partners for companies involved in KTT.

However, in Switzerland as in other countries, company size is closely correlated with the intensity of KTT activities. Moreover, a significant proportion of companies state that a lack of interest and internal resources to pursue R&D is one of the main obstacles to taking part in KTT activities. Additional factors hindering KTT activities include a lack of interest on the part of higher education institutions in business-related R&D and their limited entrepreneurial drive.

Entrepreneurship

Start-up companies can offer new or improved products and provide support to already established companies in specific areas of expertise. Therefore, entrepreneurial activity and entrepreneurship within the population is crucial for the development of innovation. In Switzerland, those most likely to start an entrepreneurial activity fall into the 25-to-34 or 45-to-54 age category. However, the proportion of the Swiss labour force that has either started or managed a new business is lower than in the USA, South Korea and Israel. The working population in Switzerland primarily states that they do not have the required skills to start a business and are afraid of failing. Moreover, entrepreneurship as a career step seems to be less highly regarded in Switzerland than in the vast majority of the countries considered in the international comparison.

Innovation Activities of Companies

The proportion of innovative companies is declining in Switzerland. In the industrial sector, it fell from 67% to 55% between 2006 and 2016. In the services sector, the proportion of innovative companies fell from 54% to 44% over the same period. Although these two proportions were the highest among peer countries in the early 2000s and Switzerland remains in the top group today, it lags behind Finland and the Netherlands. These two countries

have reported strong growth since 2012. The latest results from 2016 show that gaps between peer countries have narrowed considerably.

However, Swiss companies sell fewer market innovations than most of their peers (especially the Netherlands and Italy). This is particularly true of the services sector. In most cases, the 'innovations' marketed in Switzerland are only novel for the company in question. In other words, only a few companies in Switzerland actually launch entirely new innovative products or services that were not previously available on other markets.

Structural Change

Switzerland is among the industrialised countries able to actively respond to new market developments, to tap the potential of technological progress and to adapt to structural changes in demand and competition. Industries with intensive research activities (grouped together in the sub-sectors 'high-tech industry' and 'modern services') account for over half of nominal added value. Only the USA, Germany and South Korea have similarly high proportions.

Since 2000, the proportion of low-tech industry in nominal added value in Switzerland has decreased significantly. In contrast, the proportion of services in nominal added value has risen. This development can be seen in nearly all of the countries compared. As in most peer countries, this increase in Switzerland is mainly due to the higher share of modern services in nominal added value.

Table B 9.2: Forms of knowledge and technology transfer activities in Switzerland

Percentage of companies active in KTT	Before 2005	2005-2010	2012-2017
Informal contacts	56.9	63.0	51.6
Infrastructure	12.5	15.2	13.2
Training and mobility	52.6	60.0	49.7
Research	17.7	18.2	14.9
Advice	15.2	16.0	13.7

Share of companies active in KTT assigning a value of 4 or 5 (large or very large importance) on a scale of 1 to 5 to the forms of KTT listed.
Source: KOF calculation

Table B 9.3: Knowledge and technology transfer partners in Switzerland

Percentage of companies active in KTT	Before 2005	2005-2010	2012-2017
ETH Domain	62.3	72.6	64.8
Cantonal universities	42.8	42.8	33.0
Specialized higher education institutions	60.8	71.0	66.3

Share of companies active in KTT that have made a transfer knowledge with at least one institution in the sector concerned.
Source: KOF calculation

Table B 7.4: Technological advantage revealed, 2014-2016

Health Technologies		Biotechnologies		Environmental Technologies		Nanotechnologies		Information and Communication Technologies	
Israel	209	Denmark	250	Japan	209	Singapore	599	China	183
Netherlands	162	Singapore	203	Singapore	162	USA	154	Sweden	145
Switzerland	154	USA	170	France	169	Israel	145	Finland	128
USA	154	Israel	142	Korea	126	UK	124	Korea	121
Denmark	142	UK	141	Germany	122	Korea	105	Israel	116
Singapore	124	Switzerland	133	Denmark	113	Finland	103	USA	107
UK	120	France	115	EU-28	106	France	92	Singapore	94
Italy	101	Norway	110	Israel	97	Netherlands	88	Japan	80
EU-28	92	Netherlands	110	UK	84	EU-28	75	UK	75
Korea	84	EU-28	84	USA	68	Denmark	71	EU-28	59
France	82	Korea	88	Italy	67	Sweden	69	France	57
Norway	78	Austria	82	Finland	66	Japan	66	Netherlands	54
Sweden	72	Italy	69	Austria	64	Italy	58	Germany	46
Austria	72	Finland	65	Switzerland	56	Switzerland	51	Denmark	39
Japan	69	Sweden	64	Norway	53	China	50	Switzerland	39
Germany	66	Germany	63	Netherlands	34	Germany	35	Austria	36
Finland	55	Japan	57	China	33	Austria	24	Norway	35
China	50	China	44	Sweden	23	Norway	12	Italy	29

Technological advantage revealed: share of a country's PCT patent applications in a given technology compared to the worldwide share of patent applications in that same technology. The revealed technology advantage is 0 when the country does not hold any patents in the field, 100 when the country's share in the field is equal to the world share in the same field (no particular specialization) and more than 100 when a specialization is observed.
Health technologies include the fields of medical technology and pharmacies.

Environmental technologies bring together a wide range of technologies relating to the management of pollution, water or the mitigation of climate changes. Nanotechnology brings together scientific activities which take entities with a controlled geometric size of less than 100nm as their work object.
Calculated on the basis of PCT patent applications.

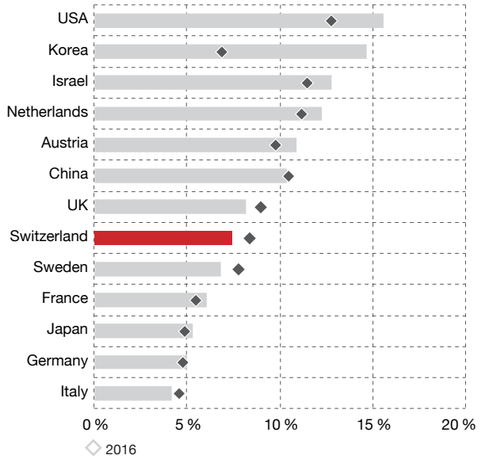
Source: OECD, SERI calculations

Comparison of Switzerland with Leading Research and Innovation Metropoles

A differentiated comparison of Switzerland with 21 leading research and innovation metropoles around the world confirms that it is in a very good position overall. However, Switzerland stands out less clearly in this comparison than in the comparison with peer countries. For example, the ratio of intramuros R&D expenditure to GDP is significantly higher in eight other leading research and innovation metropoles, including the San Francisco Bay Area and Daejeon. As far as neighbouring countries are concerned, only Baden-Württemberg has a higher ratio of R&D expenditure to GDP than Switzerland. In terms of the number of research publications per capita, Switzerland is surpassed only by three North American metropoles: the Boston and New York metropolitan areas and the San Francisco Bay Area. In Europe, the Paris metropolitan area is not far behind Switzerland.

For patents per capita, Switzerland is surpassed only by the San Francisco Bay area. In Europe, the Paris metropolitan area, Bavaria and Baden-Württemberg rank immediately behind Switzerland, but by some considerable way. Although the number of innovative companies in Switzerland is declining, only Baden-Württemberg has a higher share of innovative companies in the total number of companies. Bavaria and Lombardy/Piedmont are roughly on a par with Switzerland. Finally, in terms of the share of employment in knowledge-intensive sectors, Switzerland ranks sixth. The first three positions are held by Baden-Württemberg, Bavaria and the Paris metropolitan area.According to the residence place of the inventors.

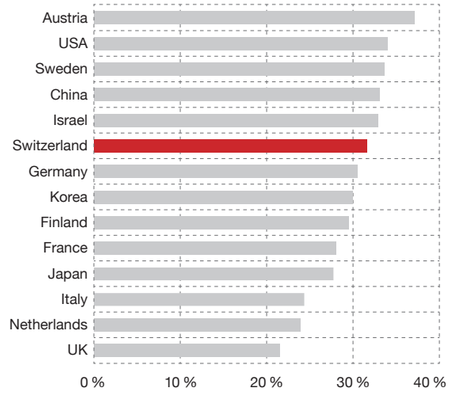
Figure B 10.1: Rate of Business creation, 2018



Share of 18 to 64 year olds who have started or managed a new business (3 to 42 months old) in 2018.
Exception to the reference year 2018: Israel (2017)
Exception to the reference year 2016: Japan (2017)
Data not available: Denmark, Finland, Norway, Singapore

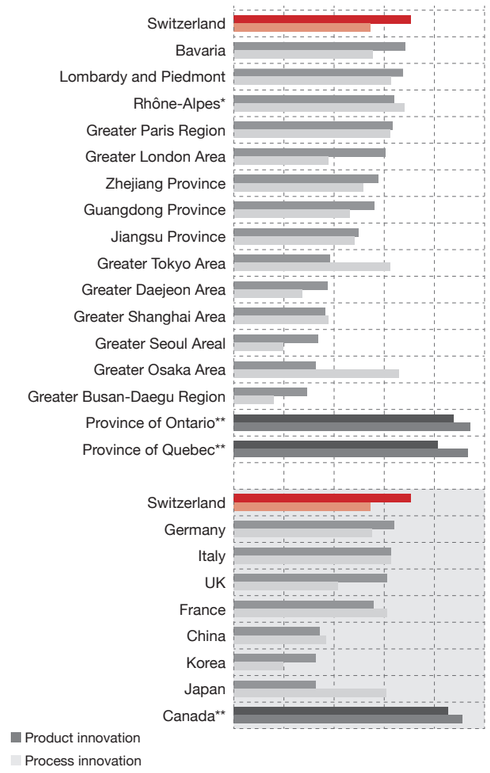
Source: GEM

Figure B 11.1: Share of recently created companies having launched at least one new product for part of their customers, 2018



Exception to the reference year 2018: Finland (2016)
Data not available: Denmark, Norway, Singapore
Source: GEM

Figure B 13.6: Share of innovative companies (product or process) in innovation regions, 2016/2017



* Rhône-Alpes includes the Auvergne region
** For Canadian regions, data are estimated from surveys and can only be compared to a limited extent with innovation survey standards. Likewise, the delimitation of branches is not directly comparable with that on which innovation surveys in Switzerland and the EU are based.
Data not available: USA
Sources: NBSC, NISTEP, STATCAN, STEPI, ZEW, ZEW calculations

Fundamentals and Further Analysis

This Brochure is based on a more extensive report, the second edition of Research and Innovation in Switzerland, which was published by SERI in 2020. SERI assumes no responsibility for the accuracy of the contents in this brochure.

- It describes the Swiss research and innovation system's structure and how it works. It explains the fundamentals of how the system is run and the role of the various players involved.
- It provides a global, long-term analysis of the Swiss research and innovation system with the use of quantitative and qualitative indicators. The report compares the Swiss research and innovation system with other developed and emerging economies over a period of several years. Various indicators relating to investment, interaction and performance are presented.
- It contains thematic studies: in each report, selected topics within the research and innovation system are examined more closely.

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