

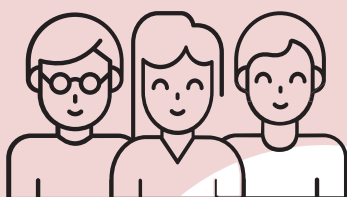
ANNUAL REPORT OF THE ETH BOARD ON THE ETH DOMAIN 2022



ETH Domain

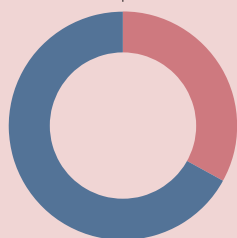
FACTS & FIGURES 2022

Students and doctoral students



37,116

Students and doctoral students



32.4%

Proportion of women

Employees with employment contracts



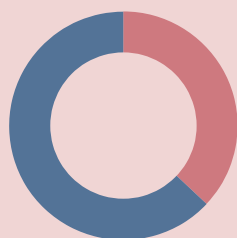
14,690 Scientific personnel

4,163 Technical personnel

4,154 Administrative personnel

24,375

Employees including professors, doctoral students and apprentices



36.4%

Proportion of women

463

Apprentices

Professors

905

85 appointments, thereof

60 newly appointed persons

25 promotions

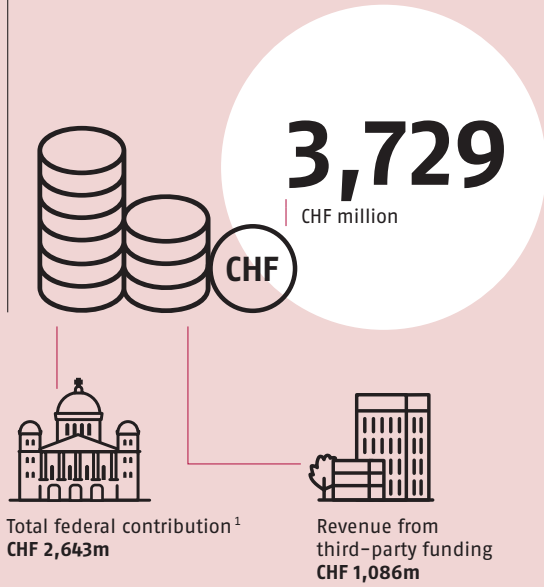


41.7%

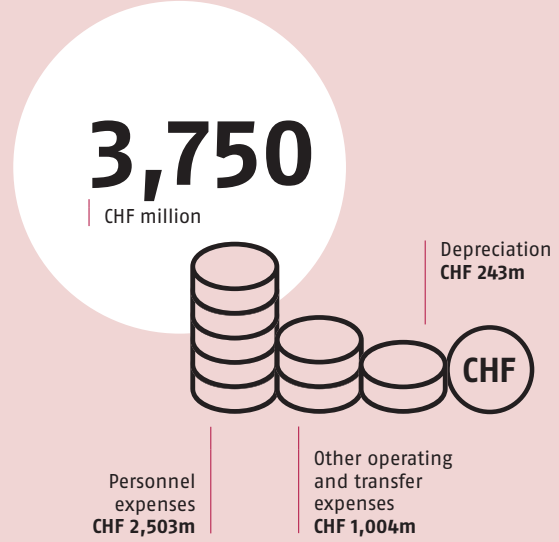
Proportion of women among new appointments



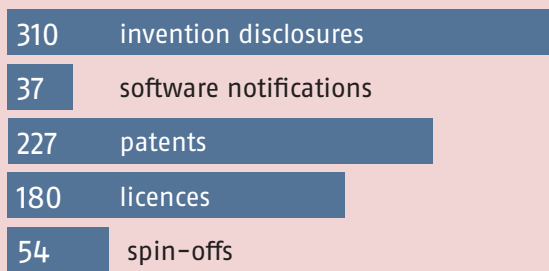
Total revenue



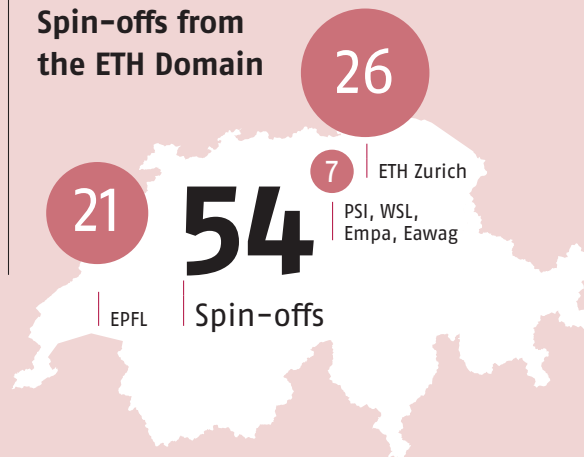
Operating expenses



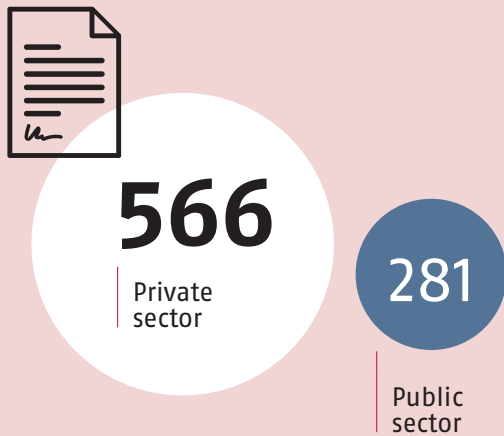
Knowledge and technology transfer



Spin-offs from the ETH Domain



Number of cooperation agreements²



University rankings



¹ Total federal contribution as per the consolidated financial statements for the ETH Domain.

² With a volume of at least CHF 50,000 each.

MISSION

The ETH Domain serves society through the pursuit of knowledge and the beneficial application of its science. The ETH Domain institutions share responsibility for education, research and knowledge and technology transfer. As degree-granting institutions, the technical universities ETH Zurich and EPFL play a leading role in Switzerland's educational system, and are supported in this role by the research institutes PSI, WSL, Empa and Eawag. With their thematically based activities, the research institutes offer continuity in knowledge and technology transfer.



The ETH Domain and its institutions

Higher education, research and innovation of the highest standard: the ETH Domain provides these services with over 24,000 employees, more than 37,000 students and doctoral students, and a pool of just under 900 professors.

The ETH Domain consists of the two Swiss Federal Institutes of Technology ETH Zurich and EPFL, and the four federal research institutes: PSI, WSL, Empa and Eawag. The strategic leadership and supervisory body of the ETH Domain is the ETH Board.

www.ethdomain.ch | www.ethboard.ch

Annual Report of the ETH Board on the ETH Domain 2022

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Financial report:
www.ethboard.ch/financialreport2022

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The ETH Board reports on the ETH Domain

Joining forces in the face of global challenges

After two years spent navigating the coronavirus pandemic, we finally saw the return of full-time, face-to-face learning and practical courses on site in 2022. That said, the war in Ukraine and the strained state of affairs in the energy sector commanded renewed flexibility at the operational level and advice and specialist input from a scientific perspective.

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ETH Domain: Juggling crises

Research for crisis management

Species decline, increasing extreme weather events as a fall-out of global warming and, to top it all off, the uncertainties regarding energy supply and digital transformation: we are living in a challenging time in which several crises are being felt at once. Meanwhile, scientists from the ETH Domain are faced with a lot to tackle.



ETH Zurich: Globally successful start-up companies

A passion for ideas

Climeworks, which is active in environmental technology, and GetYourGuide, which is involved in tourism, are two of four spin-offs from ETH Zurich that have reached a market valuation of one billion dollars. Both are prime examples of how start-ups can be led to success. For GetYourGuide founder Johannes Reck, his time at ETH Zurich played a formative role in this.

EPFL: Portrait of Maryna Viazovska

"The magic of 8 and 24"

Professor of number theory Maryna Viazovska has solved a mathematical problem that has stumped researchers for centuries. How can spheres be optimally and symmetrically packed into multidimensional space in a manner that fills all available space? Her work was recognised with the Fields Medal.





PSI: Imaging at the SLS

Imaging at the next level

Marianne Liebi (right) and Adrian Wanner are two young researchers who make the nanostructure of macroscopic samples, such as bones or brain tissue, visible in three dimensions using high-resolution images. They achieve this using measurement data obtained with X-rays at the SLS at PSI.



Empa: Quantum materials science

"It all comes down to the last atom"

Empa researchers have developed novel materials made of carbon that exploit quantum effects to exhibit previously unattainable electronic and magnetic properties. In the picture: scientist Gabriela Borin Barin (right) and Roman Fasel, head of Empa's nanotech@surfaces laboratory.



WSL: Environmental research and artificial intelligence

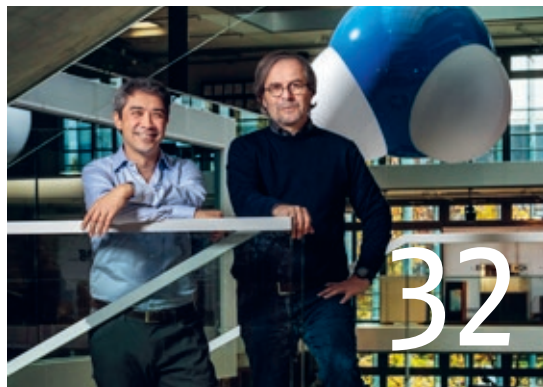
Artificial intelligence for avalanche warning systems

Digital tools, such as artificial intelligence, make it possible for environmental researchers to access larger data pools and generate new scientific findings. WSL uses these tools in various ways. For instance, they offer support with making more precise predictions about danger zones in snow and avalanche research. In the picture: Jürg Schweizer, Head of the SLF.

Eawag: Modular water infrastructures

The new gold standard?

In urban water management, the system used for treating wastewater has always been straightforward: wastewater is conveyed through the sewage system to centralised treatment plants, where it is treated. An interdisciplinary research project at Eawag led by Professors Bernhard Truffer (right) and Max Maurer is now challenging this principle, advocating instead a hybrid system with decentralised treatment plants.



FOREWORD



President of the ETH Board:
Michael O. Hengartner

Dear Readers

“Will it ever stop?” We are probably all asking ourselves this question at the moment, just as the Federal Councillor Moritz Leuenberger did during the catastrophic events of 2001. We had barely got the pandemic under control when we were faced with Russia's war of aggression against Ukraine. Institutions of the ETH Domain acted quickly in order to support Ukrainian students and researchers. They did this by providing work opportunities in the ETH Domain, extending fixed-term contracts and providing housing for new staff. The world and the ETH Domain will be dealing with the consequences of this war for a long time to come.

Despite these difficult times, the ETH Domain remains committed to delivering excellence for both Switzerland and the rest of the world. We want to continue to invest heavily in training future STEM specialists, in research areas which are of fundamental importance to Switzerland and the population, in knowledge and technology transfer for the economy and all levels of national and local government, and also in national and international research infrastructure.

Three factors are essential if the ETH Domain is to ensure that the excellence of its services is maintained and that its success continues: international openness, autonomy and stable, reliable funding. Unfortunately, two of these success factors are looking vulnerable.

On the one hand, Switzerland is yet to be associated with Horizon Europe. As a result, ETH Domain institutions are continuing to lose their appeal, their international networks are deteriorating and they are likely to suffer financial losses. The ETH Board welcomes the measures adopted by the Federal Council in order to mitigate the negative consequences of non-association. If Switzerland is to remain an international leader, it will require further investments and initiatives in order to attract and retain the best researchers.

On the other hand, the ETH Board is concerned about the Federal Government's financial prospects. High deficits have been predicted and are likely to lead to increased taxes or service cutbacks. Unallocated expenses, including the ERI and ETH Domain are in particular danger.

The ETH Domain is dependent on sufficient and stable funding from the Federal Government in order to fulfil its mission regarding teaching, research and the transfer of knowledge and technology (KTT) for the benefit of the Swiss economy and society.

Through the 2025–2028 ERI Dispatch, the Federal Council and Parliament are laying the foundations for the future of the Swiss ERI landscape and for the future of our country. Faced with challenges such as the climate and energy crisis, the shortage of skilled workers, digitalisation and cybersecurity, now is the time to increase education and research, not to cut back on it. I would like to thank you all for your commitment to Switzerland as an education and research hub. I am convinced that this is a worthwhile commitment which will bring great rewards.

Zurich / Bern, January 2023



Michael O. Hengartner,
President of the ETH Board

The ETH Board reports on the ETH Domain

JOINING FORCES IN THE FACE OF GLOBAL CHALLENGES

After two years spent navigating the coronavirus pandemic, we finally saw the return of full-time, face-to-face learning and practical courses on site in 2022, much to the appreciation of the students. That said, the war in Ukraine and the strained state of affairs in the energy sector commanded renewed flexibility at the operational level and advice and specialist input from a scientific perspective. During the reporting period, the ETH Board adopted the Strategic Plan 2025–2028 of the ETH Board for the ETH Domain and defined five Strategic Areas. The ETH Board is concerned about the unresolved situation regarding the delayed progression of association agreements with the Horizon Europe research programme.

Teaching and campus: (almost) a year of business as usual

In 2022, the increasing post-pandemic return to normality also brought with it a return of teaching without restrictions at institutions of the ETH Domain. During the coronavirus pandemic, the switch to exclusively digital lessons was a success thanks to the solid foundations in place for this and great dedication shown. ETH Zurich and EPFL continue to employ a wide range of uses for digital technologies and methods in their courses. That said, from now on, the focus is back on being a face-to-face university. The experiences throughout the coronavirus pandemic were clear indicators of the importance of face-to-face learning and practical courses in the field. Both close contact between lecturers and students and social networks among the students themselves are of great importance not only for well-being but also for academic success.

Flexibility and crisis management proved crucial once again during the reporting period when the fallout of the Russian war of aggression against Ukraine was felt in Switzerland. The institutions of the ETH Domain showed their solidarity with various offers of support for students and researchers affected by the war. For example, ETH Zurich opened up the opportunity for a dozen students from Ukraine to take part in a newly developed bridging course over one to two semesters. At the operational level, the strained state of affairs in the energy sector led the institutions of the ETH Domain to implement short-term energy-saving measures together with the Federal Administration, for example the lowering of heating temperatures. The ETH Domain has a high energy demand, partly due to its large research infrastructures, and is dependent on a reliable energy supply. As such, in autumn 2022, the ETH Board also decided on a package of measures worth CHF 10m, through which the ETH Domain's energy consumption will be further reduced, additional renewable energy



› Symbolic image: Novikov Aleksey/Shutterstock

produced and CO₂ emissions reduced by around a further 4%.

The various challenges of recent years may also have an impact on the degree programme selection of prospective Bachelor's students in the ETH Domain. For example, new admissions in the autumn semester of 2022 showed that more science and engineering science programmes are being taken. At the same time, the number of new Bachelor's students at ETH Zurich fell by just under 7%, compared to the previous year, which corresponds to a normalisation following the strong increase due to the coronavirus pandemic. EPFL has seen a growth of 15% in the number of first-year students at Bachelor's level. The ETH Board's strategy adopted in the reporting period for developing the number of students and doctoral students is dedicated to dealing with the strong demand for studies at the two Federal Institutes of Technology. Their primary goal is to maintain the high quality of teaching, ideally without restricting access to the degree courses.

Research, knowledge and technology transfer and open science for a strong Switzerland

In summer 2022, the ETH Board adopted the Strategic Plan 2025–2028 of the ETH Board for the ETH Domain.

Among other things, the ETH Board intends to promote five Strategic Areas, in which Joint Initiatives of the institutions should also come into play. A number of Joint Initiatives which target the two focal points – “Energy, Climate and Environmental Sustainability” and “Engagement and Dialogue with Society” – have already been approved for immediate implementation in the reporting period. This involves, for example, the development of sustainable materials using waste from food production and promoting the use of wood in the construction industry. Other Joint Initiatives are dedicated to the effects of climate change on ecosystems, biological diversity and energy security. Various forums of dialogue are also intended to promote mutual understanding between science and society. This is another area in which issues such as sustainability, greenhouse gas reduction and energy play an important role.

With these Joint Initiatives, the institutions are strengthening cooperation and coordination in the ETH Domain and serving Switzerland by developing solutions for global challenges of our time as well as consolidating these for the future. To this end, stable funding from the federal government is of the utmost importance and truly indispensable, especially in the

current strained financial environment. The corresponding funds for the ETH Domain will be requested from Parliament as part of the 2025–2028 ERI Dispatch.

The commitment to a strong Switzerland also involves close cooperation between the ETH Domain and the Swiss economy. KTT is intended to increase innovative strength and competitiveness and to generate jobs and added value. Start-ups play an increasingly crucial role here. The large number of spin-offs founded by ETH Zurich, EPFL and the research institutes is an impressive marker for the great innovation potential of the ETH Domain (see also p. 97). The report on spin-offs that emerged from ETH Zurich (see p. 15 et seq.) provides an insight into two particularly successful companies.

Targeted improvements to the framework conditions should further strengthen technology transfer in Switzerland. Corresponding initiatives at the federal level range from the Federal Council's directional decision for a Swiss innovation fund in summer 2022 to a range of operational measures with which KTT is to be accelerated. The institutions of the ETH Domain contribute their expertise in this regard.

The dimensions of transferral and the innovative application of knowledge are also focal points of open science. A further core element of open science is the topic of open research data (ORD). New technological developments facilitate the dissemination and collective utilisation of small and large data sets. With a programme to promote and improve ORD practices, the institutions of the ETH Domain are actively committing to their vision of a research environment that values and supports ORD from 2021 to 2024. At the same time, the ETH Domain participates in activities across Switzerland within the framework of the Swiss National ORD Strategy and is part of the ORD Strategy Council founded in 2022.

Science and politics: mutual understanding

The cooperation between science and politics became a topic of discussion several times during the reporting period in the context of dealing with the coronavirus pandemic. With the war in Ukraine and an impending energy shortage, experts from the ETH Domain, for example those in security research and the energy sector, were once again in demand in 2022 to highlight connections and develop scenarios.

The provision of scientific advice to policymakers is an important task for researchers in the ETH Domain and functions most successfully when it is leveraged on a mutual understanding of how the science and policy systems function. As such, the ETH Board recognises the need for cooperation between these players to continue to being consolidated outside of times of crisis.

The ETH Domain and all actors in the Swiss education and research sectors are heavily dependent on political matters when it comes to Horizon Europe. The delayed progression of association agreements with the EU's research programme means that Swiss ERI actors will continue to lose their appeal and their international networks will deteriorate. The ETH Board regrets that Switzerland and the EU have not yet found a solution in this regard. With the Stick to Science campaign, the ETH Board, together with leading British and Swiss actors in the scientific community, is working with the European scientific community in their efforts to mobilise Switzerland and the UK to rejoin the programme. The ETH Board's standpoint is that association with the Horizon package will always make sense – the sooner this happens, the better. The current situation is preventing the top minds in Europe's scientific and research communities from collaborating optimally and denying them access to the skills and resources available across the entire network of European institutions. This makes it more difficult to find joint solutions to global challenges such as climate change, pandemics and food security.

FASCINATION ETH DOMAIN

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ETH Domain

RESEARCH FOR CRISIS MANAGEMENT

Species decline, increasing extreme weather events as a fallout of global warming and, on top of it all, the war in Ukraine, which has also brought about uncertainties regarding energy supply and digital transformation: We are living in a challenging time in which several crises are being felt at once. Meanwhile, scientists from the ETH Domain are faced with a lot to tackle. They are investigating a diverse range of issues. Drawing on the expertise they have acquired, they are developing proposals for solutions to assist citizens, the authorities and politicians with advice and support.

The summer of 2022 was exceptionally hot and dry once again. It claimed tens of thousands of lives across Europe and showed that, in the words of Sonia Seneviratne – Department of Environmental System Sciences professor and a lead author of the latest report by the Intergovernmental Panel on Climate Change – “even our water-rich country is not immune to water shortages. Especially since the ice reserves in the Alps are shrinking at a record pace” (ETH Zurich’s *Zukunftsblog*). She and her team have calculated that these drought conditions are now to be expected around once every 20 years given the current climate.

Without human-induced global warming, such extreme events would only be expected every 400 years. “The summer of 2022 should be a wake-up call for us”, writes Seneviratne. “We need a radical phase out of oil, gas and coal – as quickly as possible.”

More vulnerable than 50 years ago

The Center for Security Studies (CSS) at ETH Zurich also deals with multidimensional crises and conflicts. “The array of threats has broadened since the Cold War era”, says professor Andreas Wenger, Director of the CSS. Whereas in the past the focus was on enemy tanks, in the context of the war

in Ukraine, it is now also a matter of arming against cyberattacks or a power shortage. At the same time, the world has become more vulnerable due to the many interdependencies and critical dependencies. “Because of global supply chains, even seemingly far-removed conflicts affect us much more today than they did 50 years ago”, explains Wenger. In Switzerland, he observes, individual threats are too often viewed in isolation and responses thus planned in contextual vacuums. As a result, the bigger picture is in danger of being lost, all the more so because there is only one body in the Swiss political system that has an overall

view. "The Federal Council is responsible for interdepartmental coordination. But we also need a centralised leadership support system so that a network of experts can be called upon at any time if necessary", stresses Wenger. The Federal Council also sees the need to establish an interdisciplinary network to form ad-hoc committees. Wenger adds that the EU, for example, has a joint fleet of firefighting aircraft. This demonstrates how leadership strategies are increasingly being based on international cooperation. "Switzerland still has some catching up to do in this respect" says Wenger.

Efficient, clean and reliable energy system of the future

Peter Richner, Head of Research Focus Area "Energy" and Deputy Director of Empa, also sees a need to catch up. "Switzerland has been dormant for decades, both in the expansion of renewable energies and in digitalisation", says Richner. Only now has it awakened – in the face of crisis. "Now people are interested in the solutions we have been working on for a long time." Richner gives numerous examples in the discussion. They range from the world record for efficiency in thin-film photovoltaics to the development of intelligent heating control technology and the establishment of a hydrogen filling station network for decarbonised truck transportation. Despite these impressively diverse means: "Empa is pursuing a single strategy. We need to switch to renewable energy – and use it sparingly and carefully", explains Richner.

Mario Paolone, professor and Chair of the EPFL Energy Centre (CEN), is also dealing with many different technical aspects of energy transition. Together with partners from academia and industry, the consortium has developed new methods and technologies to ensure Switzerland is able to be reliably supplied with clean electricity in the future, and conducted experimental testing on these solutions. This has resulted in various tools that can, for example, predict regional electricity production from wind and solar energy based on weather data or support grid operators in maintaining optimal and stable conditions in the electricity grid, even during extreme weather events. "In terms of what modern technologies can

offer energy entrepreneurs, we absolutely need the participation of political decision-makers at various levels, from the municipalities to the cantons to the federal government," Paolone emphasises.

Trust in the digital world

The EPFL Center for Digital Trust, or C4DT for short, does not deal with the electricity crisis, rather a very different crisis. "Trust is based on the ability to read the intentions of a counterpart", says its academic director Jean-Pierre Hubaux. "How can this ability, acquired over millennia, be transferred to the digital world, where I, as a user, must constantly question things such as: Is this video authentic or not?" Hubaux describes the C4DT as an interface between research, business and politics. The centre works on a variety of different projects with 20 different partners, including the University Hospital of the Canton of Vaud (CHUV) and Swisscom, as well as the private bank Lombard Odier and the Federal Office for Defence Procurement armasuisse. The projects concern the use of artificial intelligence to automatically identify the risks associated with technological innovations at an early stage. They also develop methods to enable humanitarian organisations, such as the International Committee of the Red Cross, to defend themselves against social media attacks. "Innovation means technology transfer", says Hubaux. "Our role is one of enabling: We create touch points."

Twice as much energy from sustainably used biomass

Oliver Kröcher, senior researcher at PSI, does not need to establish new touch points in politics, business and civil society. "People's interest in biomass as an energy source has always been there", states Kröcher. But now that prices are higher, interest has also increased significantly. "Today, energy from biomass is nearing the financial break-even point." As it stands, energy derived from wood, crop waste or even manure covers about 5% of the energy demand. "With optimal sustainable use, we could double this amount", claims Kröcher. Firstly, he refers to technical innovations. For example, researchers are developing new thermochemical methods to convert biomass into liquid fuel. He also highlights that in order

to better harness this potential we must utilise the wood in our forests more efficiently, instead of leaving it on the forest floor and allowing it to eventually rot away. That said, Kröcher quickly stresses that this does not mean removing all of the wood. This is because: "The dead wood in the forest is good for biodiversity".

Forests, biodiversity and resilience

"Biodiverse forests are resilient forests", says Arthur Gessler, who heads the Long-Term Forest Ecosystem Research programme at WSL. "After the record summer of 2003, we were still considered scaremongers when we warned people that various tree species such as fir and beech could increasingly encounter issues", Gessler recalls. But now, following the exceptionally warm and dry years of 2018, 2019 and 2022, there has been a general rethink. Together with his colleagues, Gessler is envisioning scenarios of what the local forest of the future could look like. He advises forest owners not to delay in establishing mixed forests. "It's just like a stock portfolio. If they bet on five species instead of just one, the chance that something will take root and continue to successfully adapt to changing environmental conditions increases", explains Gessler. Mixed forests are somewhat more complex in terms of timber uses, but more widespread in Switzerland than in France or Germany, for example, because here it is not so much the timber yield but other forest services such as avalanche protection that often play a major role. In addition, forests are the largest terrestrial carbon sinks. How forestry can contribute to achieving the goal of net zero emissions is therefore a key topic in the exchange with practitioners, which Gessler also oversees regularly as head of the forest research network SwissForestLab.

Understanding the importance of landscape

The significance of the forest as an energy supply is firmly established among Swiss citizens. "But nowadays, the potential locations for energy infrastructures being debated extend to every type of landscape", says Felix Kienast, an expert on land-use systems at WSL. Together with his colleagues, Marcel Hunziker and Boris Salak, he recently conducted a Switzer-

land-wide survey. The researchers showed survey participants typical Swiss landscapes that had been virtually equipped with various energy infrastructures.

“There is a high social acceptance for installations in areas that already house man-made structures like roads, settlements or tourist infrastructures such as ski lifts. But wind turbines or photovoltaic plants in untouched landscapes are a no-go for many people”, says Kienast. The significance of a landscape plays a role in such decisions. It’s no use trying to convince people with technocratic arguments alone, such as the number of megawatts a new power plant would generate. It is much more effective to balance the importance of the energy infrastructure with the significance of the landscape. He observed, for example, how the initial scepticism of farmers in Jura towards the wind turbines on their land dissipated when they began to see themselves as climate pioneers.

Amphibian ponds for biodiversity

Rolf Holderegger, member of the Directorate and head of the Biodiversity and Conservation Biology research unit at WSL, explains that over 90% of Switzerland’s moorlands have disappeared in the last hundred years. “Moorlands are particularly species-rich areas”, explains Holderegger. As such, watercourse redirections and land drainage have been accompanied by a loss of biodiversity. The drainage process itself also has an impact on the climate. “The peat on drained agricultural areas decomposes and releases large quantities of the greenhouse gas carbon dioxide”, states Holderegger. He adds a different perspective when

describing the current development of biodiversity. There is continuing species decline, especially when it comes to rare species, but there are also positive signs. Hundreds of new ponds and pools have been created in the canton of Aargau. As a result, amphibian populations have increased. “A study has shown that such measures are actually useful and yield successful results when implemented.”

Solutions inspired by nature

Peter Bach, who researches blue-green infrastructures at Eawag, offers a similarly pragmatic insight. The way cities are built today is ill-equipped for climate change because their large asphalt and concrete surfaces seal the soil and trap heat, Bach explains. With skilful planning – such as the enhancement of urban parks and networking of green spaces – we can ensure that more water can evaporate and drain away. “The sponge city concept would restore the natural water cycle”, says Bach. With his interdisciplinary team, he is involved in several projects in different cities around Switzerland. He is generally met with a high level of interest and great acceptance because his nature-inspired solutions are multifunctional and combine several advantages at once. “Green spaces with trees in cities not only protect against flooding, but also reduce the ambient temperature. What’s more, they increase the biodiversity in settlement areas – and the quality of life of the residents”, says Bach.

“We need a centralised leadership support system so that a network of experts can be called upon at any time if necessary.”

– Professor Andreas Wenger, Director of the Center for Security Studies (CSS)

ETH ZURICH
**PASSIONATE
FOR IDEAS**



Climeworks, which is active in environmental technology, and GetYourGuide, which is involved in tourism, are two of four spin-offs from ETH Zurich that have reached a market valuation of one billion dollars. Both are prime examples of how start-ups can be led to success. For GetYourGuide founder Johannes Reck, the success of his company is based on factors such as the principles he internalised from his time at ETH Zurich.

“ETH Zurich has taught us to intellectually push through incredibly difficult challenges. This skill still serves us well today.”

› Johannes Reck,
founder of
GetYourGuide

What do the companies Uber, Airbnb and Snapchat have in common? They were all at the top of the world's biggest unicorns listed each year by the US business magazine Fortune – companies with a market valuation of over one billion dollars. What do companies like GetYourGuide, Autoform, Scandit or Climeworks have in common? They are unicorns founded in Switzerland, all of them spin-offs from ETH Zurich. Climeworks reached this status in 2022, when the company was able to raise CHF 600 million in a financing round. The technology to filter carbon dioxide from the air, the first prototype, the first business idea to sell the captured CO₂ to Valser Mineralquellen for the production of carbonic acid – all this was developed during the time at ETH Zurich. The business model and vision have now expanded. Now, CO₂ is being compressed from the air on a grand scale and locked away in the ground, fossilised, for millennia. The permanent removal of CO₂ from the air should “become a mass product so that the climate goals can be achieved,” says Climeworks co-founder Christoph Gebald.

What does it take for a start-up company to become a unicorn? Johannes Reck, once a biochemistry student at ETH Zurich, knows the answer: He achieved this status in 2019 with his online tourism platform GetYourGuide – the first ETH Zurich spin-off to do so. As he puts it: “There are three things that are crucial. First, it's important for young entrepreneurs to understand the market they want to enter. Second, the founding team must be a perfect match in terms of skills. And third, you need a network and capital. You can't move ahead without that.” A fourth, possibly even critical quality, which Reck does not explicitly name, but which he exudes from every pore: passion for what you do.

There are three things that are crucial for success: understand the market, have a founding team with complementary skills and a good network with investors who understand the business model.

At GetYourGuide, everything seemed to fit together. The market was ripe for digital disruption and was thus also globally accessible. When the start-up was founded in 2008, the iPhone had only been on the market for a few months. That put the internet into everyone's pocket. The optimal environment for a digital booking platform for tours and recreational activities: Customers can check out tourist experiences on their own and then book them online, regardless of location. As for the founding team, it was recruited around Reck from ETH Zurich, with some of the best information technologists among them. In other words, the founders knew each other and understood how their skills complement each other. However, they quickly realised that their original business idea did not meet the “pain point” in the market that would have been necessary for tremendous and spectacular growth. They originally wanted to arrange student city tours under the company name GetYourGuide. They modified the business model to globally scalable digital sales of experiential tourism but kept the company name. This had already taken root, particularly among the younger generation. In terms of network and capital, investors of the first hour were those who had already successfully founded digital start-ups themselves and were thus also “hands-on with advice and support,” says Reck. Some of them also came from the networks around ETH Zurich. For Reck, the university has always been the key to the level of success that GetYourGuide has achieved so far. There are now 75,000 listings in around 6,000 destinations worldwide on a platform that has already been used by 80 million customers since it was founded.

When they first started out, it was students who learned one thing in particular at their university, in addition to specific technical knowledge, and that was “to intellectually push through incredibly difficult challenges”, explains Reck. That's how a biochemist and colleagues from his days as a student ended up making GetYourGuide what it is today: a company driven by a thirst for knowledge and technology that has digitally transformed essential processes of the tourism value chain but has only begun to tap into the market opportunities worldwide. So the journey continues. To this end, the company at its location in Zurich already has around 60 software developers on board – most of them from ETH Zurich and EPFL – out of a total of more than 700 employees worldwide.

Innovations and new solutions for accessibility at ETH Zurich

ETH Zurich is aiming to remove barriers at several levels and across 14 sub-projects. Its IT specialists are currently testing an app that guides users through the university buildings without obstacles. This indoor navigation program uses information from Bluetooth transmitters. 6,500 of these are already installed in the ETH Zurich buildings. Another 3,000 will be fitted for the app. The university also began equipping its classrooms with height-adjustable tables this year for accessible learning. This provides extra room for wheelchair users, for example. Another project is focusing on the learning material. The presentation, colouring and fonts make the material easier to read for people with reduced vision. Tips are conveyed through comics. An analysis is also ongoing into how to incorporate accessibility into emergency planning. This will then be laid out in guidelines. These could set an example for other institutions after the project.

Position paper: Switzerland free of fossil fuels by 2050

Switzerland is aiming to free itself of oil and gas by 2050. It has also set itself the goal of reaching net zero greenhouse gas emissions by this time. The Energy Science Center (ESC) at ETH Zurich has laid out the requirements for this in a position paper. Today, Switzerland imports around half of its energy, which represents a risk to energy security. According to the ESC, the best way for Switzerland to reduce its greenhouse gas emissions is by electrifying transport, heating and industry using green hydrogen and synthetic gas. Natural gas should only be used when CO₂ can be captured and stored. A survey carried out by the ESC showed that both the population and political parties support the necessary measures. ETH Zurich itself aims to reduce its net greenhouse gas emissions to zero by 2030 (incl. compensation).



Watch the world first on YouTube.

This experimental facility at ETH Zurich is turning air and sunlight into fuel.

> Alessandro Della Bella/ETH Zurich



Surgeons connect the liver to the perfusion machine.

> UZH

A world first in liver transplants

It was a medical breakthrough: a liver that was not suitable for transplantation was prepared on a special machine for several days and then transplanted. One year later, the patient is still doing well. This medical sensation was the achievement of the Zurich research team Liver4Life. Researchers from ETH Zurich, the University of Zurich and University Hospital Zurich designed a perfusion machine that imitates the functions of the human body. The liver was placed in this machine for three days to regenerate. Normally, an organ can only be stored for around twelve hours. Operations like this could become more frequent if the follow-up studies are successful.



Awards: honours for Ursula Keller and Momoyo Kaijima

The Swiss Science Prize Marcel Benoist is regarded among researchers as Switzerland's equivalent of the Nobel Prize. In 2022, the prize was awarded to the ETH Zurich physics professor Ursula Keller for her groundbreaking work in short-time laser physics. Keller used both theoretical models and experiments to repeatedly push the limits of ultra-fast laser physics. An example of this is the SESAM technology that she invented, which is now used for a variety of purposes in industry. Momoyo Kaijima is another ETH Zurich professor to have received a renowned award. Together with her partner Yoshiharu Tsukamoto, the Professor for Architectural Behaviorology was honoured with the Wolf Prize for her ethnographically inspired approach to architecture. The jury praised the work of her firm Atelier Bow-Wow for its sensitivity to local contexts and the social effects of architecture.

Take-off for electric plane built by students

20 students from ETH Zurich will never forget the moment when the electric aeroplane they developed, the e-Sling, took off for the first time. The project is the result of two years of development work and a lot of dedication. The plane was built in a hangar at the Innovation Park in Dübendorf. It is powered entirely by batteries and has a range of around 180 kilometres. With this project, the team aims to highlight alternatives to fossil fuels in aerospace. The young engineers now plan to develop a hydrogen drive for the small aircraft to increase its range.



Successful collaboration with universities in Ghana

January 2022 saw the beginning of the Master's degree programme in mechatronics in Ghana. This was the result of a joint development between ETH Zurich, Ghana's Ashesi University and partners from industry. ETH Zurich tutors teach students from several African countries in person together with their local colleagues. The aim is to train highly qualified and responsible engineers for the African continent. Students from Ghana also took part in the Global Development Summer School run by ETH Zurich and the KNUST University in Ghana. Together with their Swiss counterparts, they developed creative solutions for specific problems in waste processing.



Watch e-sling take off on YouTube.



Ashesi University trains highly qualified engineers.
› Nicolas Mertens

With the e-Sling, the students demonstrate that more sustainable flight is possible.
› Daniel Winkler/ETH Zurich

EPFL

"THE MAGIC OF 8 AND 24"



Professor of number theory Maryna Viazovska has solved a mathematical problem that has stumped researchers for centuries. Using a creative approach and the knowledge gained in her dissertation work, she demonstrates how spheres can be optimally and symmetrically packed into multidimensional space in a manner that fills all available space. This achievement brought her recognition with the Fields Medal, which is something like a “Nobel Prize for Mathematics”.

“It was about the problem of optimally filling abstract space with spheres up to the upper limit.”

› Maryna Viazovska, professor at EPFL



Click here for the explanation video on YouTube.

It usually starts with her black notebook, where Maryna Viazovska records the results of her thoughts, a list of complex formulas. Maryna Viazovska is a mathematician and professor at the EPFL Chair of Number Theory. Her passion is the science of arithmetic, numbers and geometric figures. She successfully participated in school mathematics competitions in her Ukrainian homeland at the age of 12. Some 25 years later in 2022, the 37-year-old received the prestigious Fields Medal, known officially as the “International Medal for Outstanding Discoveries in Mathematics”. This award, which gets its name from its Canadian benefactor, John Charles Fields (1864–1932), has been presented every four years since 1936 and is considered the “Nobel Prize of Mathematics”. Among the 60 researchers to receive the award, Viazovska was the second woman to be honoured. For the “proof that the E8 lattice provides the densest packing of identical spheres in eight dimensions and other contributions to related extremal problems”, according to the statement of the International Mathematical Union, which confers the prize.

The work sounds complicated, and it is. The fundamental question is how many identical, non-overlapping spheres can be packed into a given volume. Researchers have concerned themselves with this problem for some time. For example, German mathematician Johannes Kepler postulated in 1611 that the best way to solve this problem in three-dimensional space was by arranging the spheres into a pyramid. However, this conjecture was unproven, and it took until 1998 for a proof to be found. This question was then settled, at least in three-dimensional space. However, in mathematics, countless dimensions exist in which the same question can be posed. “What we are talking about here is pure

abstraction; while a three-dimensional space has three coordinates, a point in eight-dimensional space has eight coordinates,” Viazovska says. This is the area in which she initially conducted her research. “The question was how to optimally fill the abstract space with spheres up to the upper limit,” the researcher explains. Dimension 8 was a good choice because preliminary work had already been done in this area. For example, Massachusetts Institute of Technology (MIT) mathematician Henry Cohn and Harvard scientist Noam Elkies demonstrated more than 10 years ago that it is possible to pack the spheres almost perfectly in this dimension – perfectly within a billionth of a percent. Viazovska developed this work further by combining various fields of mathematics and also by using “modular forms” – the primary topic of her dissertation. After two years of intensive work, she developed the definitive function and provided 23 pages of proof for the perfect packing of the spheres in eight-dimensional space in March 2016. The mathematical experts were impressed, and MIT researcher Cohn congratulated and motivated her to extend her method to dimension 24, into the “Leech lattice”, which is used to construct sphere packings that are particularly efficient in 24-dimensional space. It was a week later when Viazovska, together with Cohn and two other scientists, posted a theorem on the open-source platform arXiv.org proving the perfection of the Leech lattice packing in dimension 24, thus also confirming the importance of the idea that Viazovska originally developed for dimension 8.

EPFL took notice of the gifted young researcher and invited her to serve as an associate professor on Lake Geneva. She later published her research results in the *Annals of Mathematics*, a leading mathematics journal, and has been a full professor of number theory at EPFL since 2018. It's no coincidence that she chose the university. In addition to the EPFL's reputation, the fact that the institution helped in the establishment of a dual career was crucial. With this assistance, it was also possible for her husband, who is likewise a natural scientist, to find employment there so the family of four would be able to live and do research in one location.

“I am doing basic research,” Viazovska says, “but certainly with the goal and hope in mind that these interpolation formulas can be applied in order to solve problems in areas such as differential equations or signal processing.” After all, mathematics is everywhere in everyday life, usually without people noticing. “Without mathematics, there is no Skype,” she says, “and also no optimised timetable for the Swiss train system.” However, what counts for Viazovska is “the magic of 8 and 24”. This was also the title of her acceptance speech given at the Fields Medal ceremony.

EPFL offered assistance with the establishment of a dual career: her husband, also a natural scientist, was also able to find employment at EPFL.

At the Dubochet Center for Imaging, atoms are made visible



See a YouTube video about a SARS-CoV-2 spike protein at 2Å resolution.

The Dubochet Center for Imaging (DCI) was introduced to the press on 22 November 2022. It houses the world's most advanced cryo-electron microscopes (cryo-EM), which promise considerable advances in biomedical research thanks to the precision of the images that these microscopes can obtain. The DCI has more than enough to put the Lake Geneva region on the world map of advanced imaging facilities. "We have the best model of an electron microscope for life sciences that money can buy. And we have two of them", says Henning Stahlberg, director of

the DCI. In addition, there are smaller cryo-EM instruments to optimise samples, and a prototype cryo-EM instrument will be constructed that will be dedicated to the development of new technologies to further improve image quality. The most powerful microscopes are temporarily based between the UNIL and EPFL campuses, in the Cubotron building. Two other machines are installed in Geneva.

EPFL and DeepMind use AI to control plasmas for nuclear fusion



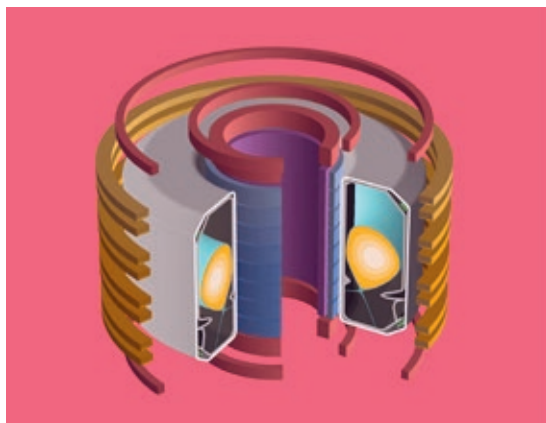
Virtual tour of the TCV tokamak.

Researchers at EPFL's Swiss Plasma Center (SPC) and DeepMind have jointly developed a new method for controlling plasma configurations for use in nuclear fusion research. EPFL's SPC has decades of experience in plasma physics and plasma control methods. DeepMind is a scientific discovery company acquired by Google in 2014 that's committed to "solving intelligence to advance science and benefit humanity". Together, they have developed a new magnetic control method for plasmas based on deep reinforcement learning, and applied it to a real-world plasma for the first time in the SPC's tokamak research facility, TCV. Their study was published in Nature in February 2022.



See the YouTube video about robotic wheelchairs.

3D model of the TCV vacuum vessel containing the plasma, surrounded by various magnetic coils to keep the plasma in place and to affect its shape.
 > DeepMind & SPC / EPFL



Diego Paez, post-doctoral researcher at LASA, tests the Qolo robotic wheelchair in the heart of Lucerne.
 > Alain Herzog / EPFL

Control for robotic wheelchairs to mitigate risk of collision in crowds

Robotic wheelchairs may soon be able to move through crowds smoothly and safely. As part of CrowdBot, an EU-funded project, EPFL researchers are exploring the technical, ethical and safety issues related to this kind of technology. The aim of the project is to eventually help the disabled get around more easily. Shoppers at Lucerne's weekly outdoor market may have come across one of EPFL's inventions in the past few weeks – a newfangled device that's part wheelchair, part robot. It's being used by researchers at EPFL's Learning Algorithms and Systems Laboratory (LASA). These robots could be humanoids, service robots or assistive robots. "You hear a lot about self-driving cars, but not about robots that could be moving around among pedestrians," says Aude Billard, the head of LASA. "However, robotics technology is clearly going in that direction, so we have to start thinking now about all that will imply."



Non-toxic, variable-stiffness threads for dexterous cardiac catheters

Engineers at EPFL and ETH Zurich developed a variable-stiffness catheter made of non-toxic threads that can transition between soft and rigid states during surgery. It could make minimally invasive surgical interventions, including the treatment of cardiac arrhythmia, simpler and more effective. To treat cardiac arrhythmia – an irregular heartbeat – surgeons can use a specific kind of catheter, for example, to access the heart, rather than opening the patient's chest. The catheter is inserted into an artery and navigated to the treatment zone.

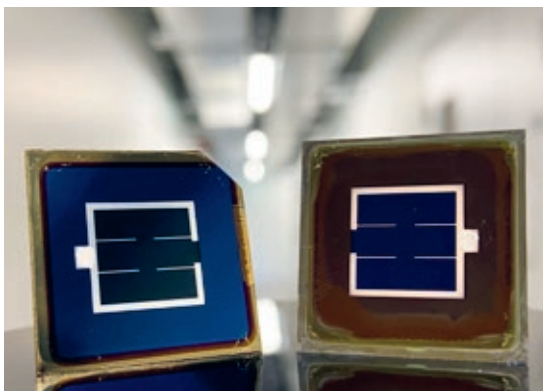


The flexibility and stiffness of the catheter can be adjusted during an operation. Yegor Piskarev, a doctoral student at EPFL's Laboratory of Intelligent Systems (LIS).

> Alain Herzog/EPFL

New world records: perovskite-on-silicon-tandem solar cells

EPFL and CSEM smash through the 30% efficiency barrier for perovskite-on-silicon-tandem solar cells – setting two certified world records. For the first time, an efficiency of 30% for perovskite-on-silicon-tandem solar cells has been exceeded thanks to a joint effort led by researchers at EPFL's School of Engineering Photovoltaics and Thin Film Electronics Laboratory (PV-lab) in partnership with the renowned innovation centre, CSEM. Independently certified by the National Renewable Energy Laboratory (NREL) in the United States, these results are a boost to high-efficiency photovoltaics (PV) and pave the way toward even more competitive solar electricity generation.



Seven distinguished women scientists get their place on the EPFL map

To mark International Women's Day on 8 March 2022, EPFL officially named squares and streets on its Lausanne campus after pioneering women in scientific and engineering fields. EPFL added the names of seven distinguished women to its campus map at an official ceremony attended by Nuria Gorrite, the president of the Vaud Cantonal Government, and Christian Maeder, the mayor of Ecublens. Martin Vetterli (EPFL President), Gisou van der Goot (Vice President for Responsible Transformation) and Julianne Jammers (Managing Director of the Swiss-Tech Convention Center) welcomed important personalities and dignitaries to the event. Among them were relatives and descendants of the seven female pioneers – a list that included four Swiss women.



International Women's Day 2022 at EPFL.

> Alain Herzog/EPFL

Perovskite-on-silicon-tandem solar cells

> C. Wolff/EPFL



PSI

IMAGING AT THE NEXT LEVEL

Their names are Marianne Liebi Adrian Wanner. Two young researchers who make the nano-structure of macroscopic samples, such as bones or brain tissue, visible in three dimensions using high-resolution images. They achieve this using measurement data obtained with X-rays at the Swiss Light Source at PSI, which is then processed and used for imaging.

“Imaging at the next level”: that’s what Marianne Liebi (pictured right) and Adrian Wanner from PSI call their ambition to develop new high-resolution visualisations of macroscopic samples.

Two researchers with a shared interest who want to examine the structure of samples that are several millimetres – or even centimetres – in size in three dimensions with a resolution of a few millionths of a millimetre and, above all, make them visible in imaging. Both have been awarded an ERC Starting Grant from the European Research Council, enabling them to establish and develop their own research area. Marianne Liebi is an assistant professor at EPFL and a group leader at PSI who holds a doctorate in food science from ETH Zurich. Last year, she was awarded the international Innovation Prize by the Friends of Helmholtz-Zentrum Berlin (HZB) association for her research efforts, more specifically for her invention of small-angle scattering tensor tomography (SASTT), with which she has succeeded in solving a problem that concerns both biologists and materials scientists: how can nanostructures in macroscopic samples be characterised in 3D? Since then, Liebi has continued developing her methodology and also conducts research on biological samples such as bones. Wanner is an interdisciplinary natural scientist with a focus on theoretical physics and neuroinformatics. He is currently doing his doctorate in neurobiology and is also a group leader at PSI, where he is researching synchrotron imaging applications to reconstruct the synaptic connectivity of hundreds of thousands of neurons in the brain.

“Imaging at the next level” is what both researchers call their ambition to develop new visualisations of macroscopic structures at the nanoscale and to advance their science through complex imaging techniques. “Developing the methodology was the cornerstone of my scientific career,” says Liebi. It began by studying tiny bone fibres, known as collagen fibrils, the orientation of which varies at different parts in a bone and which are crucial for the mechanical stability of bones. The problem

was that classical computed tomography could only be used to determine bone density, but not the more diagnostically conclusive local orientation and nanostructure. To obtain data for three-dimensional imaging, a piece of bone was transilluminated with an extremely fine and intense X-ray beam at the Swiss Light Source (SLS) at PSI. “This beam scans over the sample, measuring it point by point, meaning the local nanostructure can be determined at each of these measuring points,” says Liebi. This results in an immense amount of data, which is then processed by a mathematical algorithm elaborately developed by Liebi and pieced together in a three-dimensional image that provides information about the density and orientation of the fibrils.

What works with bones works in a similar way with brain tissue, which Wanner is currently researching. “We want to understand how nerve cells in the brain are interconnected and how they process information,” says Wanner, outlining the objective. The “cables” of the nerve cells branch out throughout the brain, connecting to other brain cells via tens of thousands of synapses. These connections and, thus, the communication between nerve cells, are disrupted or damaged by a variety of brain diseases. In order to understand how nerve cells communicate in both a healthy brain and a diseased brain, he first measures the nerve cell activity and then uses the X-ray light at the SLS to examine the neural structures of the brain tissue sample, down to the smallest branches. This results in a huge amount of experimental data, which is then assembled in a wiring diagram of the synaptic connections in the brain using artificial intelligence. The aim is to visualise the synapse and how they interact. The scientist hopes his research will help “to gain new insights into the communication circuits and function of the brain.”

Liebi and Wanner are both basic researchers. For Liebi, the focus is not only on conducting experimental research on samples, but also on the further development of her methodology, which she hopes to make usable for other branches of science. Wanner wants to gain fundamental new insights into the structure and functioning of healthy and diseased brains. Their research forms an important basis for understanding various diseases such as osteoporosis, Alzheimer’s and other neurodegenerative disorders.

Stronger magnets, faster particles, new physics

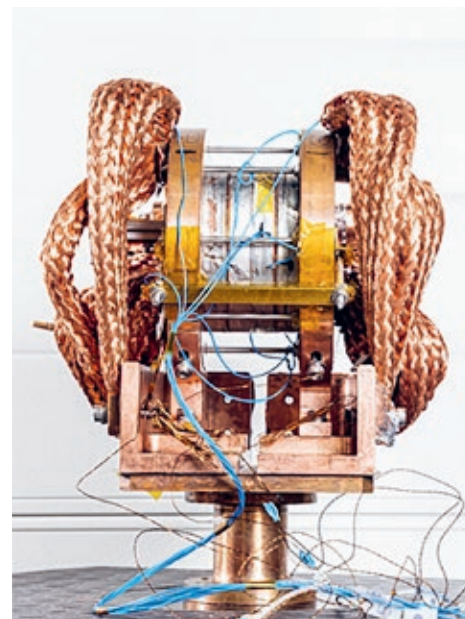
The high-field magnet, which achieves over 18 teslas, uses innovative high-temperature superconducting technology.

> PSI/Markus Fischer



Access the CHART website here.

This high-field magnet, developed at the PSI, can achieve an incredible 18 teslas. It is required to control particles in the Future Circular Collider (FCC), which is planned as the successor to the Large Hadron Collider at CERN. Stronger magnets mean faster particles than ever before, which increases the amount of energy in the collisions and provides deeper insights into the nature of our universe. Researchers achieve this using innovative high-temperature superconductor technology. This has incredible potential for practical applications like synchrotron light sources. These magnets were developed at the PSI as part of the Swiss Accelerator Research and Technology project CHART, a collaboration that aims to support the necessary technological capabilities for the FCC in Switzerland.

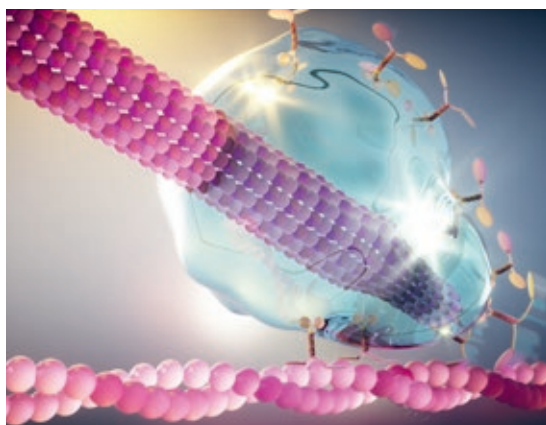


Nature's smart adhesive

Moving structures made of proteins act like a complex machine inside a cell to perform various functions. Until recently, the way that some of these parts were connected to each other was a mystery. Researchers at the PSI and ETH Zurich have discovered that protein molecules can form liquid droplets that act like glue. This smart fluid is made of biomolecules that were optimised over hundreds of millions of years of evolution to deliver the perfect material properties for maintaining smooth biological function. The researchers based their study on the protein structures that comprise the adhesive. Experiments at the Swiss Light Source synchrotron enabled investigations into these structures.

This liquid droplet consists of protein molecules. It acts like glue that holds the microtubules to an actin cable. This process is essential for the cell separation process.

> Graphics: Ella Maru Studios



The study data was collected at 22 measuring stations in 14 countries across Europe.

> Mahir Dzambegovic/PSI

European aerosol pollution map

The PSI led an international team to assess air pollution data that was collected at 22 locations in cities and rural areas across Europe. The research concentrated on pollution caused by aerosols, also known as fine dust pollution. This can be dangerous to health, as the floating particles can penetrate deep into the lungs. The composition of the fine dust varied between locations. Despite this, researchers successfully identified the main cause of aerosol pollution: the heating of residential buildings with solid fuels like wood or coal. Researchers hope that the data will help improve air quality models.



WSL
ARTIFICIAL
INTELLIGENCE FOR
AVALANCHE
WARNING SYSTEMS



Digital tools such as artificial intelligence make it possible for environmental researchers to access larger data pools and generate new scientific findings. WSL uses these tools in a wide variety of ways. For instance, they offer support with making more precise predictions about danger zones in snow and avalanche research.

“A forecast on my mobile phone about the snow slope, which I’m cruising down? That would be a fascinating vision of the future!”

› Jürg Schweizer,
Head of the SLF

Early detection of dry periods: pairing existing models of impact with sub-seasonal weather and hydrological forecasts assists with forecasting extreme droughts on drought.ch, thanks to ML.

“Citizen scientists” collect Swiss plant species: WSL developed a new DL-based method to improve the automatic identification of plant species via mobile phone apps. Image information is now enriched with information on location conditions or precise plant characteristics.

At the WSL Institute for Snow and Avalanche Research SLF, humans and machines now work hand in hand. Both areas of expertise are consolidated in the avalanche bulletin, which the institute produces on a daily basis on behalf of the Federal Government. First, three avalanche forecasters draw up a regular, expert-based forecast of the avalanche risk for the next day, working independently of one another. To do so, they make use of up-to-date information on weather trends and forecasts, data from automatic measurement stations, information from observers in mountain areas and feedback from mountain guides. Region by region, they assign these findings to one of five danger levels. Only once this has been achieved do they integrate in the computer’s automatically generated forecast, which is based on machine learning (ML). The computer has been taught how to draw up these forecasts by SLF researchers, who work in close collaboration with the Swiss Data Science Center (SDSC). Their research was immediately taken up by the team on the operational side of the avalanche warning service.

An SLF forecaster obtained some preliminary experience with the numerical prognosis model over the course of the first winter. The automatically generated forecast of avalanche danger has been available to the entire team at the warning service since winter 2021/2022. The ML method puts together a forecast without any human involvement by drawing on measurement and model data. Data from automatic measurement stations, the numerical snow cover model SNOWPACK and COSMO, MeteoSwiss’ weather forecasting model, is combined to forecast the danger level for dry avalanches over the next 24 hours.

Now, SLF researchers have refined the ML-based computer model and expanded the model palette. Winter 2022/2023 marked the first time that automatic forecasts could also be generated for wet snow avalanches and the stability of the snow cover. “Thanks to the collaboration with the SDSC, the model chain was semi-operational just 18 months after we started

and we were able to test out the automated forecasts. The results were promising,” emphasises Jürg Schweizer, who heads up the project. The model’s predictions are then integrated into the forecasts drawn up by humans. “We hope that the digital, automatically generated forecasts will improve the consistency of our warnings. They offer a valuable, independent second opinion,” states Schweizer, Head of the SLF.

The greater the danger of an avalanche, the larger the size of the avalanches that are to be expected. In addition, they indicate a critical situation. That said, it is scarcely possible to access real-time information about avalanches that are currently occurring. Detection systems based on seismology or infrasound bridge this gap, with ML used to filter out the avalanche signals. At present, initial tests are also underway at SLF to explore the use of satellite images or drone photos to obtain information on the spatial distribution or size of avalanches. These remote sensing methods have the major benefit of being able to paint a comprehensive picture of avalanche activity, ideally for the entire Swiss Alps. The remote sensor data is recorded in the avalanche warning and also serves to validate and improve models, such as dynamic avalanche models for the allocation of danger zones. “For very large avalanches, we take drone photos to capture the contours of the avalanches that have descended and to calculate the avalanche volume and mass balance.”

Artificial intelligence (AI) is also used in other areas of research at WSL. WSL is developing a system that automatically records the presence of narrow-leaved ragwort and tree of heaven along motorways, in collaboration with ETH Zurich and financed by the Federal Office for the Environment and the Federal Roads Office. Both species are on the blacklist of invasive neophytes in Switzerland. A proprietary, precision method based on deep learning (DL) was used to produce the maps, which involved filming being undertaken from inside a moving car. This approach produced reproducible, spatially high-resolution distribution maps which are also being created for other species.

Modern digital tools in environmental research make it possible to obtain a greater breadth and depth of data, thanks to automation, and subject this to a more targeted scientific evaluation. The fact that WSL uses these tools not only underpins its reputation as a leader in modern environmental research, but also highlights the interdisciplinary complexity of issues relating to climate change.

How snow affects Arctic and alpine ecosystems

Snow can stay on the ground for the majority of the year in cold environments, with powerful effects. Factors like climate change can cause snow conditions to change, with consequences for ecosystems in the Alps and Arctic. However, the effect of these changes can sometimes be surprising. Less snow in winter can make the soil colder, as it no longer has an insulating layer. In addition, many alpine plants benefit from longer-lasting snow as it protects them against frost and provides more moisture in the spring. A study led by Christian Rixen, a researcher at the WSL Institute for Snow and Avalanche Research SLF, has compiled the first comprehensive overview of the role that the snow cover plays for vegetation, the interdependencies between plants and animals, the permafrost, microbial processes and the biogeochemical cycle.

SLF opens new and sustainable office and workshop building

The WSL Institute for Snow and Avalanche Research SLF in Davos has seen strong growth in both staff and focus areas. Researchers are also experiencing great success beyond their project work. Together with the Graubünden cantonal government and with support from ETH Zurich, they are constructing the integrated Climate Change, Extremes and Natural Hazards in Alpine Regions Research Centre (CERC). The new office and workshop building has over fifty workstations. It will replace an ageing and inefficient workshop. The building was designed by Schwarz Architekten AG and is the first building in the ETH Domain to reach the highest level – Platinum – of the Swiss Sustainable Construction Standard.



Cutting-edge research for the forests of tomorrow

Rising temperatures and drier soils are having various effects on forest ecosystems, but we still know relatively little about the consequences of this increasingly frequent combination. Scientists from the WSL have proven for the first time that the atmospheric dryness caused by strong heat is accelerating tree loss. This is even the case when there is no edaphic dryness, i.e. dryness resulting from the soil itself. A greater diversity of tree species in the forests would reduce the exposure to dryness, however, and lead to greater resistance to such extreme conditions.



Here you'll find the YouTube video about drought, heat and forests.

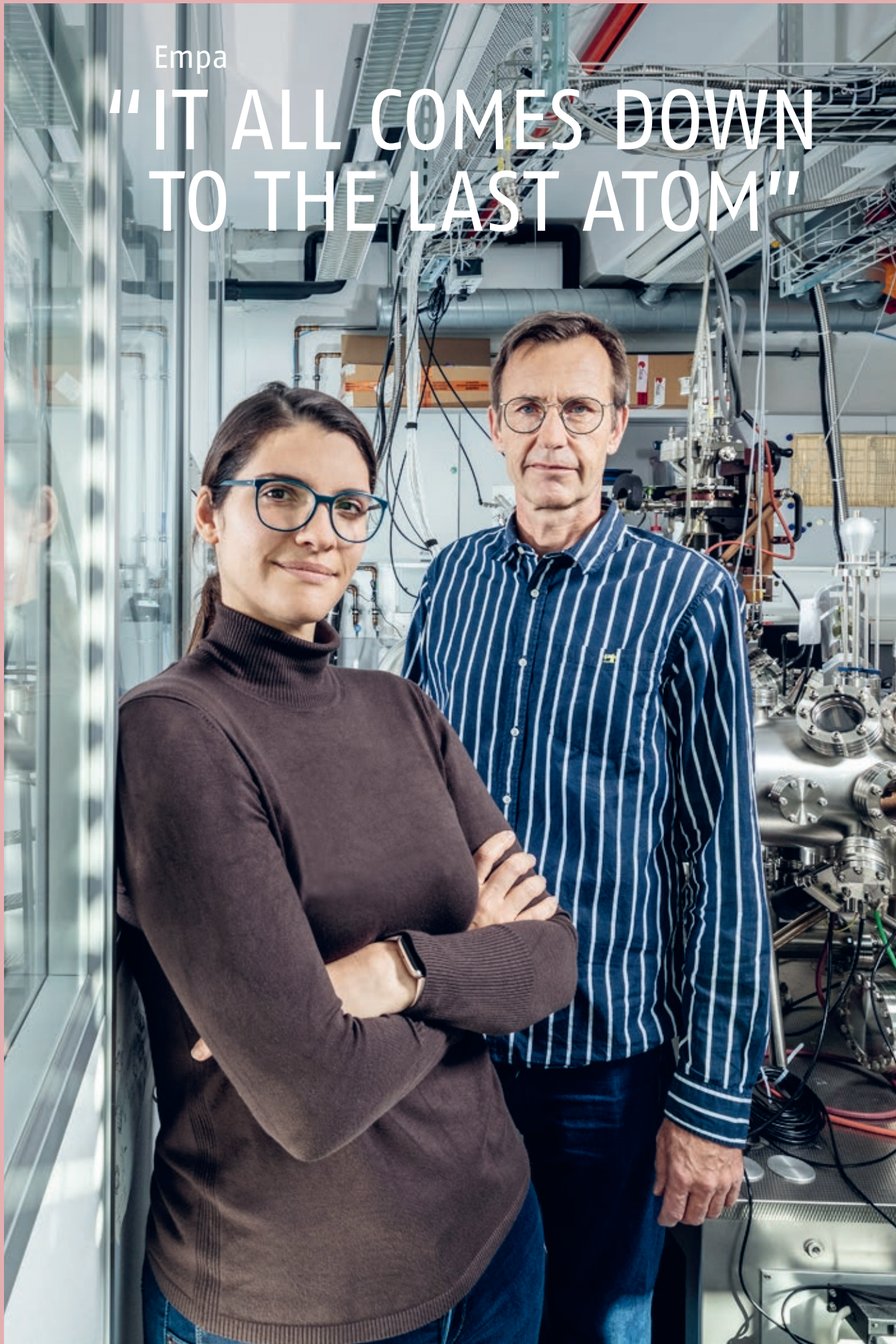


Measuring the photosynthesis of a beech tree in a mesocosm at the WSL.
 > WSL

The sustainability of the new WSL building in Davos has been certified.
 > Yves Bühler

Empa

“IT ALL COMES DOWN
TO THE LAST ATOM”



Empa researchers have developed novel materials made of carbon that exploit quantum effects to exhibit previously unattainable electronic and magnetic properties. The Werner Siemens Foundation is providing the CarboQuant project with a grant of CHF 15 million. Graphene, nanotechnology and quantum science are now widely used at Empa.

The geometry of the graphene can be used to adjust its electrical and magnetic properties. The shape, rather than chemistry, determines the properties – a completely new approach.

> Scientist Gabriela Borin Barin (pictured left) part of the team led by Roman Fasel, head of Empa's nanotech@surfaces Laboratory

This is one of those wonderful stories from the world of research that bridges the gap between the materials sciences of the past and the quantum sciences of the future. It began in 2003 when researcher Pierangelo Gröning, now head of Empa's Department of Advanced Materials and Surfaces, came to the institute to set up the nanotechnology department. He was joined by Roman Fasel, now head of the nanotech@surfaces Laboratory: they have known each other since their days at the University of Fröbourg, where the physicists researched carbon tubes, the prototype material of nanotechnology. In 2009, they realised that carbon nanotubes are only suitable to a limited extent for specific electronic applications because the synthesis process cannot be controlled in any meaningful way. Fasel, who had studied molecular structures on surfaces in his dissertation, came up with the idea of trying a controlled production of nanoribbons using molecular building blocks instead of nanotubes – think of it like a set of Lego building blocks made of molecules.

That is when graphene came into play: a modification of carbon with a two-dimensional structure and honeycomb-like pattern. A high-stability material with one disadvantage. "It is not a semiconductor, but a semimetal not useful for many electronic applications," says Fasel, "unless we succeed in restricting the movement of the electrons in such a way that the semimetal becomes a semiconductor. We did this by synthesising graphene nanoribbons and putting what is known as a band gap into the graphene." The bands, which are only a few atoms wide, were examined under the scanning tunnelling microscope. It turned out that quantum effects occurred with the reduced dimensionality of the material, and the graphene nanoribbons no longer exhibited continuous, but quantised energy states. "By adjusting the width of the band," Fasel explains, "the band gap, the most important property of the semiconductor, can actually be regulated." From their beginnings with nanotubes, researchers have now found

a way to gain complete control over the structure and physical properties of nanoribbons. They can assemble specially designed molecules into any desired band by means of molecular self-organisation and also visualise this down to the atomic structure. "It all comes down to the last atom," says Gröning. "If one is missing or in the wrong place, the whole thing no longer works." In 2010, they were able to produce the graphene nanoribbons with atomic precision for the first time.

Over the past two years, they have published reports in the journals *Nature Nanotechnology*, *Nature Chemistry* and *Nature* on magnetism in tailored carbon nanomaterials and, in particular, on a physical effect that researchers call spin fractionation. This is formed when many integer spins can be placed in a common, coherent quantum superposition, which is what the Empa scientists managed to do in precisely synthesised molecular chains. These efforts resulted in Empa's CarboQuant project, which is now being funded by the Werner Siemens Foundation in the amount of CHF 15 million over the next 10 years. What swayed the Foundation's decision was that "the geometry of the graphene can be used to adjust its electrical and magnetic properties. The shape, rather than chemistry, determines the properties – a completely new approach." The CarboQuant project now aims to lay the foundations for innovative, energy-efficient and robust quantum technologies that can also function at room temperature – with today's materials, this requires temperatures close to absolute zero degrees Celsius.

Several Empa departments are now working on graphene, nanotechnology and quantum science. Mickael Perrin, Assistant Professor at ETH Zurich, is conducting research with an ERC Starting Grant on quantum current transformers – tiny power plants made of graphene ribbons that generate electricity from waste heat through thermoelectric conversion and by exploiting quantum effects. Another Empa research group led by ETH Zurich Professor Maksym Kovalenko is investigating the synthesis and application of nanocrystals measuring just 3 to 10 nanometres. The group has mastered the synthesis of these crystals to such an extent that they can be produced in an almost monodisperse form. This opens up completely new possibilities in the development of materials: nanocrystals in superlattices with novel properties, potentially suitable for use as an energy-efficient and ultra-fast light source.

New possibilities in the development of materials: nanocrystals forming new megacrystals or superlattices through self-organisation and thus achieving novel properties such as superfluorescence.

Versatile drones for all kinds of tasks



Here you'll find the YouTube video about dual drones.



› Computer graphics: Empa

In March 2022, Mirko Kovac received a 2 million euros ERC Consolidator Grant from the EU. Kovac is a researcher at Empa and Imperial College London. He develops metamorphic drones made of flexible materials for use in complex ecosystems like the Arctic. Together with his team, he collects data there for investigating climate change or ocean pollution, for example. Another of Kovac's drones, MEDUSA, can land on water. It uses a mobile underwater capsule with a camera and sensors to monitor the water quality in lakes. In September 2022, the cover of the science journal *Nature* featured another of his innovations. It involves aerial drones working together like bees to print 3D materials in the air for constructing and repairing structures.

New methods for diagnosing neurodegenerative conditions

Empa researchers are developing ways to detect various brain diseases early. These include a textile sensor belt that records ECG, body temperature, movement patterns and more. This is because dementia causes changes in the brain that influence these parameters before leading to noticeable memory loss. Studies have been carried out at the Cantonal Hospital of St. Gallen which showed that the sensor belt can indicate changes in cognitive ability long before dementia sets in. Another Empa team found that copper ions accelerate the clotting of the body's own proteins. This is a key process in the development of Parkinson's disease. A ring-shaped device could provide early diagnosis here. Empa researchers also collaborated with the Geneva University Hospitals and the Klinik Hirslanden. They developed a diagnosis procedure that uses 3D micro-computer technology which helps to quickly find the right treatment after a stroke.

Fighting food waste with digital tools and new materials

Around 30% of all food ends up in the bin rather than on our plates. Empa researchers are aiming to reduce waste in the production and supply chains of fruit and vegetables. To do so, they are teaming up with the Basel Agency for Sustainable Energy (BASE) and using an app and digital twin technology. The virtual fruits can help small producers and suppliers improve storage and transport conditions to prevent deteriorations in quality. The mobile app gives small farmers in countries like India and Nigeria access to cooling systems and lets them monitor their products' shelf life. Empa researchers are also working together with Lidl Switzerland to develop a protective cellulose coating for fruit and vegetables. The layer is made of by-products from vegetable production like peel or pulp. This keeps the coated food fresh for much longer: around a week for bananas, for example. The coating poses no risk to health, washes off easily and reduces plastic waste.

EAWAG
**THE NEW
GOLD STANDARD?**



In urban water management, the system used for treating wastewater has always been straightforward: wastewater is conveyed through the sewage system to centralised treatment plants, where it is treated. An interdisciplinary research project at Eawag led by Professors Bernhard Truffer and Max Maurer is now challenging this principle, advocating instead a hybrid system with decentralised treatment plants – for use worldwide, but also with potential for Switzerland.

Anyone with ambitions to challenge the “gold standard”, which has proved itself over decades, needs persuasive arguments. In urban water management, this gold standard involves wastewater from households and businesses being collected through the sewage system – since the 1960s usually in centralised treatment plants – where it is treated and released back into the environment. The advent of the sewage system made it possible for human beings to live together in urban agglomerations while maintaining sanitary living conditions in the long term. So, why change a system like that?

Professor Bernhard Truffer, group leader in the environmental social sciences research department at Eawag, is con-



Watch the YouTube video on the potential benefits of resource-oriented urban water management

“In the long term, the proportion of decentralised wastewater treatment can be increased from the current 2.5% to 50%.”

> Bernhard Truffer (pictured left) and Max Maurer from Eawag

ducting research in innovation and industry dynamics in sustainable technologies. He has a convincing argument for change: on average, people produce one litre of urine each day – urine that contains large quantities of nitrogen and phosphorus. This litre of urine is then diluted with 150 litres of other household wastewater and conveyed via the sewage system for countless kilometres to a central treatment plant, where it is treated. “Basically, this is a very inefficient system,” he says. “Sewage networks are extensive and use a lot of water.” Instead, Professor Truffer proposes that in some cases a decentralised water treatment system could be used, and he advocates introducing a modular water infrastructure in Switzerland. “Decentralised systems use fewer pipes and less water if the reprocessing is carried out in a water circuit.”

It sounds obvious, and professor Max Maurer, group leader in the urban water management research department at Eawag, is convinced it will work. “Particularly since in the foreseeable future, new smart technologies will make it possible to develop fully functional and cost-effective modular water treatment systems.” The problem lies mainly in the lack of imagination shown by the water treatment experts, who are content to rest on their laurels with the centralised system. It is they who are currently making the water infrastructure investment decisions that will endure for the lifetime of future treatment systems, which can be as long as 80 years. This will, in theory at least, lead to a risk of misallocating

financial resources if they do not react in time to the technological innovations that suggest that modular, decentralised wastewater systems are the way to go.

To encourage the knowledge transfer required to put into practice the future possibilities of modular wastewater systems, as part of the Swiss National Research Programme NRP 73, Truffer and Maurer are heading up the Comix project – Challenges and Opportunities of Modular Water Infrastructures for Greening the Swiss Economy. This is an interdisciplinary project involving institutions of the ETH Domain, which for years have held claim to globally recognised expertise in all water management issues. As a result, the Comix project also incorporates scientists from ETH Zurich, the Swiss consultancy firm Ecoplan and urban water management decision-makers in Switzerland at all levels of national and local government, along with industry organisations. The issue is a significant one: can and should the current almost exclusively centralised water infrastructures be switched to a modular hybrid system in the future? This question was discussed in workshops involving all the participants. “Initially, people mainly came up with obstacles,” says Truffer, “largely preventing the introduction of decentralised wastewater systems in Switzerland or giving the impression that they were a realistic option only in outlying areas.” However, the more the end-to-end view gained ground, the stronger the impetus behind a change of heart began to build. Decentralised systems can be a good option even in urban areas, provided that innovative architecture is used to enable integrated approaches that combine the water and energy infrastructures – to provide city-centre cooling systems, for example, or if water management can be geared toward an autonomous circular economy when constructing new buildings on brownfield sites. “If we do that,” say Truffer and Maurer, “in the long term, the proportion of decentralised wastewater treatment can be increased from the current 2.5% to 50%.” They believe that Switzerland’s future will involve a hybrid wastewater system of this kind and that at least some of the current new investment should already be heading that way.

The indirect effects of climate change on bodies of water



From melting glaciers to summer droughts, climate change is directly affecting natural water systems throughout Switzerland. Eawag researchers have now shown that we must also pay attention to the indirect effects of climate change. These include the consequences of the measures we take to adjust to a warming world. The excessive expansion of hydropower, for example, can cause rivers and streams to dry out in some places. This therefore reinforces the direct effects of climate change. By improving the way we use reservoirs, we could use the water stored there to not only produce electricity, but also get through droughts.

If there is less water flowing downstream from power stations, the river becomes warmer. This increases the risk of the riverbed drying up in certain areas.

› Herzi Pinki/Wikimedia (CC BY-SA 3.0)

Using lakes and rivers to store heat and cold

Heat is added to or extracted from surface waters for cooling and heating purposes respectively. There are already large plants operating or subject to planned expansions at Lakes Geneva, Lucerne, Biel, Zurich and Constance. Eawag published a fact sheet for planners and operators of utilisation plants, specialist federal and cantonal government departments and the responsible authorities. It described the ecological effects on the utilised lakes and rivers, and summarised the main points requiring attention.



Nitrous oxide emissions from wastewater treatment

Switzerland has over 800 urban wastewater treatment plants. Eawag researchers have discovered that these damage the climate more than previously thought. They also generate around 20% of the country's nitrous oxide emissions. The main reason for this is the biological treatment process. Suitable optimisations could reduce a plant's greenhouse gas emissions by up to 75%. These include increasing nitrogen elimination and preventing the accumulation of nitrate. The measures would not negatively affect the quality of the treated water.



Link to fact sheet on the use of thermal energy from lakes and rivers.



Eawag researcher Wenzel Gruber performing maintenance on the measurement system at a wastewater treatment plant.

› Andrin Moosmann/Eawag

Lakes store large quantities of heat.

› Eawag

GOVERNANCE

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Legal basis and structure of the ETH Domain

The Federal Government operates the Federal Institutes of Technology in accordance with the Federal Constitution (Art. 63a para. 1). The Federal Act of 4 October 1991 on the Federal Institutes of Technology (ETH Act) defines this mission as this law governs the ETH Domain. Together with Art. 64 para. 3 of the Federal Constitution, it also forms the legal foundation for operating the four research institutes of the ETH Domain and for the ETH Board as the strategic governing and supervisory body of the ETH Domain.

The ETH Act defines the status, structure and mission of the ETH Domain. The ETH Domain is autonomous within the framework of the law. The ETH Act also defines the autonomy of the two Federal Institutes of Technology and the four research institutes. The ETH Domain has been allocated to the Federal Department of Economic Affairs, Education and Research (EAER) since 2013.

Tasks

According to the purpose set out in Art. 2 ETH Act, both Federal Institutes of Technology and the four research institutes (institutions of the ETH Domain) must educate students and specialists in scientific and technical fields and ensure continuing education, expand scientific knowledge through research, foster the development of junior scientific staff, provide scientific and technical services, perform public relations work, and make use of their research results. The institutions of the ETH Domain discharge their mission in observance of internationally recognised standards. They take account of Switzerland's needs and promote national and international cooperation.

Strategic objectives and expenditure ceiling

The political leadership of the ETH Domain rests with the Federal Council and the Federal Parliament. The central leadership tools are the Dispatch on the Promotion of Education, Research and Innovation (ERI Dispatch) and the associated strategic objectives set by the Federal Council for the ETH Domain. The political tools are supplemented by the ETH Board's strategic controlling, which provides information on financial reporting and mission fulfilment.

Reporting

The ETH Board reports annually to the Federal Council and shows the degree to which the strategic objectives have been met and how the ETH Domain has used the total federal contribution. The Federal Council, in turn, reports to Parliament on the achievement of the strategic objectives, drawing on the ETH Board's reporting, among other things. In each half of the Promotion of ERI Policy period, the ETH Board compiles a self-evaluation report which comments on issues specified by the competent Federal Councillor. This self-evaluation report serves as the basis for the evaluation of the ETH Domain by a group of international experts (peer review) which is to be carried out by the Federal Department of EAER.

Discussions are held twice a year between the proprietor, represented by the EAER and the Federal Department of Finance (DFE), and the ETH Board, represented by its President.

The managing and supervisory body ETH Board: mission and operating principles

The ETH Board is responsible for the strategic leadership of the ETH Domain. It defines the strategy of the ETH Domain within the framework of the strategic objectives of the Federal Council, represents the ETH Domain when dealing with policymakers and government authorities at federal level, issues directives about financial controlling, and carries out strategic controlling. It also approves the development plans of the institutions of the ETH Domain, oversees their implementation and supervises the ETH Domain (Art. 25 ETH Act). It agrees targets with the institutions and allocates federal funds, specifically on the basis of the institutions' budget requests (Art. 33a ETH Act). It submits requests to the Federal Council for the election or re-election of the Presidents of the two Federal Institutes of Technology and of the Directors of the four

research institutes (Art. 28 para. 1 and 7 ETH Act). It also appoints the other members of the Executive Boards of the two Federal Institutes of Technology and of the Directorates of the four research institutes (Art. 28 para. 4 and 7 ETH Act). Finally, the ETH Board appoints professors at the request of the Presidents of both Federal Institutes of Technology (Art. 14 para. 2 and 3 ETH Act).

The Executive Boards of both Federal Institutes and the Directorates of the four research institutes are responsible for the operational leadership of the individual institutions of the ETH Domain. In accordance with Art. 4 para. 3 of the ETH Act, the institutions of the ETH Domain assume all responsibilities which are not expressly assigned to the ETH Board by the ETH Act.

The rules of procedure of the ETH Board are published in the Official Compilation of Federal Legislation. The ETH Board usually meets five times a year for two days at a time, and arranges additional meeting days for dialogues with the institutions of the ETH Domain. The President of the ETH Board is responsible for holding periodic individual discussions with the Presidents of the two Federal Institutes of Technology and with the Directors of the research institutes.

The ETH Board performs its supervisory function through the use of the following tools: periodic reporting by the institutions on resources (finances, personnel, real estate), annual reporting by the institutions on the extent to which they have fulfilled their duties with regard to target agreements, annual discussions (known as dialogues) between the ETH Board and the institutions of the ETH Domain within the scope of strategic controlling, handling supervisory complaints addressed to it while observing subsidiarity and institutional autonomy, as well as reports by the institutions within the scope of their risk management systems. Moreover, the ETH Board's Internal Audit evaluates the risk management processes, internal control system (ICS) and governance processes of the institutions and reports on them to the ETH Board.

Vested interests and awareness-raising activities

Corporate governance guideline 6 of the Federal Council for autonomous entities of the Federal Government¹ had the two following sentences added to it: "As a supplement to existing legal regulations, the Management or Institute Council issues a code of conduct on dealing with vested interests and ensures that suitable awareness-raising activities are performed. It provides information on the measures taken in the context of the Annual Report. The Management or Institute Council are thus obliged to issue a relevant code of conduct."

¹ https://www.efv.admin.ch/efv/de/home/themen/finanzpolitik_grundlagen/cgov/grundlagen.html

Structure of the ETH Domain

* Employment contracts incl. doctoral students, as of: 31 December 2022.

ETH Domain

ETH Board
11 members
60 employees (staff, Internal Audit, Appeals Commission)

Federal Institutes of Technology

ETH Zurich
24,540 students and doctoral students
13,528 employees*

EPFL
12,576 students and doctoral students
6,457 employees*

Research institutes

PSI
2,175 employees*

WSL
623 employees*

Empa
1,021 employees*

Eawag
511 employees*

The level of regulation within the ETH Domain relating to vested interests is already very high today: Art. 24c ETH Act; Art. 2a and 7a Ordinance on the ETH Domain; Art. 11, 13, 14 Management Salaries Ordinance; Guidelines of the ETH Board on secondary employment of members of the Executive Boards of the Federal Institutes of Technology and of the Directorates of the research institutes; directives of the ETH Board on secondary employment of professors in the ETH Domain; Art. 6 ETH Ordinance Concerning Professors (revised as of 1 August 2022); Art. 56a Personnel Ordinance for the ETH Domain (Pers0-FIT); Guidelines of the two Federal Institutes of Technology on conflicts of interest and secondary employment (fully revised at the beginning of 2022). The legal requirements are consistently implemented by the ETH Board within its area of responsibility. All vested interests and secondary employment of members of the ETH Board and of members of the Executive Boards and Directorates of the ETH Domain's institutions are examined once a year by the Audit Committee and then approved by the ETH Board – subject to the proviso that the Federal Council is responsible – provided that the requirements are met in accordance with the applicable legal basis.

New vested interests and secondary employment are reported to the ETH Board during the year on an ongoing basis and examined to ensure compliance with the provisions of the Management Salaries Ordinance (no reputational risks or conflicts of interest; maximum workload of 10% of a workload; surrender of the part of the income from secondary employment which exceeds 30% of the salary). In addition, the secondary employment of members of the ETH Board and the Directors of the research institutes is published on the websites of the Swiss Confederation¹ and the ETH Board²; the institutions are responsible for publishing the secondary employment of members of the Executive Board and of the research institutes' Directorates.

Audit and Executive Committee

The Audit Committee assists the ETH Board in financial supervision and in the monitoring of risk management, of the ICS and of financial auditing activities. As a rule, it is composed of two to three "external" members of the ETH Board who are independent of the executive leadership, but may also involve additional people in a consultative capacity. The President of the ETH Board, the Head of the Internal Audit department and the Head of the Finance section of the ETH Board's staff attend the meetings in an advisory capacity.

The Executive Committee assists the ETH Board in preparing for and following up on meetings, in filling management positions of institutions in the ETH Domain and in fulfilling its duties as an employer. It also liaises with the social partners. It is composed of the President of the ETH Board (chair), the Presidents of both Federal Institutes of Technology, the representative of the research institutes and the delegates of the University Assemblies. The Executive Director and, if necessary, other members of the ETH Board's staff attend the meetings.

¹ The key legal bases can be found on the website of the ETH Board: www.ethboard.ch/legalbasis.
² www.admin.ch/ch/d/cf/ko/Gremien_interessenbindung_79.html
³ www.ethboard.ch/vestedinterests

Remuneration of the ETH Board

In 2022, the President of the ETH Board received for 0.8 FTE a gross salary of CHF 294,558 (with an annual salary of CHF 368,197 for 1.0 FTE). In addition, the employer paid social security contributions of CHF 94,177. The President is insured by the Swiss Federal Pension Fund, the rules of which determine the employer contributions.

Based on the decision of the Federal Council of 24 June 2020 regarding the fees of external members of the ETH Board who do not have an employment contract with an institution of the ETH Domain, the Vice President of the ETH Board and the President of the Audit Committee received in 2022 a lump-sum payment of CHF 32,000 each. In 2022, the other four external members of the ETH Board each received a lump sum of CHF 20,000. In addition, external members of the ETH Board were paid a total of CHF 56,500 for dialogue meetings, the Election Preparation Committee, etc. In addition, their expenses were refunded on the basis of the ETH Board Ordinance of 11 April 2002 concerning the reimbursement of expenses in the ETH Domain.

Those “institutional” members of the ETH Board who are employees of one of the institutions of the ETH Domain do not receive additional fees for their activities on the ETH Board. For the 0.7 FTE position, the ETH Board covered 40% of the wage and social security costs (incl. compensation for expenses) incurred by EPFL for the delegates of the University Assemblies of both Federal Institutes of Technology, in order to guarantee the delegates’ independence from either institution.

Executive bodies of the ETH Domain

Presidency and Members of the ETH Board

- Prof. Dr Michael O. Hengartner¹, President
- Prof. Dr Dr h. c. Barbara Haering², Vice President
- Cornelia Ritz Bossicard², President of the Audit Committee
- Prof. Dr Joël Mesot¹
- Prof. Dr Martin Vetterli¹
- Prof. Dr Gian-Luca Bona¹ (until May 2022)
- Prof. Dr Christian Rüegg¹ (since June 2022)
- Dr Kristin Becker van Slooten¹
- Marc Bürki²
- Beatrice Fasana
- Prof. Dr sc. nat., Dr h. c. mult. Susan Gasser
- Christiane Leister

Executive Board of ETH Zurich

- Prof. Dr Joël Mesot, President
- Prof. Dr Sarah Springman, Rector (until January 2022)
- Prof. Dr Günther Dissertori, Rector (since February 2022)
- Prof. Dr Detlef Günther, Vice President for Research (until December 2022)
- Dr Robert Perich, Vice President for Finance and Controlling (until March 2023)
- Prof. Dr Vanessa Wood, Vice President for Knowledge Transfer and Corporate Relations
- Prof. Dr Ulrich Weidmann, Vice President for Infrastructure
- Dr Julia Dannath-Schuh, Vice President for Personnel Development and Leadership

New member of the ETH Zurich Executive Board

- Prof. Dr Christian Wolfrum, Vice President for Research (since January 2023)

Executive Board of EPFL

- Prof. Dr Martin Vetterli, President
- Prof. Dr Jan Hesthaven, Vice President for Academic Matters
- Dr Ursula Oesterle, Vice President for Innovation
- Dr Matthias Gäumann, Vice President for Operations
- Françoise Bommensatt, Vice President for Finance
- Prof. Dr Gisou van der Goot, Vice President for Responsible Transformation

Directorate of PSI

- Prof. Dr Christian Rüegg, Director
- Prof. Dr Gabriel Aeppli, Deputy Director
- Dr Thierry Strässle, Deputy Director
- Dr Peter Allenspach, Member
- Prof. Dr Andreas Pautz, Member
- Prof. Dr Gebhard F. X. Schertler, Member
- Prof. Dr Thomas J. Schmidt, Member
- Prof. Dr Mike Seidel, Member

Directorate of WSL

- Prof. Dr Beate Jessel, Director
- Dr Christoph Hegg, Deputy Director
- Prof. Dr h.c. Anna Hersperger, Member
- Prof. Dr Rolf Holderegger, Member
- Birgit Ottmer, Member (since January 2022)
- Prof. Dr Andreas Rigling, Member (until August 2022)
- Prof. Dr Jürg Schweizer, Member
- Dr Thomas Wohlgemuth, Member (since September 2022)

Directorate of Empa

- Prof. Dr Gian-Luca Bona, Director (until May 2022)
- Prof. Dr Tanja Zimmermann, Director (since June 2022)
- Dr Peter Richner, Deputy Director
- Dr Brigitte Buchmann, Member
- Dr Alex Dommann, Member
- Dr Pierangelo Gröning, Member
- Dr Urs Leemann, Member

New member of the Directorate of Empa

- Dr Lorenz Herrmann, Member (since January 2023)

Directorate of Eawag

- Prof. Dr Janet Hering, Director (until December 2022)
- Prof. Dr Rik Eggen, Deputy Director
- Prof. Dr Jukka Jokela, Member
- Prof. Dr Tove Larsen, Member
- Gabriele Mayer, Member
- Prof. Dr Christian Zurbrügg, Member
- Prof. Dr Carsten Schubert, Member

New member of the Directorate of Eawag

- Prof. Dr Martin Ackermann, Director (since January 2023)

 Appeals body
ETH Appeals Commission

The Internal Appeals Commission of the Federal Institutes of Technology decides on appeals against rulings made by bodies of the institutions of the ETH Domain (Art. 37 para. 3 ETH Act). It is an independent internal appeals body with its registered office in Bern and is administratively assigned to the ETH Board, to which it reports (Art. 37a ETH Act). Since 2022, the Federal Council elects the members of the ETH Appeals Commission. Appeals mainly relate to matters arising from legislation on higher education and human resources. Appeals against the rulings of the ETH Appeals Commission can be made to the Federal Administrative Court.

- Lawyer Barbara Gmür Wenger, President
- Dr iur. Beatrix Schibli, Vice President
- Prof. Dr Simone Deparis, Member
- Lawyer Anne Dorthe, Member
- Jonas Philippe, Member
- Dr Dieter Ramseier, Member
- Prof. Thomas Vogel, Member

 ETH Board support
Staff of the ETH Board

The ETH Board's staff support the ETH Board in fulfilling its legal mandate, particularly regarding strategic leadership, supervision, promotion of cooperation in the ETH Domain and liaising with the Federal authorities (Art. 26b ETH Act).

Executive Team

- Dr Michael Käppeli, Executive Director
- Dr Monique Weber-Mandrin, Deputy Executive Director and Head of Legal Services
- Dr Kurt Baltensperger, Head of Science
- Gian-Andri Casutt, Head of Communications
- Dr Dieter Künzli, Head of Finance and Personnel
- Michael Quetting, Head of Real Estate

Internal audit

The ETH Board employs Internal Audit staff, as per Art. 35a^{ter} ETH Act.

The department conducts internal audits for the institutions of the ETH Domain.

- Patrick Graber, Chief Audit Executive

¹ Member of the Executive Committee

² Member of the Audit Committee

Status as at 31 December 2022
(reference is also made to changes agreed in 2022 which will become effective in 2023)

Ombuds Office

Ombuds Office

The Ombuds Office of the ETH Board is an independent body responsible in a subsidiary capacity for dealing with reports of illegal and unethical conduct observed by members of the ETH Domain in the course of ETH Domain-related activity. Subsidiary capacity means that, whenever possible, reports must initially be made inside the two Federal Institutes of Technology or the four research institutes, first to senior bodies or, if this is deemed unreasonable, to the bodies responsible for dealing with such reports in the institutions concerned.

This applies without prejudice to Art. 22a of the Federal Personnel Act (FPA). The employees are obliged to report all officially prosecutable crimes or offences which they have discovered during their official work or which have been reported to them, to the criminal prosecution authorities, their line managers or the Swiss Federal Audit Office (SFAO).

The ombudsman is:

- Dr Res Nyffenegger, external lawyer in Bern

Conciliation Commission

Conciliation Commission under the Gender Equality Act for the ETH Domain

The Conciliation Commission under the Gender Equality Act for the ETH Domain provides information and advice in the event of disputes which fall under the Gender Equality Act that involve employment relationships in the ETH Domain. The aim of the conciliation process is to achieve a mutually acceptable solution to the dispute in verbal negotiations, with the assistance of the parties (employer and employee), in order to avoid court proceedings. The Conciliation Commission does not issue any judgments. It handles cases confidentially, but not anonymously.

President's Office:

- Dr Anne-Catherine Hahn, President

Employer representatives:

- Andreas Kirstein, ETH Zurich (member)
- H el ene Fueger, EPFL (member)
- Natalie Lerch-Pieper, PSI/Eawag (substitute member)
- David Heusser, Empa/WSL (substitute member)

Employee representative:

- Gregor Spuhler, ETH Zurich (member)
- Prof. Dr Sabine S usstrunk, EPFL (member)
- Dr Rowena Crockett, Empa/WSL (substitute member)
- Dario Marty, PSI/Eawag (substitute member)

Monitoring and auditing

Internal control system

The institutions of the ETH Domain each have an ICS (Art. 35^a^{bis} ETH Act). It was introduced using the template provided by the Federal Government. Its objectives are to protect the assets of the ETH Domain, to prevent errors and irregularities in accounting and to ensure proper accounting and reliable reporting. It is an integral part of the audit by the SFAO or the auditors appointed by it. The focus is on financially relevant business processes.

Internal audit

The Internal Audit department conducts internal audits for the institutions of the ETH Domain (Art. 35^a^{ter} para. 1 of the ETH Act). This department reports directly to the President of the ETH Board and its activities are supervised by the Audit Committee. The Internal Audit department provides independent and objective auditing services. It is also responsible for coordinating and supporting the external audits of the ETH Domain.

Auditors

The SFAO performs external auditing duties for the ETH Domain (Art. 35^a^{ter} para. 3 ETH Act). In 2022, it audited the consolidated financial statements of both Federal Institutes of Technology and the consolidated financial statements of the ETH Domain, and it conducted interim audits. The audits of the research institutes are performed by the SFAO jointly with PricewaterhouseCoopers (PwC). The SFAO's audit report on the consolidated financial statements of the ETH Domain comprises an audit report and a so-called "comprehensive report". These reports are discussed with representatives of the SFAO in the Audit Committee every year. In 2022, the SFAO invoiced the ETH Board for the total amount of CHF 548,556 (CHF 327,813 for the 2022 annual audit and CHF 220,743 for the 2022 interim audit).

Information policy

Its legal mandate makes the ETH Board an interface between academia, policymakers and society. Within its rules of procedure, the ETH Board undertakes to ensure honest, appropriate and transparent communication for the benefit of society and aims to explain its decisions and reinforce the role and reputation of the ETH Domain. Responsibility for this rests with the President. The key communication tools are the ETH Board's Annual Report to the Federal Government, the website www.ethboard.ch, targeted media relations work and the case-by-case illumination of relevant facts and positions, particularly regarding policies on education, research and innovation.

Participations and cooperations

In accordance with Art. 3a of the ETH Act, the two Federal Institutes of Technology and the four research institutes may found or invest in companies, or cooperate with third parties in any other way within the framework of the strategic objectives and the ETH Board's directives, for the purpose of fulfilling their duties. The investments and relationships with controlled and associated entities are listed in sections 20 and 35 of the annual financial statements in the ETH Board's Annual Report and Financial Report respectively. These mainly involve investments in foundations and simple partnerships which meet accounting standards. The controlled entities Société du Quartier de l'Innovation (SQIE) and Société du Quartier Nord de l'EPFL (SQNE), which maintain buildings on a finance lease basis with contracts over a lease term of up to 40 years, generate cash outflows therefrom of about CHF 9 million per year. The associated entities have significant investments in the ETH Zurich Foundation. The contribution to the annual result of the ETH Domain amounted to CHF -34m.



Michael O. Hengartner

* 1966, Swiss / Canadian
Prof. Dr

President of the ETH Board since February 2020.

Michael O. Hengartner served as President of the University of Zurich (UZH) from February 2014 to January 2020. From 2016 until his resignation as President of the UZH, he also served as President of swissuniversities. Hengartner has dual Swiss and Canadian citizenship. He grew up in Quebec City where he studied Biochemistry at the Université Laval. In 1994, he was awarded his doctorate at the Massachusetts Institute of Technology in the laboratory of Nobel Laureate H. Robert Horvitz. After that, he headed a research group at the Cold Spring Harbor Laboratory in the USA until 2001. In 2001, he was appointed to the newly established Ernst Hadorn Endowed Professorship at the Institute of Molecular Biology at the UZH. From 2009 to 2014, he was Dean of the Faculty of Science of the UZH.



Barbara Haering

* 1953, Swiss / Canadian
Prof. Dr sc. nat., Dr h. c. sc. pol.

Vice President of the ETH Board since 2021.
Member of the ETH Board and of the Audit Committee since 2008.

Barbara Haering studied Natural Sciences and obtained a doctorate in Spatial Planning at ETH Zurich in 1996. She runs Barbara Haering GmbH for strategic consulting of public and private institutions. In addition, she chairs the Conseil d'orientation stratégique at the University of Geneva and the Council of Foundation of the Geneva International Centre for Humanitarian Demining. Moreover, Haering is a member of the University Council of Dresden University of Technology and a member of the Research and Technology Advisory Committee at Graz University of Technology. She is also a lecturer at the University of Lausanne.



Joël Mesot

* 1964, Swiss
Prof. Dr sc. nat.

Member of the ETH Board and of the Executive Committee since 2010. President of ETH Zurich since 2019.

Joël Mesot studied Physics at ETH Zurich, obtaining a doctorate in Solid State Physics in 1992. He was awarded the Swiss Physical Society (SPG) IBM Prize in 1995 and the ETH Zurich Latsis Prize in 2002. After research residencies in France and the US, he came to ETH Zurich and joined PSI, where he became Head of the Laboratory for Neutron Scattering in 2004. He was director of PSI from 2008 to 2018, and he has been a full professor of physics at ETH Zurich since 2008. Mesot is part of various national and international advisory bodies, including the Foundation Board of the "Switzerland Innovation" Park, the Marcel Benoist Foundation and the Governing Board CREATE (Singapore).

> Markus Bertschi / ETH Zurich



Marc Bürki

* 1961, Swiss
Dipl. El.-Ing.

Member of the ETH Board since 2017 and of the Audit Committee since 2018. CEO of Swissquote Group Holding Ltd since 1999 and of Swissquote Bank Ltd since 2002.

Marc Bürki obtained a degree in Electrical Engineering from EPFL. After gaining his initial professional experience with the European Space Agency in the Netherlands, he formed Marvel Communications S.A. in Gland in 1990, a company that specialised in the development of financial information software. Swissquote Group Holding Ltd, which specialises in online trading, was formed in 1999 and was floated on the stock market in 2000. In 2001, Swissquote Bank Ltd received a banking licence. Bürki is the CEO of both companies. Furthermore, he is President of the Board of Directors of Swissquote MEA Ltd, Dubai, UAE (since 2012), of Swissquote Ltd, London, UK, and of Swissquote Asia Ltd, Hong Kong (both since 2014), and of Swissquote Pte. Ltd, Singapore, and Swissquote Bank Europe SA, Luxembourg (both since 2019). Since 2021 he has been President of the Board of Directors of YUH Ltd, a joint venture between Swissquote and PostFinance.

> Swissquote



Beatrice Fasana

* 1969, Swiss
Dipl. Ing. Lm

Member of the ETH Board since 2012.
Managing Director at Sandro Vanini SA since 2013.

Beatrice Fasana studied Food Science at ETH Zurich. After a traineeship at the "Nestlé Research and Development Center" in New Milford (Connecticut, USA), she worked in various leadership roles for several large food and beverage production companies in Switzerland, including manager of Chocolat Frey's "Chewing Gum" Profit Center and as a marketing manager for Coca-Cola. Until the end of 2012, she ran her own company, BeFood Consulting SA. Since 2013, she has held the position of Managing Director at Sandro Vanini SA, a company of the Haecy Group. Fasana is also a member of the Board and Chair of the Management Committee of the University of Applied Sciences and Arts of Southern Switzerland (SUPSI, Scuola universitaria professionale della Svizzera italiana) and has been a member of the Board of Directors of Raiffeisen Bank del Basso Mendrisiotto since 2018.



Susan Gasser

* 1955, Swiss
Prof. Dr sc. nat., Dr h. c. mult.

Member of the ETH Board since 2018. Director of the ISREC Foundation at the AGORA Research Centre since February 2021. Visiting professor at the University of Lausanne since 2021.

Susan Gasser studied Biology and Biophysics at the University of Chicago and obtained a doctorate at the University of Basel. She was group leader at the Swiss Institute for Experimental Cancer Research (ISREC) from 1986 until she was appointed full professor at the University of Geneva in 2001. From 2004 until 2019, she was Director of the Friedrich Miescher Institute for Biomedical Research (FMI) in Basel. She was also a full professor of Molecular Biology at the University of Basel from 2005 to 2021. Since 2021, she has been a visiting professor at the University of Lausanne and the ISREC Foundation Director at the AGORA Research Centre. Gasser chairs the scientific advisory board of the Helmholtz Association health centres (research area health), is a member of the scientific advisory board of the Francis Crick Institute in London and a member of the European Molecular Biology Laboratory (EMBL) in Heidelberg. From 2014 to 2019, she chaired the Gender Equality Commission of the SNSF.

> Nestlé Nutrition Council



Martin Vetterli

* 1957, Swiss
Prof. Dr sc.

Member of the ETH Board and of the Executive Committee since 2017. President of EPFL since 2017.

Martin Vetterli received his degree in Electrical Engineering from ETH Zurich, before then completing his Master of Science at Stanford University and finally obtaining his doctorate at EPFL. Following professorships at Columbia University and at the University of California, Berkeley, he returned to EPFL as full professor of Communication Systems in 1995. From 2000 to 2003, Vetterli was a member of the Swiss Science Council (SSC). From 2004 to 2011, Vetterli was Vice President of EPFL, and he was Dean of the School of Computer and Communication Sciences at EPFL from 2011 to 2012. From 2013 until the end of 2016, he was President of the National Research Council of the Swiss National Science Foundation (SNSF).

> Nik Hunger / EPFL



Christian Rüegg

* 1976, Swiss
Prof. Dr sc. nat.

Member of the ETH Board since June 2022 and representative of the research institutes. Director of PSI since 2020. Dual professorship at ETH Zurich / EPFL and professor at the University of Geneva.

Christian Rüegg studied Physics at ETH Zurich, obtaining his doctorate in 2005 at the Laboratory for Neutron Scattering at ETH Zurich and PSI. From 2005 to 2011, he worked at the London Centre for Nanotechnology at University College London (UCL) and Imperial College London. He was a Royal Society University Research Fellow and Assistant and Associate Professor at UCL. From 2011 to 2016, he headed the PSI Laboratory for Neutron Scattering and Imaging in the Research Division of Neutrons and Muons, and from 2017 to 2020, he was the head of this Research Division. Rüegg represents PSI on numerous international committees for large-scale research facilities and as part of important cantonal / national initiatives for the promotion of innovation, such as Switzerland Innovation. > PSI



Kristin Becker van Slooten

* 1962, Swiss / German
Dr

Member of the ETH Board and of the Executive Committee since 2017. Representative of the university assemblies of ETH Zurich / EPFL on the ETH Board. Project head of equal opportunities at EPFL since 2017. Maître d'enseignement et de recherche (MER).

Environmental scientist Kristin Becker van Slooten studied Biology at the University of Geneva and obtained her doctorate in Environmental Chemistry and Ecotoxicology at EPFL. From 1995 to 2002, she was employed as a scientist at the Laboratory for Environmental Chemistry and Ecotoxicology, where she headed up the Experimental Ecotoxicology research group from 2002, obtaining the title of MER in 2005. From 2006 to 2016, she was an advisor to the President and General Secretary of EPFL. Becker van Slooten has been the project manager for equal opportunities at EPFL since 2017 and has reprised her role as a delegate on the ETH Board, representing the university assemblies of ETH Zurich and of EPFL as she did from 2004 to 2006.



Christiane Leister

* 1955, Swiss / German
Graduate economist (Dipl.-Vw.)

Member of the ETH Board since 2017. Owner and President of the Board of Directors of the Leister Group since 1993.

After graduating from Christian Albrecht University of Kiel with a degree in Economics, Christiane Leister started her career at Jungheinrich (floor-level conveyors and warehousing systems). She then headed the Controlling and Finance departments of Vereinigte Papierwerke AG and Milupa AG. She took over strategic and operational duties within the Leister family business in 1989. She has been the owner of the Leister companies since 1993, where she also acted as operations manager until 2014. During that time, Leister diversified the companies with new technologies and expanded them internationally to create the Leister Group.

> Leister Ltd



Cornelia Ritz Bossicard

* 1972, Swiss
Business economist, graduate auditor

Member of the ETH Board and President of the Audit Committee since May 2021. Independent board member.

Cornelia Ritz Bossicard studied Business Administration at HEC Lausanne and the Freie Universität Berlin, and obtained a Master of Science in Business Administration. In addition, she is qualified as both a Swiss Certified Accountant and a US Certified Public Accountant. From 1995 to 2014, she worked as an auditor with PwC, both in Switzerland and Silicon Valley, USA. Since 2014, she has been a sparing partner for strategy, corporate governance and finance and served on a variety of Boards of multinational companies as an independent board member. She is the founder of 2bridge Ltd and, among other things, President of IVF HARTMANN, swissVR, and the César Ritz Foundation Niederwald, and a member of the administration of the Federation of Migros Cooperatives and of the Board of Directors of Läderach. Having chaired various audit committees for many years, Ritz Bossicard is a recognised expert in financial supervision.

> Cornelia Ritz Bossicard

A complete overview of the vested interests of the members of the ETH Board can be found at www.ethboard.ch/vestedinterests.

Personnel matters

Personnel matters of the Federal Council

On 23 February 2022, the Federal Council appointed [Tanja Zimmermann](#) as the new CEO of Empa. The Federal Council also confirmed [Joël Mesot](#) as President of ETH Zurich for another four years and elected [Christian Rüegg](#), Director of the Paul Scherrer Institute (PSI), to join the ETH Board. On 29 June 2022, he elected [Martin Ackermann](#) as the new Director of Eawag.

Election of the new Director of Empa

[Tanja Zimmermann](#) took up her new role as Director of Empa on 1 June 2022. She succeeded Gian-Luca Bona, who had reached retirement age. Professor Zimmermann obtained her doctorate from the University of Hamburg in 2007. Between 2001 and 2012, she established the research field of cellulose nanocomposites at Empa in close cooperation with industry. From 2011 to 2017, she was Head of Empa's laboratory for Applied Wood Materials. Since autumn 2017, she has been a member of the Empa Directorate and Head of the Functional Materials department, which has a staff of around 200 employees.

Re-election of the President of ETH Zurich

The Federal Council also confirmed [Joël Mesot](#) in his position as President of ETH Zurich for an additional four years from 1 January 2023. In doing so, the Federal Council acknowledged Professor Mesot's great achievements as President of ETH Zurich and the numerous important initiatives that he has launched.

Election of a new ETH Board member

The Federal Council also elected [Christian Rüegg](#), Director of PSI, as a new member of the ETH Board. Following the retirement of Gian-Luca Bona, Professor Rüegg took over as representative of the four research institutes PSI, WSL, Empa and Eawag on 1 June 2022.

Election of the new Director of Eawag

As the new Director of Eawag, [Martin Ackermann](#) succeeded Janet Hering, who had reached retirement age. Ackermann currently serves as Professor of Microbial Systems Ecology at ETH Zurich and a group leader at Eawag. He took up his new position on 1 January 2023. Professor Ackermann studied biology at the University of Basel, where he obtained his doctorate in 2002. He then worked as a postdoctoral researcher at the University of California in San Diego for two years.

In 2004, he took up a position as a senior research associate at ETH Zurich, and was appointed associate professor of the SNSF in March 2006, associate professor by the ETH Board in 2008 and full professor in 2015. In addition to his professorship at ETH Zurich, professor Ackermann headed a research department with a staff of around 50 at Eawag for 10 years. In 2020 and 2021, he was Vice-President and President of the Swiss National COVID-19 Science Task Force.

Personnel matters of the ETH Board

Appointment to the Executive Board of ETH Zurich

The ETH Board appointed [Christian Wolfrum](#) as a new member of the Executive Board of ETH Zurich. He succeeded Professor Detlef Günter as Vice President for research. Professor Wolfrum obtained his doctorate from the University of Münster in 2000. ETH Zurich appointed him associate professor for obesity research in 2008, associate professor in 2010 and full professor for translational nutritional biology in 2016. In addition to his research and teaching activities, he has also been highly successful in and committed to putting his research results to practice. He took up his new position on 1 January 2023.

Appointments to the WSL Directorate

The ETH Board appointed [Dr Thomas Wohlgemuth](#) as a new member of the WSL Directorate as of 1 September 2022. The WSL Directorate thus comprises seven members: three women and four men. Wohlgemuth has simultaneously taken over the interim leadership of the Forest Dynamics Research Unit (since September 2022). He is a renowned researcher in the field of forest and disturbance ecology with close links to biodiversity and climate change aspects.

Appointment to the Empa Directorate

The ETH Board appointed [Dr Lorenz Herrmann](#) as a new member of the Directorate at Empa. Herrmann previously worked at ABB, where he held various management positions. He has been Head of the Advanced Materials and Surfaces department at Empa since August 2022, succeeding Pierangelo Gröning, who is set to retire.

Professorial matters

Refer to the right-hand side of page 47 for information about the appointment of professors.

Professorial matters

Appointment of professors

In 2022, the ETH Board dealt with 194 professorial matters at its meetings. It appointed 85 professors in total, 60 of whom were new appointments and 25 of whom were promoted internally. At ETH Zurich, 17 women and 25 men were appointed, and 15 women and 26 men were appointed at EPFL. In addition, there is the new Director of Empa and the new Director of Eawag, both of whom were appointed full professor at both ETH Zurich and EPFL. The ETH Board also awarded the title “Professor of Practice” for the first time in 2022. This title can be conferred on external persons who possess professional experience, are outstanding in their field and lecture at one of the Federal Institutes of Technology.

Out of the 30 full professor appointments, 12 involved promotions of associate professors, and one was a promotion of an assistant professor with tenure track.

Of the associate professors, 12 of the 18 appointments were promotions of assistant professors with tenure track.

Women accounted for 25 (41.7%) of the 60 newly appointed professors in 2022. Over the past four years, the average proportion of women among newly appointed professors has been 39.5%.

In addition, the ETH Board awarded the title of professor (adjunct professor) to 11 scientists, two of whom were women.

Retirements and resignations

In 2022, the ETH Board was informed of 39 retirements: 24 from ETH Zurich, 14 from EPFL and the retirement of the Director of Empa – a full professor at both ETH Zurich and EPFL until June 2022. In addition, ETH Zurich and EPFL advised the ETH Board of a total of 16 resignations for other reasons.

Appointments

85

Professors, 17 of whom were women and 25 men at ETH Zurich, as well as 15 women and 26 men at EPFL and one woman and one man at both ETH Zurich and EPFL

The total 85 appointments included:

full professors

30

15 of whom were women

associate professors

18

4 of whom were women

Proportion of women

41.7%

of newly appointed persons

assistant professors with tenure track

26

12 of whom were women

assistant professors without tenure track

11

2 of whom were women

Risk situation and risk management

As the managing and supervisory body, the ETH Board sets out the risk policy for the ETH Domain and has set various targets for the two Federal Institutes of Technology and the four research institutes. On the one hand, this serves to ensure that the tasks are performed effectively, cost-efficiently and with foresight, and that functional and innovative capability are maintained. On the other hand, this should guarantee personal safety and the security of property and other assets to the greatest possible extent. The leadership of the institutions is intended to be supported by comprehensive, transparent and up-to-date risk information, risk awareness should be promoted among students and staff and the good reputation of the ETH Domain is to be safeguarded.

The institutions' presidents and directors are responsible for risk management. The institutions have their own procedures for risk management, which serve to identify and evaluate the individual risks, as well as strategies for coping with them and for monitoring them appropriately. A risk manager and/or a risk committee coordinates the risk management activities and supervision of risk management procedures. Each institution keeps its own risk catalogue in which the identified risks are described in detail with an assessment on the basis of probability of occurrence and extent of the potential damage. Here, consideration is given to the possible effect a risk could have on reputation. The individual profile, specific focus and size of each institution are reflected in its risk catalogue. Thus, the two Federal Institutes of Technology have different core risks to the four research institutes, and the assessment of the same risks can vary. As part of their annual reporting to the ETH Board, the institutions provide information about their core risks, above all their current status, extent and possible consequences. Core risks are those risks with potentially significant financial consequences and that have an above-average probability of occurring. They directly endanger the fulfilment of the legal duties. The reports on the core risks are then submitted to the department responsible for the ETH Domain (the Federal Department of Economic Affairs, Education and Research, EAER). Moreover, the ETH Board must be informed directly by the institutions about any extraordinary changes in risk or damaging events.

The effects of an inhibiting political and legal environment (especially the relationship between Switzerland

and the EU and the non-association of Switzerland in Horizon Europe), the sharp increase in energy prices and the threat of power shortages, as well as the uncertainty in terms of funding developments, are three of the greatest risks faced by the ETH Domain. Non-association also carries the risk of losing competitiveness and difficulties in recruiting and retaining leading researchers. Other major core risks of the ETH Domain are associated with the significant impairment of an institution's operations due to major events (e.g. pandemics, geopolitical conflicts, extreme weather events), violence/threats against people and the loss of key personnel, cyberattacks, possible infringements of scientific integrity and good academic practice, taking on excessive obligations and the risk of a lack of oversight of non-current financial obligations and the consequences of such, as well as the loss of management and control due to the creation of external structures.

Despite careful risk management, it cannot be ruled out that an institution may be affected by a damaging event which endangers the fulfilment of its duties enshrined in law. In this case, the ETH Board would submit a request to EAER, for the attention of the Federal Council, to adapt the strategic goals or increase the federal financial contribution in accordance with Art. 30 para. 2 of the Ordinance on Finance and Accounting of the ETH Domain following consultation with the Federal Finance Administration (FFA). The insurance policies taken out by the institutions are of great importance. The institutions must take out insurance against possible losses, subsidiary to other measures, where such insurance is feasible and the funding is sufficient for it. Each institution is responsible for taking out insurance cover and administering its own insurance portfolio. When doing this, they have to take into account their specific risk situation, strive for an appropriate cost/benefit ratio and ensure compliance with the federal regulations governing public sector procurement. The insurance cover must meet the standards which are customary in the Swiss insurance market and be concluded with an insurance institution that is licensed in Switzerland. The institutions have taken out property and employers' liability insurance policies, as well as smaller insurance policies for specific risks. The real estate owned by the Federal Government is not insured, because this follows a strategy of self-insurance.

STRATEGIC OBJECTIVES

Teaching <small>Objective 1</small>	50
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Knowledge and technology transfer <small>Objective 4</small>	63
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Working conditions, equal opportunities and young scientific talent <small>Objective 9</small>	84

Details of the Federal Council's strategic objectives for the ETH Domain can be found on the SERI website www.sbf.admin.ch under Higher Education/ETH Domain.

Strategic objective

TEACHING

1

In 2022, 37,116 students and doctoral students were enrolled at ETH Zurich and EPFL. The innovative forms of teaching designed in recent years are constantly being improved and the acquisition of interdisciplinary competencies remains a key element of teaching. The expansion of continuing education programmes, in particular, contributed to the transfer of knowledge to society.

Excellence in research and competence-oriented education

Education in the ETH Domain is deemed highly attractive at home and abroad. In 2022, 24,540 students and doctoral students were enrolled at ETH Zurich and 12,576 at EPFL. Compared to previous years, it should be noted that no visiting students have been included in these figures since 2021. The share of women among students and doctoral students continued to rise, albeit very slightly (2022: 32.4%, 2021: 32.3%); while Bachelor's and Master's programmes saw an increase from 31.6% in 2021 to 31.8% in 2022. The proportion of foreign students and doctoral students also increased (2022: 49.5%, 2021: 48.1%) (for detailed figures on students and doctoral students, see p. 92 et seq.).

The two Federal Institutes of Technology are continuously developing their study programmes with a view towards reflecting the needs of society. EPFL launched two Master's degree programmes in 2022, NeuroX (in neuroscience and neuroengineering) and Quantum

Science and Engineering, with a cross-faculty orientation. In addition, a new Master's degree in Statistics was created in the Department of Mathematics. ETH Zurich made major adjustments to the programmes of Civil Engineering, Environmental Engineering and Human Medicine for Bachelor's degrees, and to Mechanical Engineering, Biology, Data Science, Biochemistry – Chemical Biology and Materials Science for Master's degrees.

The joint doctoral programme Learning Science of EPFL and ETH Zurich, which was launched in 2021, recorded high demand from doctoral students in its first year, who are jointly supervised by members of both Federal Institutes of Technology. Preparations for the programme's first winter school began in the reporting period. At the turn of the year, ETH Zurich also enacted its Ordinance on the Doctorate revised in 2021 and the associated implementation regulations, and revised its guidelines on scientific integrity (also see Objective 2, p. 59). An additional course entitled "Ethics and Scientific Integrity" for doctoral students was also introduced in this context.

The research institutes also make a significant contribution to the educational offering of the ETH Domain. Their commitment to teaching came to a total of 21,348 teaching hours at national or foreign universities in 2022 (2021: 19,305). The research institutes supervised 778 Bachelor's and Master's theses as well as 912 doctoral theses. In the reporting period, several scientists from the research institutes were again appointed as professors (including as adjunct professors) at ETH Zurich, EPFL or another Swiss university, providing impetus in new and socially relevant research areas. For example, WSL and ETH Zurich created two joint professorship-level positions to focus on the

topics of mass movement and hydrology in mountain regions. The newly appointed associate professor (with tenure track) and the newly appointed associate professor work at the “Climate Change, Extremes and Natural Hazards in Alpine Regions Research Centre” (CERC) in Davos, which was founded in 2021.

Encouraging interdisciplinary competencies

The institutions of the ETH Domain promote the development of interdisciplinary competencies with the aim of enabling students and doctoral students to deal with and solve complex social problems. Particular importance is attached to the development of critical and self-critical thinking. To that end, they promote, among other things, dialogue and cooperation with the humanities and social sciences. At EPFL, a working group is working on developing programmes in this area, as well as strengthening links between the College of Humanities, the College of Management of Technology and the other faculties. For example, Eawag offers courses in cooperation with the University of Bern that shed light on the relationship between democracy and sustainability. Furthermore, Eawag, together with ETH Zurich, WSL and the University of Bern, launched the SNSF-Sinergia project TREBRIDGE, which uses an integrated natural and social science perspective to research the transformation towards resilient ecosystems and also contributes to teaching.

To promote interdisciplinary competencies, EPFL has initiated the further development of its Career Centre into a Centre for Transversal Competencies and Careers. This process, which will be completed in 2023, will help to integrate the development of interdisciplinary competencies and skills into all curricula and doctoral programmes. In the reporting period, ETH Zurich expanded its ETH Talent project, which focuses on teaching personal and social competencies and thus complements the topic- and method-specific skills of graduates. Students, doctoral students and postdocs can use the myPath catalogue to find out about extra-curricular activities and initiatives at ETH Zurich. A pilot project on internal coaching was implemented at PSI, which expands the PSI Education Center’s interdisciplinary programmes with a low-threshold advisory service adapted to personal needs for dealing with professional challenges.

The promotion of interdisciplinary approaches is of crucial importance for the development of interdisciplinary competencies. The successful MAKE programme, which promotes transversal project-based learning among students, is being continued at EPFL. A special focus of the new interdisciplinary projects launched in the reporting period is on how to deal with environmental problems. For example, students develop solutions for recycling building materials or extracting CO₂ from the air. A crucial innovation of MAKE was the inauguration of the “Student and Project Outreach Tank” (SPOT), which not only supports students but also allows professors to test course models. ETH Zurich has created a new Collaborative

With their online programming environment and support for storytelling, interactive visualisations and various types of learning activities, Jupyter Notebooks offer great features for education.

› Alain Herzog/EPFL



Learning Platform (CLP) to act as a link between the highly structured programmes and the Student Project House, where students work on projects completely independently. In CLP programmes, students can develop methodological, social and personal skills in interdisciplinary teams under the guidance of trained student coaches.

Strengthening computer skills in the various programmes is also a central interest of the two Federal Institutes of Technology. ETH Zurich launched a school-wide initiative called “Computational Competencies” in 2021 following intensive preparations the previous year. This aims to incorporate the skills of computational thinking, programming, data analysis and data-based modelling into all programmes. An important component is the integration of the teaching of computer skills in subject-specific courses. Both Federal Institutes of Technology are involved in the programme “Strengthening Digital Skills in Teaching” as part of the federally funded cooperation projects (also see Objective 5, p. 69). Both EPFL (leading house) and ETH Zurich are participating in the federally funded project “Swiss Digital Skills Academy”, which aims to establish a platform for the exchange of education resources in the field of digital skills. In another project, the two Federal Institutes of Technology (again with EPFL as the leading house), together with the University of Neuchâtel, developed an evaluation scheme for ethical aspects of information systems and a role-play to help students make ethical decisions in the area of Machine Learning (ML). The research institutes are also involved in teaching computer skills. For example, WSL developed a new course for researchers and doctoral students on the use of modern software engineering tools and high-performance computing to enable automation of data pipelines. The course aims to promote “open science” and to ensure the reproducibility of research results.

Innovations and quality assurance in teaching

Faced with the increasing digitalisation of the working world and society, the institutions of the ETH Domain are developing innovations in teaching. The coronavirus pandemic has revealed how important new forms of teaching are, and these have remained in use after the pandemic. The teachers’ conference at ETH Zurich has honoured three such innovative formats with the “KITE Award”, which is given for teaching projects that are both effective and demonstrate long-term benefits. For example, a concept was awarded that makes it possible to conduct physics experiments with everyday objects at home.

This revealed equivalent or even better learning effects than in laboratory experiments and greater motivation among the students. Two pilot projects have been launched at EPFL to expand the digital recording of lessons. In terms of a “one-button solution”, technical solutions are to be found, for example, so that courses can be recorded in all classrooms easily. Courses in the form of “flipped classrooms” were further expanded at EPFL in the academic year 2021–2022, for example in the departments of Mathematics and Physics. The use of Jupyter Notebooks, which are interactive documents, by students has increased even more. The number of users has almost doubled compared to the previous year. A project was launched at WSL to create “digital twins” of forest areas. The virtual forests can be used for teaching, communication and training purposes.

The two Federal Institutes of Technology take various measures to continuously ensure the excellence of their curricula. EPFL was awarded accreditation with one single condition by the Swiss Accreditation Council in 2022 following an assessment procedure by the Swiss Agency of Accreditation and Quality Assurance (AAQ). Also in the reporting period, EPFL initiated the renewal of the accreditation of its engineering degree programmes with the French “commission des titres d’ingénieur” (CTI). EPFL also used the two accreditation procedures as an opportunity to take a critical look at its programmes in the area of teaching and to make selective improvements. ETH Zurich, which has already undergone the procedure for institutional accreditation in accordance with the Higher Education Act (HEdA) in the previous year, evaluated the programmes of the three departments of Mathematics, Computer Science and Mechanical and Process Engineering in 2022 as part of a peer review. As a new element of teaching quality assurance, peer feedback was introduced as a pilot project, providing mutual support among lecturers to improve teaching. The two Federal Institutes of Technology regularly conduct surveys among students to assess the quality of teaching and general satisfaction among students. In this context, ETH Zurich reviewed the mode of teaching assessments by students in the above-mentioned three departments (peer review) in the reporting period, while EPFL, in turn, revised its guidelines for the assessment of courses. The new provisions in the guidelines came into force in autumn 2022. As a further quality assurance measure, EPFL further developed its Propaedeutic Center, which was founded in 2021 and is intended to facilitate the organisation and running of courses in the first year of study, at several levels in the reporting period. For example, it created additional courses in linear algebra, calculus, physics and “Information, Computation and Communication” (ICC) to support students.

Promotion of national and international mobility

The institutions of the ETH Domain support the national and international mobility of students in order to promote the exchange of experiences and ideas as well as the acquisition of language skills. In the reporting period, ETH Zurich joined the European university alliance ENHANCE, which, among other things, promotes cross-border cooperation in teaching (also see Objective 6, p. 73). At EPFL, the Education Outreach Department (SPE) is responsible for building partnerships and strengthening exchange networks at the international level. In 2022, the SPE was able to conclude three new student exchange agreements with European universities, as well as one with a Vietnamese university. In addition, all agreements with the European partner institutions were thoroughly evaluated. For detailed data on visiting students, see Fig. 11, p. 96.

Summer and winter schools are also an important element in promoting cross-institutional exchanges. ETH Zurich and EPFL jointly organised a total of seven such events for doctoral students in the reporting period.

Further education

Further education is an effective tool for the transfer of knowledge between scientists and society. In the reporting period, the institutions of the ETH Domain once again expanded their further education programme. EPFL established a new continuing education unit to support the development of new courses that best meet the needs of industry and society. In this context, for example, EPFL launched a new programme portfolio on the topic of sustainable and resilient value chains. EPFL also signed a four-year contract with the Federal Statistical Office to provide further education in data science. ETH Zurich created a new Master of Advanced Studies (MAS) in Preservation and Construction History, which offers an interdisciplinary and integrated education in order to assess inventory issues competently and to preserve architectural heritage. In addition, ETH Zurich launched two further Certificate of Advanced Studies (CAS) programmes to complement the existing CAS "ETH in Regenerative Materials – Essentials". Both new programmes are intended to serve as specialisation options.

Among the research institutes, PSI continued to expand its further education programmes in the reporting period, including in the areas of machine safety, X-ray technology and radiation protection. For example, the PSI Education Center has intensified its collaboration with external partners in the health sector and with the operators of Swiss nuclear power plants to ensure radiation protection training for the specialists there. Empa, PSI and the Swiss Center for Electronics and Microtechnology (CSEM) hold annual Technology Briefing events with the aim of informing specialists from industry and business about current practical issues and opportunities relating to new technologies. The Technology Briefing event in December 2022 addressed the topic of photovoltaics and presented the latest technology developments, their potential and issues of technical system integration. Empa-Akademie has been providing online continuing education courses since 2021, which have proven to be a good complement to on-site courses and appeal to a broader target audience. In courses and workshops, Empa also presents the latest research findings so that they can be put into practice, for example from NEST on circular construction for major clients such as the Federal Office for Buildings and Logistics (FOBL) or on 3D printing in medical technology for the medtech industry. In the reporting period, Eawag's practical further education programme, PEAK, offered nine courses on a wide range of topics in German, French and English.

All institutions of the ETH Domain, together with the "International Institute for Management Development" in Lausanne, launched a pilot round for an "Advanced Academic Leadership Programme" (AALP) in 2022, which is to be further developed and expanded after the conclusion of the pilot phase. The programme is aimed at academic leaders in the ETH Domain from the level of professor or laboratory director and imparts application-oriented knowledge in the areas of personnel and institutional management, the promotion of innovation and business start-ups, and the social role and responsibility of science.

Strategy to develop the number of students and doctoral students

The number of students and doctoral students at ETH Zurich and EPFL has increased by 32%. Growth in the fields of engineering sciences and information and communication technology was particularly strong (39% and 114% respectively). In view of the high demand for these graduates in the labour market, this is a positive development. However, further strong growth in student numbers, especially without a simultaneous increase in funding, could jeopardise the quality of teaching in the long term, e.g. due to insufficient capacities and infrastructures, a deterioration in the (wider) faculty/student ratio or excessive workloads for staff in the areas of administration and teaching. The ETH Board, therefore, worked out a strategy together with the institutions of the ETH Domain to reduce the risks to the quality of teaching that could result from the increase in student numbers. Consultation on this strategy took place in 2022.

Strategic objective

RESEARCH

2

The ETH Domain continues to carry out its research activities at the highest international level. In order to contribute through research to anticipating and solving the most pressing global challenges, various Joint Initiatives have been launched within the Strategic Area “Energy, Climate and Environmental Sustainability”. Once again this year, researchers from the ETH Domain stood out for the particularly large number of scientific publications and awards they received.

Leading international position in research

The opening of the Centre for Origin and Prevalence of Life at ETH Zurich – which aims to investigate the origin and distribution of life in the universe – was one of the highlights of the reporting period. Under the leadership of Nobel Laureate Didier Queloz, this research and teaching centre aims to promote scientific cooperation across disciplinary boundaries as well as to exploit interdisciplinary opportunities and synergies. In 2022, a large number of cross-disciplinary research projects were undertaken. This includes, in particular, the mathematical theory developed by EPFL researchers to describe the relationship between the speed of cell development and the risk of damage or mutations in the DNA. The interdisciplinary project combines mathematics and molecular biology and is of particular interest for a better understanding of the

development of cancer cells. PSI led an interdisciplinary cooperation with the Istituto Italiano di Tecnologia in Genoa, Italy, in which findings from structural biology were used computationally for drug design. The result was a novel substance that inhibits cell growth and prevents cell division in tumours.

Projects with international interdisciplinary cooperation benefit from the bundling of specialist knowledge, expertise and infrastructure. Accordingly, their potential impact increases. The project by an international research team led by an Empa expert – in collaboration with Imperial College London, where the project leader is also based – uses a cooperative swarm of drones to enable the 3D printing of materials for the construction or repair of buildings and structures (see p. 31). In 2022, physicists at EPFL also revised one of the basic laws underlying plasma and nuclear fusion research as part of a far-reaching European collaboration. This law is relevant to the design of several large-scale projects such as ITER (see also Objective 3, p. 62). A WSL team was able to prove that urban bee-keeping endangers wild bees in a transnational European project called BioVEINS, which is supported by the European Commission, among others. The research, published in 2022, provides important information for strategies to conserve bee diversity. Eawag is also leading a research project funded by European partners to improve the risk assessment of chemicals (PARC). The objective of the project is to identify pharmaceuticals and synthetic antioxidant metabolites in wastewater-treatment plants and to track their degradation during wastewater treatment. Empa is also involved in this project, specifically with regard to new concepts and approaches such as “Safe” and “Sustainable by Design” for chemical products and their applications.

As Switzerland is considered a non-associated third country in Horizon Europe, researchers in Switzerland were not able to participate in the calls for the prestigious ERC Grants 2023 in 2022. An ETH Zurich research group is a partner in one of these projects, which were selected in 2022 for funding starting in 2023. Six projects from EPFL, four from ETH Zurich and one from PSI were selected in the 2021 call for ERC Consolidator Grants, the results of which were published in 2022. Switzerland was still able to participate in this call for proposals, but funding for these projects is now being secured by the State Secretariat for Education, Research and Innovation (SERI). In addition, an Empa researcher has received an ERC Consolidator Grant as part of the researcher's dual affiliation with Imperial College London. The researchers of the ETH Domain also participated in the calls for projects launched by the SNSF in 2022 as part of the transition measures. Of the 62 projects selected for an SNSF Starting Grant 2022, 26% come from the ETH Domain. The institutions of the ETH Domain also continue to be involved in national funding programmes such as the National Centres of Competence in Research (NCCRs) or the National Research Programmes (NRP). Of the 22 NCCRs underway in 2022 or until 2022, 13 were under the leadership (leading house) or co-leadership (co-leading house) of one of the institutions of the ETH Domain. Some of these NCCRs were successfully completed in 2022. These include the NCCRs "Quantum Science & Technology", "Molecular Ultrafast Science and Technology" and "Intelligent Robots for Improving the Quality of Life", which were started 12 years ago.

The numerous awards given to researchers from the ETH Domain attest to the high level of their expertise. The highlight of the reporting period was undoubtedly the award of the Fields Medal to Maryna Viazovska (see p. 19 et seq.). In addition, there are international recognitions such as the Wolf Prize in Architecture, awarded to Momoyo Kaijima and her partner Yoshiharu Tsukamoto for their ethnographically inspired approach to architecture (see p. 18), or the Claude E. Shannon Award, a prestigious prize for information theory, which was awarded to Rüdiger Urbanke. Alexander Grimm, in turn, is one of the winners of the Nicholas Kurti Science Prize 2022 for his work on non-linear effects in quantum information processing. At the national level, the Marcel Benoist Science Prize went to Ursula Keller (see p. 18), and Zoë Holmes was one of the two winners of the Sandoz Family Foundation Monique de Meuron's programme for the promotion of young academics. Among the project awards, the Mülheim Water Award is noteworthy, which went to the Water Wall project, which aims to reuse toilet and handwashing wastewater in a closed cycle.

Complementary competencies in the ETH Domain

The six cooperation projects and initiatives of the institutions of the ETH Domain – launched in 2021 and supported by the ETH Board with start-up funding from its reserves – are making good progress. These were joined in 2022 by the Joint Initiatives within the framework of the ETH Domain's Strategic Areas for 2025–2028 (for details on the Strategic Areas, see Objective 5, p. 68). As the challenges in the topics of "Energy, Climate and Environmental Sustainability" and "Engagement and Dialogue with Society" are particularly urgent, the ETH Board decided to support initiatives in these Strategic Areas as early as 2022. Six Joint Initiatives were launched in the Strategic Area "Energy, Climate and Environmental Sustainability". Some of these initiatives aim to develop solutions to the challenges posed by climate change to ecosystems and biodiversity, to achieve a negative CO₂ footprint or to secure energy supplies. In addition, a Swiss centre for net zero emissions is to be established. Other initiatives are to develop sustainable materials from food production waste or promote the use of wood in the construction industry. The Joint Initiatives in the Strategic Area "Engagement and Dialogue with Society" are addressed under Objective 4, p. 66.

Furthermore, the ENRICH project (see Objective 5, p. 68) enables the research institutes to strengthen their scientific cooperation in specific research areas as well as in sustainable development activities and to coordinate their complementary programmes in the best possible way.

Research activities in the energy sector

The ETH Domain is particularly committed to energy research. Its commitment was further stepped up in 2022 with the launch of the Strategic Area "Energy, Climate and Environmental Sustainability" (see above). In addition, Innosuisse's various flagship initiatives related to energy or decarbonisation gained momentum in the reporting period (also see Objective 4, p. 63 et seq.). The institutions of the ETH Domain also play a leading role in the SWEET (Swiss Energy Research for the Energy Transition) funding programme; three of the four consortia selected in 2021 are under their leadership.

Moreover, the scientists of the ETH Domain provide their expertise on issues relating to security of supply and the restructuring of the energy system. The expert group on security of supply of the Energy Science Center (ESC) of ETH Zurich, for example, presented a position paper in the reporting period on the most important steps towards Switzerland abandoning fossil energy sources. Other researchers from ETH Zurich, together with their colleagues from the Delft University of Technology in the Netherlands, have identified various options for making the European energy system green and self-sufficient by 2050.

The first steering committee of the research centre “Centre for Origin and Prevalence of Life” is made up of Roland Riek, Didier Queloz, Cara Magnabosco and Sascha Quanz (from left to right).

> Marco Rosasco
Photography/ETH Zurich



In another new study, researchers from Empa and the University of Geneva outlined how Switzerland could reduce its electricity imports through a diversified expansion of renewable energy. Apart from the examples mentioned above, numerous ETH Domain research projects also contribute directly to the Swiss Energy Strategy 2050. For example, the European BIOCTANE project launched in 2022 with the participation of PSI is looking at the conversion of water-containing organic waste such as food into aviation fuel and, as such, aims to develop solutions with a view to the net zero target in the aviation sector.

Enhancement of computer sciences and information technology

The institutions of the ETH Domain are actively involved in the training and further education of teachers of computer science and computational thinking. ETH Zurich is now offering a CAS in Computer Science and Computer Science Didactics in cooperation with the Graubünden University of Teacher Education. EPFL had already set up a CAS in 2021 for the training and further education of computer science teachers at the secondary level. A second group of 20 participants started the CAS in the reporting period. EPFL also participates in the BeLEARN association, funded by the Canton of Bern, which aims to promote the development of competencies regarding digital tools and their use in education.

The institutions are also planning to strengthen computational thinking and computer science. In its first year of existence, the new PSI research area “Scientific Computing, Theory and Data” (SCD) has developed dynamically and now already has four research units. Thanks to the generous commitment of the Dieter Schwarz Foundation, ETH Zurich was able to establish two new professorships at the interface of education, digital transformation and artificial intelligence.

Protection against cyber risks

The Swiss Support Center for Cybersecurity (SSCC), which was jointly launched by ETH Zurich and EPFL in 2020 as part of the “National strategy for the protection of Switzerland against cyber risks”, signed an official partnership agreement between the two Institutes of Technology in 2022, which also provides for the involvement of external partners. The Center for Digital Trust (C4DT), based at EPFL, continued to grow in 2022, hiring three additional staff members. The Center also launched six new projects in the reporting period and organised workshops, discussion groups and conferences.

Research in the field of cyber and communication security is also of great importance in the ETH Domain. For the first time, an international team, including scientists from EPFL, has been able to experimentally demonstrate a cryptographic method that provides a level of communication security that is not possible with conventional cryptography. SCION, a network technology that ETH Zurich has developed over the last eight years with the aim of providing secure, reliable, and high-quality Internet connections, is now also being applied in the ETH Domain. The two Federal Institutes of Technology have also been working closely together in the area of teaching by offering a joint Master’s degree programme in cyber security since 2019. In 2022, a team of students from ETH Zurich and EPFL took part for the first time in the Cyber Strategy Challenge event organised by the Geneva Centre for Security Policy. The objective of the competition was to manage a realistically simulated international cyber security crisis. In addition, two IT specialists from EPFL won a major prize at the Trusted Media Challenge in Singapore, a five-month competition to decipher the code of deepfakes.

Research priorities

The Swiss Personalized Health Network (SPHN) and the Strategic Focus Area (SFA) Personalized Health and Related Technologies (PHRT) of the ETH Domain have jointly launched the National Data Streams (NDS) project call in 2022. The four selected projects have already started and cover the fields of infectious diseases in intensive care, oncology, paediatrics and health services research. The Swiss Multi-Omics Center (SMOC) was also established in 2022 as part of PHRT as a platform for the generation, analysis and interpretation of human multi-omics data in the clinical setting. SMOC is the result of a collaboration between ETH Zurich, PSI, EPFL, Empa, SPHN and the Swiss Institute of Bioinformatics (SIB); its activities are based on the Swiss Data Science Center (SDSC) (see below). The activities of the ETH Domain within the PHRT framework complete the long list of research projects related to human medicine topics.

The SDSC is jointly operated by EPFL, ETH Zurich and, since 2021, PSI. Thanks to the establishment of the third hub at PSI, several projects relating to innovative data solutions for large-scale research facilities were launched in 2022. In the reporting period, the SDSC published the sixth call for projects in the field of data science. In addition, the SDSC works closely with the research focus of the ETH Domain PHRT (see above). There are numerous projects in progress within the SDSC in the fields of computer science, environmental science, engineering sciences, health and biology, physics and social sciences.

The SFA Advanced Manufacturing (AM) comprised 12 ongoing research projects in addition to the development of new technology platforms within the ETH Domain in 2022. The annual meeting organised by Empa brought together around 100 participants from science and industry virtually in March 2022. One of the objectives was to review the projects and activities funded within the AM research focus, but also to bring together experts from different disciplines and fields to further strengthen networking among the scientific and technical community in advanced manufacturing. The SAMCE (Swiss AM Community Events) series of events, which was set up jointly by SATW, ETH Zurich, EPFL and Empa, pursues the same objective.

In addition to the SFAs adopted for the period 2021–2024, the ETH Domain is also very active in the area of energy, environment and sustainability (also p. 56 “Energy”). In connection with the production of plastics and their disposal, Eawag research has shown, for example, that the biologically active, slow-flow sand filters used in lake water treatment remove nanoplastics very efficiently from the raw water. EPFL scientists have developed a substitute for PET plastic made from inedible plant material. A new study by Empa, carried out in collaboration with Utrecht University in the Netherlands and Austria’s national meteorological and geophysical service, has found that the dispersion of nanoplastics in the air is much more widespread than previously thought, reaching even into the high altitudes. In addition, a recent WSL study has shown that trees can absorb nanoplastics through their roots.

On the subject of climate change, researchers from ETH Zurich and WSL have reconstructed the shrinkage of glaciers in the 20th century for the whole of Switzerland for the first time. They used historical imagery and concluded that the volume of glaciers declined by half between 1931 and 2016. PSI scientists have developed a new approach to deep learning in terms of a more accurate consideration of the effect of aerosols on cloud formation in meteorological and climatic models. Other PSI researchers, together with colleagues from ETH Zurich, have demonstrated that photochemical processes in aerosols occur two to three times faster than previously assumed due to light being amplified by solar radiation. They propose to include these effects in future climate models. WSL studies have also shown that up to 10% of the beech trees whose foliage changed colour during the extremely dry summer of 2018 have since died. This significantly exceeds the natural die-off rate. The early shedding of the leaves was, therefore, more a sign of weakness than a protective mechanism of the trees.

The ETH Domain is committed to ensuring that the research data collected and the results obtained are accessible. The ETH Domain’s commitment to freely available research data (open research data, ORD) is described in more detail in the “Review” section of this Annual Report on page 10. ETH Zurich also issued new guidelines for the management of research data in 2022.

To promote good scientific practices and integrity in research, EPFL introduced the online training course “Conducting research the right way” in 2021. This has been actively recommended for new professors since 2022. In addition, the topic of integrity was part of the “New Faculty Orientation Events” programme for new professors at ETH Zurich in the reporting period. ETH Zurich also introduced a course on ethics and scientific integrity for all doctoral students in connection with the revision of the Ordinance on the Doctorate (also see Objective 1, p. 50). Furthermore, ETH Zurich’s completely revised guidelines on scientific integrity came into force at the beginning of 2022. After analysing various minor cases of conflict related to scientific integrity, WSL concluded that its strategy of continuous active communication of advisory services and early intervention is effective.

Strategic objective

RESEARCH INFRASTRUCTURES

3

The number of scientists using the research infrastructures of the ETH Domain has largely normalised and corresponds to the level before the coronavirus pandemic. The three projects for research infrastructures of the ETH Domain, which are enshrined in the Swiss Roadmap 2019, will be continued. In addition, the ETH Domain has submitted several research infrastructure projects for the Swiss Roadmap 2023.

Operation, further development and provision of large research infrastructures

The ETH Domain owns and operates a unique portfolio of large research infrastructures that are made available to the national and international scientific community. While access to these infrastructures had to be restricted during the peak phases of the coronavirus pandemic, their use by scientists was practically back to normal in 2022. This applies, among other things, to the major PSI research infrastructures, NEST on the Empa–Eawag campus and other Empa research and demonstration platforms.

Some important milestones were also reached in 2022. In addition to regular user operations at the SwissFEL X-ray free-electron laser, PSI also pushed ahead with its expansion. In March 2022, X-ray light was delivered to the CRISTALLINA experimental station for the first time. In the future, this will allow for the investigation of specific quantum states as well as serial protein

crystallography in the femtosecond range. The objective is to make important research contributions to both quantum science and structural biology.

There is considerable demand for the major research infrastructures of PSI. The average annual availability of the PSI accelerator facilities in the period 2019–2022 was 95.5%. Almost half of the testing time slots were allocated to Swiss groups, most of which belong to the ETH Domain. However, the PSI's facilities are still also heavily used by industry.

The resources of the Swiss National Supercomputing Centre (CSCS) are also in high demand. In fact, the total resources available in 2022 were divided between the Piz Daint (the supercomputer hosted by CSCS) and Swiss Share in the Finnish LUMI system. In addition, total demand exceeded available resources by a factor of two and a half. The number of publications related to the use of the CSCS has also continued to increase.

The development of new major research infrastructures and platforms, as well as major upgrades, are coordinated at the national level through the Swiss Roadmap for Research Infrastructures process. In parallel to the projects based on this roadmap, the institutions of the ETH Domain are investing in the expansion of their infrastructures and in the creation of platforms on existing premises. For example, the Dubochet Center for Imaging (DCI) is a joint platform of EPFL, the University of Lausanne and the University of Geneva that was launched at the end of 2021. The Center was inaugurated in 2022. The DCI has some of the most advanced electron microscopes in the world, which promises significant advances in biomedical research. For its part, WSL set up a laboratory for the analysis of environmental DNA (eDNA) in 2022. The

laboratory was designed according to special cleanliness standards, including a filter system and permanent slight overpressure in the laboratory rooms to prevent contamination of the samples. Planning for the new NEST unit STEP2, dedicated to research and innovation, is also progressing rapidly. The various prototype tests took place in 2022, and the building application was submitted. In the long term, the STEP2 unit aims to initiate innovations with respect to the circular economy, industrial and digital manufacturing, building envelopes and energy systems. In the meantime, planning has begun for two further units focusing on the application of drones in the construction and operation of buildings and on net zero technologies. Also as part of NEST, Eawag has been offering a virtual tour of the WaterHub since 2022 through a film that explains the projects taking place there.

Several updates are necessary in order to be able to make optimal use of the infrastructures in the long term. For example, WSL has modernised an infrastructure for long-term observation of tree growth that has been in place in the Lötschental valley since 2006. The 15-year-old sensors have been replaced and now enable the collection and transmission of data virtually in real time. Finally, the Blue Brain Project at EPFL is continuing its objective of creating a model of the entire mouse brain by 2024 based on models of brain tissues. The researchers actively involved in the project continued to complete the modelling of the different brain regions and tissues in 2022. Thanks to this modelling, they were able to gain new insights into the plasticity of the brain and how learning works. This work, produced in collaboration with international

science teams, was published in 2022, in addition to about 30 other publications related to the Blue Brain Project in the same year.

Swiss Roadmap for Research Infrastructures: implementation of the strategic projects

The implementation of the three research infrastructure projects of the ETH Domain enshrined in the Roadmap 2019 for the period 2021–2024 was well under way in 2022. Preparatory work for the comprehensive upgrade of the Swiss Light Source SLS (“SLS 2.0 project”) is in full swing. The first new special magnets needed for the infrastructure conversion have arrived at PSI, and numerous prototypes of critical components have been developed and tested before going into industrial series production. In May 2022, the Cantonal Council of Aargau also decided to support the project financially until 2026.

Catalysis Hub (SwissCAT+) is a technology platform to support the development of innovative catalytic processes in the field of renewable energy and chemicals. For this purpose, it uses state-of-the-art high-throughput technology in combination with computer-aided data analysis based on artificial intelligence (AI) and machine learning (ML). The main objective for the first years of the project is to provide the most appropriate and modern infrastructure for all aspects of catalyst discovery and development as well as to bring together the best available experts from the ETH Domain in this field. The year 2022 was primarily spent preparing the laboratories, recruiting the necessary staff, acquiring the main equipment and setting up the data processing system. The two hubs (at ETH

In the course of the SLS 2.0 upgrade project, more than 1,000 new magnets were installed on the electron storage ring. The first quadrupole electromagnets have now arrived at PSI and are being individually tested and measured.

> Mahir Dzambegovic / PSI



Zurich and EPFL) are now in a position to validate automated experimental procedures and initiate initial studies.

The new CSCS computer infrastructure was funded as part of the HPCN-24 initiative (HPCN: High-Performance Computing and Networking) and will, among other things, replace the current Piz Daint supercomputer from spring 2024. Work began in summer 2020 and will be completed in early 2024.

The Swiss Roadmap 2023 process also made good headway in the reporting period. The SNSF gave six of the eight projects proposed by the institutions of the ETH Domain an A rating. The ETH Board supports the inclusion of these six major research infrastructures in the Swiss Roadmap 2023. However, their implementation and funding will depend on the budget of the ETH Domain approved by the Federal Government for the period 2025–2028.

Involvement in international research infrastructures

The institutions of the ETH Domain participate in international research infrastructures, both in terms of development and with regard to their smooth operation. For example, CSCS is a member of the consortium that operates Europe's most powerful supercomputer, LUMI. It was officially launched in Finland in June 2022. Swiss scientists have access to the LUMI system thanks to Swiss Share. Furthermore, the Swiss Plasma Center (SPC) at EPFL is one of Europe's most important centres for fusion research. Its activities are supported by the EUROfusion consortium, which operates on behalf of EURATOM. As of June 2021, the EU no longer considers Switzerland to be a state involved in the construction of ITER. However, a cooperation agreement was reached between the European agency Fusion for Energy and EPFL at the end of 2022. Under this agreement, EPFL is allowed to participate in certain ITER-related activities even without being a member of EURATOM.

Participation in and access to international research infrastructures promotes cooperation and drives scientific and technological progress. For the past three years, NASA's InSight mission has been using a seismometer system developed by an EU consortium that also includes researchers from ETH Zurich to measure seismic waves on Mars. In the course of two large meteorite impacts on Mars, researchers from ETH Zurich, in collaboration with the InSight team of scientists, were able to observe seismic waves on the surface of a planet other than Earth for the first time. The evaluation of the seismic data from Mars has led to several publications over the last three years under the leadership of ETH Zurich.

In addition, Empa has developed the necessary basic instruments and configurations for the European CO₂-monitoring satellite Copernicus as part of its research activities.

Many of the international infrastructure projects in which the institutions of the ETH Domain are involved are located on the European continent. Through PSI, Switzerland is involved in the construction and operation of the European Spallation Source (ESS) in Lund, Sweden. Thanks to far-reaching advances in the project in 2022, three of the five planned instruments with PSI participation have already entered the installation phase on site. In addition to the above examples, PSI is participating in the EURO-LABS project. This is a decentralised research infrastructure service in nuclear and particle physics. The project, which will run for four years, was launched in 2022. PSI and ETH Zurich also participate in ReMade@ARI, a pan-European network of analytical research infrastructures to promote the circular economy. With the stations in Davos and on the Jungfrauoch, ETH Zurich, Empa and WSL are also actively involved in the pan-European greenhouse gas research infrastructure ICOS (Integrated Carbon Observation System), which contributes guidelines and measures against climate change and its consequences.

At the European level, coordination and cooperation in the development of major research infrastructures is ensured by the ESFRI Forum. Since association with the Horizon Europe programme is a prerequisite for participation in ESFRI, the Swiss delegation, including the experts working in the strategic working groups, is now excluded from the Forum.

Strategic objective

KNOWLEDGE AND TECHNOLOGY TRANSFER

4

With numerous patents, cooperation agreements and spin-offs, the institutions of the ETH Domain also contributed to the transfer of knowledge and technology in 2022 and thus to Switzerland's innovative strength. They have also maintained direct exchange with society in a variety of ways and have been active at the interface between science, politics and public authorities. They also play an important role in the generation project Switzerland Innovation.

Research cooperation with the Swiss business community and the public sector

By transforming scientific findings into marketable products and services, the ETH Domain makes a significant contribution to Switzerland's competitiveness and innovation. In the reporting period, the institutions of the ETH Domain 227 registered new patents and 180 licences as well as 310 invention disclosures and 37 software notifications (see p. 97). In addition, there were 556 collaboration agreements with the private sector and 281 with the public sector (see. Fig. 14, p. 98). Regular networking events such as the ETH Industry Day or EPFL's innovation forum "FORWARD" lay the foundation for multifaceted collaboration, which can include the most diverse types of cooperation partners. ETH Zurich, for example, launched two major programmes with Roche in the reporting period.

The pharmaceutical company will fund 20 research projects with doctoral students and postdocs in each of the next three to four years. PSI entered into a cooperation and licensing agreement with the start-up AlphaSYNT to bring the direct methanation for energy storage developed at PSI to the market. AlphaSYNT and PSI also jointly participate in a European collaboration to demonstrate the full value chain for the use of biomethane in the European transport and energy system. Empa, together with numerous large companies and the Tech Cluster Zug, has initiated a hydrogen-based demonstration plant with a view to decarbonising Swiss industry. At EPFL, the KNOVA programme launched in 2021 was in great demand. Many companies gain a year-long insight into the innovation potential of the academic world thanks to this novel concept.

When it comes to cooperation with Swiss SMEs, projects often proceed with the support of the funding agency Innosuisse. The projects approved last year under the new Innosuisse "Flagship" initiative have picked up speed. The institutions of the ETH Domain are closely involved in this new format, which aims to stimulate innovation in areas relevant to a large part of the economy or society. For example, EPFL and Empa, together with five other research institutions, are part of the CircuBAT flagship, which aims to develop a closed-loop model for batteries. In the PSI-led flagship DeCIRRA on the decarbonisation of cities and regions, in which ETH Zurich also participates, numerous workshops were held in the reporting period together with the more than 30 partner organisations, including on the topics of CO₂ transport and photovoltaics. Several Innosuisse innovation boosters also started again in 2022, for example the Empa-led booster on the circular building industry, which is dedicated to actively promoting circular building.

The two environmental research institutes WSL and Eawag often contribute their expertise in the context of collaborations with public authorities. In the reporting period, for example, Eawag researchers supported two municipalities in conducting extensive pilot studies on activated carbon filtration in their wastewater treatment plants. The ValueDecisions web app developed by Eawag can also be used in a variety of ways, e.g. by engineering firms or municipalities. The app helps professionals to analyse complex decision problems in a simple way, e.g. to choose the most appropriate flood warning system or the best replacement for an old sewage treatment plant. In 2022, WSL launched one project each on socio-economic scenarios for risk analyses and on the impacts of climate change on ecosystem services. This is part of the framework of the programme "Decision Support for Dealing with Climate Change in Switzerland", which is supported by the National Centre for Climate Service (NCCS), which promotes climate-compatible decision-making as a national coordination and innovation body. Internationally, WSL was able to contribute its expertise in this area to a working group of the Academy for Territorial Development of the Leibniz Association. New requirements require regional planning in Germany to derive flood protection specifications from the flood risk, also in order to achieve sufficient adaptation to climate change.

Favourable conditions for KTT and enterprise

A symbol of the entrepreneurial ambitions among students and researchers in the ETH Domain are the new spin-offs founded each year. These amounted to 54 in 2022 (see p. 97). Two of the particularly successful companies that transfer innovations directly into marketable products and services are presented in more detail in the report on p. 15 et seq. The method developed at PSI and used by the spin-off GratXray for improved early detection of breast cancer has been nominated for the European Patent Office's 2022 Inventor Award. Many of the prospective or already realised spin-offs are currently also to be found in the field of food tech or green tech. After "Planted", ETH Zurich has now announced plans for "Marbled Meat" and "Vegi-Shrimps". At Empa, viboo AG won the Greentech Start-up Battle at Swiss Digital Days 2022 and the Empa Innovation Award. The fledgling company offers a digital service to reduce the energy consumption of buildings by up to 30%.

In addition to the long-established funding programmes such as EPFL's "Innogrants", ETH Zurich's "Pioneer Fellowships" and PSI's "Founder Fellowships", Empa's "Entrepreneur Fellowship", which was introduced in 2021, was also advertised again in the reporting period. WSL also launched a new internal funding programme for implementation projects. This complements the programme for innovative research projects by focusing on projects that provide an additional benefit for practical application based on exist-

ing results, data or products. The new "blaze" programme introduced at EPFL in 2021, which mentors student initiatives on their way to market entry, is becoming established. Other structures in the ETH Domain that support entrepreneurship are also constantly being reviewed and expanded. For example, ETH Zurich 2022 established the Spin-off, Licensing, Equity and Compliance group as part of ETH transfer in order to simplify the technology transfer processes for start-ups. The institutions of the ETH Domain often also work together on this. For example, the glatec incubator of Eawag and Empa serves to promote start-up companies and research collaboration in the fields of materials science, environmental science and technology. In 2022, it supported various already established and three newly founded spin-offs. Empa offered an entrepreneurship course online and with an on-site boot camp for the first time in cooperation with ETH Zurich.

Innovation partnerships with business or private donors also promote entrepreneurship in the ETH Domain on a large scale. ETH Zurich launched a long-term partnership with UBS in 2022. "Entrepreneurial thinking and acting" is to be promoted over the next 10 years. Also in the reporting period, Wyss Zurich, a joint accelerator of ETH Zurich and the University of Zurich for regenerative medicine and robotics, extended its activities for another six to eight years thanks to another donation from Hansjörg Wyss.

National network of technology transfer centres in Advanced Manufacturing

In the context of the Federal Government's "Action Plan for Digitalisation", the ETH Domain played a key role in the establishment of the association of technology transfer centres in the field of "Advanced Manufacturing" (AM-TTC). The first two centres, ANAXAM and "Swiss m4m Center", are now supported by the Federal Government as research institutions of national importance. In the reporting period, ANAXAM completed projects with customers from the metal industry, among others, in which research using small-angle neutron scattering contributed to improving the material properties of steel. The "Swiss m4m Center" was the first customer to be allowed to commission a new type of 3D printing system and integrate it into the certified process for the production of dental prostheses.

Together, the two centres held an information and networking event in August 2022 on the topic of "Making technologies usable for industry", in which Hightech Zentrum Aargau was also involved.

At the end of the year, the AM-TTC Alliance and the Federal Department of Economic Affairs, Education and Research (EAER) also decided to fund two additional centres in the fields of collaborative robotics and photonics.

Strong involvement in Switzerland Innovation

With its various locations, Switzerland Innovation aims to improve networking between science and business and offer innovation-friendly conditions for companies and researchers. All locations were evaluated in 2022, the results of which will be incorporated into the further development of the Switzerland Innovation strategy.

At the Switzerland Innovation Park Zurich site on the Dübendorf airfield, the long-term rental solution for two hangars and several annex buildings was pursued by ETH Zurich in the reporting period. For several years now, student projects in electromobility and space have found ideal conditions for prototype development in Hangar 3 at the Dübendorf airfield. Joint projects with industrial partners are planned for Hangar 2. In the Park Network West EPFL, the establishment of the new Soft Landing Programme is underway, thanks to which the networking of the locations is to be intensified and foreign investments attracted. At Park Innovaare, PSI focuses on attracting established companies, including multinationals. These efforts were again significantly strengthened in the reporting period by an increase in staff. The new Switzerland Innovation Park East location benefits from close cooperation with Empa St. Gallen. In the reporting period, "Startfeld", the network for start-ups in St. Gallen, in which Empa is involved, merged with the Innovation Park. A series of joint presentations of the Innovation Park East with Empa was initiated.

Dialogue with society and tasks assigned by the Federal Government

Making scientific facts, problems and new findings accessible to a broad public is an important task of the institutions of the ETH Domain. The aim is to enter into a direct dialogue with the public on socially relevant research topics of the ETH Domain. The institutions live up to this task, for example, through exhibitions, of which there were many in 2022, often in connection with public events. Eawag presented the "Steinmann-Eawag Collection" with its unique archive of Switzerland's fish diversity from 1871 to 1953 at the Natural History Museum in Bern. PSI opened its completely redesigned exhibition in the Visitor Centre. Under the motto "Visiting the researchers", it uses interactive exhibits to convey the research focus of PSI in a playful way. PSI reached a particularly large number of people in October with its "Open Day", when around 15,000 visitors gained an insight into the research activities of PSI at over 40 stations and through guided tours, demonstrations and lectures. ETH Zurich participated in the Milano Design Week 2022 with the exhibition "Material Shapes the Ages" in the House of Switzerland, and the Department of Physics entered into a collaboration with Technorama Winterthur to bring quantum physics to a wider audience. With an exhibition in the main hall of ETH Zurich, the Energy Science Center offered visitors information on the energy system and the scenarios we may be moving towards. In the reporting period, EPFL organised the Scientastic science festival on the campus in Lausanne and in Sion and participated in other exhibitions and events such as the "Nuit de la Science" in Geneva and

Quantum physics holds enormous potential. Thanks to Empa's CarboQuant project, quantum physics is also to play a role in everyday life. The research is aimed at a building material for next-generation quantum computers (also see p. 29 et seq.).

A look into the shimmering golden chamber under the scanning tunnelling microscope, where material samples are being measured in a vacuum.



the BEA trade fair in Bern. Several institutions were also present at the OLMA public fair in St. Gallen, such as Empa together with Avenenergy Suisse on the topic of sustainable mobility and power-to-gas technology as well as with the Switzerland Innovation Park East on digital twins, and WSL as part of the Graubünden special show. This year's guest canton provided a platform for the WSL Institute for Snow and Avalanche Research SLF. The SLF's exhibit – artificial stone for rockfall tests – attracted many interested visitors, resulting in numerous valuable conversations.

A particular concern of the institutions of the ETH Domain is the promotion of young people's interest in the subjects of mathematics, information technology, natural sciences and technology (STEM). Many programmes for this target group are offered on a regular basis and are based on close cooperation with schools and baccalaureate schools. In 2022, EPFL expanded its range of "Pre-university weeks for high school students" with new courses, including "Decoding QR codes". With these "pre-university weeks", students can get an early taste of university life towards the end of their secondary school years. Empa in Dübendorf and the Innovation Network's Education Lab at Empa St. Gallen are visited by thousands of schoolchildren every year as part of various activities and guided tours. WSL launched the new Forte Edu web app in the school programme of the Swiss National Museum's "In the Forest" exhibition, which informs children about forests and climate change. Various programmes offered by the institutions of the ETH Domain are also specifically aimed at girls and young women. For example, EPFL has continued to expand its programme for girls aged seven to 16 to build confidence in their own abilities and encourage them to pursue STEM studies. In 2022, with a similar aim, PSI featured a number of outstanding female researchers from its own ranks to mark the International Day of Women and Girls in Science. Finally, ETH Zurich announced a particularly extensive initiative to increase interest in STEM subjects in the summer of 2022. As part of the strategic partnership with UBS, new communication channels are to be established over the next 10 years based on existing formats in order to promote enthusiasm for STEM subjects, especially among target groups that have been more difficult to reach to date.

An important aspect of the dialogue with society is advising public authorities and political decision-makers on current issues. In the previous year, there was a strong focus on scientific policy advice in connection with the coronavirus pandemic. The researchers also addressed this topic in 2022. For example, the Federal Government and the cantons have set up a new scientific advisory committee on COVID-19, headed by Professor Tanja Stadler (ETH Zurich). Furthermore, the monitoring of SARS-CoV-2 was extended to over 100 wastewater treatment plants based on the findings of the project by Eawag, EPFL and ETH Zurich to estimate the reproduction number. Together with researchers from the University of Basel, PSI developed a new type of rapid test that does not detect virus components but rather the antibodies produced by the immune system and thus also allows for conclusions to be drawn about the course of the infection and is transferable to other viral pathogens. In addition to the coronavirus pandemic, expertise in the security sector was also in high demand in the reporting period against the backdrop of Russia's war against Ukraine. For example, the Center for Security Studies (CSS) at ETH Zurich provided ongoing information on current developments, such as the publication of "Policy Perspectives". In structural terms, a central contact point was created at ETH Zurich in 2022 with the Science Policy Interface, which supports mutual contact and cooperation between researchers, politics and public administration.

With a focus on the topics of energy and sustainable development, the institutions of the ETH Domain were also involved in a variety of platforms, initiatives and exchange events at the interface between science, politics and public authorities. In the Strategic Area "Engagement and Dialogue with Society" of the ETH Domain 2025–2028, four Joint Initiatives (also see Objective 5, p. 68) were launched in 2022. One of these is in cooperation with the Museum of Transport in Lucerne and its planned new energy exhibition. ETH Zurich and EPFL are founding members of the Sustainable Switzerland dialogue platform launched in 2022. The dialogue platform is run by the company NZZ with partners from business and science and aims to raise awareness for sustainable development in Switzerland and contribute to cooperation. PSI organised an "energy briefing" in Bern in the summer, in which Empa also participated. Representatives from research, industry and federal offices discussed the topic of net zero CO₂. Eawag established the new exchange, information and networking platform "Swiss Groundwater Network".

In addition, the fishing advisory office (FIBER) run jointly by Eawag and the Federal Office for the Environment was extended for another four years. WSL provided an important foundation for the national drought early warning system with the drought.ch research platform, which is now being built by the Federal Government on this basis. Another focus of the WSL was on extreme events in its "WSL Forum Suisse Romande 2022", which was dedicated to the theme of "Extreme events in the forest – everyone has to act". The French-language event is an important contribution to reaching professionals in the French-speaking part of Switzerland.

Finally, the ETH Domain itself serves as a role model in the area of environment and energy, which is reported on in more detail in Objective 8 on p. 82 et seq.

In conclusion, reference is made to some current developments in the tasks transferred to the ETH Domain by the Federal Government in accordance with the Notes to the Strategic Objectives. Eawag and EPFL house the Swiss Centre for Applied Ecotoxicology. In 2022, the Centre worked together with two federal offices, among others, on the development of bioindicators for assessing soil quality as part of the National Action Plan on Plant Protection Products. WSL provides diagnostic and coordination services for the new regulations in the field of active monitoring for the protection of forests against harmful organisms. In 2022, after three successful pilot years, WSL and the Federal Office for the Environment supported an expansion of this area monitoring to other cantons. With its studies and experimental investigations, PSI's Laboratory for Waste Management contributed significantly to the scientific and technical basis for Nagra's siting proposal for a deep geological repository for radioactive waste, which was published in September 2022. The Swiss Seismological Service at ETH Zurich, as a specialised agency of the Federal Government, conducted experiments with various partners, including in the globally unique underground Bedretto Laboratory for Geosciences and Geoenergies, which was extended again in 2022.

Strategic objective

COOPERATION AND COORDINATION

5

Cooperation between the institutions of the ETH Domain and with other Swiss educational and research institutions continued to take place at a wide variety of levels in 2022. Hospitals were once again important partners for the wide-ranging activities in the field of medicine and medical technology. In the reporting period, the ETH Board also adopted the strategy for the locations of the institutions of the ETH Domain.

Cooperation within and outside the ETH Domain

Cooperation between the institutions of the ETH Domain was further strengthened in the reporting period through the new instrument of Joint Initiatives. Joint Initiatives are large, time-limited collaborative initiatives that typically involve at least two institutions. They take place within the framework of the five Strategic Areas defined by the ETH Board in its Strategic Plan 2025–2028 for the ETH Domain, which was adopted in 2022. The Strategic Areas aim to respond to some of the most pressing global challenges. In the two areas “Energy, Climate and Environmental Sustainability” and “Engagement and Dialogue with Society”, a number of Joint Initiatives were approved for immediate implementation in 2022 (see also Objective 2, p. 56, and Objective 4, p. 66). At the same time, the bottom-up initiative called ENRICH of the four research institutes of the ETH Domain, which was launched in

2021 and aims to strengthen their cooperation in a targeted manner, gained momentum. Two joint position papers on the topics of health and data science were developed with a view to the coming ERI period. In September, the “Sensors Marketplace” was held on the Empa–Eawag campus to identify synergies between the sensor specialists at the four research institutes and discuss joint project ideas. In addition, the research institutes are planning to jointly offer further education for their own staff in the future in the “Lead Campus”, i.e. under one organisational umbrella.

Alongside these new approaches, there are long-established formats of cooperation. In research, reference should be made to the SFA as well as to the cooperation projects in which complementary competencies of the institutions are used (see Objective 2, especially “Complementary competencies in the ETH Domain” and “Research priorities”, p. 56 and p. 58, respectively). The large research infrastructures are also important drivers of cooperation (see Objective 3, p. 60 et seq.). In teaching, the close cooperation is evident in the form of joint Master’s degree programmes and doctoral programmes. The participation of the research institutes in teaching and the joint supervision of doctoral students also plays an important role (also see Objective 1, p. 50).

Cooperation beyond the ETH Domain also plays a significant role. It is often common for several institutions in the field to collaborate with other national scientific partners. The Swiss Glacier Monitoring Network GLAMOS is operated jointly by ETH Zurich and the Universities of Fribourg and Zurich. The executive director is employed by WSL. The monitoring network registered record ice melt in 2022 – over 6% of the ice volume was lost in a single year. Empa, PSI and the

Bern University of Applied Sciences jointly organised the fourth Swiss Battery Days at Empa in August. Young researchers in the field of battery materials research and cell production were offered a platform there to present their results and establish international contacts. Eawag organised an information day on the “Dynamics of water” at EPFL, where experts were able to exchange information on new opportunities for collecting and using water data. In addition to the Eawag speakers, researchers from EPFL, the University of Lausanne and the Ecotox Centre also gave presentations. Long-standing cooperation between EPFL and the University of Lausanne also exists through the Social and Human Sciences (SHS) programme, the teaching programme of the College of Sciences of the University of Lausanne and the activities of “Sciences²”, in which lecturers from the two universities offer courses in each other’s fields to students from the other university. The Collegium Helveticum, a joint Institute for Advanced Studies of ETH Zurich, the University of Zurich and the Zurich University of the Arts, also focuses on interdisciplinarity. The Collegium offers a creative environment for the realisation of innovative scientific and artistic projects at the premises of the ETH Zurich Observatory. A new Fellow programme was introduced in 2021/2022, with a focus on promoting cross-disciplinary exchange and cooperation.

Structure of the Swiss higher education sector

As members of swissuniversities, ETH Zurich and EPFL are closely involved in shaping the Swiss higher education sector and have, for example, contributed to the Strategic Planning of swissuniversities for the years 2025–2028, which was adopted in the reporting period. Both universities have gone through the process for institutional accreditation in accordance with the HEaA (also see Objective 1, p.52 et seq.). All six institutions of the ETH Domain also participate intensively in the cooperation projects which the Federal Government funds in the context of the project contributions via swissuniversities. The ETH Board makes the funds for specific forms of participation centrally available to the research institutes that are not eligible for contributions. For example, as part of the programme “Diversity, Inclusion and Equal Opportunities in University Development”, ETH Zurich, EPFL and PSI, together with several Swiss universities and universities of applied sciences, are participating in the Fem-Spin project, which aims to promote equal opportunities in the area of spin-off activities through a specific focus on women (also see Objective 1 for participation in the programme “Strengthening Digital Skills in Teaching”, p. 52).

Cooperation between the different types of universities is also a central element in shaping the Swiss higher education sector. In the reporting period, the EPFL doctorate school renewed the agreement on the supervision of dissertations with the University of Applied Sciences and Arts of Western Switzerland and made preparations for a more comprehensive agree-

Hands-on research for young and old. The next Scientifica – the Zurich Science Days of ETH Zurich and the University of Zurich – will be held from 1 to 3 September 2023.

> Alessandro Della Bella/
ETH Zurich / UZH



ment aimed at strengthening co-leaderships. Finally, the ETH Domain also makes an important contribution to coordination with its research infrastructures, which are available to the entire Swiss research community. In addition to the activities mentioned in Objective 3 (see p. 60 et sqq., the Swiss High-field NMR Facility was also opened in the reporting period. This infrastructure in Biomolecular Structure and Function is operated by ETH Zurich together with the Universities of Basel and Zurich and is open to both the scientific community and industry.

Review of the function and structure of the ETH Domain

In order to maintain the leading role of the ETH Domain in the face of increasing global competition for the coming decades, the ETH Board has started work, with its eyes on the future, on the review of the function and structure of the ETH Domain. An initial analysis was carried out in the reporting period. Its objective was to develop a common view of the strengths and weaknesses of the structure of the ETH Domain. These discussions will be continued and expanded in 2023.

Strategic alliances

ETH Zurich and EPFL work closely with various Swiss technology competence centres and research institutes funded by the Federal Government within the framework of strategic alliances. ETH Zurich cooperates with inspire AG, the competence centre for technology transfer to the mechanical, electrical and metal industries, and with IRB, the Institute for Research in Biomedicine. The topics of the strategic alliance with inspire AG were revised in 2022. This was done partly for the purpose of enabling further professorships to cooperate with the competence centre and thus strengthen the alliance. EPFL maintains strategic alliances with the Idiap Research Institute, which specialises in artificial intelligence, CSEM and the Swiss Tropical and Public Health Institute (Swiss TPH). This cooperation includes both teaching and research as well as knowledge and technology transfer. For example, about 50 employees at Idiap are currently also enrolled in the doctorate schools "Electrical Engineering" and "Computer and Communication Sciences" at EPFL.

At CSEM, cooperation with EPFL is particularly prominent in photovoltaics research. In this context, the Micro-Manufacturing Science and Engineering Center (M2C), inaugurated in September 2022, with its infrastructure jointly supported by both institutions, offers a new place for intensive cooperation. As part of the strategic alliance between EPFL and Swiss TPH, the first publications of the two large SNSF Sinergia projects were published in the reporting period. A new project with the EssentialTech Center at EPFL is being developed. This will focus on developing an incubator for premature babies that is affordable for low- and middle-income countries.

Activities in the areas of medicine and medical technology

Several of the institutions in the ETH Domain are actively involved in medical and medical technology research, maintaining close cooperation with Swiss hospitals. For example, researchers from Empa and the University of Geneva, together with the Hirslanden Clinic, developed a new diagnostic procedure for strokes to enable the fastest possible selection of the optimal treatment (see p.31). A project by PSI, Empa and ETH Zurich together with the Cantonal Hospital St.Gallen examined the increase in the therapeutic effect of proton therapy through the use of nanoparticles. ETH Zurich strengthened its presence on the health campus of the Cantonal Hospital Baden.

Empa's content focuses on various approaches to improving medical wound treatment. In the reporting period, important insights were gained for the development of intelligent dressings that release drugs in a controlled manner. EPFL conducts intensive research at the interface of neuroscience, neurotechnology and artificial intelligence. Various faculties joined forces to found the Neuro-X Institute to advance interdisciplinary research into therapies for patients with neurological disorders. A large number of studies were published in 2022, including one on non-invasive brain stimulation, which can restore the acquisition of motor skills in people with reduced learning ability. Another project succeeded in developing a digital twin model of the fruit fly, which is of great importance for the production of bio-inspired robots. Diagnostics plays an important role at PSI. In cooperation with ETH Zurich, researchers developed a diagnostic method for tumours that is gentler on the kidneys, and in collaboration with the Children's Hospital Zurich, they conducted a study with 80 children to develop a breathing test for asthma. This is to make diagnostics possible without physical intervention.

Infrastructure initiatives were announced in the reporting period by the medical research centre of the Zurich university campus "The Loop Zurich", in which ETH Zurich is a founding member, and by PSI. "The Loop Zurich" launched an initiative for a central biomedical informatics platform. This aims to enable translational, data-driven medicine and make routine healthcare data usable for research. PSI received approval from Swissmedic to commission a new pharmaceutical laboratory for the production of radiopharmaceuticals for tumour treatment. The laboratory started producing small batches of highly specific medicines for Swiss hospitals in July, which cannot be produced for stock due to the short half-life of the radionuclides.

The ETH Domain also contributes to the training of the next generation of medical professionals: ETH Zurich with its Bachelor's degree programme in Human Medicine for 100 students per year and EPFL with its "gateway" to the medical faculties of the Universities of Lausanne and Geneva, which was also used by some students in 2022. A new MAS in Digital Clinical Research was also launched at ETH Zurich in the reporting period. The course of study is aimed at working healthcare professionals who are interested in clinical research issues related to novel technologies.

Strategy for the sites of the institutions of the ETH Domain

The national and international presence of the institutions of the ETH Domain extends beyond their original sites. The "associated locations" play an important role in the positioning of the ETH Domain, as they support technology transfer in particular and attract talent. In order to ensure a coherent strategic approach and to identify challenges at an early stage, the ETH Board developed a strategy for the associated locations and adopted it in 2022. It specifies criteria and processes for the establishment, renewal or closure of sites that work with cantonal or international partners. This includes academic and structural aspects as well as infrastructural, political and financial conditions. From now on, the associated locations will be evaluated periodically. Communication within the institutions of the ETH Domain and with the public will also be ensured.

Strategic objective

INTERNATIONAL POSITIONING AND COOPERATION

6

In 2022, the institutions of the ETH Domain were once again able to further strengthen their position as key players of global importance in teaching and research. They achieved this also thanks to extensive international cooperation projects and initiatives as well as an expansion of alliance networks. Where the associated locations abroad are concerned, a decision was taken in the reporting period to discontinue the EPFL location in the United Arab Emirates.

Attractiveness of the ETH Domain

The institutions of the ETH Domain attach great importance to remaining attractive to highly qualified foreign students, doctoral students and researchers. To recruit international students, the institutions of the ETH Domain award scholarships to study in Switzerland, among other things. For example, the Eawag Partnership Program (EPP), which was established in 2008, provides six scholarships annually for students from developing countries, creating sustainable contacts in African and Asian countries and institutions. In the reporting period, these went to doctoral students from Pakistan and Côte d'Ivoire, among others, for their research on faecal sludge. International summer schools also help the institutions of the ETH Domain to remain attractive to foreign students. For example, WSL organised several events in cooperation with vari-

ous universities and research institutions in Europe, covering a wide range of topics, such as forest ecosystems and land system science.

International mobility programmes are also an important means of making the ETH Domain more attractive to outstanding researchers. In particular, the COFUND programme of the European Marie Skłodowska-Curie Actions (MSCA) has so far been an important instrument within the Horizon 2020 research programme. One such programme is the EPFLglobalLeaders fellowship programme for doctoral students, which aims to teach transversal skills for solving global problems in the spirit of sustainable development. PSI has been running the COFUND programme PSI FELLOW since 2012, which has enabled around 30 postdocs to implement their research projects at PSI in each round of calls for proposals and – just like EPFLglobalLeaders – conducted its last round of calls for proposals in 2022. The successful programmes can no longer be renewed due to Switzerland's status as a non-associated third country in Horizon Europe (successor programme of Horizon 2020). As a transitional measure for the European mobility programmes, the SNSF created the individual Swiss Postdoctoral Fellowships on behalf of SERI. Also important for international exchange are the MSCA Doctoral Networks (Horizon Europe). PSI and WSL were able to become associated partners in several newly initiated networks. Funding for programme participation is provided by SERI.

The individual institutions of the ETH Domain offer individual mobility programmes. Outstanding postdoctoral researchers can transfer to ETH Zurich for two years with the ETH Zurich Postdoctoral Fellowships. The ETH Career Seed Awards also support promising young researchers at an early stage of their careers. The EPFL

doctorate school renewed an agreement with the Ministry of Education of Taiwan in 2022 to provide scholarships to highly qualified applicants from Taiwan for five-year research residencies at EPFL. The “Young Scientist Fellowship”, established in 2021, was awarded for the second time at Empa. This year it was awarded to an exceptionally talented young scientist who is researching the use of nanoparticles to deliver more efficient radiation therapy against cancer. Eawag awards one two-year postdoctoral fellowship per year, which in 2022 went to an environmental toxicologist working on the biotransformation of micropollutants in fish.

International cooperation

The institutions of the ETH Domain belong to various international networks and alliances. ETH Zurich and EPFL, for example, are members of the Global University Leaders Forum (GULF), the International Sustainable Campus Network (ISCN) and the European Association of Universities of Science and Technology (CESAER). ETH Zurich further strengthened its international ties by joining the ENHANCE Alliance in 2022, an association of 10 leading universities of science and technology in Europe. ENHANCE was established in 2019 as part of the European Universities Initiative launched by the EU Commission and aims to deepen institutional cooperation in Europe in teaching, research, innovation and services. EPFL, for its part, reaffirmed international cooperation within the framework of EuroTech

Universities, a network of six of the best universities of science and technology in Europe. The research institutes also participate in international cooperation and networks, such as Eawag's involvement in the Sustainable Sanitation Alliance (SuSanA), which is committed to the UN's Sustainable Development Goals. A special milestone in 2022 was the signing of a cooperation agreement between Switzerland and the European Space Agency (ESA) on the establishment of a joint competence centre at PSI, the European Space Deep-Tech Innovation Centre (ESDI). The centre will help to improve the transfer of scientific knowledge to ESA and the private sector. PSI chaired the League of European Accelerator-based Photon Sources (LEAPS) consortium in 2022. The WSL Institute for Snow and Avalanche Research SLF was given a new role in international cooperation. The World Meteorological Organization (WMO) designated the SLF as a leading competence centre for snow monitoring. In 2022, Empa was particularly involved in cross-border research cooperation by organising an international conference on isotopomers and isotopes, which was attended by researchers from 17 countries.

Bottom-up initiatives and collaborations also represent a central element of international cooperation among the institutions of the ETH Domain. For example, ETH Zurich cooperates with the University of Cambridge School of Physical Sciences as part of the newly founded Centre for Origin and Prevalence of Life,



The Blue Diversion Autarky Toilet works without being connected to a water supply and does not rely on sewerage, meaning it can also be implemented in areas with poor infrastructure. By separating the flush water, urine and faeces, the system also enables valuable resources to be recovered.

› Alessandro Della Bella / Eawag

which is headed by Nobel Prize laureate Didier Queloz (also see Objective 2, p. 55). Moreover, ETH Zurich and EPFL helped to establish the Institute for Computer Science, Artificial Intelligence and Technology (INSAIT) in Sofia, Bulgaria, which was officially opened in 2022. One of the LLB instruments (Small Angle Neutron Scattering) was transferred to the large-scale research facility SINQ of PSI, installed there and inaugurated in February thanks to a cooperation with Laboratoire Léon Brillouin (LLB) in France. Eawag researchers conducted a citizen science project in Zimbabwe, which for the first time scientifically recorded water pollution in a mining area with the involvement of the local population. Empa cooperated with the Technical University of Denmark (DTU) and the University of Copenhagen to explore how to create health-promoting foods and innovative biodegradable materials from sugar beet residues.

ETH Zurich and EPFL's two associated locations abroad contributed to the global reputation of the ETH Domain. For example, at the Singapore-ETH Centre (SEC), an international research team has been working on a high-resolution 3D mapping project to create a "digital twin" of Singapore's underground space. The mapping method, which is designed to increase efficiency in the planning of construction projects, may also be used in Switzerland in the future. Digital twins of urban areas, with which concepts for cooling urban space can be developed, were also the subject of research by an Empa scientist working at SEC as part of the Cooling Singapore project. The EPFL Middle East site in Ras Al Khaimah (United Arab Emirates) will not be continued despite the successful cooperation. Maintaining the site would have required a new funding model and significant investment. Since it was established in 2009, EPFL Middle East has trained numerous students and doctoral students in the field of energy and conducted a wide range of research, which has led to the establishment of successful start-ups, among other things.

Active role in the framework of the bilateral cooperation

Based on a mandate from SERI, ETH Zurich acts as the leading house for Switzerland's bilateral research cooperation with China, South Korea, Japan and the Association of Southeast Asian Nations (ASEAN) region. This involves support for cooperation between researchers from various Swiss universities and universities of applied sciences and their Asian partners. In addition, students and young researchers benefit from mobility or research residencies. Empa also signed a Memorandum of Understanding with the National Science and Technology Development Agency (NSTDA) of Thailand for the Southeast Asian region with the aim of promoting bilateral cooperation in research and innovation.

The African continent is also a priority region for bilateral cooperation. EPFL is represented in 18 African countries through the Excellence in Africa (EXAF) Centre, which was set up in 2019. A special focus of the centre in 2022 was on digital education and research. One example is the digital education platform "African Cities Lab", which is funded by the State Secretariat for Economic Affairs (SECO) and aims to contribute to sustainable urban planning and development on the African continent. ETH Zurich's ETH for Development (ETH4D) initiative further advanced its cooperation with Ghana. Not only was it possible to launch a Master's degree programme in mechatronics prepared and accredited in the previous year, but also to organise a summer school on global challenges in waste management (see p. 18). Eawag is committed to sustainable wastewater and solid waste management in small African towns as part of the Water, Behaviour Change and Environmental Sanitation (WABES) project funded by the Swiss Agency for Development and Cooperation (SDC). Empa and the Basel Agency for Sustainable Energy (BASE) have developed a mobile app for rural Nigeria that gives smallholders access to cold chains and lets them monitor the shelf life of their produce in order to minimise losses in food production.

As a result of the Russian war of aggression against Ukraine, the institutions of the ETH Domain have reviewed and partially terminated their cooperation with Russian partners. They also launched support programmes for affected students and researchers. For example, they provided Ukrainian refugees with work opportunities in the ETH Domain, extended fixed-term employment contracts and provided housing for new staff.

Strategic objective

SOURCES OF FINANCING AND ALLOCATION OF FUNDS

7

Important prerequisites for first-rate basic research are a solid financial basis and responsible management of funds. In 2022, the total federal contribution made up 71% of the total revenue of the ETH Domain, with 29% from third-party funding. The stable development of the total federal contribution thus forms a reliable basis for maintaining the strategic freedom of action and the independence of teaching and research.

Allocation of funds based on relevant criteria

In accordance with Art. 33a of the ETH Act, the ETH Board allocates federal funds (total federal contribution) to the institutions. The allocation of funding within the ETH Domain is governed by Art. 12(2) of the Ordinance for the ETH Domain. The Federal Council's strategic objectives for the ETH Domain, based on the corresponding expenditure ceiling, form the basis for the ETH Board's target agreements with the institutions.

When making these annual allocations of funding to the institutions, the ETH Board draws upon the budget requests of the institutions, the attainment of objectives and the assessment of their academic performance. The institutions' financial burdens on the basis of their teaching, research and knowledge and technology transfer (KTT) activities, as well as the tasks assigned by the Federal Government, have thus been given due consideration. The funding effectively available to the ETH Board (budgetary credits) is then decided by the Parliament in December. Any changes

in the funding available are taken into account when allocating funds in March of the following year.

The Federal Assembly approved a total of CHF 2,666m for the 2022 budget of the ETH Domain (FedD Ia of 16 December 2021) (see Fig. 1, p. 77). The budget growth requested by the institutions of the ETH Domain for 2022 exceeded the federal funding available in March 2021 by CHF 25m. The ETH Board therefore decided to finance the expenditure surplus from its reserves and allocated CHF 2,691m as follows.

It allocated CHF 2,504m for the institutions' base budgets:

– ETH Zurich	CHF 1,289m
– EPFL	CHF 688m
– PSI	CHF 295m
– WSL	CHF 62m
– Empa	CHF 107m
– Eawag	CHF 62m

CHF 172m was allocated for strategic projects of the ETH Domain:

- Research infrastructure/large-scale research projects: CHF 87m
- Strategic focus areas (SFAs): CHF 29m
- Incentive and seed capital funding, cooperation projects, other central and various expenses, as well as special funds: CHF 56m

CHF 15m was allocated for the ETH Board:

- Own consumption by the Administration of the ETH Board and Internal Appeals Commission

Development of third-party funding

Total 2022 revenue of CHF 3,729m consisted of the total federal contribution (CHF 2,643m, 71%) and revenue from third-party funding (CHF 1,086m, 29%).¹ The share of third-party funding was at the level seen in previous years. A long-term comparison shows that the share of third-party funding has increased (see Fig. 2, p. 77).

Having stable, sufficient financial resources is an important prerequisite for strengthening the national research landscape and positioning the institutions of the ETH Domain at the forefront in international competition. This creates the financial flexibility and planning certainty that is needed in order to be able to implement new developments in education and research. The expansion of the financing sources and the responsible, cost-effective use of entrusted financial resources are of key importance for maintaining the competitiveness of Switzerland as a centre of research.

Revenue from third-party funding showed a mixed trend in 2022. Compared with the previous year, revenue from third-party funding decreased by CHF 62m (previous year: CHF 1,148m). This was mainly due to negative net financial income and income from participations. On the other hand, donations and other revenue rose. Project revenue came in slightly above the level of the previous year.

With regard to 2022 revenue from third-party funding, about half stemmed from competitive projects that received national (SNF/Innosuisse: CHF 313m; 2021: CHF 309m) and European (Horizon 2020, ERC Grants, Horizon Europe: CHF 154m; 2021: CHF 160m) research funding (on the Swiss transitional measures for Horizon Europe, see next section). Other significant sources of funding were cooperation with the business sector (CHF 136m, 2021: CHF 136m), research funding from Federal Government projects (policy research: CHF 87m; 2021: CHF 87m) and cooperation projects with the cantons, communes and various international organisations (CHF 106m, 2021: CHF 95m). Other third-party funding included donations and bequests (CHF 138m, 2021: CHF 122m), tuition fees and revenue from continuing education courses (CHF 58m, 2021: CHF 56m) and the various service revenues (other revenue: CHF 157m, 2021: CHF 127m) and net financial income and income from participations (CHF -51m, 2021: CHF 54m).

Researchers at Swiss universities are able to participate in only a part of the Horizon Europe research programme, since Switzerland has the status of a non-associated third country. This is shown in the 2022 revenues with CHF 18m (see p. 108 and the Financial Report of the ETH Domain). The presented revenues do not correspond to the obtained third-party funds but rather to the progress made in the projects financed

with third-party funds. The dedicated third-party funds entered in the balance and the funding commitments do a better job of showing the success achieved in obtaining third-party funds (see next section). It is not yet possible to predict whether the transitional measures adopted by the Federal Government will be able to completely cover the gap that has arisen from the EU FPs. The institutions of the ETH Domain therefore support their researchers with various activities in order to diversify their financing sources. These include such measures as documentation about the wide range of financing options, like the Compendium for Collaborations at EPFL, and events for obtaining information and exchanging views that are attended by financing agencies and other funders.

When making an overall assessment of the development of third-party funding, it is also necessary to take into account the development of dedicated third-party funds from contracts recognised in accordance with IPSAS 23, as well as funding commitments.

- The dedicated third-party funds show the inventories of project commitments for which services are still to be provided in the following years. In 2022 they increased by CHF 36m (CHF 1,641m, thereof CHF 202m from Federal Government transitional measures; 2021: CHF 1,605m).
- Funding commitments (SNF, Innosuisse, EU FP) increased year-on-year by 27%. With CHF 201m of a total of CHF 492m, the Federal Government transitional measures had an effect in 2022 (2021: CHF 388m; 2020: CHF 468m).

With regard to projects financed by third parties, the incurred indirect costs are netted, where possible. Contributions for indirect research costs serve to partially cover the costs that the institutions incur from research projects. The attracted research projects must be consistent with the core mandate and strategy and be able to be carried out in the viable financial framework so that the base budget is not jeopardised. Different overhead contributions are generally an expression of the self-interest of the institutions involved, which varies from case to case.

Maintaining teaching and research freedom

The acquisition of third-party funding by the ETH Domain is regulated by the ETH Act, the ETH Ordinance and by various directives and guidelines on the level of the ETH Domain and the institutions. Compliance with them is checked continuously. The two Federal Institutes of Technology and the four research institutes guarantee freedom of teaching and research by ensuring that the research results of third-party funded projects can be published and that the publication freedom of funded persons and projects is assured at all times. Research freedom and the right to use research results are enshrined in the strategy for knowledge and

¹ This refers to the total federal contribution of the Federal Government as accounted for in the consolidated financial statements of the ETH Domain (financing contribution of CHF 2,441m and the federal contribution to accommodation of CHF 202m). On the other hand, the two approved loans, which are credited to the expenditure ceiling, amount to CHF 2,666m (financing contribution or operating credit: CHF 2,441m and investment credit: CHF 225m).

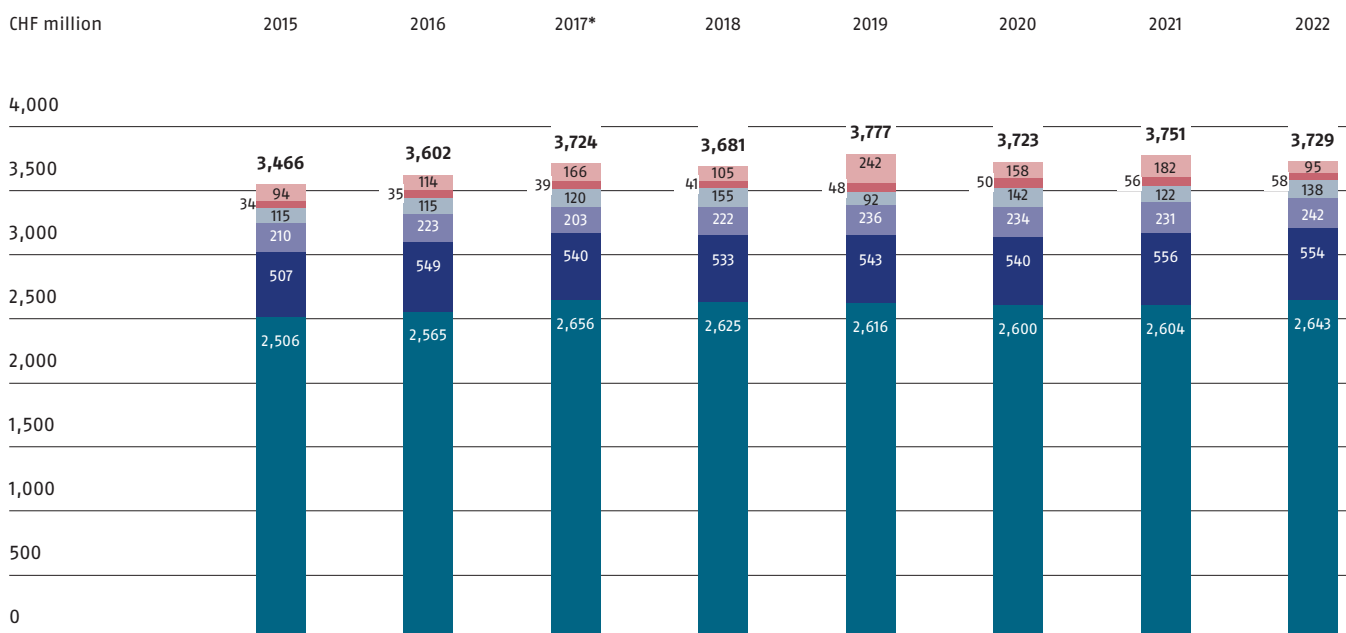
Fig. 1: Allocation of funding to the institutions of the ETH Domain (after taking into account the reallocation in credit/funds within 2022)

CHF millions	2018	2019	2020	2021	2022	Δ 2021/2022	
						abs.	%
ETH Domain^{1,2,10}	2,530.9	2,581.2	2,596.1	2,600.1	2,666.2	66.1	2.5
ETH Zurich ³	1,300.5	1,298.1	1,314.9	1,316.3	1,349.3	32.9	2.5
EPFL ⁴	664.9	664.8	698.4	712.1	725.7	13.6	1.9
PSI ^{5,6}	307.3	309.8	315.1	336.5	340.5	4.0	1.2
WSL ⁷	58.3	57.7	59.4	63.2	65.3	2.1	3.3
Empa ⁸	105.2	115.7	114.8	126.9	119.9	-7.0	-5.5
Eawag	61.5	60.5	62.2	62.2	62.8	0.6	0.9
ETH Board ⁹	33.2	74.7	31.3	-17.2	2.8	20.0	n/a

Additional information on the budget/financial statements 2022:

- ¹ Total allocation of funds in 2022.
- ² Annual tranches in accordance with the approved expenditure ceiling for 2021-2024 (credits taking into account the expenditure ceiling): annual tranche for 2022: CHF 2,661m/federal decree (FedD) on the budget according to FedD Ia for 2022: CHF 2,666m.
- ³ Including upgrade of the Sustained scientific user lab for simulation-based science at the CSCS (HPCN-24): CHF 23m, start-up funding President: CHF 3m, development of the Catalysis Hub Cat+: CHF 4m, streamlining of the real estate portfolio: CHF 10m.
- ⁴ Including the neuro information technology project, the Blue Brain Project: CHF 22m, development of the Catalysis Hub Cat+: CHF 3m.
- ⁵ Including upgrade of the Swiss Light Source (SLS 2.0): CHF 35m, Quantum Matter and Materials Discovery Center (QMMC): CHF 3m, CHART project: CHF 1m.
- ⁶ Including special funds (CHF 5m).
- ⁷ Including Next Evolution in Sustainable Building Technologies NEST and Empa Site Masterplan (total: CHF 11m).
- ⁸ Including start-up funding Director (CHF 3m).
- ⁹ Including strategic projects, financing the dismantling of accelerator systems at PSI (CHF 11m); reporting period 2022: the low revenue of CHF 3m takes into account that CHF 25m of funds allocated in 2022 were financed from the reserves of the ETH Board.
- ¹⁰ Including strategic focus areas (Personalized Health and Related Technologies, Advanced Manufacturing, Data Science): CHF 29m.

Fig. 2: Change in revenue 2015-2022



2015-2022

■ Total federal contribution

* including sub-consolidation ETH Zurich and EPFL from 2017

Third-party funding:

- Research contributions of the Federal Government and the EU
- Research contributions of the private sector, other cooperation projects
- Donations and bequests
- Tuition fees, continuing education
- Other revenue

technology transfer and in internal directives and are regulated in the research contracts with the donors. In addition, the handling of donations is regulated explicitly by directives.

Increase in efficiency and use of synergy effects

In 2022, all institutions introduced additional measures to reduce energy consumption in order, on the one hand, to achieve sustainability goals and, on the other, to attenuate the effects of rising costs. These include turning off unneeded equipment and choosing energy-efficient equipment for replacements, including in research. In addition, room temperatures were lowered to the minimum permitted by law, some buildings were no longer heated on weekends and hot water supply was discontinued in some cases.

Joint projects and the use of research infrastructures likewise result in significant efficiency increases and synergy effects. These include SFA projects and ENRICH, the bottom-up initiative started by the four research institutes that strengthens the cooperation in select scientific fields, with activities concerning sustainable development of the campus, and the coordination of complementary offers, such as a joint continuing education programme. The Swiss Data Science Center (SDSC), which is jointly operated by EPFL, ETH Zurich and PSI, makes it possible to concentrate skills in the key area of data science. ETH Zurich and EPFL are generating positive effects with various platforms shared by the researchers. On the one hand, the shared use of equipment greatly increases the degree of their use. On the other, the pooling of equipment makes it possible to optimise investments.

Use is also made of synergies from various administrative and logistics activities. For instance, Empa, Eawag and WSL operate the joint finance platform SAP 3RI, and Eawag is home to the library Lib4RI shared by all four research institutes. The reporting platform SAP FC, which is used by the entire ETH Domain, has also proved effective. When new accounting standards are introduced, a cross-departmental, coordinated procedure is likewise specified. All institutions contribute human resources to the responsible centre of excellence IPSAS. In order to ensure an efficient operation, ETH Zurich moreover pooled liquidity for the entire ETH Domain. Coordinated procurement within the ETH Domain (KoBe ETH+) and the procurement platform used together with the University of Zurich achieves significant savings. Moreover, in all institutions, various digitalisation projects have been implemented in the research support processes or are being advanced. This not only makes the organisation more efficient, but also more resilient to events such as a pandemic.

Reserves

In the context of the strategic objectives 2021–2024 set by the Federal Council for the ETH Domain, the Federal Council expects other equity (sum of the reserves with internal dedication, the reserves without dedication and the accumulated surplus/deficit) to be reduced by at least 10% by 2024. Donations, bequests and reserves from associated entities are excluded from the strategic objective. They must be used in accordance with the donors' external specifications.

The reserve target, other equity, amounted to CHF 1,402m at the end of 2019 and to CHF 1,416m at the end of 2022. The value at the end of 2019 constitutes the baseline figure for the reduction target. Since then, the reserves with internal dedication and reserves without dedication have been reduced by CHF 170m, which was offset by an increase in the accumulated surplus of CHF 184m. The increase includes, inter alia, the accounting gain of CHF 53m generated in 2022 from the contract concluded for the planned purchase of the previously leased SwissTech Convention Center (STCC) by EPFL. The purchase, which is expected to close in 2024 at the earliest and by the end of 2026 at the latest, is being financed from the reserves, which will then be reduced by the agreed purchase price of CHF 140m.

The reserves in the ETH Domain have been managed actively for years. As part of its reserve policy, the ETH Board issued guidelines on this topic for the ETH Domain in 2019. The institutions regulate the operational reserve management in internal directives and regulations. The details on the use of funds from the reserves are published in each case in the Financial Report of the ETH Domain. The targeted appropriation of reserves for setting strategic focal points in teaching and research and realising large-scale research infrastructure is integrated into the institutions' budgeting and planning processes. This ensures that the reserves and all funds are appropriated in a sustainable manner in accordance with the strategy.

Dismantling and disposal of accelerator plants

Radioactive waste arises from the use of nuclear energy and ionising radiation applications in medicine, industry and research (MIR waste). The Nuclear Energy Act and the Radiation Protection Act set out the requirements for disposal. The financing of the provision for the decommissioning of the PSI accelerator plants (CHF 536m) will be provided by means of annual savings which will be added to the financing contribution. As at the end of 2022, the savings amounted to a total of CHF 54m (savings amount in 2022: CHF 11m). PSI has so far used around CHF 11m (2022: CHF 4m) of the accrued savings for measures in connection with the decommissioning.

Strategic objective

REAL ESTATE MANAGEMENT AND SUSTAINABILITY

8

The turmoil caused by the coronavirus pandemic in 2020 and 2021 was followed in 2022 by the global uncertainty brought about by the war in Ukraine. Persistent supply bottlenecks, delivery delays and, moreover, a considerable jump in inflation caused problems for the construction industry and thus for the projects of the ETH Domain. Approved contingent credits are coming under pressure. In addition, teaching and research institutions are facing sharply rising energy costs as well as energy shortages.

Strategy and long-term portfolio development

Balancing the requirements of teaching, research and KTT with the fulfilment of the Federal Government's specifications with regard to real estate management, while at the same time preserving value and functionality, poses a considerable challenge with the available resources. Other factors that severely limit the expansion of the real estate portfolio include increasing statutory restrictions and the added costs associated with the modernisation work needed for the often historical building stock.

ETH Zurich has set down its vision – “Real estate creates an inspiring environment for the ETH Zurich of today and tomorrow” – in 10 principles. They are given greater specificity under the headings “Academic Strategy Process”, “Cost Effectiveness” and “Sustain-

ability”. The assumption is that the number of students will rise continuously until 2030 with reduced growth in financial resources. Repeated reprioritisation processes, a more efficient use of existing spaces and the implementation of forward-looking workplace designs (multi-space/desk-sharing) are intended to provide some relief here.

At **EPFL**, the inter-communal master plan of the eight municipalities to the west of Lausanne was approved by the cantonal government. The City of Lausanne and the Canton of Vaud were presented with the joint vision for the development of EPFL and UNIL (EPFL-UNIL Hautes Ecoles master plan), which dealt with the provision of areas in the north for expansions. The continuing coronavirus pandemic prompted extensive considerations about workplace plans, the future workplace supply, forward-looking teaching methods, like MOOCs (massive open online courses) and DLLs (rooms for practical and multidisciplinary working), and the future of work, such as teleworking, desk-sharing and spatial consolidation. Laboratories are in considerable need of renovations and technical as well as safety modifications. At the same time, the vision of an “Advanced Science Campus” was developed.

At **PSI** as well, the core elements of the real estate strategy include implementation of the workplace plans, particularly for new buildings. In addition, units are to be relocated to the Park Innovaare in order to spatially consolidate other areas, free up space for repurposings, refurbishments and earthquake retro-fittings, and support the project SLS 2.0. This also helps cover the office and laboratory needs identified in the spatial and financial master plans (SFMPs) and achieve thematic clusters. Moreover, by continuing to dismantle decommissioned nuclear installations and by demolishing select buildings, further construction

sites are being created for the planned PSI Campus 2030. The building services engineering and the laboratory infrastructure at **Empa** properties, which are more than 50 years old, no longer satisfy current requirements. Modern laboratories are urgently needed, i.e. dry and wet chemistry laboratories, as well as clean rooms. The further implementation of the Master Plan **Empa Eawag** Research Campus on the Dübendorf campus should ease the situation here in the medium term.

Raw material prices and construction costs, which rose further in 2022, as well as significantly higher energy prices (electricity, gas) and energy shortages, prompted all six institutions to launch additional programmes to increase efficiency with regard to energy consumption and space management and to generate electricity using photovoltaics. In 2022, a substantial portfolio change was also made in the ETH Domain. ETH Zurich exchanged a property in the residential zone for one near the university in the centre of Zurich for future development.

Real estate management in figures

The purchase value of the ETH Domain's real estate portfolio at the end of 2022 amounted to CHF 8.43bn. In terms of value, this represents about one-third of the entire real estate portfolio of the Federal Government. The book value is around CHF 4.16bn. The ETH Domain uses around 400 buildings on 120 plots of land. The main usable area reported at the end of 2022, which covers 1,022,530 m², is up 1.4% compared to 2021. The mix of space (see Fig. 28, p. 104) – consisting of spaces in state-owned buildings for own use and use by third parties and leased spaces in third-party buildings (in m² of main usable area since 2013) – shows how some of the growth in recent years was only able to be covered using additional leased spaces. The lease rate of the ETH Domain remains low at 15.9% of the main usable spaces. The growth in leased spaces after 2013 is attributable to the newly defined, statistical allocation of the spaces. Without this effect, there would be a decrease in the spaces used by third parties.

Ongoing and completed projects

The demand for new buildings, expansions and repairs remains consistently high. In 2022, numerous new projects were launched to maintain value and functionality. Refurbishments are being carried out with a view to improving use, operating costs, energy status, disabled access and earthquake safety, among other things. The Federal Government's specifications issued in 2020 in the area of workplace design (including multi-space/desk-sharing) had an impact on the institutions' long-term portfolio planning. At **ETH Zurich**, the special building regulations for the Höggerberg campus entered into effect for the "Höggerberg 2040 Master Plan". The following major ongoing construction projects were continued: new GLC

research building with laboratory and office spaces for the health sciences, refurbishment and expansion of the ML/FHK Machine Laboratory with centralised energy supply for the Zentrum location, the renovation of the covered car park and forecourt at HG in the centre of Zurich and, in Basel, the new BSS building. Construction delays were encountered during work on the GLC and BSS new building projects, as well as added costs with GLC. The ETH Board requested an additional credit for GLC in supplement Ia to the 2023 budget. With regard to BSS in Basel, reciprocal claims with the general contractor and the consequences of incurred delays were able to be cleared up for the time being. Refurbishment work and construction of the new HIF building continued at the Höggerberg campus. In addition, construction started on the new HPQ physics building on the Höggerberg campus for quantum physics research. At **EPFL**, the legal mandate to maintain value and functionality in the case of energy projects was implemented by renovating the energy centre and expanding the lake water pumping station. The DLL EL Engineering building was commissioned. In addition, all sanitary facilities in the CM building were reconstructed to be gender-neutral, with the work also including the integration of concepts for the reuse/recovery of wastewater.

On the **PSI site**, it was possible to implement several measures of the PSI Campus 2030 working group, such as designing rooftop gardens and pedestrian zones. Work also began in 2022 on preparation of the PSI site master plan together with the ETH Zurich Chair of Landscape Architecture, and shell construction was completed for the new OBBA office building. The expansion of the ORAB Swiss Federal Interim Storage Facility has reached the point where commissioning can begin. Work continued on the construction of the new Kiwi nursery building and the new Quantum Matter and Materials Discovery Center (QMMC), on the dismantling of the WWPA (electrical workshop) and on various small refurbishments. **WSL** completed the replacement construction for Building D in Davos (SNBS platinum certificate and Minergie-P ECO standard) (see also p. 28). Employees moved into the building in the autumn of 2022. In addition, BBL took over a guest-house in Cadenazzo. In Birmensdorf, planning continued for the workshop building (in Minergie-P ECO standard). The joint construction project Master Plan Research Campus **Empa Eawag**, stage 1, is making rapid progress, and the topping-out ceremony took place in the summer of 2022. Among other things, urgently needed modern laboratories are being built there. In addition, 144 ground probe holes were drilled for the new seasonal geothermal storage unit. Both institutions are also continuing to implement their strategies for creating desk-sharing workplaces. Various flat roofs were refurbished at the Dübendorf site and given a safety upgrade.

The Stiftung Baukultur Schweiz (Swiss Building Culture Foundation) has awarded the new SLF construction in Davos with the SNBS platinum certificate. Design: Schwarz Architekten, Zurich.
 › Clemens Güdel



Investments and source of funds in 2022

The 2022 investment credit for buildings in the ETH Domain amounted to CHF 224.76m. It stood at roughly the level of the previous year (CHF 226.75m) and thus higher than the long-term average. In light of the uncertainties due to the pandemic and the war, a credit reallocation of CHF 20.86m took place between the investment credit and the federal financial contribution. No dedicated reserves were created. Some 49.4% of the investments related to new buildings, and 50.6% to ensuring that value and functionality were maintained. No third-party funds were used for federal real estate (co-financing). CHF 91.8m was used from the federal financial contribution for investments in user-specific operating facilities that will be owned by the institutions. These investments were supplemented by third-party funding of CHF 0.9m. The total volume of construction authorised by the ETH Domain in 2022 amounted to CHF 317.8m (see Fig. 30, p. 105). The ETH Domain received an accommodation credit of CHF 201.0m in 2022 for the imputed rent on federal real estate. The Source of Funds chart (see Fig. 25, p. 103) shows the sources of funds for the buildings in the ETH Domain since 2013. The annual fluctuations are dependent on the type of grant and the status of the current construction projects.

Construction programme for 2022

In the case of new construction projects planned in the context of new builds, extensions or refurbishments, the ETH Domain applied for the necessary contingent credits with its annual construction programme in 2022. The 2023 construction programme totalling CHF 204.0m (total credit), approved by the Federal Parliament on 8 December 2022, includes the following major projects: ETH Zurich requested a contingent credit of CHF 31.1m to build a new HRZ data centre (Hönggerberg campus), a pure infrastructure building without workstations. EPFL requested a contingent credit of CHF 34m to purchase a right to use UNIL's new Sciences de la Vie (SDLV) building on the

Dorigny campus, based on a collaboration agreement between EPFL and UNIL. PSI requested a contingent credit of CHF 22.5m to construct the new QMMC laboratory building in Villigen. In addition, it requested an additional credit of CHF 5.4m to complete the dismantling of the PROTEUS research reactor in Villigen. A contingent credit of CHF 111m was requested for additional real estate projects in the ETH Domain. Accordingly, construction projects costing up to CHF 10m are being carried out, and projects over CHF 10m are being planned.

Maintaining value and functionality

The ETH Board is legally obliged to maintain the value and functionality of the properties of the ETH Domain, and this is in the interests of the Federal Government as the owner of the real estate and of the ETH Domain as the user. Despite the advanced age of some of the buildings and their intensive use, the current condition value of 81.1% determined in 2022 remains constantly high in relation to the new value (see Fig. 26, p. 103). The refurbishment work on the historical building stock is considerable in some cases, leading to challenging projects. Renovation projects in excess of CHF 473.3m are currently included in the 2023–2026 real estate investment plan. They triggered an investment volume of some CHF 317.5m in 2022. In addition, ongoing maintenance work amounting to about CHF 50m on average is funded from the federal financial contribution. Consequently, the ETH Domain demonstrated that it is using the building stock provided by the Federal Government responsibly and sustainably.

Coordination tasks

In 2022, the Real Estate department of the ETH Board once again coordinated the interests of the institutions of the ETH Domain with those of the Federal Administration in the development of norms, standards and guidelines for the planning, realisation and operation of real estate. This coordination takes place with the participation of the institutions and includes

their co-determination and active involvement in this process. The most important topics were structural reforms and environmental and energy-saving measures in view of an imminent energy shortage, which would be a substantial risk for the energy-intensive teaching and research institutions. In the field of sustainability, the Real Estate department has played not only a coordinating role but also a role in shaping various working groups on topics such as digitalisation in the construction sector, building culture, life cycle costing, energy and the environment (pursuant to the Exemplary Energy and Climate initiative, EEC). Moreover, the ETH Board is a member of the Coordination Conference of Public-Sector Building and Real Estate Authorities (KBOB) and the Office for University Buildings (FHB) of the University Council of the Swiss University Conference.

Governance

With the publication of the audit report BE 21214, the Swiss Federal Audit Office (SFAO) confirmed the functioning of the supervisory function of the ETH Board as a building and real estate authority in real estate management of the ETH Domain, with regard to which operational responsibilities and powers are largely delegated to the institutions. In a further audit, it also confirmed the existence of an internal control system (ICS) in the financially relevant processes of the ETH Domain real estate. Governance and the ongoing improvement processes prove a careful handling of the Federal Government's real estate that has been made available for use. After a year of practical application, the minimum standards in the management of the construction projects of the ETH Domain were updated by the ETH Board and the institutions jointly. In the estimation of the SFAO, they have become well established and form a sound basis for managing and documenting the construction projects. Case studies of nine selected projects of all institutions were used to plausibilise the cooperation of the ETH Board with the project management of the institutions.

In June 2022, after several years of negotiations, EPFL, the ETH Board and Credit Suisse Funds AG were able to agree on a premature reversion of the SwissTech Convention Center (STCC). The STCC is strategically important and operationally necessary for teaching, research, and knowledge and technology transfer. It

was constructed on the Ecublens campus in 2010 under a building right and has been leased by EPFL since 2014. The required contingent credit was requested in supplement II to the 2022 budget and approved by the Federal Parliament. The reversion indemnity of CHF 146m will result in considerable savings of lease costs and amortisation payments (buying is less expensive than leasing). The project implements a recommendation made by the SFAO in 2016. This transaction will be financed from the EPFL reserves. Transfer of ownership will take place between 2024 and 2026.

Environment and energy: between ambitious objectives, major accomplishments and shortages in 2022

In 2022, the ETH Domain once again increased its efforts in the field of the environment, energy and sustainability and took further steps towards meeting the objectives. At the same time, the second half of the year was marked by the preparation for possible gas and electricity shortages in the winter of 2022/2023.

The "Climate Package" passed by the Federal Council in 2019 set ambitious objectives for the ETH Domain, including with respect to CO₂ emissions. In addition, the ETH Domain plans to play a social pioneering role in the area of climate protection. Numerous projects, measures and ideas leading in new directions are intended to reduce CO₂ emissions as quickly as possible in the area of buildings, in research processes and in procurement.

For the purpose of CO₂ reduction and offsetting, an overarching concept was drawn up for the entire ETH Domain and elaborated by the institutions: For instance, in October 2022, ETH Zurich published the white paper "ETH Zurich striving for net zero by 2030", which contains a qualitative reduction path, as well as the concrete strategy Net Zero CO₂ by 2030 for the Hönggerberg site. EPFL is in the process of preparing its climate and sustainability strategy 2023–2026. In connection with this strategy, it set up a climate planning fund (CHF 2m by 2024), e.g. for giving buildings an energy retrofit. All institutions have a strategy for the sustainable construction and refurbishment of their properties. At WSL, a building was commissioned (Davos D) that has been awarded Minergie-P ECO and SNBS platinum, the best possible level of the Swiss

Strategic real estate management in the ETH Domain

Efficient building infrastructure is a central requirement for enabling both Federal Institutes of Technology and the four research institutes to achieve their targets in teaching and research and to meet the required quality standards. The real estate of the ETH Domain is owned by the Federal Government. The investment credit for construction is earmarked annually in the budget. It appears in the state accounts under the Federal Department of Finance (specifically the Federal Office for Buildings and Logistics, FOBL). As one of the Federal Government's three building and real estate authorities, the ETH Board assumes the ownership role in trust. It is responsible for the real estate portfolio of the ETH Domain and consults the institutions

on strategic real estate management in order to ensure the functionality of the real estate portfolio in the medium and long term and to preserve its cultural value. Needs-based planning, and the timely realisation of new construction projects, conversions and refurbishments, are at the heart of its remit. The preservation of value and functionality is the result of needs-based planning, geared – also in the interests of the owner – towards cost/benefit considerations, as well as corresponding controlling at ETH Board level. The owner is kept abreast of this by way of reports from the ETH Board.

building labels.

The reduction of CO₂ emissions at source is making great progress, particularly in the area of building services engineering systems. For instance, ETH Zurich commissioned the cooling network ETH Zentrum (partial network), which enables the intelligent use of waste heat. EPFL commissioned an energy centre coupled with a 2 MW data centre in order to use heat and cold exchange and in that way to increase the efficiency of heat pumps and server cooling systems. At PSI, the Aare water pump station is being converted to enable the efficient supply of cold water to the accelerator facilities. On the campus of Empa and Eawag in Dübendorf, a new energy system is currently being implemented, which at mean temperature level enables use of waste heat via ground probe fields.

However, the measures still being implemented to prevent COVID-19 infections (particularly room ventilation) are continuing to result in an added need for energy and thus in higher CO₂ emissions.

In order to accelerate operational climate protection in the ETH Domain, the ETH Board, at the suggestion of its president, pledged CHF 10m from the reserves of the ETH Board as seed funding for additional climate protection measures. The seed funding is intended to further lower own energy consumption, produce additional renewable energy and reduce CO₂ emissions by about a further 4%. The projects financed with this include an additional geothermal probe field at ETH Zurich, the installation of additional photovoltaic systems at all six institutions of the ETH Domain, and efficiency increases relating to the operation of research facilities and energy retrofitting of buildings.

All of the institutions of the ETH Domain have programmes, policies and regulations in place to reduce business travel. The aim is to reduce the impact that the institutions have on the climate and at the same time to ensure that research and teaching operates at a high level. With regard to commuting, incentives are in place for switching to public transportation, non-motorised transportation or low-emission vehicles. Pursuant to the requirements, business flights should be reduced to a minimum.

The ETH Domain has long been committed to the circular economy, a topic considered in Switzerland to be worthy of exploration. For example, a voluntary Circular Economy Charter is currently being developed under the aegis of Empa and AWEL (the Office for Waste, Water, Energy and Air of the Canton of Zurich). At ETH Zurich, a first attempt was made to record the material content of an existing building using scans and the manual assignment of materials. At PSI, chemicals management was reorganised and now ensures the seamless traceability of ordered chemicals, up to and including final collection at the newly developed collection site for the purpose of profes-

sional disposal.

Sustainable management of green spaces has a very high priority at the institutions of the ETH Domain. They follow the biodiversity strategy and the Swiss Landscape Concept of the Federal Government. The majority of the sites are certified and recertified by the foundation Nature & Economy. In 2022, the ETH Domain additionally concluded a declaration of commitment with BAFU concerning the sustainable management of green spaces, including a commitment not to use peat. To implement this operationally, ETH Zurich developed a far-reaching sustainability and biodiversity concept for the Hönggerberg campus, for example. At PSI, the "biological success monitoring" by SwissFEL recently confirmed that the efforts to achieve the highest possible biodiversity at the facility are bearing fruit. In a meadow at Eawag, which had been used as a car park, the gravel was used to lay out a low-nutrient meadow.

Developed and already in use at Eawag, all new sanitary facilities at the EPFL campus will also be outfitted with a system for separating water (grey, yellow and black water). Long-term plans call for the installation of a urine-processing system to extract fertiliser for agriculture and/or forestry.

The ETH Domain has been participating in the VBE initiative since 2014. Objectives in this regard include expansion of the ETH Zurich Energy Grid and sustainable campus catering, such as at WSL and EPFL, which at EPFL will lead to the provision of 80% vegetarian or vegan offerings in the cafeterias by 2030.

Due to the war in Ukraine, it became clear in the summer that gas and electricity shortages could occur in the winter of 2022/2023. The institutions of the ETH Domain prepared for this new challenge individually, but in close coordination with the other federal building and real estate authorities and with ASTRA. Geopolitical developments influenced and, in some cases, accelerated the implementation of the plan to reduce and optimise energy consumption.

In this regard, added costs are also expected for energy deliveries, which will likely amount to about CHF 7m in 2022. Even higher added costs are expected for 2023.

Strategic objective

WORKING CONDITIONS, EQUAL OPPORTUNITIES AND YOUNG SCIENTIFIC TALENT

9

The HR policy in 2022 was shaped by future of work topics – such as changed forms of working, with the focus on working from home, desk-sharing, mobile working, digitalisation and modern work environment – and by respect campaigns, continual development of managers and further development and expansion of social and leadership skills, as well as by raising awareness for diversity, equal opportunities, sexual harassment and bullying.

A work attitude based on integrity

At **ETH Zurich**, social and leadership skills were developed and the important values of respect and integrity were enhanced in workshops and meetings. Managerial staff were advised and supported by specialised teams, speakers were invited to talk about the topics of diversity, inclusion and integrity, and e-learning on the handling of sexual harassment was introduced. For professors, conflict mediation discussions were created as part of the offering “Science Friction”. **ETH Zurich**, **EPFL** and **PSI** actively participated in the design of the Advanced Academic Leadership Program for professors of the ETH Domain with management responsibility beyond their field. When a new position was taken, ETH Zurich offered specific continuing education and support at all hierarchical levels, developed e-learning courses, such as Research

Integrity and Respect, and created a Respect Compliance Officer position to resolve conflicts. At **PSI**, the first Leadership Days were held for all managers on cultural and leadership development, with a focus on the challenges for the working world in the “new normal”, as well as an obligatory online training course on the topic of respect. **WSL** focused on management training courses and individual development programmes. The 2022 employee survey showed a high degree of satisfaction. A further point of emphasis was the introduction of a modern timekeeping tool. In connection with the onboarding of new employees, **Empa** rigorously focused on imparting the guidelines for integrity in research, compliance and the Code of Conduct. At **Eawag**, speciality-, management-, skills- and soft-skills-based training courses were offered, and learning objectives were tied to new requirements and needs and integrated in the sequences.

Working conditions, development and continuing education

All institutions of the ETH Domain carried out a variety of training sessions, courses and continuing education offerings, which were continually revised and adapted to meet the corresponding needs. Changed forms of working and the period after the pandemic were addressed at **ETH Zurich** under the title “Future of Work”. For the preceding phase, “Return to the Office”, guidelines were presented with which teams and research groups could develop the form of collaboration. The findings were then utilised and expanded upon via a survey for all employees. In order to develop and promote management skills, **EPFL** offered management training courses, including hybrid courses, for professors and managers. At **PSI**, the training course “CAS Leadership in Science” was developed further for all managers and specialists, and it is being

conducted with the FHNW (University of Applied Sciences and Arts Northwestern Switzerland) and the other research institutes. For managers of the ETH Domain who have the potential for top positions in teaching, research or administration, as well as on national and international bodies, the Advanced Academic Leadership Programme (AALP) at the International Institute for Management Development (IMD) in Lausanne took place for the first time. **WSL** focused on targeted career planning for scientific and technical staff. New permanent management and tenure-track positions were created, and employees were given internal job promotions. **Empa** focused on basic management training courses and also on the "CAS Leadership in Science". It trained staff on conflict management and supported doctoral students and postdocs in advancing their professional careers. **Eawag** further expanded the diverse offer of in-person and hybrid events. Career workshops, courses in project management and presentation techniques for doctoral students and postdoctoral researchers, as well as for scientific and technical staff, made a successful contribution to personal and skills development.

Giving priority to domestic labour force potential

All institutions took suitable measures in order to meet the legal requirement to give priority to employees living in Switzerland. They took into consideration the statutory criteria and recommendations in the recruitment of new employees. Open positions in the administrative and technical area are posted on the institution websites and Swiss job sites and are reported pursuant to the RAV (regional employment agencies) statutory rules. PSI collaborates with the business development office of the Canton of Aargau on the "Work Life Aargau" site.

Equal opportunities, diversity and inclusion

In order to promote equal opportunities, all institutions in 2022 launched various programmes and measures, worded job postings in a gender-neutral manner or developed inclusive communication concepts. As part of its general action plan, **ETH Zurich** implemented numerous programmes, such as H.I.T. High Potential University Leaders Identity & Skills Training Program, CONNECT, in order to bring young scientists together with role models in industry and the public sector, Fix The Leaky Pipeline and training courses on unconscious bias. **EPFL** is underscoring the importance of equal opportunities with a project to raise awareness of inclusive communication and with special video presentations, as well as by organising workshops. The research institutes **PSI**, **Empa** and **Eawag** created the joint PSI-Empa-Eawag Competence Centre for Diversity & Inclusion (D&I) in order to exploit synergies. A regular exchange of views also took place with the PSI employee representative groups, the Equal Opportunity Committee (KfC), the Personnel Commission (PeKo) and the PhD & Postdoc Association (PPA). In its current gender action plan, **WSL** focused on careful

communication and, whenever possible, included all genders. It took part in the preparation for the Switzerland-wide campaign of the Swiss universities against sexual harassment in the university environment in 2023. The equal opportunity action plan of **Empa** consists of six specific fields of action, including respectful behaviour, women in management positions and diversity and inclusion, as well as a regular exchange of views by the D&I expert with the Equal Opportunity Steering Committee. **Eawag**, working with the D&I expert and the Equal Opportunity Committee (EOC), also adapted the wording in job postings and application procedures to be gender-appropriate, and structured recruitment more specifically to a gender-neutral employment relationship. Offers like working from home, flexible working and part-time working were further extended, helping to achieve a healthy work-life balance.

ETH Zurich began developing a diversity strategy with the focal points ETH as an Employer, Anti-discrimination, People & Culture, Data & Monitoring and Research & Teaching. Training courses and events were carried out on the topics of anti-racism and anti-discrimination, inclusive culture, language and representation, as well as on barrier-free communication and sexual harassment, and networking events were held for the LGBTQIA+ community. **EPFL** founded the Trust and Support Network (TSN), the first point of contact in situations of discrimination and psychosocial risks. The project LGBTQ+ Safe Space was continued and complemented by the working group Inclusive Name Change. Moreover, general-neutral toilets and shower stalls were installed on the campus. The video about the **PSI** diversity policy was nominated as one of the best short films at the 2022 Fantoche Festival. PSI implemented its action plan on equal opportunity, diversity and inclusion, continued mentoring programmes for young prospective managers and women with management ambitions and embedded the diversity module in manager training. The jointly created D&I Competence Centre is part of various networks. With webinars, culture-specific brochures and diversity websites, **Empa** raised the visibility of minorities in order to improve mutual understanding and interaction. **Eawag** extended the respect campaign, employees took part in seminars and improv theatre on topics like hierarchy or microaggression with regard to racism. Targeted and creative initiatives with video messages, poster campaigns and intranet sites buttressed and raised awareness of the topics of diversity and inclusion. The Newsletter for Equity, published monthly by **PSI**, **WSL** and **Empa**, also addressed new developments and best practices concerning diversity and inclusion topics.

Prevention of bullying, discrimination and sexual harassment

All institutions of the ETH Domain further expanded their measures to prevent bullying, sexual harassment,

discrimination, threats and violence and raised the awareness of their employees regarding these topics. As part of the initiative "Stand up for respect", **ETH Zurich** launched the e-learning course "Handling sexual harassment in daily life at school and work". Thus, a new prevention offering is available to all members on the topic of sexual harassment. The **EPFL** task force "Bullying A-Z and developing a culture of respect" reviewed internal processes for preventing and handling harassment situations and psychosocial risks. With the e-learning course "You are not alone", it also developed an interactive, immersive training course for all members. **PSI** enacted the Code of Conduct "Respect", revised the internal processes concerning harassment, bullying and conflicts, conducted training courses on the topic of respect for managers, developed a web-based training course for employees, and expanded the pool of internal/external confidential advisors as low-threshold points of contact. All research institutes carried out awareness-raising campaigns across various channels. **WSL**, **Empa** and **Eawag** also set down their policies in a Code of Conduct "Respect". In the event of breaches, conflicts or problems, employees can turn to a wide network of internal and external specialists and advisory offices. All research institutes carried out awareness-raising campaigns across various channels.

Increasing the proportion of women in management positions

ETH Zurich developed a "Strategy on the appointment of female professors and sustainable dual-career solutions". The "Policy for equal opportunities in faculty recruitment" at **EPFL** established standards to

ensure recruiting processes that grant women and men equal opportunities. The proportion of women at **both universities** in the case of new appointments showed that the measures and efforts that have already been implemented are taking hold and that the desired goal was achieved or in some cases even exceeded. The dual-career programme introduced by **EPFL** is increasing the opportunities in the international competition for the best talent. When filling management positions and bodies, all institutions of the ETH Domain pay attention to an appropriate proportion of women and promote the recruitment of women. With the tools Textio and Diversifier, **ETH Zurich** conducted a pilot exercise for gender-appropriate job advertisements with positive results. **EPFL** coordinated a series of mentoring, coaching and training programmes and networking events in order to promote equal opportunities both for academic careers and in industry. Moreover, since 2022, it has been taking part, together with ETH Zurich and PSI, in the project FemSpin, which is being supported by the P7 programme through project-linked contributions from swissuniversities and is intended to improve the position of women in spin-offs and start-ups. Several years ago, **PSI** created a mentoring programme for women with management ambitions, which in 2022 was newly expanded under the name feM-LEAD (female Mentoring: Leadership for Equity And Diversity) to include **WSL** and **Empa**. In addition, the **WSL** gender action plan concentrates explicitly on women in research and management positions. It comprises a variety of measures for recruitment, advancement, career promotion, creation of sustainable networks and for a healthy work-life balance. At **Empa**, the D&I

To promote equal opportunities, all of the institutions decided in 2022 to launch various programmes and initiatives, adapt job postings to be gender-neutral and set out concepts for inclusive communication.

> Illustration: EPFL



expert provided information about unconscious bias and highlighted options for bolstering the recruitment of women and supporting young talent. Women without management positions are given the opportunity to temporarily take part in management training sessions or possibilities in order to boost the attractiveness of such positions. **Eawag** focused on the proven, balanced gender ratio in management positions, which manifests itself both in recruitment as well as in internal changes of position and promotions. In the case of job postings for, in particular, management positions, all institutions made an effort to appeal to women in as targeted a manner as possible. **All institutions of the ETH Domain** participated in the joint programmes Fix The Leaky Pipeline and CONNECT.

Training and promotion of young scientists

ETH Zurich held a "Postdoc Career Week" for postdoctoral researchers in order to highlight the opportunities and challenges associated with choosing a future career. The ETH Career Center offers doctoral students a variety of career events with real networking opportunities, as well as other application aids, and, on the "myPath" platform, the systematic development of extra-curricular skills. **EPFL** also provided a broad spectrum of training courses, assistance measures and offers of all-around skills. These specifically promote careers in research, innovation and entrepreneurship and in particular provide answers to questions about financing, management, contracts and intellectual property, as well as about professional ethics. Centre Carrière and EPFL Alumni offer special monitoring programmes, training courses and access to job offers. The **PSI** Career Center offers advisory services, publishes a newsletter and stages events. The PSI Education Center conducts courses in transferable skills. **WSL** offered support in the form of a variety of courses, the PhD and Postdoc Club, workshops and networking events, as well as a PhD coach for one-on-one discussions. The tenure-track approach creates transparency about long-term job opportunities. In addition, workshops on career planning were offered for doctoral students and postdoctoral researchers. **Empa** and PSI held camps for children of primary school age in order to arouse the interest of young people for natural and engineering sciences. This aim is also served by the annual National Future Day, in which all institutions take part.

Integration of people with limitations

In the spirit of social responsibility as an employer, the ETH Domain supported employees with performance limitations at a variety of workplaces to enable them to remain on their original team and in their role. For instance, various case management offices at all institutions of the ETH Domain supported line managers and employees in the event of extended absences due to accident or illness. The experiences showed great results with job reintegration or in the case of an activity adapted to meet the limitations. Moreover, all

institutions facilitated work deployments by external persons for job trials and reintegration deployments, and continued to conduct their successful reintegration programmes.

Training apprentices

In order to improve the quality of vocational education, **ETH Zurich** created a new teaching laboratory for basic commercial education, which focuses on capacity for action and the new reform of the commercial profession. As a contribution to the objective "diversity and inclusion", the pre-apprenticeship pilot programme to support integration (INVOL) has been offered in the Facility Services department since 2021. For the one-year practical training, it was possible to create additional training spots in the vocational fields of information technology and logistics. The interdisciplinary cooperation on the "Young 'n' Rising" team formed by apprentices is giving rise to sought-after internal services and projects. **EPFL** strengthened its presence and advertising for the university as a training establishment. The **research institutes** formed an inter-institutional think tank with the aim of getting more girls excited about STEM careers and degree courses. They often receive prizes and awards for apprentice training and number among the best host companies for apprentices in Switzerland. For instance, an apprentice at PSI took second place at the WorldSkills Competition 2022 in the Electronics Technician category.

Outlook

In 2023, the focus will be on the digitalisation and automation of HR processes as part of e-workflows and e-dossiers, as well as the development of a life-long learning hub. Management, personnel development as well as work processes and collaboration will be analysed in more depth and revised. A gender-appropriate work culture will be maintained, and the expansion and development of career and management tracks for men, women and non-binary individuals will be advanced, as will a quota arrangement in the recruitment of managers.

Key Figures Personnel 2022

On 31 December 2022, the headcount in the ETH Domain stood at 24,375 employment contracts (ECs) or 20,678.2 full-time equivalents (FTEs) (see Fig. 17, p. 100). The headcount increased by 107 ECs (+0.4%) or 144.4 FTEs compared to the previous year. The increase in headcount was much smaller compared to previous years (growth rates between 2% and 4%). This was mainly due to the fluctuating use of research assistants on a part-time or hourly-wage basis with a low employment level at ETH Zurich.

The scientific staff, which also includes doctoral students, remained by far the largest role in the ETH Domain with 14,690 ECs (12,245.5 FTEs, 60.3% of the total headcount, see Fig. 17, p. 100), followed by the technical staff, which accounted for 4,163 ECs (3,722.4 FTEs) or 17.1% of the headcount. 17.0% of all employees, or 4,154 ECs (3,326.1 FTEs), were administrative employees and 1.9% were apprentices. 2022 saw the new appointment of 18 professorships, with the total number of professors now at 905 ECs (872.0 FTE). They made up 3.7% of the total headcount.

Professors

In 2022, ETH Zurich and EPFL had a total of 715 full and associate professors. In addition, they had 145 assistant professors with tenure track (TT) and 45 assistant professors without TT (see Fig. 18, p. 100).

The proportion of women in these three categories grew from 19.8% to 21.9% in 2022. The figures were 17.3% for full and associate professors, 40.7% for assistant professors with TT and 33.3% for assistant professors without TT.

In 2022, 67.2% of the total of 905 professors came from abroad (2021: 67.0%). Of these, 46.9% (2021: 47.8%) came from the EU and 20.3% from other countries (2021: 19.2%) (see Fig. 19, p. 101).

Financing the professorships

Of the 546 professors (523.8 FTEs) employed at ETH Zurich as of 31 December 2022, 465.3 FTEs (88.8%) were financed by the total federal contribution, 14.2 FTEs (2.7%) by SNSF, 1.3 FTEs (0.25%) by government-funded research, 13.3 FTEs (2.6%) by EU research programmes, and 29.7 FTEs (5.7%) by third-party financial research contributions, as well as by donations and bequests.

Of the 359 professorships (348.2 FTEs) at EPFL as of 31 December 2022, 330.2 FTEs (94.8%) were financed by the total federal contribution, none by the SNSF, InnoSuisse or the EU research programmes, 1.0 FTE (0.3%) by government-funded research, and 17.0 FTEs (4.9%) by third-party financial research contributions, as well as by donations and bequests.

Proportion of women

The proportion of women in the ETH Domain rose to 36.4% in 2022 (2021: 35.9%), although this varied greatly by institution, role and discipline (see Fig. 22, p. 102).

The proportion of women in managerial positions (from function level 10) rose to 23.9% (2021: 22.7%). The two universities, WSL and Eawag made a significant contribution to this increase.

Apprentices

In the reporting period, the ETH Domain offered apprenticeship places to 463 people in more than 20 different career paths. Women accounted for 31.5% of apprentices in 2022.

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Monitoring table on the strategic objectives by the Federal Council

Fig. 3: Monitoring table on the strategic objectives set by the Federal Council for the ETH Domain for 2021–2024

Indicators	Reference values			Monitoring	
	2013	2017	2020	2021	2022
TEACHING					
Students and doctoral students ETH Zurich and EPFL (headcount)					
New admissions					
At Bachelor's level	5,255	4,756	5,245	5,218	5,295
Students¹	22,099	25,059	28,637	29,243	30,141
Proportion of women (%)	29.1	30.6	31.7	31.9	32.0
Proportion of foreign nationals (%)	35.5	38.4	40.7	40.9	42.8
At Bachelor's level ¹	13,995	14,385	15,983	16,650	16,995
Proportion of women (%)	28.6	30.6	32.0	32.5	32.4
Proportion of foreign nationals (%)	30.9	29.4	32.6	34.1	36.2
At Master's level ¹	7,241	8,895	11,143	11,741	12,329
Proportion of women (%)	29.4	29.4	30.3	30.4	30.9
Proportion of foreign nationals (%)	43.1	45.4	48.4	50.0	51.6
On MAS / MBA programmes	863	840	816	852	817
Proportion of women (%)	34.6	38.8	42.6	42.1	41.7
Proportion of foreign nationals (%)	45.7	51.5	47.7	48.5	47.9
Visiting students (incoming) ¹	–	939	695	–	–
Proportion of women (%)	–	35.5	33.7	–	–
Proportion of foreign nationals (%)	–	96.5	95.0	–	–
Supervision ratio					
Bachelor's and Master's students per professor	27.7	28.3	31.7	33.2	33.6
Doctoral students	5,947	6,234	6,598	6,867	6,975
Proportion of women (%)	30.4	30.8	33.6	33.9	34.0
Proportion of foreign nationals (%)	72.6	75.0	78.1	78.6	78.6
Supervision ratio					
Doctoral students per professor	7.7	7.6	7.7	8.0	8.0
Students and doctoral students¹	28,046	31,293	35,235	36,110	37,116
Proportion of women (%)	29.4	30.6	32.0	32.3	32.4
Proportion of foreign nationals (%)	43.3	45.7	47.7	48.1	49.5
Supervision ratio					
Students and doctoral students per professor	36.5	38.0	41.2	42.3	42.6
Degrees					
Bachelor	2,249	2,602	3,007	3,213	3,148
Diploma, Master	2,663	3,065	3,344	3,898	3,760
MAS/MBA	346	394	249	304	318
Doctorate	993	1,258	1,171	1,257	1,458
Teaching and supervision by the research institutes					
Teaching hours	15,670	17,992	18,553	19,305	21,348
Bachelor's, Master's and Diploma projects	532	602	608	736	727
Doctoral students	797	807	842	872	924
Proportion of women (%)	36.3	39.0	39.9	39.0	38.4
Proportion enrolled in the ETH Domain (%)	67.9	67.7	70.3	70.8	69.4
Proportion enrolled at a foreign university (%)	13.4	10.3	9.1	11.0	12.1

RESEARCH					
Publications²	–	–	–	–	–
Research contributions, mandates and scientific services (in CHF millions)	–	743.2	774.1	787.7	795.4
of which Swiss National Science Foundation (SNSF)	209.0	260.3	262.6	267.8	268.3
of which Innosuisse	36.8	62.6	50.6	41.3	44.3
of which EU Framework programmes for Research and Innovation (EU FP)	135.2	139.2	146.4	160.2	154.4
KNOWLEDGE AND TECHNOLOGY TRANSFER (KTT)					
Invention disclosures ³	–	343	310	330	310
Software notifications ^{3,4}	–	26	32	39	37
Patents	193	206	217	213	227
Licences ⁵	223	377	338	181	180
Spin-offs	43	48	66	60	54
STAFF (FTE)					
Professors	767.7	823.8	854.6	854.6	872.0
Proportion of women (%)	12.4	14.8	18.6	20.0	21.8
Proportion of foreign nationals (%)	67.1	67.2	67.3	67.7	67.7
Scientific staff	9,927.3	11,204.4	11,994.6	12,277.4	12,245.5
Technical staff	3,157.3	3,439.8	3,676.3	3,722.3	3,772.4
Administrative staff	2,279.0	2,690.0	3,118.9	3,214.9	3,326.2
Apprentices	435.0	473.6	472.6	464.6	462.1
FINANCES / REAL ESTATE					
Total federal contribution (expenditure ceiling perspective) (in CHF million)	2,271.4	2,530.8	2,596.1	2,600.1	2,666.2
of which federal financial contribution	2,073.9	2,377.9	2,355.1	2,373.3	2,441.4
of which investment credit for construction in the ETH Domain	197.5	152.9	241.0	226.8	224.8

¹ Until 2016, visiting students (incoming) were counted yearly in the numbers of students at Bachelor's and Master's levels. In 2017–2020, visiting students were reported yearly as a separate student category and counted in the total number of students. Since 2021, visiting students are reported per semester in a separate table (see Fig. 11, p. 96) and are no longer counted in the total number of students. Without this modification, ETH Zurich and EPFL would have counted a total of 30,294 in 2021.

² Publishing activity is assessed every four years as part of the intermediate evaluation.

³ Additional KTT indicators introduced in 2017.

⁴ Open Source Software not included.

⁵ The definition of licences was revised in 2021. This category no longer includes contracts with prior IP transfer and contracts for software licences of less than CHF 1,000. This should be taken into account when comparing with the figures for previous years. Without this change, the total number of licences would have been 406 in 2021.

Indicators and counting methods for the monitoring table and the academic achievement report

If not specified in more detail, the term "students" is always understood to mean students at Bachelor's and Master's levels, as well as students on Master of Advanced Studies and Master of Business Administration (MAS/MBA) continuing education programmes. Doctoral students are defined as a separate category. Students and doctoral students are counted in numbers of persons (headcount). These figures may differ from those which ETH Zurich and EPFL enter in their respective annual reports, as there are different counting methods.

Since 2021, exchange students are no longer included in the total number of students. Incoming exchange students (students who are enrolled at another university and study for at least three months or 20 ECTS at one of the two Federal Institutes of Technology) and outgoing exchange students (students who are enrolled at one of the two Federal Institutes of Technology and study for at least three months or 20 ECTS at another university) are now listed in a separate table for each semester. Foreign students and doctoral students form two sub-categories: foreign-educated foreign nationals who were

resident abroad while obtaining the relevant necessary qualifications, and Swiss-educated foreign nationals who were resident in Switzerland while obtaining the relevant necessary qualifications.

The employment level of all staff is counted in terms of full-time equivalents (FTE). Professors, both full and associate, as well as assistant professors, including those recipients of the Swiss National Science Foundation (SNSF) Eccellenza professorial fellowship who are employed at one of the two Federal Institutes of Technology, are taken into account in calculating the supervision ratio. Senior scientists and *Maîtres d'enseignement et de recherche* (MER) from both Federal Institutes of Technology correspond to the academic staff in management roles or senior management staff. Some of them are adjunct professors. To determine the "expanded" supervision ratio, the Senior Scientists and MER of both Federal Institutes of Technology are added to the professors. The teaching hours delivered by the research institutes do not include preparation time, only the time spent in the presence of students.

Academic achievement report

Fig. 4: Students and doctoral students by discipline

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Δ 2021 / 2022	
												in %
Architecture	3,097	3,066	3,060	3,030	3,047	3,041	3,090	3,035	3,169	3,254	85	2.7
ETH Zurich	1,852	1,783	1,805	1,771	1,823	1,855	1,904	1,923	2,031	2,136	105	5.2
EPFL	1,245	1,283	1,255	1,259	1,224	1,186	1,186	1,112	1,138	1,118	-20	-1.8
Civil and Geomatic Engineering	3,074	2,946	2,882	2,860	2,791	2,777	2,716	2,700	2,641	2,576	-65	-2.5
ETH Zurich	1,740	1,731	1,716	1,701	1,688	1,667	1,614	1,646	1,606	1,537	-69	-4.3
EPFL	1,334	1,215	1,166	1,159	1,103	1,110	1,102	1,054	1,035	1,039	4	0.4
Engineering Sciences	7,245	7,502	7,903	8,069	8,398	8,699	9,081	9,577	9,795	10,045	250	2.6
ETH Zurich	4,549	4,729	4,930	4,993	5,135	5,224	5,467	5,851	6,053	6,202	149	2.5
EPFL	2,696	2,773	2,973	3,076	3,263	3,475	3,614	3,726	3,742	3,843	101	2.7
Information and Communications Technology	2,536	2,665	2,809	3,033	3,261	3,648	4,031	4,529	4,929	5,417	488	9.9
ETH Zurich	1,158	1,247	1,405	1,536	1,753	1,991	2,246	2,560	2,776	3,021	245	8.8
EPFL	1,378	1,418	1,404	1,497	1,508	1,657	1,785	1,969	2,153	2,396	243	11.3
Exact and Natural Sciences	4,883	4,944	5,145	5,442	5,595	5,810	5,940	6,290	6,412	6,689	277	4.3
ETH Zurich	2,972	3,024	3,157	3,352	3,505	3,691	3,794	4,039	4,063	4,238	175	4.3
EPFL	1,911	1,920	1,988	2,090	2,090	2,119	2,146	2,251	2,349	2,451	102	4.3
Human Medicine¹	-	-	-	-	99	192	286	296	311	302	-9	-2.9
ETH Zurich	-	-	-	-	99	192	286	296	311	302	-9	-2.9
Life Sciences	3,879	3,990	4,051	4,216	4,312	4,500	4,624	4,859	4,864	4,942	78	1.6
ETH Zurich	2,923	3,012	3,044	3,162	3,218	3,326	3,433	3,566	3,595	3,658	63	1.8
EPFL	956	978	1,007	1,054	1,094	1,174	1,191	1,293	1,269	1,284	15	1.2
System-oriented Natural Sciences	2,159	2,211	2,284	2,411	2,437	2,520	2,538	2,569	2,542	2,447	-95	-3.7
ETH Zurich	2,159	2,211	2,284	2,411	2,437	2,520	2,538	2,569	2,542	2,447	-95	-3.7
Management, Technology, Economics	897	913	913	972	973	966	954	937	962	965	3	0.3
ETH Zurich	549	579	582	571	583	573	560	566	571	574	3	0.5
EPFL	348	334	331	401	390	393	394	371	391	391	0	0.0
Humanities, Social and Political Sciences²	276	300	310	318	380	378	382	443	485	479	-6	-1.2
ETH Zurich	276	300	310	318	366	358	351	406	435	425	-10	-2.3
EPFL	-	-	-	-	14	20	31	37	50	54	4	8.0
Total students and doctoral students	28,046	28,537	29,357	30,351	31,293	32,531	33,642	35,235	36,110	37,116	1,006	2.8
ETH Zurich	18,178	18,616	19,233	19,815	20,607	21,397	22,193	23,422	23,983	24,540	557	2.3
EPFL	9,868	9,921	10,124	10,536	10,686	11,134	11,449	11,813	12,127	12,576	449	3.7
Women	8,238	8,414	8,677	9,091	9,587	10,167	10,675	11,280	11,660	12,027	367	3.1
ETH Zurich	5,560	5,701	5,873	6,164	6,563	6,917	7,304	7,768	7,995	8,194	199	2.5
EPFL	2,678	2,713	2,804	2,927	3,024	3,250	3,371	3,512	3,665	3,833	168	4.6
Foreign nationals	12,152	12,354	12,804	13,615	14,290	15,160	15,993	16,799	17,368	18,387	1,019	5.9
ETH Zurich	6,751	6,949	7,226	7,563	7,972	8,433	8,876	9,438	9,808	10,371	563	5.7
EPFL	5,401	5,405	5,578	6,052	6,318	6,727	7,117	7,361	7,560	8,016	456	6.0

Since 2021, visiting students are no longer being counted in the student totals. This should be taken into account when comparing figures previous years.

¹ ETH Zurich introduced a Bachelor's degree in Human Medicine in 2017.

² EPFL introduced a Master's degree in Digital Humanities in 2017.

Fig. 5: Students and doctoral students by academic level

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Δ 2021/2022	
												in %
Bachelor's programmes	13,995	13,944	14,292	14,727	14,385	14,792	15,243	15,983	16,650	16,995	345	2.1
ETH Zurich	8,817	8,820	9,087	9,309	9,262	9,517	9,895	10,355	10,642	10,665	23	0.2
EPFL	5,178	5,124	5,205	5,418	5,123	5,275	5,348	5,628	6,008	6,330	322	5.4
Master's programmes	7,241	7,781	8,126	8,662	8,895	9,517	10,163	11,143	11,741	12,329	588	5.0
ETH Zurich	4,811	5,187	5,480	5,861	6,158	6,590	7,037	7,790	8,206	8,641	435	5.3
EPFL	2,430	2,594	2,646	2,801	2,737	2,927	3,126	3,353	3,535	3,688	153	4.3
MAS/MBA	863	805	836	828	840	827	809	816	852	817	-35	-4.1
ETH Zurich	661	634	640	635	646	635	626	644	675	673	-2	-0.3
EPFL	202	171	196	193	194	192	183	172	177	144	-33	-18.6
Visiting students (incoming)¹	-	-	-	-	939	1,004	1,060	695	-	-	-	-
ETH Zurich	-	-	-	-	449	480	467	317	-	-	-	-
EPFL	-	-	-	-	490	524	593	378	-	-	-	-
Total number of students¹	22,099	22,530	23,254	24,217	25,059	26,140	27,275	28,637	29,243	30,141	898	3.1
ETH Zurich	14,289	14,641	15,207	15,805	16,515	17,222	18,025	19,106	19,523	19,979	456	2.3
EPFL	7,810	7,889	8,047	8,412	8,544	8,918	9,250	9,531	9,720	10,162	442	4.5
Doctoral programmes	5,947	6,007	6,103	6,134	6,234	6,391	6,367	6,598	6,867	6,975	108	1.6
ETH Zurich	3,889	3,975	4,026	4,010	4,092	4,175	4,168	4,316	4,460	4,561	101	2.3
EPFL	2,058	2,032	2,077	2,124	2,142	2,216	2,199	2,282	2,407	2,414	7	0.3
Total students and doctoral students¹	28,046	28,537	29,357	30,351	31,293	32,531	33,642	35,235	36,110	37,116	1,006	2.8
ETH Zurich	18,178	18,616	19,233	19,815	20,607	21,397	22,193	23,422	23,983	24,540	557	2.3
EPFL	9,868	9,921	10,124	10,536	10,686	11,134	11,449	11,813	12,127	12,576	449	3.7

¹ Until 2016, visiting students (incoming) were counted yearly in the numbers of students at Bachelor's and Master's levels. In 2017–2020, visiting students were reported yearly as a separate student category and counted in the total number of students. Since 2021, visiting students are reported per semester in a separate table (see Fig. 11, p. 96) and are no longer counted in the total number of students. Without this modification, ETH Zurich and EPFL would have counted a total of 30,294 in 2021.

Fig. 6: New admissions to the Bachelor's level at ETH Zurich and EPFL

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Δ 2021 / 2022	
												in %
Architecture	604	564	573	569	437	450	468	498	550	546	-4	-0.7
Civil and Geomatic Engineering	613	486	493	488	366	370	383	403	384	336	-48	-12.5
Engineering Sciences	1,429	1,393	1,550	1,518	1,350	1,303	1,353	1,327	1,333	1,401	68	5.1
Information and Communications Technology	547	595	596	679	582	662	708	780	799	897	98	12.3
Exact and Natural Sciences	969	952	1,001	1,108	985	928	952	1,074	1,091	1,162	71	6.5
Human Medicine ¹	-	-	-	-	100	100	100	100	99	99	0	0.0
Life Sciences	744	721	695	778	635	696	725	719	659	620	-39	-5.9
System-oriented Natural Sciences	335	316	366	372	288	307	259	326	288	219	-69	-24.0
Management, Technology, Economics	-	-	-	-	-	-	-	-	-	-	-	-
Humanities, Social and Political Sciences	14	14	16	19	13	11	18	18	15	15	0	0.0
Total	5,255	5,041	5,290	5,531	4,756	4,827	4,966	5,245	5,218	5,295	77	1.5

¹ ETH Zurich introduced a Bachelor's degree in Human Medicine in 2017. New admissions in this discipline are limited to 100 and will therefore remain stable over the years.

Fig. 7: Percentage of women among students and doctoral students at ETH Zurich and EPFL

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
% at the Bachelor's level	28.6	28.7	29.2	30.0	30.6	31.6	31.9	32.0	32.5	32.4
% at the Master's level	29.4	29.5	28.6	28.5	29.4	29.6	29.8	30.3	30.4	30.9
% at the Bachelor's and Master's level	28.9	29.0	28.9	29.4	30.1	30.8	31.1	31.3	31.6	31.8
% on MAS/MBA programmes	34.6	35.0	38.6	37.9	38.8	40.6	40.3	42.6	42.1	41.7
% at the doctoral level	30.4	30.6	30.6	31.0	30.8	31.4	32.8	33.6	33.9	34.0

Fig. 8: Supervision ratios at ETH Zurich and EPFL

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Supervision ratio										
at Bachelor's/Master's level	27.7	28.0	28.6	29.2	28.3	29.7	30.6	31.7	33.2	33.6
at Doctoral level	7.7	7.8	7.8	7.7	7.6	7.8	7.7	7.7	8.0	8.0
Extended supervision ratio										
at Bachelor's/Master's level	18.7	18.8	19.3	19.8	19.2	20.0	20.7	21.5	22.5	22.8
at Doctoral level	5.2	5.2	5.3	5.2	5.1	5.3	5.2	5.2	5.4	5.4

Fig. 9: Percentage of foreign nationals among students and doctoral students at ETH Zurich and EPFL

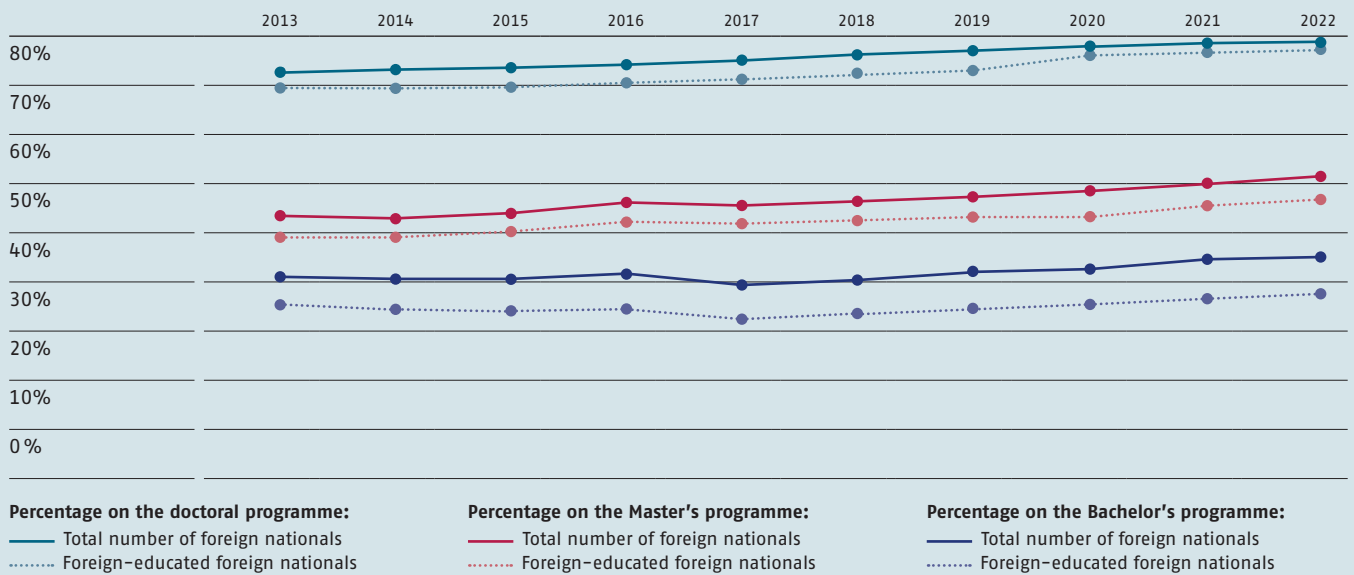


Fig. 10: Degrees awarded by academic level

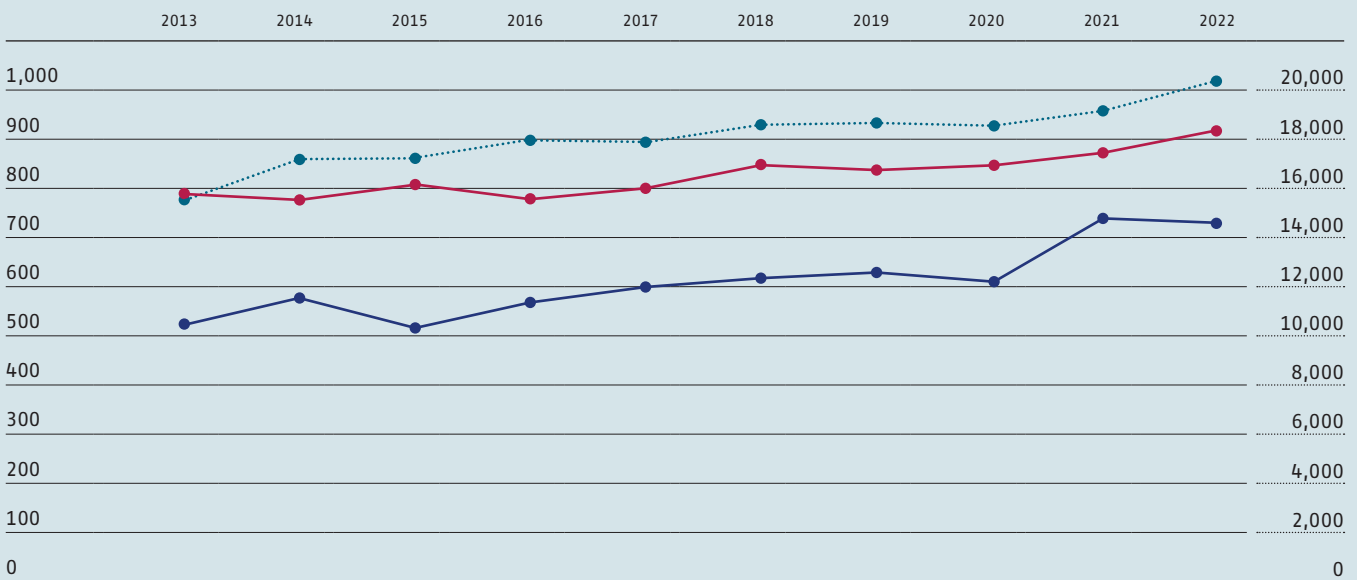
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Δ 2021/2022	
												in %
Bachelor	2,249	2,538	2,528	2,500	2,602	2,686	2,876	3,007	3,213	3,148	-65	-2.0
ETH Zurich	1,447	1,579	1,564	1,571	1,606	1,678	1,758	1,843	2,084	1,934	-150	-7.2
EPFL	802	959	964	929	996	1,008	1,118	1,164	1,129	1,214	85	7.5
Master	2,663	2,711	2,821	2,989	3,065	3,240	3,368	3,344	3,898	3,760	-138	-3.5
ETH Zurich	1,847	1,839	1,879	2,015	2,072	2,196	2,335	2,260	2,723	2,512	-211	-7.7
EPFL	816	872	942	974	993	1,044	1,033	1,084	1,175	1,248	73	6.2
MAS/MBA	346	260	254	303	394	343	324	249	304	318	14	4.6
ETH Zurich	228	205	175	203	272	232	245	160	219	236	17	7.8
EPFL	118	55	79	100	122	111	79	89	85	82	-3	-3.5
Doctorate	993	1,197	1,109	1,256	1,258	1,209	1,290	1,171	1,257	1,458	201	16.0
ETH Zurich	579	769	718	851	827	802	866	781	820	1,005	185	22.6
EPFL	414	428	391	405	431	407	424	390	437	453	16	3.7

Fig. 11: Visiting students

	2021		2022	
	Spring Semester	Autumn Semester	Spring Semester	Autumn Semester
Incoming				
at ETH Zurich	287	460	401	385
at EPFL	552	622	786	629
Outgoing				
from ETH Zurich	76	154	228	255
from EPFL	264	396	373	460

Since 2021, visiting students are no longer being counted in the student totals and now figure only in the table above per semester. It should be noted that the figures given per semester cannot be added together to obtain an annual total, without counting students present during the two semester twice.

Fig. 12: Teaching and supervision by research institutes



Left axis: Number of supervised Bachelor's, Master's, Diploma and doctoral theses

Right axis: Number of teaching hours per year

- Number of supervised doctoral theses
- Number of supervised Bachelor's, Master's and Diploma theses
- Number of teaching hours per year

Knowledge and technology transfer

Fig. 13: Knowledge and technology transfer in the ETH Domain

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Invention disclosures¹	–	–	–	–	343	358	329	310	330	310
ETH Zurich	–	–	–	–	171	205	159	165	169	142
EPFL	–	–	–	–	134	119	132	107	121	138
Research institutes	–	–	–	–	38	34	38	38	40	30
Software notifications^{1,2}	–	–	–	–	26	36	40	32	39	37
ETH Zurich	–	–	–	–	20	19	26	18	24	28
EPFL	–	–	–	–	6	13	13	14	12	6
Research institutes	–	–	–	–	0	4	1	0	3	3
Patents	193	211	219	230	206	230	224	217	213	227
ETH Zurich	103	82	98	109	84	109	102	115	99	104
EPFL	66	99	88	100	95	95	98	75	88	95
Research institutes	24	30	33	21	27	26	24	27	26	28
Licences³	223	270	311	353	377	341	324	338	181	180
ETH Zurich	38	35	50	78	82	87	62	43	27	29
EPFL	41	46	48	58	50	39	50	53	40	43
Research institutes	144	189	213	217	245	215	212	242	114	108
Spin-offs	43	49	48	50	48	55	59	66	60	54
ETH Zurich	24	22	25	25	25	27	30	34	25	26
EPFL	12	24	18	20	15	25	23	25	32	21
Research institutes	7	3	5	5	8	3	6	7	3	7

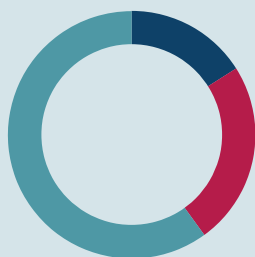
¹ Invention disclosures and software notifications were introduced in 2017 as additional KTT indicators.

² Open Source Software not included.

³ The definition of licences was revised in 2021. This category no longer includes contracts with prior IP transfer and contracts for software licences of less than CHF 1,000. This should be taken into account when comparing with the figures for previous years. Without this change, the total number of licences would have been 406 in 2021.

Licences

180



ETH Zurich	29
EPFL	43
Research institutes	108

Invention disclosures

310

Software notifications

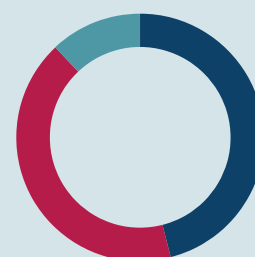
37

Spin-offs

54

Patents

227



ETH Zurich	104
EPFL	95
Research institutes	28

Fig. 14: Collaboration with the private and public sector

	2017	2018	2019	2020	2021	2022
Collaboration contracts with the private sector	507	594	570	610	585	566
of which Financed by the private sector	316	415	404	388	396	390
ETH Zurich	122	149	163	143	172	171
EPFL	99	120	125	95	94	120
Research institutions	95	146	116	150	130	99
of which Financed by Innosuisse / EU FP *	191	179	166	222	189	176
ETH Zurich	57	74	55	72	72	62
EPFL	66	49	61	56	45	41
Research institutions	68	56	50	94	72	73
Collaboration contracts with the Swiss public sector	285	261	278	262	272	281
ETH Zurich	88	100	88	92	94	87
EPFL	54	43	51	47	46	42
Research institutions	143	118	139	123	132	152

Number of new collaboration agreements (research agreements and scientific services) with the private and Swiss public sector involving a volume of at least CHF 50,000 per contract. These indicators were introduced in 2017.

* EU FP: European Framework Programmes for Research and Innovation

KTT indicators and counting method

Patents exclusively refer to first filings. The definition of licences was revised in 2021. This category now no longer includes contracts involving previous IP transfer or software licence contracts with a value of less than CHF 1,000. This must be taken into account when comparing these figures with those from previous years. The invention disclosures and software notifications correspond to the reports and notifications submitted in writing to the Technology Transfer Offices of the institutions of the ETH Domain in the reporting period. They reflect activities in the early phases of the innovation process, thereby supplementing the other KTT indicators. Open source software is not considered.

In order to reflect the cooperation between the institutions and private enterprise and the public sector, only recently concluded cooperation agreements are included. These are only research contracts and scientific services with a volume of at least CHF 50,000 per contract. Cooperation with the private sector is divided into two categories: projects that are directly financed by industry in Switzerland or abroad; and those funded by Innosuisse or the EU Research Framework Programmes for Research and Innovation (EU FP). Cooperation with the public sector includes contracts with public sector institutions in Switzerland but not those with national or international research funding organisations and foundations.

Globally respected rankings (see Fig. 15 and 16)

The universities are assessed and ranked by institutions and businesses using various methods. THE (Times Higher Education World University Rankings) uses 13 key performance indicators for teaching (30% weighting), research (30%), citations (30%), international outlook (7.5%) and industry income (2.5%).

QS (QS World University Rankings) focuses mainly on reputation (with a 40% weighting on academic reputation and 10% on employer reputation), followed by faculty/student ratio (20%), citations per faculty (20%) and international faculty ratio/international student ratio (5% each).

ARWU (Academic Ranking of World Universities of Shanghai Ranking Consultancy) makes use of performance indicators based on the academic performance or research output – in particular Nobel Prizes or Fields Medals – of graduates, staff and highly cited researchers from the institutions assessed. The publication activity of an institution is

also judged based on the number of articles that have been published in a select group of the most respected journals, and the ratio between the number of publications and the number of researchers employed at an institution.

CWTS Leiden (Centre for Science and Technology Studies Leiden Ranking) is based solely on the publication activity of the universities, using this to calculate the indicators to assess research performance. One commonly used indicator for ranking the universities in the CWTS Leiden ranking is the number and proportion of publications each university has among the top 10% of the most-cited publications in the relevant field (PP (top 10%)). The CWTS Leiden World and Europe rankings of both Federal Institutes of Technology (see Fig. 15) are based on this indicator.

University rankings

Fig. 15: Rankings of ETH Zurich (blue) and EPFL (red) according to the THE, QS, ARWU and CWTS Leiden Rankings in 2022/2023

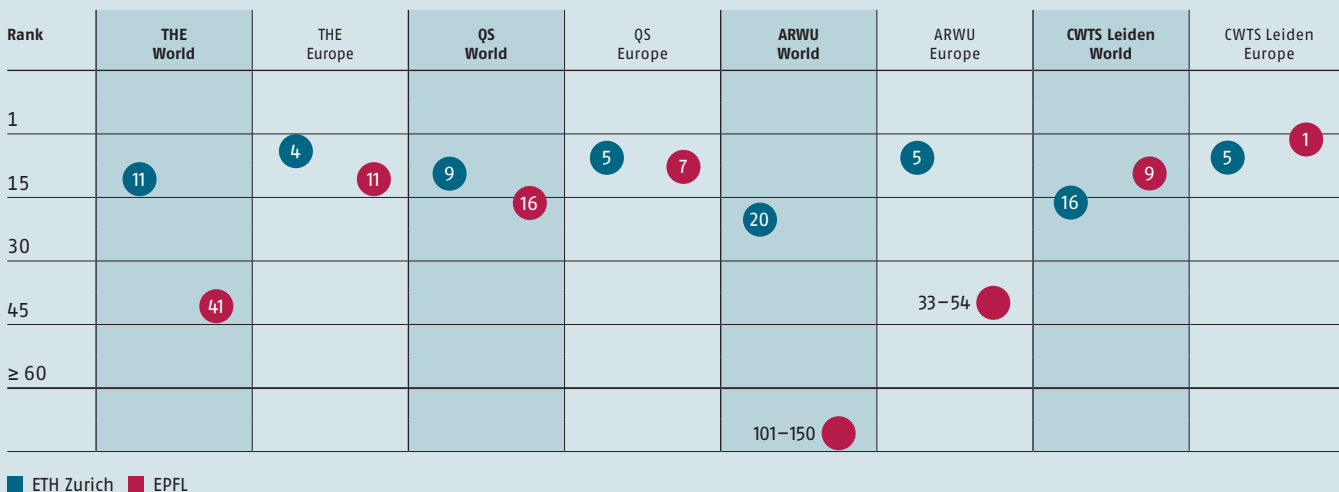
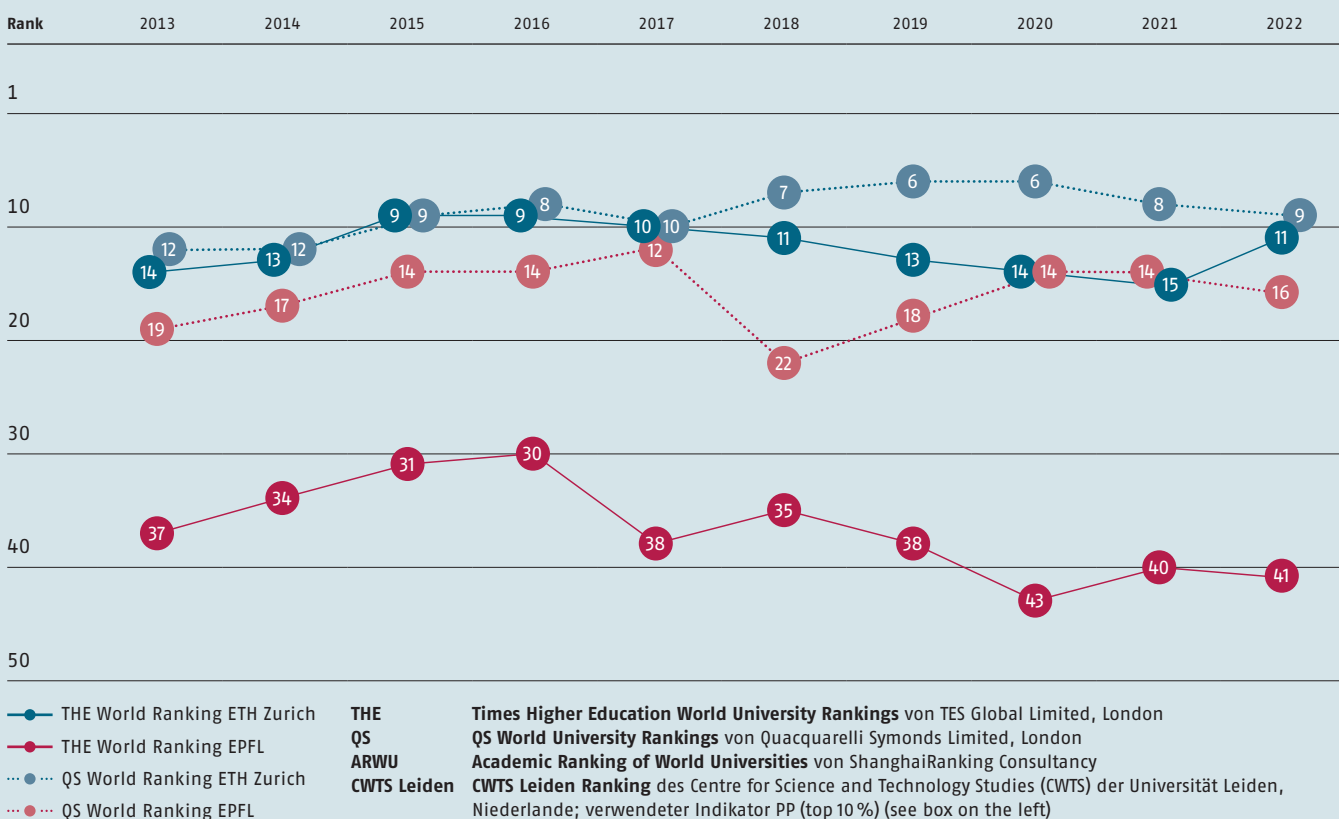


Fig. 16: Rankings of ETH Zurich (blue) and EPFL (red) according to the THE and QS World Rankings 2013–2022



Personnel

Fig. 17: Headcount and employment level by function group

2022	Men			Women			ETH Domain		
	EC	FTE	ø EL %	EC	FTE	ø EL %	EC	FT	ø EL %
Professors (F/A)	591	566.4	95.8	124	118.2	95.3	715	684.6	95.7
Assistant professors with tenure track	86	86.0	100.0	59	58.2	98.6	145	144.2	99.4
Assistant professors without tenure track	30	29.8	99.3	15	13.4	89.3	45	43.2	96.0
Scientific personnel	9,843	8,342.7	84.8	4,847	3,902.8	80.5	14,690	12,245.5	83.4
of whom senior scientific personnel	695	666.0	95.8	130	120.2	92.5	825	786.2	95.3
Technical personnel	3,223	3,026.5	93.9	940	745.9	79.4	4,163	3,772.4	90.6
Administrative personnel	1,402	1,220.7	87.1	2,752	2,105.5	76.5	4,154	3,326.2	80.1
Apprentices	317	317.0	100.0	146	145.1	99.4	463	462.1	99.8
Total	15,492	13,589.1	87.7	8,883	7,089.1	79.8	24,375	20,678.2	84.8

Headcount (employment contracts, EC) and employment level (EL) of men, women and the entire ETH Domain by function group. Senior scientists, *maîtres d'enseignement et de recherche* (MER) and other senior personnel are counted separately, but nevertheless are still included under scientific personnel. A total of 6,975 doctoral students are enrolled at the two Federal Institutes of Technology. Of these, all who are employed in the ETH Domain are included under scientific personnel.

Fig. 18: Development in the numbers of female and male professors

	2022			2021			Changes		
	Men	Women	Total	Men	Women	Total	Men in %	Women in %	Total in %
Professors (F/A)	591	124	715	595	115	710	-0.7	7.8	0.7
Assistant professors with tenure track	86	59	145	86	44	130	0.0	34.1	11.5
Assistant professors without tenure track	30	15	45	30	17	47	0.0	-11.8	-4.3
Total professors	707	198	905	711	176	887	-0.6	12.5	2.0

Change in the number of professors according to: full and associate professors, assistant professors with tenure track and assistant professors without tenure track. The three last columns show the percentage change since the previous year.

Professorial categories

The various professorial categories differ with regard to status and employment conditions. Full (F) and associate (A) professors, and assistant professors with and without tenure track (TT) teach and undertake research at both Federal Institutes of Technology. Professors with TT can become permanently employed as full or associate professors if they meet a certain performance target. Full and associate professors are appointed permanently, while assistant professors sign employment contracts for four years. The latter can be renewed for a maximum of another four years; in the case of parenthood or for any other just cause, it is possible to renew the employment contacts for up to another year.

In the context of cooperating with other universities and research institutions, there is the option of a dual professorship and the appointment of affiliated professors with a low FTE level.

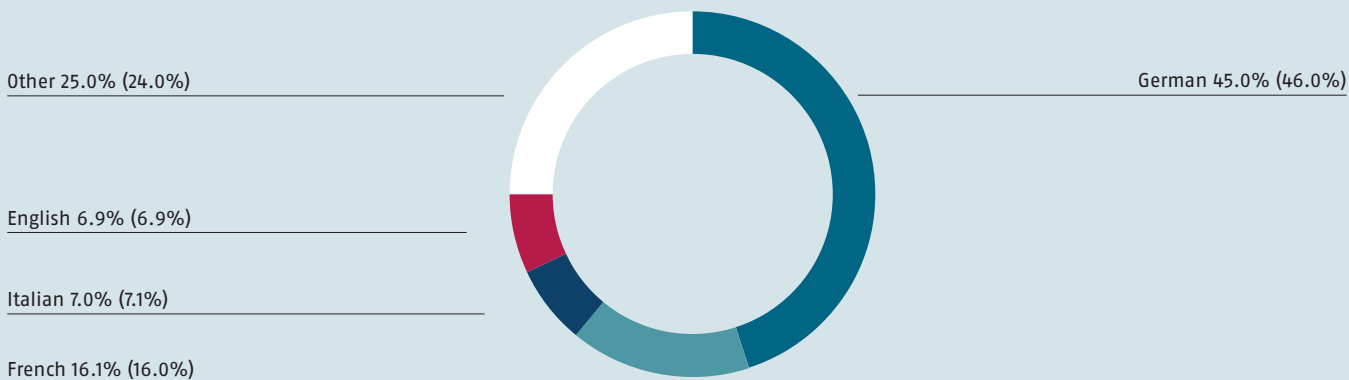
In recognition of outstanding performances in teaching and research, the title of adjunct professor may be conferred on senior scientific staff (*senior scientists/Maîtres d'enseignement et de recherche*, MER). Since 2022, the ETH Board has been able to award the title of Professor of practice to external persons who have extensive professional experience and have excelled in their field. They take on teaching duties. The ordinance concerning professors does not apply to these persons.

Fig. 19: Origin of male and female professors

	Switzerland			EU			Other		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Professors (F/A)	223	43	266	275	60	335	93	21	114
Assistant professors with tenure track	11	8	19	44	26	70	31	25	56
Assistant professors without tenure track	8	4	12	10	9	19	12	2	14
Total professors	242	55	297	329	95	424	136	48	184

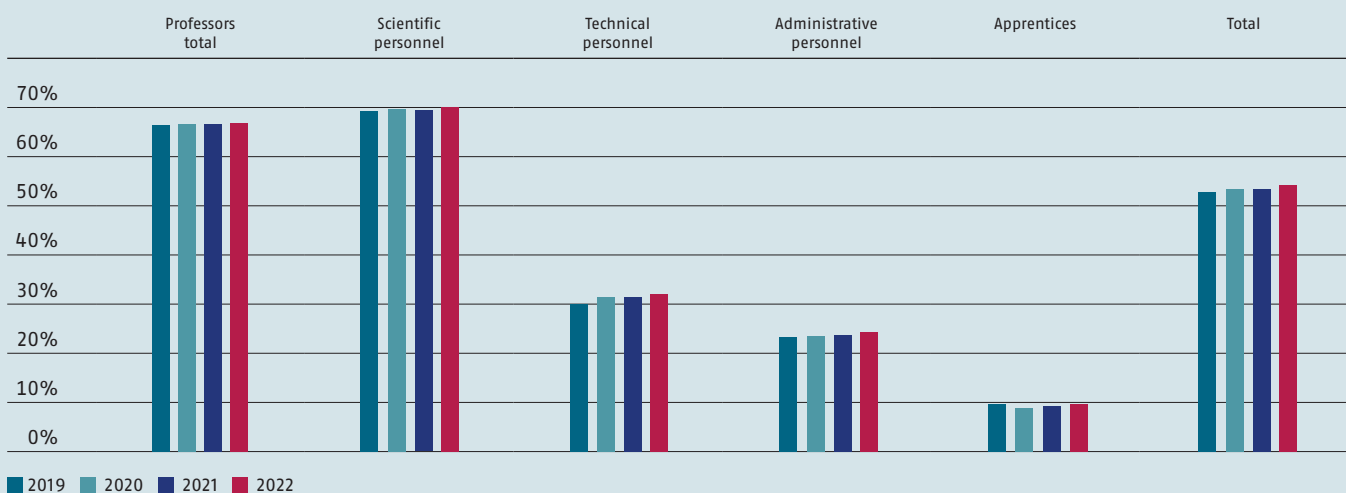
Number of professors broken down by origin: Switzerland, the EU and other countries.

Fig. 20: Employees' native languages



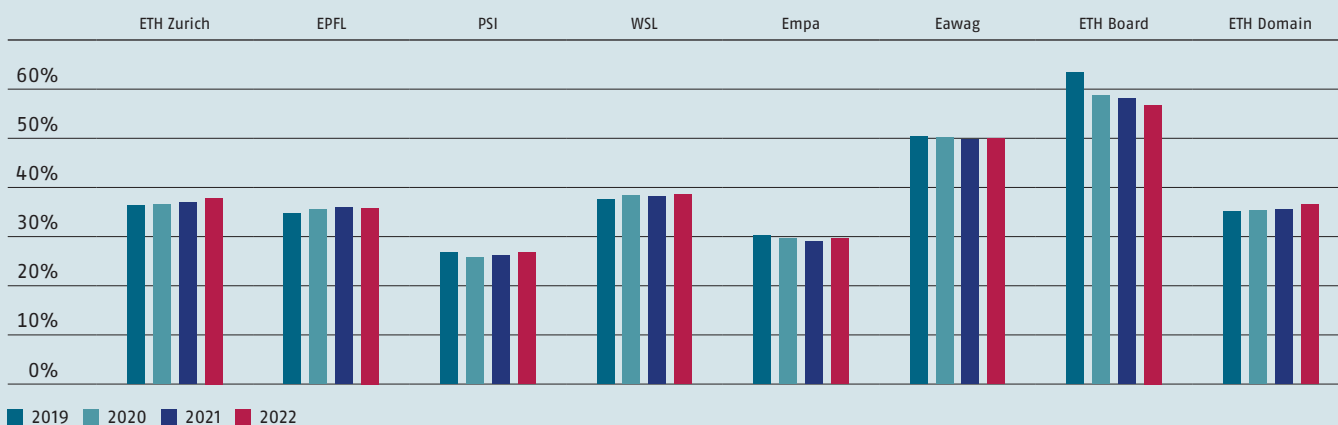
Native languages of employees in the ETH Domain in 2022. Figures for the previous years are shown in brackets.

Fig. 21: Development in the proportions of foreign employees by function group



Development in the proportions of foreign employees in the ETH Domain by function group (in relation to the number of employment contracts, EC).

Fig. 22: Development in the proportion of women by institution



Development in the proportion of women by institution over the past four years (in relation to the number of employment contracts, EC).

Fig. 23: Development in the proportion of women in management positions in the ETH Domain

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	2,643	2,697	2,745	2,767	2,793	2,810	2,853	2,897	2,928	2,982	3,049	3,061
Women	413	445	464	492	507	521	561	576	610	644	693	733
Men	2,230	2,252	2,281	2,275	2,286	2,289	2,292	2,321	2,318	2,338	2,356	2,328
in % Women	15.6	16.5	16.9	17.8	18.2	18.5	19.7	19.9	20.8	21.6	22.7	23.9
in % Men	84.4	83.5	83.1	82.2	81.8	81.5	80.3	80.1	79.2	78.4	77.3	76.1

Development of the proportion of women in management positions in figures and percentages, i.e. function level 10 to 15 and professorship (with employment contracts, EC).

Abb. 24: Source of funds by function group

Function group		Professors (all)	Scientific personnel	Technical personnel	Administrative personnel	Total FTE
Source of funds						
Total federal contribution	2021	778.0	6,086.9	3,045.9	2,853.3	12,764.1
Federal financial contribution	2022	795.5	6,213.6	3,118.4	2,928.5	13,056.0
	Δ 2021/2022	17.5	126.7	72.5	75.2	291.9
Third-party resources	2021	31.0	4,350.1	262.8	81.3	4,725.2
Research funding (SNSF, Innosuisse, further), government-funded research and EU research programmes	2022	29.8	4,118.8	236.2	80.8	4,465.6
	Δ 2021/2022	-1.2	-231.3	-26.6	-0.5	-259.6
Industry-oriented research, donations/bequests	2021	45.6	1,835.6	413.6	285.1	2,579.9
	2022	46.7	1,913.9	417.3	316.6	2,694.5
	Δ 2021/2022	1.1	78.3	3.7	31.5	114.6
Total	2021	854.6	12,272.6	3,722.3	3,219.7	20,069.2
	2022	872.0	12,246.3	3,771.9	3,325.9	20,216.1
	Δ 2021/2022	17.4	-26.3	49.6	106.2	146.9

Source of funds according to function groups (in FTEs) in 2022 compared to 2021. Δ (delta) shows the absolute change compared to the previous year. Figures exclude apprentices (462,1 FTEs) and trainees.

Real estate

Fig. 25: Source of funds for ETH Domain constructions (in CHF millions)

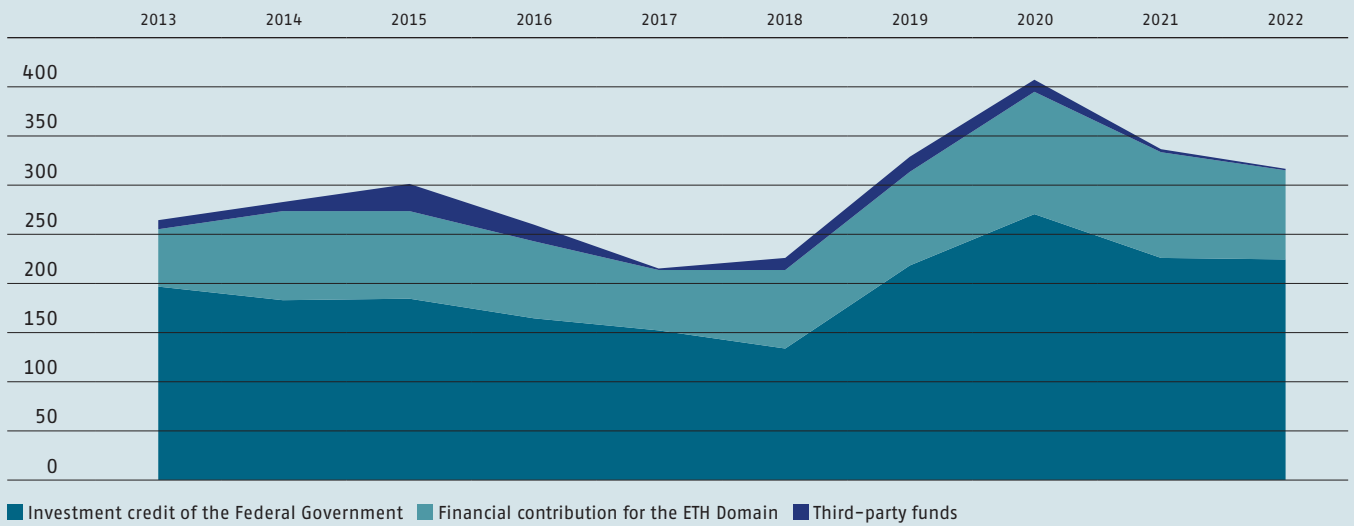


Fig. 26: Condition value as of 31 December 2022

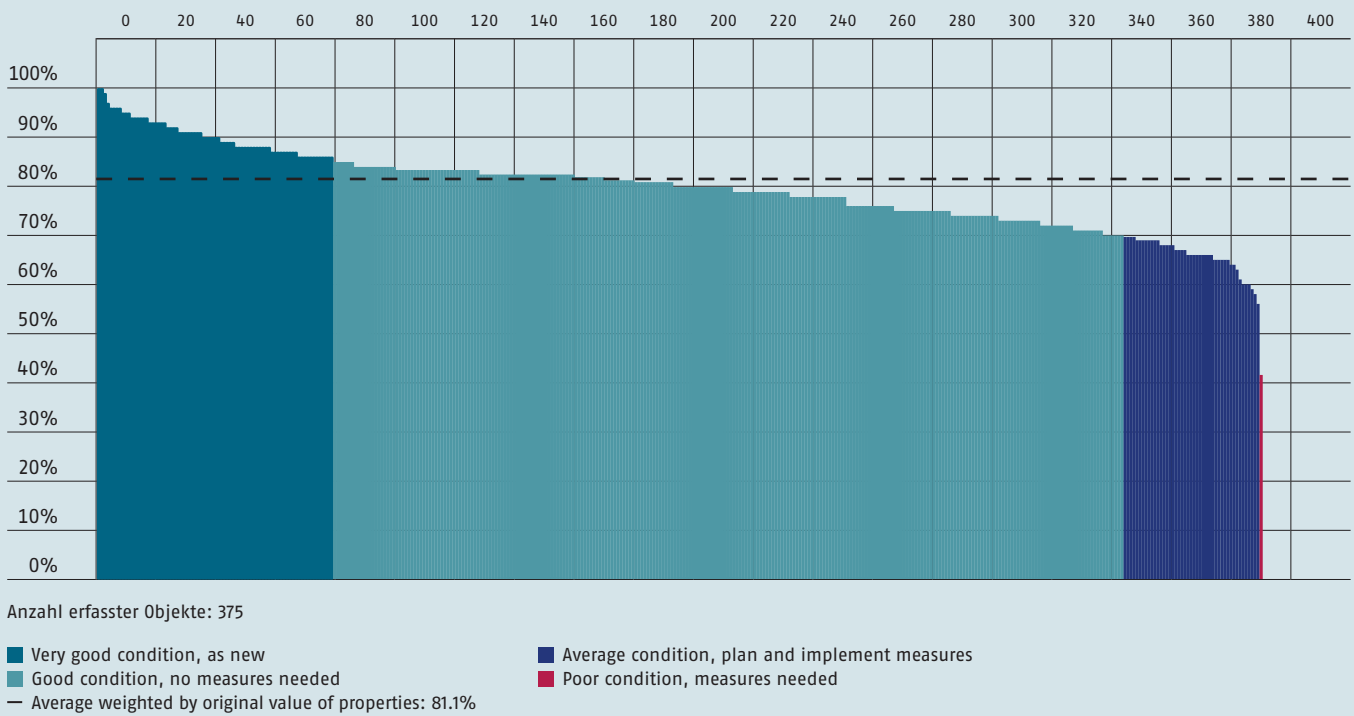


Fig. 27: Development of the main usable area by institution in %



Fig. 28: Mix of areas (in 1,000 m²)

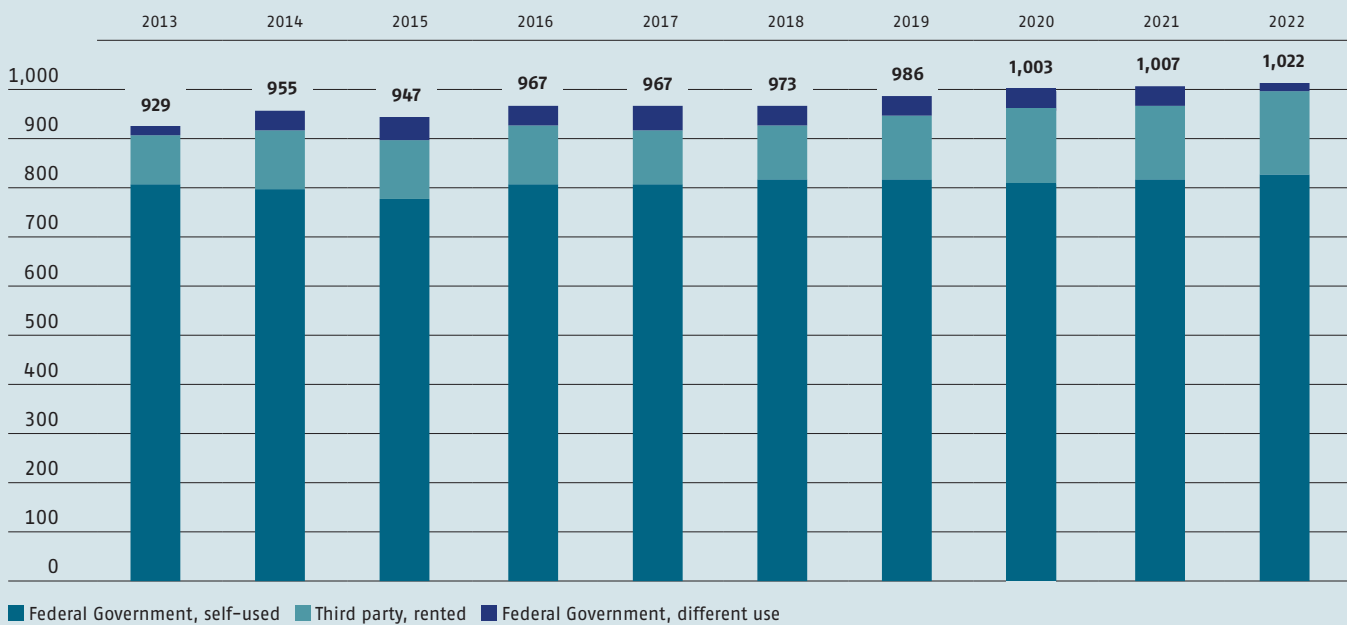


Fig. 29: Quantity structure of the ETH Domain portfolio

CHF millions	ETH Zurich	EPFL	PSI	WSL	Empa	Eawag	Total
Buildings							
Quantity	133	79	131	22	24	12	401
Original value	3,654	1,758	642	111	369	125	6,660
Book value	1,166	837	201	47	74	63	2,388
Plots							
Quantity	65	19	10	16	4	4	118
Book value	693	243	30	24	63	10	1,063
Book value of installations under construction	579	37	27	1	59	6	708
Building rights (not valuated, in compliance with regulations)							0
Total assets (book value real estate)	2,437	1,117	258	72	196	79	4,160
Provisions (e.g. for polluted sites, asbestos, radioactive waste)							256

Quantity and value of all government-owned real estate allocated to the institutions of the ETH Domain.

Fig. 30: Investments

CHF 1,000	ETH Zurich	EPFL	PSI	WSL	Empa	Eawag	Total
Investment credit from Federal Government	136,000	24,000	18,650	4,750	37,600	3,760	224,760
of which for new or replacement constructions	46,667	6,196	16,511	4,711	36,262	631	110,977
of which for maintenance of value and functionality	89,333	17,804	2,139	39	1,338	3,129	113,783
Financial contribution investments (for user-specific construction)	64,621	16,338	4,198	925	4,596	1,118	91,797
Third-party resources	404	0	0	0	520	0	923
Construction expenses of the Institutions	201,025	40,338	22,848	5,675	42,716	4,878	317,480
Main usable area (m ²)	512,600	297,100	113,920	18,920	60,040	19,950	1,022,530
Construction expenses per m ² main usable area (CHF/m ²)	392	136	201	300	711	245	310

2022 investments in the ETH Domain portfolio, based on the main usable area (in m²). This is the part of the usable area that is directly allocated to the core task of teaching and research. Because the research institutes themselves do not provide teaching, a figure for the area across the entire Domain – for example in relation to the number of students – would not be very informative.

Environment and energy

Fig. 31: Environment and energy data

		ETH Domain 2020	ETH Domain 2021	ETH Zurich	EPFL	PSI	WSL	Empa	Eawag	ETH Domain Trend 2022 ¹
BASIC DATA										
Energy reference area (ERA) ²	m ²	1,467,944	1,482,996	699,961	428,019	171,330	25,924	123,442	34,320	1,485,864
Full-time equivalent ³	FTE	39,941	41,738	23,974	12,966	2,066	858	1,175	699	42,596
ENERGY⁴										
Final energy, net⁷	kWh / a	439,003,317	473,031,646	196,969,112	99,074,850	152,449,753	4,597,462	16,466,808	3,473,661	456,887,089
Electricity, net (not incl. self-produced)	kWh / a	321,431,871	371,014,550	135,363,313	71,870,000	146,527,598	3,204,016	11,050,808	2,998,815	363,597,880
Consumption of uncertified electricity	kWh / a	0	0	0	0	0	0	0	0	
Consumption of certified electricity	kWh / a	321,431,871	369,540,975	134,831,120	71,870,000	146,202,176	3,083,966	10,720,864	2,832,849	
Electricity (without naturemade star)	kWh / a	312,189,265	346,346,751	130,831,120	55,870,000	145,929,449	810,089	12,906,093	0	
Photovoltaic naturemade star	kWh / a	2,080,997	2,343,548	0	2,000,000	272,727	0	0	70,821	
Hydro power naturemade star	kWh / a	13,599,888	22,762,028	4,000,000	14,000,000	0	2,000,000	0	2,762,028	
Wind naturemade star	kWh / a	150,705	273,877	0	0	0	273,877	0	0	
Sale of electricity	kWh / a	-6,588,984	-2,185,229	0	0	0	0	-2,185,229	0	
Heat	kWh / a	116,069,503	101,842,296	61,522,000	27,016,000	6,059,860	1,014,178	5,589,446	640,812	
Fuel oil	kWh / a	791,168	2,217,705	1,513,000	284,000	287,860	103,995	0	28,850	
Natural gas, biogas	kWh / a	80,275,186	69,303,289	39,650,000	25,724,000	0	0	3,724,289	205,000	
District heating	kWh / a	59,197,109	58,209,445	48,472,000	1,008,000	5,772,000	0	2,550,483	406,962	
Woodchip	kWh / a	858,019	910,183	0	0	0	910,183	0	0	
Sale of heat	kWh / a	-25,051,979	-28,798,326	-28,113,000	0	0	0	-685,326	0	
Fuels (own vehicles)	kWh / a	1,501,943	1,648,375	615,992	188,850	187,717	499,318	156,498	0	
Energy: additional information										
Energy costs, electricity and heat ⁵	CHF / a	48,998,517	55,472,888	27,798,034	9,861,280	14,937,635	522,858	1,833,636	519,445	59,960,021
Self-generated renewable electricity	kWh / a	914,989	1,473,575	532,193	0	325,422	120,050	329,944	165,966	
Total sale to third parties	kWh / a	-31,133,984	-30,298,229	-28,113,000	0	0	0	-2,185,229	0	
WATER (DRINKING WATER)	M³	480,661	422,675	189,954	150,000	53,563	6,523	16,611	6,024	576,641
MATERIALS										
Paper	kg	184,528	134,785	77,500	28,226	18,097	3,906	3,859	3,197	157,647
Paper, new fibre	kg	50,119	45,316	14,000	21,083	9,714	307	174	38	52,776
Paper, recycled	kg	134,409	89,469	63,500	7,143	8,383	3,599	3,685	3,159	104,871
KEY FIGURES: ENVIRONMENTAL IMPACT										
Primary energy⁶	kWh / a	510,064,300	554,189,208	219,573,347	119,879,439	184,291,891	7,195,220	18,582,236	4,667,075	
Proportion of renewable energies	%	66	72	58	62	94	58	75	77	
CO₂ emissions	t CO₂ / a	32,704	29,704	18,330	9,081	613	384	1,078	217	

¹ Provisional figures for the year under review (trend), as at: start of March 2023.

² The energy reference area is the sum of all gross floor areas, above and below ground, which must be heated or air-conditioned in order to be used.

³ The FTE (full-time equivalent) value listed here was supplemented by the number of students with an FTE value of 0.68 to produce the consumption per person.

⁴ The key figures indicated for electricity and heat show the total consumption of both for buildings, as well as for teaching and research activities.

⁵ The key indicator "energy costs" shows all expenditure (cash out) for the provision of energy (heat and electricity).

⁶ In energy economics, one refers to primary energy as the energy that is available using the original forms or resources of energy, such as fuel (e.g., coal or natural gas), as well as energy carriers such as sun, wind or nuclear fuels.

⁷ Final energy is the portion of the primary energy that is left after losses due to energy conversion and transmission, after it is supplied via the consumer's domestic connection. The final energy basically corresponds to the energy that is purchased.

FINANCES

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* Extract from the Financial Report 2022

Financial Report:
www.ethboard.ch/financialreport2022

Consolidated financial statements

Table 1: Statement of financial performance of the ETH Domain (consolidated)

CHF millions	Notes	Budget 2022	Actual 2022	Actual 2021	Change to Actual absolute
Federal financial contribution		2,441	2,441	2,373	68
Federal contribution to accommodation		202	202	230	-29
Total federal contribution	7	2,643	2,643	2,604	39
Tuition fees, continuing education	8	53	58	56	2
Swiss National Science Foundation (SNSF), regular research funding		274	267	268	-1
Swiss National Science Foundation (SNSF), transitional measures Confederation		n/a	1	n/a	n/a
Swiss Innovation Agency (Innosuisse), regular research funding		53	44	41	3
Swiss Innovation Agency (Innosuisse), transitional measures Confederation		n/a	-	n/a	n/a
Special federal funding of applied research		79	87	87	-
EU Framework Programmes for Research and Innovation (EU-FPs), regular research funding		155	137	160	-23
EU Framework Programmes for Research and Innovation (EU-FPs), transitional measures Confederation		n/a	17	n/a	n/a
Industry-oriented research (private sector)		141	136	136	-
Other project-oriented third-party funding (incl. cantons, municipalities, international organisations), regular research funding		85	105	95	10
Other project-oriented third-party funding (incl. cantons, municipalities, international organisations), transitional measures Confederation		n/a	-	n/a	n/a
Research contributions, mandates and scientific services	9	786	795	788	8
Donations and bequests	10	95	138	122	16
Other revenue	11	121	146	127	19
Operating revenue*		3,698	3,780	3,697	83
Personnel expenses	5, 12, 28	2,466	2,503	2,426	77
Other operating expenses	13	931	944	893	51
Depreciation	21, 23	260	243	266	-23
Transfer expenses	14	99	60	56	4
Operating expenses		3,755	3,750	3,641	109
OPERATING RESULT		-57	30	56	-26
NET FINANCE INCOME / EXPENSE*	15	-1	-27	26	-53
Share of surplus / deficit of associated entities and joint ventures*	20	-	-25	28	-53
SURPLUS (+) OR DEFICIT (-)		-58	-21	110	-131
*Total revenue		3,697	3,729	3,751	-22

Table 2: Balance sheet of the ETH Domain (consolidated))

CHF millions	Notes	31.12.2022	31.12.2021	Change absolute
CURRENT ASSETS				
Cash and cash equivalents	16	742	1,862	-1,120
Current receivables from non-exchange transactions	17	622	637	-15
Current receivables from exchange transactions	17	72	73	-2
Current financial assets and loans	22	1,540	488	1,051
Inventories	18	12	12	-
Prepaid expenses and accrued income	19	60	70	-10
Total current assets		3,048	3,143	-95
NON-CURRENT ASSETS				
Property, plant and equipment	21	2,179	2,032	147
Intangible assets	21	59	60	-1
Non-current receivables from non-exchange transactions	17	1,045	979	66
Non-current receivables from exchange transactions	17	-	-	-
Investments in associated entities and joint ventures	20	246	271	-24
Non-current financial assets and loans	22	72	64	8
Co-financing	23	109	114	-5
Total non-current assets		3,709	3,518	191
TOTAL ASSETS		6,757	6,661	96
LIABILITIES				
Current liabilities	24	171	168	3
Current financial liabilities	25	17	14	2
Accrued expenses and deferred income	26	194	179	15
Short-term provisions	27	99	105	-6
Short-term liabilities		480	466	14
Dedicated third-party funds	29	1,641	1,605	36
Non-current financial liabilities	25	382	327	55
Net defined benefit liabilities	28	320	615	-294
Long-term provisions	27	603	604	-1
Long-term liabilities		2,947	3,150	-204
Total liabilities		3,427	3,616	-189
EQUITY				
Valuation reserves		721	424	297
Reserves from associated entities	20	246	271	-24
Donations, grants, co-financing		948	953	-5
Other equity		1,415	1,397	18
Total equity		3,330	3,045	285
TOTAL LIABILITIES AND EQUITY		6,757	6,661	96

Total federal contribution

In accordance with IPSAS, the statement of financial performance on page 108 shows the surplus or deficit after adjusting for revenue and expenses not attributable to the current period. In the statement of financial performance, the total federal contribution is made up of the expenditure credit (A231.0181) and the federal contribution to accommodation credit (A231.0182: Federal contribution to accommodation, ETH Domain), which constitutes a credit for the use of real estate owned by the Federal Government. In 2022, the federal contribution to accommodation amounted to CHF 201.6m. Together with the federal financial contribution (A231.0181) of CHF 2,441.4m, the total federal contribution (statement of financial performance view) came to CHF 2,643.0m.

In the ERI Dispatch, the total federal contribution is made up of the federal financial contribution credit (A231.0181) and the investments in buildings of the ETH Domain credit (A202.0134). These count towards the expenditure ceiling. The following provides an explanation of the total federal contribution from the expenditure ceiling perspective, which is oriented towards the credit perspective affecting expenditure and amounted to CHF 2,666.4m in 2022. It comprises the two expenditure credits that count towards the expenditure ceiling of the ETH Domain and are approved by the Parliament each year: expenditure credit (A231.0181: Federal financial contribution) and investment credit (A202.0134: Investments in buildings of the ETH Domain).

The ETH Domain's expenditure ceiling for the period from 2021 to 2024

In order to implement its strategic planning for the period from 2021 to 2024, the Federal Council applied by way of ERI Dispatch 2021–2024 for an expenditure ceiling of CHF 10,810.7m (average annual growth of 2.5% on the basis of the expected budget for 2020 of CHF 2,556.2m). The expenditure ceiling for the period from 2021 to 2024 was approved on 10 December 2020 with FedD 4 concerning ERI Dispatch 2021–2024 (FedD I 2021 72). It includes the costs of CHF 11m per year for the dismantling and disposal of the accelerator facilities at PSI. However, the expenditure ceiling does not yet include the ceiling-raising expenditures of CHF 10.4m for the dismantling and disposal of the Federal Government's nuclear installations at PSI. Without these expenditures, the ETH Domain does not provisionally utilise CHF 13.8m of the credits that count towards the expenditure ceiling (see Fig. 32).

Approved credits in 2022

In FedD Ia concerning the 2022 budget, the Federal Assembly approved the two credits that count towards the expenditure ceiling, which total CHF 2,666.2m. Compared with the 2021 financial statements (CHF 2,600.2m), the increase was CHF 66.1m.

The federal financial contribution (credit A231.0181) amounted to CHF 2,441.4m and the investment credit to CHF 224.8m. Since dedicated reserves were neither created nor released for the investment credit, the ETH Domain received altogether CHF 2,666.2m from the total federal contribution (2021: CHF 2,600.1m).

Fig. 32: Expenditure ceiling and credits for the ETH Domain in the ERI period from 2021 to 2024

CHF millions

	2,588.0	2,660.9	2,740.1	2,821.7	10,810.7
Actual 2021	2,373.3	-226.8			2,600.1
Actual 2022		2,441.4	-224.8		2,666.2
Budget 2023			2,521.5	214.5	2,736.0
FP 2024				2,608.4	196.6 2,805.0
Not claimed for the time being*					3.4 (eff.13.8)

* The expenditure ceiling for the period from 2021 to 2024 that is not claimed for the time being amounts to CHF 10,807.3m. It includes the expenditures of CHF 10.4m for the dismantling and disposal of the Federal Government's nuclear installations at PSI (Decree of the Federal Council of 10 June 2022). These would raise the ceiling in the event that the total expenditure ceiling approved by the Parliament for the period from 2021 to 2024 were to be exceeded.

■ A231.0181 Federal financial contribution
 ■ A202.0134 Investments in constructions of the ETH Domain

Financial plan (FP)

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- all scientists in the ETH Domain's institutions in the preparation of the reports,
- the members of the ISP Group of the ETH Domain (Implementation Strategic Planning),
- the members of the ETH Domain ComTeam (Heads of Communication and their staff),
- the specialits and employees of the ETH Board staff and of the institutions of the ETH Domain.

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The ETH Domain consists of the two Swiss Federal Institutes of Technology ETH Zurich and EPFL as well as the four federal research institutions, the Paul Scherrer Institute (PSI), WSL, Empa and Eawag. Appointed by the Federal Council, the ETH Board is the strategic governing and supervisory body of the ETH Domain.

www.ethboard.ch

The Institutions of the ETH Domain:

ETH zürich

ETH Zurich

520 professors, over 24,500 students and doctoral students, 3,000 technical and administrative staff as well as 6,700 scientific staff from over 120 countries: they all research, teach, learn and work at ETH Zurich. Networked globally with the scientific community, and rooted in Switzerland via National Centres of Competence in Research. More than 5,000 young people graduate every year, bringing the latest knowledge to Swiss companies. Or they found one of the two dozen or so spin-offs established each year in industries with a promising future like nanotechnology, medtech, cybersecurity or computer science. www.ethz.ch



PSI

The Paul Scherrer Institute (PSI) develops, builds and operates large-scale and complex research facilities, which it makes available for use by the national and international research community. All of these large-scale research facilities are unique in Switzerland, and in some cases the PSI is the only place in the world to have them. The institute's own research focuses on the fields of matter and materials, energy and the environment, as well as humanity and health. www.psi.ch



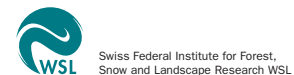
Empa

Empa is the interdisciplinary research institute of the ETH Domain for materials science and technology. On the basis of its research, it develops innovative solutions to meet the biggest challenges currently facing industry and society, and therefore plays a significant role in reinforcing the international capacity and competitiveness of Swiss industry in an increasingly competitive environment. www.empa.ch

EPFL

EPFL

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WSL

WSL investigates changes to the terrestrial environment and the use and protection of natural habitats and cultural landscapes. It monitors and researches the condition and progress of forests, landscape, biodiversity, natural hazards and snow and ice, and develops sustainable solutions for socially relevant problems. WSL also includes the WSL Institute for Snow and Avalanche Research SLF Davos. www.wsl.ch



Eawag

Eawag is one of the world's leading water research institutes. Its strength and success are based on the combination of research, teaching and further education that it has provided for over 80 years, along with consultancy and the transfer of knowledge. The combination of natural sciences, engineering and social sciences enables comprehensive research into water in relatively untouched rivers and lakes, right through to waste water management systems. www.eawag.ch

Cover page

Maryna Viazovska has been awarded the Fields Medal 2022. The EPFL Professor for number theory solved a mathematical problem that has stumped researchers for centuries (see also p. 19 f.).

Back page

"A forecast on my mobile phone about the snow slope, which I'm cruising down? That would be a fascinating vision of the future!", says Jürg Schweizer, Head of the SLF on digital possibilities in snow research (see also p. 26 f.).



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