Annual Report 2012
of the ETH Board on the ETH Domain
The upper reaches of the Sense in the Canton of Fribourg that have been left to nature served the “Integrated River Management” project as an object of study for the rehabilitation of watercourses in Switzerland. ETH Zurich, EPFL, WSL and Eawag were involved in the interdisciplinary project completed in 2012 (see p. 56).
Annual Report 2012
of the ETH Board on the ETH Domain
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Dear members of the Federal Council
Dear members of the National Council and Swiss Council of States
Dear readers

Figures do not lie: Student numbers at both Federal Institutes of Technology have risen by 50% over the past decade. The number of master’s degrees awarded came to 2,300 in 2012 and we recorded an increase in new bachelor’s students of 4.8% to over 13,000. These figures tell a success story. They show that there is strong demand for the courses we offer, especially among Swiss high school graduates, and that the quality of teaching and research at both Federal Institutes of Technology is indisputably high. This is also confirmed by global rankings of universities, international research competitions and awards – the six institutions of the ETH Domain are top players throughout the world. Their graduates have excellent prospects on the labour market. Statistics show that graduates in the so-called MINT disciplines (mathematics, informatics, natural sciences and technology) are quickly finding jobs in business and administration thanks to their proven competence. The growing number of students in these disciplines is enabling us to supply business and society with the smart minds being sought in this area.

However, it is necessary to maintain and further develop the leading positions we have achieved and this is also something we are working on. For example, in the reporting year we inaugurated ETH Zurich’s new national supercomputing centre in Lugano–Cornaredo. PSI has pushed ahead sufficiently with the development of the X-ray free electron laser SwissFEL for the foundation to be laid in 2013. And the fact that at the start of 2013 the EU selected the Human Brain Project (HBP) under the leadership of EPFL as one of two European flagship projects worthy of international funding is particularly deserving of mention. This is the result of long-standing and intensive commitment in 2012 on the part of EPFL and the ETH Domain. There is of course also a downside to all these success stories: the strong influx of students has brought about a further deterioration in the supervision ratio between professors and students despite the fact that 86 professorships were newly created or refilled in the reporting year. Investments in teaching will therefore retain a high priority in the future.

My overall conclusion is that the ETH Domain has made further progress in 2012. This is a claim that has always adorned the cover of our Activity Report in previous years. We are also moving forward here and renaming the latter 2012 Annual Report in line with the corporate governance of the Federal Government as the idea is to report on our “business”, i.e. the achievement of our objectives. I would like to extend my warmest thanks to all who have contributed towards the successful implementation of our objectives – the government, our professors, our employees and our students.

Dr Fritz Schiesser
President of the ETH Board
Both the political and economic environments exert a major influence on the academic life of the ETH Domain. The “Overview” section outlines the major issues here. The picture shows the panoramic view across EPFL’s Rolex Learning Center on Lake Geneva (picture: EPFL/Alain Herzog).
A strikingly positive development in terms of the numbers enrolling for bachelor’s degrees is that the strongest growth rates were recorded for life sciences (+21.1%) and engineering sciences courses (9.2%). Altogether 5,072 students embarked on a bachelor’s degree at one of the two Federal Institutes of Technology, 234 or 4.8% more than in the previous year. Of the total number of 13,359 bachelor’s and 6,981 master’s students, 74% and 59% respectively hold Swiss qualifications. Over two thirds of the 5,836 doctoral students hold foreign qualifications.

The renewed upturn in figures for new students and graduates shows that the ETH Domain meets the expectations and requirements of society and the business world for greater numbers of up-and-coming talent to be educated in the MINT disciplines. However, it is also important at the same time not to permit any compromises or cutbacks in terms of the quality and attractiveness of teaching despite rising student numbers. With this in mind the ETH Board already reallocated almost 17m CHF for teaching duties within the scope of performance-oriented asset allocation in early 2012. Parliament also increased the budget appropriation originally envisaged for the ETH Domain during the consultations for the dispatch of the Federal Council on the promotion of education, research and innovation from 2013 to 2016. It justified this by the fact that student numbers grew by around 48% between 2004 and 2012, while the federal contribution only rose by around 22%. The ETH Board welcomed this move but also acknowledges its duty to look for means and ways of obtaining additional funding sources for teaching and research.

The four research institutes also made a significant contribution to teaching in 2012: Their staff taught for a total of 14,735 hours at one of the two Federal Institutes of Technology and at universities and universities of applied sciences over the year. In addition 1,349 students worked on their bachelor’s, master’s and doctoral theses at one of the research institutes.

The theme of energy also remained very high up on the political agenda in 2012. In recent years the ETH Domain has invested an annual sum of between 150 and 190m CHF from its own funds in energy research. Thanks to this long-standing commitment and the established cooperation of the researchers, the ETH Domain was able to make a swift and substantial contribution to the “Coordinated Energy Research Switzerland – Measures in the Years 2013–2016” plan of action of the Confederation in 2012. The Confederation wanted to know in which areas tangible contributions to the energy turnaround could be expected soonest from increased research efforts as the politically agreed exit from nuclear energy (Energy Strategy 2050) and Switzerland’s climate objectives called for a fundamental restructuring of the Swiss energy supply system. A group of experts* laid out five fields of action and support for the phasing out of nuclear energy. The Federal Council then used this to propose seven networked, inter-university centres of competence for energy efficiency; grids, their components and energy systems; storage; electricity supply; economy, environment, law and conduct; efficient concepts, processes and components for mobility; and biomass (see p. 44).

* Headed by the SERI to which representatives of the ETH Domain also belong.
New research centres
Two strategically important research centres marked milestones for the ETH Domain in 2012. In the presence of Federal Councillor Alain Berset and representatives of the ETH Domain, the Singapore ETH Centre for Global Environmental Sustainability was opened in Singapore on 16 March (see p. 88) and the Swiss National Supercomputing Centre (CSCS) was opened at the new site in Lugano–Cornaredo on 31 August. Both centres belonging to ETH Zurich are the result of several years of intensive planning and decision-making processes and fulfill two explicit objectives of the 2008–2011/2012 performance mandate of the Federal Council to the ETH Domain.

Ultra-short x-ray laser pulses measured precisely
An international team led by researchers from the Paul Scherrer Institute (PSI) for the first time carried out precise measurements of the pulses of “hard” x-ray lasers in 2012. Scientists from a wide range of disciplines use these pulses to shed light on the structure and workings of material at the atomic level. This will make it possible at a later stage to develop better medicines, more powerful computer components and more efficient catalysts for the conversion of energy. The measurements were carried out with the world’s first hard x-ray laser installed at Stanford, California, thereby laying the foundation for the best possible scientific use of these installations – including the SwissFEL planned at PSI.

Forests as recreational areas: valued and at threat
The Swiss population has a broad understanding and appreciation of the wide range of forest products and services, as is reflected by a representative survey entitled “Socio-cultural forest monitoring” evaluated by WSI on behalf of the Federal Office for the Environment (BAFU) and jointly presented in February 2012. WSL also discovered in 2012 that the area infested by the oriental chestnut gall wasp in the forests of Ticino had expanded significantly. The forest is also at threat from other pests. For example, in 2012 WSL investigated the Asian longhorn beetle that was discovered in Switzerland in 2011 and reached Europe and Switzerland from East Asia as a result of international trade flows. The demand for WSL’s expertise in harmful forest organisms, their spread and how to combat them is all the greater in an era of globalisation (see p. 94).

How “green” are biofuels?
On behalf of the Swiss Federal Office of Energy (SFOE) and in collaboration with Agroscope Reckenholz-Tänikon Research Station and PSI, Empa updated the fundamentals for the environmental assessment of a large number of biofuels and their production chains. The upshot is that when viewed overall, very few biofuels are more environmentally friendly than petrol. The study published in September 2012 shows that biofuels from deforested areas usually cause more greenhouse gases than fossil fuels. Clearing woodland and bush areas in order to develop monocultures for energy production is to be avoided, as this considerably worsens the greenhouse gas balance sheet and burdens the environment. The use of land and forestry residues such as straw, garden and timber waste for energy purposes is advantageous – but only if these cannot be used in other ways or if their extraction from their natural cycle does not reduce the fertility of the soil and biodiversity.

Study of lakes returns to its origin
EPFL and Eawag created the Margaretha Kamprad Chair of Limnology and Environmental Science that is named after the second wife of the founder of IKEA, who was a great lover of nature. The discipline of limnology, i.e. the study of lakes, that was founded over 100 years ago by Vaudois researcher François-Alphonse Forel, is therefore returning to its roots. The Chair is supported by a partnership with Ferring Pharmaceuticals, who will provide a financial injection of 5 million CHF, and will focus on the research of lake ecosystems, which are fragile and often heavily affected by human activity. Globally renowned expert in aquatic physics Alfred Wüest has been nominated to hold the new Chair and will combine this task with his role as Head of the Aquatic Physics Group at Eawag.

ETH Domain project becomes FET flagship
At the end of January 2013, the EU selected the Human Brain Project (HBP) under the leadership of EPFL as one of two flagships as part of the European Future and Emerging Technologies initiative (FET). This major success enabled the ETH Domain to consolidate its standing as an important research partner at the European level (see p. 23 and 50).
Promotion of major national projects – new laws for tertiary institutions

In the 2012 performance mandate, the Federal Council instructed the ETH Domain to enhance cooperation in the tertiary education sector and to promote national projects such as the X-ray free-electron laser SwissFEL and the Swiss National Supercomputing centre as well as the application for European flagship project status for the Human Brain Project. The regulatory environment was shaped by reforms to the federal legislation for the tertiary education sector and for research and innovation. Thanks to the amendments to the ETH Law, the ETH Board can now manage the strong increase in student numbers in a targeted manner.

In accordance with the decision taken by the Federal Council in 2010, the Federal Government’s Message on finance is now submitted to the newly elected Parliament in order to improve its alignment with the planning of legislation. In the reporting year this led to a transition period that was bridged with a one-year Message on the promotion of education, research and innovation (ERI Message). The 2012 performance mandate for the ETH Domain was basically a continuation of the previous 2008–2011 mandate albeit with various supplements. The ETH Domain followed this mandate and focused on the issues highlighted by the Federal Council and Parliament (see enclosed “Performance mandate”).

Implementation of focal points in 2012 performance mandate
- Promotion of SwissFEL project: PSI continued to forge ahead with the planning and completion of prototypes for core components of the facilities in 2012. Development orders to Swiss industry were accelerated with funds originating from the Federal Council’s package of measures to combat the strong franc and used for launching the project in the previous year (2011).
- Implementation of high-performance computing and networking strategy of the ETH Board formulated in 2007: The initial implementation phase of the HPCN strategy has been completed and the new Swiss National Supercomputing Centre (CSCS) in Lugano–Cornaredo was moved into as scheduled in spring 2012. The supercomputing infrastructure there was developed further and is now operated sustainably as a user-centric research laboratory. In this way ETH Zurich is continuing the national high-performance computing and networking strategy (HPCN strategy) of the ETH Board under the authority of the Confederation.
- Application by the Human Brain Project consortium (HBP) under the leadership of EPFL for flagship project status from the European Commission’s Future and Emerging Technologies (FET) initiative. Two out of six consortia invited by the EU in May 2011 were selected in January 2013 for co-financing over 10 years by the European Commission: the Human Brain Project (www.humanbrainproject.eu) and Graphene. The selection of the Human Brain Project as one of the two winning projects enabled this additional objective in the 2012 performance mandate to be fulfilled (see p. 23 and 50).

Cooperation within the ETH Domain and with the Swiss tertiary institutions was also intensified in compliance with the performance mandate in the reporting year. Examples of these efforts include:
- In 2012, the ETH Zurich, University of Zurich and Zurich University Hospital launched the “Zurich University Medicine” initiative which collates findings from basic research, clinical research and medical care to create new focal areas that use knowledge from all three of these sectors. One of these is biomedical imaging. A new centre serves to reinforce the existing competencies in Zurich, from technology development to clinical application. This initiative will further strengthen Zurich’s reputation as a centre of research (see p. 78).
- EPFL fosters four successful strategic alliances with centres of competence and research institutions: with CSEM, Institut de Recherche Idiap (Idiap), Institut de Recherche en Ophtalmologie (IRO) and the Swiss Tropical and Public Health Institute (Swiss TPH).
- The national Tissue Engineering for Drug Development and Substance Testing (TEDD) centre of competence operates a platform where new technologies for testing substances for the pharmaceutical industry and personalised medicine can mature and reach application readiness. In this regard, ETH Zurich and Empa cooperate closely with ZHAW (Zurich University of Applied Sciences), HSR Hochschule für Technik Rapperswil, Swiss Center for Electronics and Microtechnology (CSEM), University Hospital Basel and a number of private companies.

Changes to the regulatory environment
The regulatory environment in 2012 was overshadowed by the introduction of the Federal Act on the Funding and Coordination of the Higher Education Sector (Funding and Coordination...
Act) as well as the complete revision of the Federal Act on the Promotion of Research and Innovation (FAPRI). The ETH Domain was also affected by this and successfully participated in this important restructuring of the regulatory environment.

The Funding and Coordination Act was adopted by the Federal Parliament in autumn 2011 and is now in the implementation phase. In view of this, the universities, universities of applied sciences and teacher training colleges established the “swissuniversities” association in November 2012, which is intended to replace the CRUS (Rectors’ Conference of the Swiss Universities) and the representative bodies of the universities of applied sciences and teacher training colleges. The President of ETH Zurich also sits on the board of “swissuniversities” (www.swissuniversities.ch).

Before the Funding and Coordination Act can enter into force, the Cooperation Agreement between the Federal Government and University Cantons on Matters Relating to Universities (ZSAV) and the Intercantonal Agreement on Swiss Higher Education (University Concordat) must be adopted. The Swiss Conference of Cantonal Ministers of Education (EDK) carried out a consultation for both agreements in the second half of 2012. The ETH Board proposed that the University Board be supported by a preparatory committee – similar to the current Conference for Chief Officers in “University Matters” of the SUC – and that the ETH Board should also be represented on this body. The inclusion of all partners in the newly established committees is very important, if only because the law makes provision for enhanced coordination in areas that are “highly cost-intensive”.

In 2012 the Federal Parliament also discussed the FAPRI, which is similarly important to the ETH Domain and which the ETH Board also helped to prepare. The ETH Board is very pleased with the version of the law that was adopted during the 2012 winter session. It is particularly satisfied with the fact that the text of the law refers to basic research and contains clear financing guidelines for contributions pledged to research institutions of national importance under Art. 15 of the draft law (Art. 16 of the law in the current legal version) as well as similar rules for the CFI and SNF in the international context.

The ETH Board also welcomes the fact that initial disagreements between the National Council and the Council of States have been overcome and the Swiss Innovation Park can now be built at several networked locations. The solution adopted contributes towards safeguarding the equilibrium between the language regions and fostering cooperation with the universities. The newly established Swiss Innovation Park Association is drawing up proposals for the design of the Swiss Innovation Park. ETH Zurich, EPFL and Empa joined the association as committed members.

The Ordinance on Research and Innovation Promotion (RIPO) will also be addressed in 2013, with pending issues to be decided such as the reimbursement of indirect costs (overhead costs) and the handling of intellectual property rights to research projects promoted with federal funds. The ETH Board would like its concerns regarding expansion and flexibility to be taken into consideration.

As both Federal Institutes of Technology are attracting more and more students from all over the world, there is a need for action with regard to the admission and promotion of young talent. The number of applications for admission to a master’s degree increased particularly steeply: In 2012 around 2,500 external students applied for admission to a master’s degree at ETH Zurich and around 1,900 applied at EPFL (of which 2,032 and 1,759 respectively held a foreign degree). Of the applicants with foreign degrees, 20.5 % (417) were accepted for a master’s degree in Zurich and 15.2 % (267) in Lausanne. The ETH Board therefore called on Parliament to create a legal basis as part of the adjustment of the ETH Law to the two-level university system with bachelor’s and master’s degrees (Bologna reform process) that can be used to restrict the admission of students with foreign qualifications. It is particularly important in view of the available capacities at master’s level to guarantee the quality of teaching and education at both Federal Institutes of Technology. The revision of the ETH Law gives authority to the ETH Board to do this in Article 16a. However, a Matura school-leaving certificate still grants admission to a course of study at a Federal Institute of Technology.

Budgetary changes

The Federal Parliament approved the 2013–2016 ERI Message in autumn 2012. A smoothing of expenses for 2013 to 2016 was decided, which will increase the ERI credits requested by the Federal Council by a total of 157m CHF over four years, 103m CHF of which will fall to the ETH Domain. The ETH Board sees this as a clear signal by the political sector in favour of a continuous and sustainable development of the institutions of the ETH Domain.

The Federal Council’s Message of 17 October 2012 to the Federal Parliament on the “Coordinated Energy Research Switzerland – Measures for 2013 to 2016” plan of action pledged a total of 60m CHF to the ETH Domain (of which for 2013: 12m CHF, 2014: 16m CHF, 2015: 16m CHF, 2016: 16m CHF). These are not additional funds but for political reasons they are to be added to the budgetary framework which was increased by Parliament, and may only be used for their earmarked purpose.

In view of the economic environment, the forecast is by no means bold: The structural deficit in the Federal budget is likely to grow. To comply with the debt cap, the Federal Council approved a two-level restructuring concept: First of all the 2013 budget will be restructured in this regard, after which a package for consolidation and a critical review of expenditure will follow for the period from 2014 to 2016 (CRE 2014). From 2014 the Federal Council intends to use this package to lighten the Federal budget by 700m CHF per year over a two-year period. The education and research sector is to contribute 31m CHF per year to this reduction (without taking account of the investment credit for real estate in the ETH Domain). Under the CRE 2014, the ETH Domain’s budgetary framework is therefore likely to be reduced again after the increase as part of the smoothing of annual growth rates mentioned above. Apart from this the ETH Domain is facing enormous challenges as the result of the growth in student numbers and implementation of the Confederation’s energy strategy.
Global economy in crisis – education creates jobs

The world economy has now been struggling for five years with the consequences of a global financial and debt crisis that is hampering growth. Switzerland has also been unable to escape this. In this environment, companies in many countries have cut back their investments in research and development (R&E) and pressure has increased on government-sponsored research for swifter commercial use. However, it remains undisputed that investments in education offer better protection against unemployment and that investments in research promote innovation. With this in mind, the Federal Government continued to invest in the research infrastructure in 2012 and in doing so supported Swiss industry.

The year 2008 marked the start of a global economic crisis that subsequently developed into a debt crisis and from which the world economy has not really recovered to this day. The heavy indebtedness of many economies in Europe, the US and, to some extent, also in Asia is continuing to hamper economic performance. Growth remains low in Europe and the US, and a downturn in economic performance is also taking place in prospering emerging economies such as China. The medium-term economic forecasts offer no prospect at all of a turn-around. This cooling of the economy is also being felt in Switzerland. Alongside relatively robust domestic sectors (near-consumer industries, home-centric services), the export sectors also remained under pressure over the past year.

Useful effects of education expenditure

The effects of a global economic downturn can always be felt everywhere. However, an OECD study (Education at a Glance 2012) shows that a higher level of education offers better protection against unemployment and therefore translates into a more crisis-resistant labour market. Education accordingly has clear-cut economic and labour market benefits: In the OECD, average unemployment between the start of the crisis in 2008 and 2010 for workers without a higher secondary level qualification rose from an already high 8.8% to 12.5%, while average unemployment for persons with a higher secondary level qualification only increased from 4.9% to 7.6%. Average unemployment in the OECD for university graduates remained low and only increased from 3.3% to 4.7% over the same period.

The conclusion is clear: A higher standard of education also brings with it better opportunities on the labour market in times of crisis. This will not change for as long as societal demand for well-qualified workers continues to rise. There is no sign of a turnaround here. In Switzerland, demand from society and the business sector for students in the MINT subjects (mathematics, informatics, natural sciences and technology) remains high and the lack of engineers, chemists, physicists and other natural scientists has by no means been remedied.

The forecasts of ETH Zurich and EPFL for the 2013-2016 legislative period are based on considerably higher student numbers than the scenarios of the Federal Statistical Office (FSO). In view of the expected growth in student numbers, compromises on teaching quality can only be avoided if more funds are provided than those indicated by the FSO figures.

Innovation activities on the decline in the aftermath of the crisis

The uncertain global economic environment resulted in most OECD countries cutting expenditure for research and development (R&D) and other innovation activities. According to OECD figures, corporate investments in R&D in the OECD area shrank by a record 4.5% in 2009. With the exception of Korea and France, R&D expenditure declined in all countries. The corresponding data of the KOF Swiss Economic Institute at ETH Zurich show that the number of companies with R&D activities also contracted slightly in Switzerland from 2009 to 2011. However, as innovation output usually follows economic trends with a slight delay, it is pleasing to note that the innovation climate in Switzerland has not worsened to date. In fact, the long-term trend shows that obstacles to innovation are significantly losing importance.

A further aspect of the economic crisis is reflected in the fact that in 2011 the OECD averages for the establishment of new companies and venture capital investments were still well below their pre-crisis levels, while the number of corporate bankruptcies rose dramatically. However, there were no economic renewal processes in subsectors of the economy or forced structural changes recorded, both of which would help to strengthen the economy. Here too, therefore, the current economic environment is very unlikely to spur innovation activity.

Worldwide government measures

Under pressure from the effects of the crisis, most European countries instigated government measures to support the...
The economic environment

In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this. In the aftermath of the economic crisis and in the face of scarcer public funds, pressure for the commercial exploitation of the research results of public projects is rising. Technology transfer is gaining greater significance as a result of this. In the OECD area, increasing professionalisation can be observed here, and technology transfer is gaining greater significance as a result of this.
Tight capacities in teaching – top performance in research

In terms of teaching, the rising number of students is increasingly resulting in a deterioration of supervision ratios – especially in the MINT subjects which involve a high degree of supervision. More financial resources are thus required and the ETH Board therefore reallocated funds internally in 2012. In terms of research the ETH Domain leads the international competition. The efforts of the institutions serve to maintain this high standard and open up new forward-looking research areas. The ETH Board is striving to improve the underlying conditions for both basic and applied research. Appropriate resources are being deployed for interdisciplinary cooperation, including across borders, and the promotion of leading-edge technologies and large-scale research projects. This serves to enhance the appeal of the ETH Domain for students, researchers and teachers alike.

Teaching
The number of students at both Federal Institutes of Technology has been rising continuously for years. This is a positive development and proof of the appeal of the institutions and the quality of teaching. However, the other side of the coin is that around 27,000 students and doctoral candidates, around half of them at bachelor’s level and a quarter at master’s level, require supervision and support. In view of the major influx, both Federal Institutes of Technology are facing the challenge of keeping the quality of teaching, internships and scientific projects in the laboratory at the highest level. Additional professorships that are financed by the Federal financial contribution or by third-party start-up funding, as well as additional jobs for senior academic staff, have eased the difficult situation somewhat. The share of professorships financed by third-party funding now amounts to 46 professors, which is equivalent to around 6% of total professorships (765 employment contacts). These additional professorships now represent a significant and welcome factor for maintaining as good a supervision ratio as possible.

Rising student numbers challenge quality of teaching
The reality in teaching is clear to see: the supervision ratio between teaching staff and students has been deteriorating for years. Particularly in the MINT subjects (mathematics, informatics, natural sciences and technology), which involve a high degree of supervision, there is the risk that this could have negative consequences in terms of the quality of education. Additional professorships that are financed by the Federal financial contribution or by third-party start-up funding, as well as additional jobs for senior academic staff, have eased the difficult situation somewhat. The share of professorships financed by third-party funding now amounts to 46 professors, which is equivalent to around 6% of total professorships (765 employment contacts). These additional professorships now represent a significant and welcome factor for maintaining as good a supervision ratio as possible.

Fig. 1: Students

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of students including doctoral students at both Federal Institutes of Technology</th>
<th>of which bachelor’s students</th>
<th>of which master’s students</th>
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<tbody>
<tr>
<td>2000</td>
<td>15,592</td>
<td>5,969</td>
<td>4,649</td>
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<tr>
<td>2004</td>
<td>18,341</td>
<td>10,138</td>
<td>5,326</td>
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<tr>
<td>2008</td>
<td>21,056</td>
<td>10,970</td>
<td>5,997</td>
</tr>
<tr>
<td>2009</td>
<td>22,560</td>
<td>11,716</td>
<td>6,568</td>
</tr>
<tr>
<td>2010</td>
<td>24,104</td>
<td>12,600</td>
<td>6,981</td>
</tr>
<tr>
<td>2011</td>
<td>25,629</td>
<td>13,359</td>
<td></td>
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<tr>
<td>2012</td>
<td>27,078</td>
<td>13,599</td>
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In view of the fraught overall situation in teaching, the ETH Board repeatedly allocated an above-average share of the annual growth of the budget appropriation to the two Federal Institutes of Technology in recent years. The aim of this was to cover the additional expenses incurred for the continuously rising number of students as both Federal Institutes of Technology have required additional professorships.
Institutes of Technology must be able at all times to offer their students sufficient supervision as well as an education directly related to research. Despite these efforts, it was not always possible to avoid capacity bottlenecks and it therefore became necessary to take additional measures. For this reason, the ETH Board called for an amendment to the ETH Law to enable it to restrict the admission of applicants with foreign qualifications to a higher semester at an entire university or to individual courses of study, at the request of one of the Federal Institutes of Technology. The ETH Board received this authority at the start of 2013 and therefore now has an additional means at its disposal for securing the high quality of teaching. Grammar school pupils with a Swiss Matura, however, retain unrestricted access to a course at one of the Federal Institutes of Technology.

The important role played by the research institutes in teaching in general, and in the education of doctoral students in particular, is also undisputed. In the past year alone, 807 theses and 542 bachelor’s and master’s theses were completed at the research institutes. The contribution of the research institutes to teaching is of course far greater. Employees of PSI, WSL, Empa and Eawag gave many lectures and offered special courses, both within the ETH Domain and at other universities. With these commitments, however, the research institutes also increasingly reached their capacity limits.

The ETH Board devoted a lot of attention to this situation and accordingly made a fundamental decision on 5/6 December 2012 to pave the way for a socially acceptable increase in tuition fees. The additional income to be expected from this as of 2015 is to be invested in teaching. Measures, among other things, to improve the situation with regard to student supervision are also in the pipeline. In view of the broadly supported parliamentary initiative “Fair tuition fees at ETH” that created a new situation, the ETH Board decided on 6 March 2013 to suspend the project.

An interesting development in teaching in the reporting year was represented by so-called Massive Open Online Courses (MOOCs) – freely accessible online courses, generally offered free of charge, that were initially brought onto the market by private providers and US universities in a large-scale initiative covering a wide range of subjects. It is clear that Swiss universities and tertiary institutions are also affected by this. Both Federal Institutes of Technology informed the ETH Board how they wished to react to this innovative teaching model. EPFL decided initially to participate in MOOCs with three courses on a platform for online courses (www.coursera.com). In this way it aims to gain experience in the practical implementation of such courses and also to assess the potential of MOOCs for teaching on its own campus. Meanwhile, ETH Zurich makes use of web-based teaching and learning platforms such as ‘equilibrium’, which was developed by the Institute for Technology in Architecture (see p. 36).

**Promotion of young scientific talent**

The main problems in the promotion of young talent at universities were again the subject of repeated public discussion and made it onto the political agenda in the reporting year; one example is Postulate 12.3343 of the Council of State’s Committee for Science, Education and Culture of 26 April 2012. Above all, the ETH Domain is involved in the preparation of a report by the State Secretariat for Education, Research and Innovation (SERI) on this topic. The ETH Domain retains a broad spectrum of promotional measures for young scientific talent ranging from coaching programmes to assistant professorships with tenure track.

The promotion of equal opportunities for women and men also forms an integral part of the development of young talent. There can be no doubt that special efforts are required here: It is very often talented young women who, in spite of their proven scientific qualifications, do not consider an academic career or end their career early. This phenomenon is known in the academic world as the “leaky pipeline”. It would also be helpful if promotional measures in this area were especially tailored to specific scientific fields. ETH Zurich launched a programme to monitor this trend back in 2009/2010 that will now provide bi-annual data in this regard.

The ETH Board’s strategic plan for the 2013–2016 mandate period also envisages using 0.4 % of the Federal financing...
contribution for measures to promote equal opportunities, which represents a significant increase on previous years. The financial expenses of the institutes of the ETH Domain in this area are now to be recorded through monitoring (see p. 72 ff.).

International successful research
The ETH Domain continued to lead international competition in terms of research in 2012. This was reflected, among other things, by the fact that researchers from the ETH Domain re-

ceived similar record amounts of EU subsidies as in 2011. In particular, the ETH Domain was granted the highest number of ERC Grants ever to be recorded in 2012 (19 Starting and 17 Advanced Grants). The ETH Domain is also heavily involved in the particle physics experiments at the CERN. Such basic research at large-scale research facilities also delivers fundamental new findings. To take one example, the data published in summer 2012 that suggested the discovery of the Higgs boson or at least a particle that looks suspiciously like the Higgs boson allows conclusions to be drawn on the structure of matter. This is the culmination of many years of scientific planning of experiments and development work for the realisation of the required research infrastructure. Large-scale facilities developed in complex, multinational collaboration demand long-term commitments on the part of the institutions and countries involved. The steadfast and reliable commitment of Switzerland, the ETH Domain and the participating universities allowed Swiss researchers to take the lead in the development of specific detector components, thereby protecting their technological and methodological head start.

Under the leadership of the SBFI, a group of experts that included representatives of the ETH Domain drew up the "Coordinated Energy Research Switzerland" plan of action, which is related to the Confederation’s new energy strategy and for which implementation was approved by the Federal Council in mid-2012 (see p. 10 and 44). The ETH Board placed the lead for this work in the hands of the Chairman of the Management Board of the PSI-affiliated Competence Center Energy and Mobility (CCEM). The essential content of this strategy was derived from many years of energy research carried out by the very active institutes of the ETH Domain. In this regard, the ETH Board also published the brochure “Energy research in focus: Contribution of the ETH Domain to the restructuring of the energy system” in collaboration with the institutes of the ETH Domain in early summer 2012.

Specific strategic tasks
The Federal Council’s performance mandate to the ETH Domain for the years 2008–2012 included a number of specific tasks in which progress was also achieved in 2012.

Implementation of the supercomputing strategy
With regard to the new building for the Swiss National Supercomputing Centre in Lugano-Cornaredo, further steps for implementation of the supercomputing strategy were carried out: At the end of the year the new “Piz Daint” Cray system was installed and will be available to the research community with a peak performance of 750 teraflops from spring 2013.

SystemsX.ch
The Swiss initiative to promote systems biology, SystemsX.ch, launched its sixth project tender in 2012. A total of 11 research, technology and development projects (of which 10 from the ETH Domain), 4 transfer projects (of which 1 from the ETH Domain), 11 interdisciplinary doctoral thesis projects (of which 9 from the ETH Domain) and 4 transition postdoctoral fellowships (of which 3 from the ETH Domain) were approved out of 82 submissions. These projects promote interdisciplinary and cross-institutional collaboration in the field of life sciences and enable Switzerland to establish a pioneering role in systems biology that builds on the fruits of the human genome project, molecular biology and various technological developments. The in-depth analysis of biological processes and the understanding of systemic relationships derived from this facilitate new therapeutic approaches to medicine, for example.

In the reporting year, SystemsX.ch was also the co-organiser of the Systems Biology of Human Diseases Conference in Heidelberg, Germany, and in October 2012 a closed-door meeting for the doctoral students of all partner institutions took place in Engelberg. Finally, Professor Lucas Pelkmans of the University of Zurich was appointed new director of SystemsX.ch. He replaced Professor Ruedi Aebersold of ETH Zurich, who had headed the initiative since its establishment in 2007, at the beginning of 2013.

Nano-Tera.ch
The Nano–Tera.ch research initiative that has existed since 2008 deploys engineering science findings and information technologies to open up new opportunities for promoting the health and safety of people and the environment. The Executive Committee of Nano–Tera.ch launched five strategic

Fig. 4: Second-party funds from the EU in m CHF

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<tbody>
<tr>
<td>Second-party funds from the EU in m CHF</td>
<td>49.0</td>
<td>97.7</td>
<td>114.2</td>
<td>110.4</td>
<td>128.3</td>
<td>126.5</td>
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Annual Report 2012 on the ETH Domain
measures in 2012 that all aim to enhance the efficiency of the research programme. Three of these measures include the construction of industrial test benches for researching intelligent energy systems, improved integration of users in the area of pervasive health systems, and a detailed analysis of the reliability and applicability of sensor-generated data. Two further measures aim to promote international cooperation and the transfer of technology to the industrial sector. The website www.nano-tera.ch is one of the most important channels for distributing information on the programme. It counted more than 85,000 visitors from more than 120 countries in the reporting period alone. Nano-Tera.ch is now actively preparing for the second programme phase (2013–2016): Two new tenders were launched in autumn 2011 and spring 2012 which attracted 51 proposals, 18 of which were selected for financing.

**IMT – Institute for Microtechnology**

At the interface between basic research and industrial implementation, EPFL’s IMT works very closely with local industry. A new building complex known as Microcity is currently being built and will in future house the Neuchâtel site of the IMT. Due to its geographical proximity to CSEM, the Neodé incubator and science and technology park will also move to the same building.

In August 2012, EPFL took part in the organisation of “Micro12” in Neuchâtel, a three-day event that brought together all players in the microtechnology sector. The attending representatives of industry highlighted the extremely important role played by the training of engineers and the value of intensive collaboration with the research institutions, both of which serve as decisive components of the efforts to keep industrial production in Switzerland. It is also pleasing to note that in 2012 the six laboratories in Neuchâtel received more than 12m CHF in financial research support from third parties.

EPFL also made a decisive contribution to the IMT in Neuchâtel in the reporting year: It appointed three new professors and introduced a fourth chair. Private companies are providing start-up funding for two of these four chairs in order to express their interest in the work done at the IMT.

**Research in architecture**

The “New Urban Quality” (NRP 65) national research programme is developing new concepts and strategies for urban development and reviewing their feasibility. Researchers at ETH Zurich are managing two of the five NRP projects and are involved in two others as project partners. EPFL is likewise involved in two projects. The annual NRP 65 conference at ETH Zurich in November 2012 was attended by around 100 scientists and practitioners. In a second phase of the programme, the research findings and needs of the practice are to be aligned and a new concept developed at nationwide level for spatial and city planning.

**Centre for Applied Ecotoxicology**

The Ecotox Centre of Eawag and EPFL is the centre of competence for all practical ecotoxicological questions and projects in Switzerland. As the first step towards a comprehensive ecotoxicological assessment concept, it developed an approach for active estrogenic substances in running waterbodies in the reporting year. Several projects were coordinated with interested government authorities in order to establish material flow models that can cost-effectively supplement the taking of samples and chemical analyses. The Ecotox Centre also made a valuable contribution to the development of a decision tree for the ecotoxicological prioritisation of chemical mixtures. This new assessment method reduces the work involved in assessing the toxicity of such mixtures. At an international level the Ecotox Centre served, among other things, as OECD national coordinator for ecotoxicology and participated in work groups on the standardisation of test systems, and it is also one of the partners in the EU’s DEMEAU project on promising technologies that tackle pollutants in waste water.

www.oekotoxzentrum.ch

**Competence centres of the ETH Domain**

When the Federal Council decided on its future energy strategy and initial measures to implement “Coordinated Energy Research Switzerland” were carried out in the ETH Domain, the ETH Board also sprang into action and on 5/6 December 2012 decided to adjust the financing for the two centres of competence, CCEM (Energy and Mobility) and CCES (Environment and Sustainability), for the 2013–2016 period accordingly: The start-up funding of the ETH Board allocated to the CCEM and CCES until the end of the 2013–2016 period is already to be paid out in 2013. This will provide both centres of competence with full funding for their projects for the next two years and, in doing so, optimally position CCEM and CCES as important partners in the implementation of “Coordinated Energy Research Switzerland”.

**CCEM Energy and Mobility**

Together with leading house PSI, CCEM has expanded its activities with 12 new projects. Among these are projects that could potentially open up new opportunities for the future of energy: Sustainable Cities, Urban Energy Modeling, Exhaust Gas After-Treatments, Methanisation, Solar Fuels, Hydrogen Technologies, and Optimisation of the Use of Wood as Renewable Energy. So far CCEM has initiated and financed 50 projects thanks to the start-up funding of the ETH Board. The direct financial contribution from industry to the overall costs of these projects (including the funds of the institutions involved) now comes to 19%. This shows how closely CCEM’s work is linked to the needs of the industrial sector.

The share covered by competitive government funds reached 23% and reflects the high degree of scientific originality of the projects submitted. Universities of applied sciences are also involved in most of these projects and therefore serve as an important link between basic research and the final product. The “Novatlantis – Sustainability at the ETH Domain” project made it possible for CCEM to support the cities, regions and cantons with the transfer of knowledge from CCEM projects.

www.ccem.ch
Selected national tasks

External customers estimate the added value of the ETH Library of ETH Zurich to be four times higher than its costs. This emerged from a survey carried out in 2011 and analysed in 2012. The ETH Library also received top marks for general satisfaction. It is therefore of central importance for Switzerland as a scientific location and for industry and business.

The Archives of ETH Zurich were once more expanded in the reporting year. The Archives of Contemporary History, for example, contain the complete collection of historical papers of Swissmem, the Association of the Swiss Mechanical and Electrical Engineering Industries, comprising around 270 metres of documents and audiovisual materials on the history of the Swiss mechanical and electrical engineering industries since 1883. At the beginning of 2012, the Thomas Mann Archives were also affiliated with the ETH Library. In November 2012, several Archives of ETH Zurich participated in the Swiss Archive Day with the theme “Human, all too human”.

The KOF Swiss Economic Institute at ETH Zurich organised various events in 2012, including the KOF Economic Forum on the minimum exchange rate for the Swiss franc and the KOF Forecast Conference on the opportunities and challenges for Switzerland as a financial centre. The Center for International Research in Economic Tendency Surveys (CIRET) located at KOF held its annual conference in Vienna in September.

A new magnetic configuration called Snowflake was tested for the first time on the variable configuration tokamak reactor at the Centre de Recherches en Physique des Plasmas CRPP of EPFL. Snowflake could mean significant progress in the evacuation of heat and particles from the reactor, which is one of the biggest problems in nuclear fusion. As part of the European project ITER/Broader Approach, the CRPP finalised its work in 2012 on the suitability of a test cell for the International Fusion Material Irradiation Facility and the development of mechanical measurement methods for small samples.

The avalanche bulletin of the WSL Institute for Snow and Avalanche Research SLF has recently been redesigned. The bulletin on the internet is now based on a zoomable, interactive hazard map. The “White Risk” app has also been developed for mobile devices. Demand for the services of the Swiss forest protection unit of WSL is also growing (see p. 94).

Empa now also measures the number of ultra–fine particles in the atmosphere at some stations of the National Air Pollution Monitoring Network (NABEL). This permits an in–depth investigation of possible effects on human health and provides the basis for further measures for reducing air pollution.

Under the authority of the Radiation Protection Department of the Federal Office of Public Health FOPH, Eawag uses its gamma laboratories to constantly monitor radioactivity in aquatic systems. Together with WSL and the Federal Office for the Environment FOEN it also participates in the National River Monitoring and Survey Programme (NADUF) which tracks and monitors the concentration of substances occurring in selected Swiss watercourses.

CCES – Environment and Sustainability
The research activities of CCES for the second activity period to 2016 have now been defined: A total of seven interdisciplinary, cross–institutional joint projects and the continuation of the Swiss Experiment Platform (collection and management of environmental data) have been approved. Activities that require an exchange of knowledge between researchers and stakeholder groups outside the scientific sector have been strengthened considerably. On the initiative of several cantonal environmental departments, a number of different master’s dissertations were also written on topics that are of practical relevance to these departments. In collaboration with the MINT Learning Center of ETH Zurich and various teacher training colleges, CCES also developed environment–related school materials for secondary levels I and II.

www.cces.ethz.ch

CCMX – Materials Science and Technology
The Competence Centre for Materials Science and Technology (CCMX) serves as a driver for long–term research partnerships between the ETH Domain and Swiss industry.

CCMX started with the implementation of its strategy for 2012 to 2016. This comprises the provision of partial start–up funding for new professorships, primarily in research areas in which EPFL and ETH Zurich are active. CCMX will also create several research platforms co–financed by industry for researching scientific issues that are fundamental to industry. Two professors have already been appointed for 2013, and two additional positions are currently being advertised. Joint research platforms with industry are also increasingly taking shape. In addition to 29 current projects, seven other courses and events targeting academic and industrial researchers were also organised. These were very successful.

www.ccmx.ch

NCCBI – Biomedical Imaging
The NCCBI (National Competence Center in Biomedical Imaging), founded in 2006, is responsible for coordinating the efforts of the participating institutions (ETH Domain, universities and hospitals) in order to generate synergies in biomedical imaging. The Center has so far provided funding via four tenders to 33 projects that has been drawn on by 70 (co–)applicants. Five further cross–institutional projects were
launched in the reporting year and two PhD theses were successfully completed. The NCCBI’s doctoral programme currently comprises 24 pending theses and three new thesis – projects scheduled to start at the beginning of 2013.

www.nccbi.ch

Lively knowledge and technology transfer

During its annual strategy and control meetings with the institutions (dialogues), the ETH Board also expects to be periodically informed of the activities related to the transfer of knowledge and technology (KTT) in the ETH Domain. All institutions in the ETH Domain attach great importance to KTT. The monitoring figures disclosed in this report only refer to activities that can be measured directly in the form of patents, licences and spin-offs. These monitoring figures reveal a consistent level of KTT activities over several years. Around 40 spin-offs arise each year from the institutes of the ETH Domain.

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<td>46</td>
<td>45</td>
<td>38</td>
<td>40</td>
<td>38</td>
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Fig. 5: Spin-offs

Together with the institutions of the ETH Domain, the ETH Board published the brochure “Focus on Switzerland’s Innovative Power: the ETH Domain’s Knowledge and Technology Transfer” in the early summer of 2012. This provides a comprehensive picture of the KTT activities of the ETH Domain and uses typical and very impressive examples to illustrate these. It has been widely distributed at renowned economic events.

Graduates from the ETH Domain help shape the interaction with industry and public administration by transferring the latest knowledge and research findings. It is therefore very important to the institutions of the ETH Domain that their graduates should see themselves as part of the KTT chain and make a substantial contribution to innovation output in our country. This is a reason why both Federal Institutes of Technology and the research institutes of the ETH Domain offer students opportunities to design and carry out highly complex research, among other things, in cooperation with industry or the public administration.

Important KTT work is often also carried out as part of large-scale research projects. The key factor here is that scientific experiments can often only be carried out after many years of intensive preparation to develop the required technologies and methods of measurement. A great deal of KTT work is carried out and technological innovations with considerable market potential are created during this development phase. For example, the development of detectors for experiments at CERN led to the establishment of Dectris, a spin-off of PSI. Today Dectris employs around 40 people in Baden and reported annual sales of 20m CHF for 2012. An other example of successful KTT in the reporting year can be seen in the fact that concept studies and the construction of SwissFEL components gave rise to cooperation with industry. The industry partners involved are already benefiting today from the transfer of technology resulting from this. Current examples of this include the joint development of SwissFEL components with MDC Max Daetwyler AG and TEL Mechatronics AG, (formerly Oerlikon Mechatronics, see p. 60).

Approximately two years after opening, EPFL’s Innovation Square is already more than 80 % full with eleven companies located there. Around 1,200 employees work there, some 700 of them at the PSE Science Park. This encouraging development underlines the need of private research outfits to be located close to tertiary institutions and their infrastructures. In return, researchers at the tertiary institutions learn about the immediate problems encountered in business practice and gain valuable insights into the material and financial challenges associated with the transfer of technology from science to business (see p. 59).

ETH Zurich opened the Innovation and Entrepreneurship Lab (ieLab) to support young entrepreneurs of ETH Zurich in September 2012. The ieLab offers them facilities and programmes for the interactive, team-based development of innovative ideas, supports them with individual coaching and advises them together with ETH Transfer on contractual, legal and IP issues. It also assists them in finding venture partners and investors. By the end of 2012, 20 young talents from a Federal Institute of Technology had already found an entrepreneurial home at the ieLab (see p. 59).

Following completion, the planned experimental NEST building on the Empa site will offer industrial partners and institutions of the ETH Domain a unique platform for testing, evaluating and optimising innovations in building technology and the energy sector under real everyday conditions (see p. 46).

An initiative of EPFL and ETH Zurich concerning the establishment of platforms for translational research together with Swiss universities and the pharmaceutical and medical technology sectors was adopted as a cooperation and innovation project of the Swiss University Conference (SUC). To this end, it was merged with a second project aimed at strengthening the technology sectors was adopted as a cooperation and innovation project of the Swiss University Conference (SUC). To this end, it was merged with a second project aimed at strengthening clinical research that was submitted by the universities. The joint SwissTransMed project now permits translational research platforms to be established with the medical faculties, following a decision to finance this made by the SUC in the autumn of 2012. SwissTransMed is part of the ETH Med-Strategy of ETH Zurich and EPFL, one of the aims of which is
to improve the integration of biomedical research in the ETH Domain, especially in the medical technology segment, with the universities and hospitals. This strategy also provided the foundation for a new and more targeted training of medical students who later wish to work in research, and in particular to make use of state-of-the-art medical technology. In future it should be possible for holders of a bachelor’s degree in life sciences at a Federal Institute of Technology to transfer to a higher semester in medicine at a cantonal university.

In the international environment
One objective of the increasing internationalisation of the academic activities of both Federal Institutes of Technology and the four research institutes of the ETH Domain is to expand and further develop competencies. However, it is just as important for the ETH Domain to make a substantial contribution towards solving specific challenges facing society, the business world and the environment, not just in Switzerland but throughout the world. Strategic alliances with selected universities, research institutions and countries with a similar positioning are intended to achieve this and are being continuously expanded and intensified.

An important role here is played by cooperation with partners from the European Union (EU) in the field of education, research and innovation. Apart from the Swiss National Science Foundation, the European Research Framework programmes are the most important competitive support instrument for Swiss researchers. The two Federal Institutes of Technology and the cantonal universities are the largest financial beneficiaries in Switzerland.

Both Federal Institutes of Technology further stepped up their cooperation with partner universities abroad in the reporting year. As part of the IDEA League, ETH Zurich fosters cooperation in Europe with Imperial College London, Delft University of Technology TU Delft, RWTH Aachen and ParisTech. The aim is to achieve a continuous joint improvement by exchanging experiences and benchmarking in the fields of teaching, research and innovation. On top of this, doctoral programmes address the major unsolved issues of our time, such as the challenges posed by an ageing society (see p. 68 below).

In 2012, ETH Zurich was the first foreign university to move into the new CREATE Tower research building on the site of the National University of Singapore (NUS). Further research groups from foreign universities will now gradually move into the CREATE tower, including scientists from the Massachusetts Institute of Technology (MIT), the University of California Berkeley and Technische Universität München (TUM). The first project that ETH Zurich is realising together with its partners, the “Future Cities Laboratory” (FCL), addresses the theme of sustainable urban development. Risk research and food security will be added in the medium term as further topics to be sustainable urban development. Risk research and food security will be added in the medium term as further topics to be.

Scientific evaluation: The cornerstone of academic benchmarking
In autumn 2012 the ETH Board reviewed and developed further the principles which it applies for evaluating units in the ETH Domain. Among other things, the following was decided: As before, every institution in the ETH Domain (or parts thereof such as departments (ETH Zurich), faculties (EPFL) or departments and laboratories) is to be evaluated in terms of its scientific quality by international groups of experts at least once every eight years. The experts are to be selected in accordance with clearly defined principles. Conflicts of interest are to be avoided or, if this is not possible, disclosed to all parties. Evaluations of an institution of the ETH Domain as a whole are to be commissioned by the ETH Board and evaluations of individual units of the institutions by the Executive Boards or Directorates.

Several members of a team of experts must come from similar institutions and hold positions there that allow them to evaluate and assess the scientific quality and strategic positioning of the evaluated institutions, as well as their strengths and weaknesses, in a holistic context. The findings gathered in this way will enable comparisons to be drawn with other universities and institutions with a similar international positioning. Evaluations therefore also serve as a means of benchmarking. The evaluated institution is to use the conclusions and recommendations drawn from the evaluations to derive specific measures for improving quality and to define and enhance future development objectives and strategy adjustments. It must also prepare a statement on the report by the team of experts for the attention of the ETH Board in which it summarises the results of the evaluation and defines implementation targets resulting from this.

In 2012, the ETH Board took note of the evaluations of three departments at ETH Zurich, one faculty at EPFL, and four laboratories at PSI. Empa was also evaluated in 2012. The results will be submitted to the ETH Board in May 2013. At the request of the new Director of WSL, the ETH Board also decided to evaluate this research institute. It specified the reference topics and decided on the composition of the team of experts for this evaluation, which will be carried out in 2013.

Rankings
International rankings of universities attract a great deal of attention throughout the world as they provide an easy means of comparing the quality of universities. Although the methods used for preparing the rankings are not always comprehensible and the results of different rankings display sharp divergences, it is nevertheless possible to identify clear trends in the results: As before, the top US universities continue to lead the way internationally. In Europe, both Fed-
eral Institutes of Technology occupy top positions and were able to improve their rankings even further in 2012. ETH Zurich has consolidated its position as by far the best continental European university and, compared with the previous year, EPFL has made significant advances in most rankings and categories. However, it is noticeable that among the medium rankings there is an increasing number of Asian universities, and these have recently been advancing closer to the top positions. The overall development also shows that the competition is increasing and becoming stronger and that maintaining the positions achieved will pose a major challenge in the future.

Further information about the rankings can be found in the report on academic performance in the Close-up chapter (see pp 108 and 109).

**FET flagship projects**

At the end of January 2013, the EU selected the Human Brain Project (HBP) under the leadership of EPFL and the Swedish-led Graphene project, involving researchers from ETH Zurich and Empa, as flagship projects within the scope of the European Future and Emerging Technologies initiative. The final selection among six projects also included the Guardian Angels project led jointly by ETH Zurich and EPFL as well as the FuturICT project that is being coordinated by ETH Zurich.

The main objective of the Human Brain flagship project coordinated by EPFL lies in achieving computer-aided simulations of the human brain. This should facilitate key advances in the neurosciences, medicine, the social sciences and in information technology and robotics. The project aims to build on EPFL’s Blue Brain neuroinformatics project. This has for a long time been one of three strategic initiatives of the ETH Domain, the financing of which has been planned by the ETH Board. As well as EPFL, the other Swiss institutions involved in HBP are ETH Zurich, the University of Berne, the University of Zurich and IBM.

The high share in the final selection of projects with leading participation by research groups of the ETH Domain testifies to the excellent international competitiveness of its institutions. The application by the Human Brain Project for EU flagship status as stipulated in the performance mandate of the Federal Council to the ETH Domain for 2012 has been crowned at the European level with selection as one of the two winning projects. This major success achieved by Professor Henry Markram and colleagues from EPFL confirms the high international competitiveness of long-term, scientifically founded strategic major projects of the ETH Domain that are singled out for financial support by the Confederation and can therefore be implemented rapidly.

The FET flagship initiative forms part of the European researchers’ partnership. The contribution of the EU to the initial implementation phase of the two flagship projects will be financed on the basis of the seventh EU research framework programme. The eighth EU Research Framework Programme (Horizon 2020), which is still being negotiated, will apply to the second phase. The European research partnership is of major importance to Switzerland as a centre of research. Successes from the ETH Domain provide decisive impulses for our research and hence also for our teaching. They contribute greatly to the appeal of the institutions for students, researchers and teachers alike from across the world.
Personnel changes enacted by the Federal Council
Institutions of the ETH Domain
On request of the ETH Board, the Federal Council appointed the Director of Empa, Professor Dr Gian–Luca Bona, for another four years. The second term will begin on 1 September 2013.

Personnel changes enacted by the ETH Board
Successor to Professor Dr Ralph Eichler, President of ETH Zurich: The ETH Board has approved the requirements profile for the future President of ETH Zurich. The job will be advertised in the first quarter of 2013. The ETH Board will not delegate selection of the person for final proposal to the Federal Council to a selection committee, but carry this out as the superordinate body. The term of office of the current President of ETH Zurich expires at the end of 2014.

Audit Committee
The ETH Board has appointed its Vice–President, Professor Dr Paul Herrling, to the Audit Committee, which is therefore now composed of Beth Krasna (President), Dr Barbara Haering and Paul Herrling.

Election to the Executive Board of ETH Zurich
Professor Dr Lino Guzzella was elected as a member of the Executive Board of ETH Zurich on 1 August 2012 for a term of office of four years. The ETH Board accordingly complied with the request of the President of ETH Zurich, Professor Dr Ralph Eichler. Lino Guzzella has been Professor of Thermotronics since 1999. He replaced Professor Dr Heidi Wunderli-Allenspach.

Resignation from the Executive Board of ETH Zurich
Professor Dr Heidi Wunderli-Allenspach, Full Professor of Pharmaceutical Biology and member of the Executive Board of ETH Zurich, retired on 31 July 2012. With heartfelt thanks for her commitment, the ETH Board took its leave from the Rector, who was the first woman to be elected to the Executive Board in 2007.

Election to the Executive Board of EPFL
Professor Dr Karl Aberer was appointed EPFL Vice–President of Information Systems at the request of the President of EPFL, Professor Dr Patrick Aebischer. Karl Aberer took up his position on 1 September 2012. Information Systems was upgraded to become an independent vice–presidency because of its importance for the future development of EPFL. Karl Aberer completed a doctorate in mathematics at ETH Zurich in 1991. He was appointed Full Professor of Distributed Information Systems at EPFL in 2000.

Election/Re-election to the Executive Board of EPFL
At the request of the President of EPFL, Professor Dr Patrick Aebischer, the ETH Board re-elected Vice–President Dr Adrienne Fumagalli and Vice–President Professor Dr Philippe Gillet for the period from 1 March 2012 until 29 February 2016. It also re-elected Professor Dr Francis–Luc Perret as Vice–President for another term of office until 31 July 2013 by way of exception from the retirement provisions. Furthermore at the beginning of March 2013 the ETH Board has appointed Dr André Schneider as a member of the Executive Board. He will succeed Professor Dr Francis–Luc Perret as Vice–President for Planning and Logistics on 1 August 2013. At present, André Schneider is Chairman and CEO of André Schneider Global Advisory, his own consultancy firm for sustainable development in sectors such as energy, mobility, infrastructures and banking. Previously, André Schneider had worked for the World Economic Forum (WEF) for 12 years.

The ETH Board also acknowledged and approved the request submitted in 2012 by the President of EPFL, Professor Dr Patrick Aebischer, to spend a half-year sabbatical in his 14th year of service at the head of EPFL addressing the new forms of teaching. The Federal Council granted its approval on 20 February 2013 and appointed Professor Dr Philippe Gillet, Vice–President for Academic Affairs, as Acting President of EPFL and Member of the ETH Board for the period from 1 August 2013–31 January 2014.

Resignation of Vice Director of PSI
Martin Jermann, Vice Director and Head of Staff of PSI, resigned on reaching retirement age as of 30 November 2012. The ETH Board warmly thanks Martin Jermann for his long–standing commitment, which for a time also included management of PSI as Acting Director and for many years was focused particularly on the development of protone therapy in Switzerland.

WSL Directorate
The new Director of WSL, Professor Dr Konrad Steffen, took up office on 1 July 2012. The ETH Board thanks the previous Director, Professor Dr James Kirchner, who forewent another term of office, for his commitment and wishes him every success and satisfaction in his new focus on research and teaching as a professor at ETH Zurich.

Confirmations of members of the WSL directorate
Dr Christoph Hegg, Professor Dr Rolf Holderegger, Dr Andreas Rigling, Dr Jürg Schweizer and Dr Niklaus Zimmermann will continue as members of the WSL directorate. The ETH Board confirmed the appointment of the directorate members at the request of the new Director of WSL, Professor Dr Konrad Steffen. The ETH Board had previously extended their term of office from 30 June to 31 December 2012 to enable Konrad Steffen to decide on the appointment of his directorate members after taking up office on 1 July 2012.

Resignations from the Directorate of Empa
On 31 July 2012 Roland Knechtle, member of the Empa directorate and Head of the Support department, resigned on reaching retirement. The ETH Board thanks him cordially for his long–standing commitment. Dr Urs Leemann has now taken over as Head of the Support department at Empa.

Dr Peter Hofer retired on 1 September 2012 as Vice Director and long–standing member of the Empa directorate. The ETH Board warmly thanks him for his many years of commitment, which for a time also included management of Empa as Acting Director. To complete the Empa directorate back in December 2011, the ETH Board had already appointed Dr Brigitte Buchmann. She took up office on 1 September 2012.

Appointment of member of the Eawag directorate
Professor Dr Hansruedi Siegrist was elected as a member of the Eawag directorate at the request of the Eawag Director,
Professor Dr Janet Hering. Hansruedi Siegrist has been working for Eawag since 1986, most recently as Head of Process Engineering. He is also a lecturer at EPFL and ETH Zurich, where he has been an adjunct professor since 2002.

Appointment of employer representatives of the ETH Domain’s pension fund
In its function as employer, the ETH Board appointed the existing and two new employer representatives to the joint board of trustees of the pension fund of the ETH Domain for a term of office from 1 January 2013 until 31 December 2016. The appointments were made at the request of the presidents of ETH Zurich and EPFL as well as the directors of the four research institutes.

Elected by the European Commission
Dr Dr h. c. Barbara Haering, member of the ETH Board and President of the Institut des Hautes Etudes en Administration Public (IDHEAP) in Lausanne, among others, was elected by the European Commission as a member of the new European Research and Innovation Area Board. The Board itself elected her as co-chair.

Professorial changes
As part of their strategic four-year plans, the two Federal Institutes of Technology submit their rolling plans for professorships to the ETH Board in the first half of each year. The ETH Board appoints the individual professors at the request of the presidents of the two Federal Institutes of Technology. Altogether the ETH Board dealt with 141 professorial changes in the reporting year. Around two thirds of these concerned appointments of professors and adjunct professors and one third concerned resignations and other business, above all reappointments of assistant professors following successful interim evaluations.

Appointments
The ETH Board appointed 86 professors altogether in 2012 (of which 17 women): 51 at ETH Zurich (of which 11 women) and 35 at EPFL (of which 6 women). This results in a proportion of women professors amounting to 19.8 %, following a significant increase in the past four years. Of the 86 appointments, 50 were full professors (of which 9 women), 16 were associate professors (of which 5 women), 12 were tenure track assistant professors (of which 1 woman) and 8 were assistant professors without tenure track (of which 2 women). A total of 25 appointments involved either promotions of associate professors to full professors or of assistant professors to associate professors; altogether 61 people were therefore appointed as professors at ETH Zurich (43) or EPFL (18). The ETH Board also granted adjunct professorship to nine scientists.

Retirements and resignations
In 2012 the ETH Board received 17 notices of retirement for reasons of age, 9 at ETH Zurich and 8 at EPFL. ETH Zurich and EPFL also notified the ETH Board of 4 and 2 resignations respectively and the reasons for these.
The ETH Domain and its environment
The Federal Act on the Federal Institutes of Technology (ETH Law) of 4 October 1991 defines the status, structure and mission of the ETH Domain. According to the legislative provisions, the ETH Domain is autonomous and the ETH Law stipulates that it is affiliated to the responsible department. The ETH Law also defines the autonomy of both Federal Institutes of Technology and, indirectly, the four research institutes. The ETH Board is the strategic leading body of the ETH Domain.

Mission and leadership
According to the principal mission of the institutions of the ETH Domain (Art. 2 ETH Law), both Federal Institutes of Technology and the four research institutes are to do the following:
- To educate students and specialists in scientific and technical fields and to provide permanent continuing education,
- To expand scientific findings through research,
- To foster upcoming young scientists,
- To render scientific and technical services, and
- To exploit their research findings.

The institutions of the ETH Domain discharge their mission in observance of internationally recognised standards. They take account of Switzerland’s needs and promote international cooperation.

Performance mandate and budget appropriation
The ETH Domain is managed according to an effect-oriented leadership model. The political authorities specify performance standards and key financial parameters while the ETH Domain, as a service provider, is responsible for implementation of the specifications.

Political leadership is the responsibility of the Federal Parliament and the Federal Council. The following core leadership tools are used: The Federal resolution approved by Parliament, which includes a four-year budget appropriation; a performance mandate for the ETH Domain from the Federal Council, which is tailored to the budget; and the annual credit allocation from Parliament. The Federal resolution regarding budget appropriation over a four-year performance period is based on the Federal Council’s Message on the promotion of education, research and innovation. These political tools are complemented by financial controlling which provides information on the accounts and mission fulfillment. The ETH Board’s reporting system comprises three parts: In the annual report, the ETH Board reports on the achievement of performance goals and illustrates how the annual federal financial contribution has been used. In a self-evaluation report in each half of the performance period, the ETH Board indicates the extent to which the goals of the performance mandate have already been met. At the end of the performance period, the ETH Board provides a final report on how the performance mandate was fulfilled during the performance period just ended. The final report must be approved by the Swiss Federal Assembly. The self-evaluation report by the ETH Board provides a basis for the evaluation (peer review) of the ETH Domain to be undertaken by external experts on behalf of the responsible department. Along with each budget appropriation application for the next performance period, the responsible department gives Parliament an interim report on the degree of target achievement, which is compiled halfway through the performance period (Art. 34a ETH Law). The ETH Board is responsible for the strategic leadership of the ETH Domain (see next section). Operational leadership within the ETH Domain is the responsibility of the institutions of the ETH Domain. They assume all responsibilities which are not assigned to the ETH Board by the ETH Law.

Executive leadership of the institutions of the ETH Domain is the responsibility of the members of the Executive Boards of both Federal Institutes of Technology and the members of the directorates of the four research institutes.

ETH Board: Mission and operating principles
The ETH Board defines the strategy of the ETH Domain within the framework of the performance mandate, represents the ETH Domain to the government and government authorities at the federal level, issues controlling directives, carries out strategic controlling, approves the development plans of the institutions of the ETH Domain, oversees their implementation and supervises the ETH Domain (Art. 25 ETH Law). It agrees targets with both Federal Institutes of Technology and the four research institutes, and allocates Federal funding on the basis of the institutions’ budget requests. It submits requests to the Federal Council for the selection of the Presidents of both Federal Institutes of Technology and of the Directors of the four research institutes, elects the other members of the Executive Boards of both Federal Institutes of Technology and appoints the other members of the directorates of the four research institutes. Finally, the ETH Board appoints the professors at the request of the Presidents of both
Federal Institutes of Technology. It performs its supervisory function through the use of the following tools: periodic reporting from the institutions on resources (finances, human resources, real estate), annual reporting from the institutions on the status of mission fulfillment with regard to agreed targets, annual talks between the ETH Board and the institutions (so-called dialogues) within the context of strategic controlling, and reports from the institutions within the framework of their risk management systems. Moreover, the ETH Board’s Internal Audit staff evaluate the risk management processes, internal control system and governance processes of the institutions and report on them to the ETH Board, in particular the ETH Board’s Audit Committee.

The rules of procedure of the ETH Board are published in the compilation of Federal law. The ETH Board meets five times a year for one or two days at a time. It met for nine days in 2012. The meetings focused on strategic and budgetary discussions, the reporting of the institutions of the ETH Domain, the appointment of professors and the selection or appointment of prominent figures for the vice-presidencies and directorates of the institutions of the ETH Domain. The ETH Board also spent another seven days in dialogues with the institutions of the ETH Domain. Finally, it proposed to the Federal Council the re-election of the Director of Empa.

In addition, proprietor discussions are held twice annually between the President of the ETH Board, the General Secretary of the responsible department, the State Secretary for Education and Research, and the Director of the Federal Finance Administration. The President of the ETH Board is responsible for periodic individual discussions with the Presidents of the Federal Institutes of Technology and the Directors of the research institutes, who present reports about the strategic development of their institutions.

Audit and Executive Committees
The Audit Committee assists the ETH Board in financial supervision and in the monitoring of risk management, of the internal control system and of financial auditing activities. It is generally composed of three ETH Board members who are independent of the executive leadership, but may also involve additional people in a consultative capacity. The head of the Internal Audit department and the head of the Finance section of the ETH Board’s staff attend the meetings.

The Executive Committee assists the ETH Board in preparing for and following up on meetings, in filling executive positions at the institutions and in fulfilling its duties as an employer. It also liaises with 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 representative of the University Assemblies. The executive director and, if necessary, the head of the Human Resources section of the ETH Board’s staff attend the meetings.

Remuneration of the ETH Board
In 2012, the President of the ETH Board received a salary of 355,506 CHF (including 80,167 CHF social insurance contributions) for his 80 % position. In addition, he received an entertainment...
allowance of 5,000 CHF. The President is insured by the Swiss Federal Pension Fund, the rules of which determine the employer’s contribution. The other six members of the ETH Board who are not employees of either of the two Federal Institutes of Technology or of the four research institutes each received a lump sum of 20,000 CHF in 2012. Additionally, they were paid a total of 47,000 CHF in meeting attendance remuneration and reimbursed for expenses actually incurred in accordance with the expenses rules. Those 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 scope of a 50 % position, the ETH Board covers the wage and social costs incurred by ETH Zurich for the representative of the University Assemblies of both Federal Institutes of Technology, in order to guarantee this representative’s independence from any institution.

**Internal Appeals Commission of the ETH**

Administratively, the Internal Appeals Commission of the ETH is part of the ETH Board and decides on appeals against rulings made by bodies of both Federal Institutes of Technology and
Overview | Organisation and governance

Internal Audit
The Internal Audit department conducts internal audits for ETH Zurich, EPFL and the research institutes of the ETH Domain (Art. 35a para. 1 ETH Law). It is responsible for auditing the accounts of the individual institutions and the ETH Domain's consolidated accounts. In 2012, the Swiss Federal Audit Office (SFAO) delegated the auditing of the financial statements of the four research institutes to PricewaterhouseCoopers, Berne. The SFAO’s audit report on the consolidated accounts comprises a confirmation report and a management letter. The Audit Committee discusses these reports annually with representatives of the SFAO. The SFAO’s fee for auditing services in 2012 was 476,000 CHF.

Internal control system
Both Federal Institutes of Technology and the four research institutes have an internal control system, which was introduced in line with Federal regulations. The SFAO can thus audit the accounting system and finance-related business processes using the same methods as for other Federal institutions or private-sector enterprises of comparable size.

Information policy
Its statutory role makes the ETH Board an interface between science, politics 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 resides 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.

Guidelines concerning secondary occupations
The ETH Board issued guidelines regarding the procedure for secondary occupations exercised by members of the Executive Boards of the two Federal Institutes of Technology and members of the directorates of the four research institutes. Persons affected notify the ETH Board of their occupations, which then carries out a review to determine whether the overall time commitment is too great or conflicts of interest could arise. In these cases the responsible Federal department must decide in accordance with the Management Remuneration Ordinance issued by the Federal Council whether the approval of the Federal Council is required for the pursuit of paid secondary occupations. The guidelines came into force on 15 October 2012.
Members of the ETH Board

Fritz Schiesser
* 1954, Swiss citizen, Dr iur.
President of the ETH Board (80 %) and
of the Executive Committee since 2008
Lawyer at RHS & Partner Rechtsanwälte and notary since 1998
(part-time)

Fritz Schiesser studied law at the University of Zurich and has been a lawyer and notary since 1998. From 1990 to 2007, he was a member of the Swiss Council of States, where he served as President from 2003 to 2004, and he was President of the Foundation Council of the Swiss National Science Foundation from 1999 to 2007. Fritz Schiesser is a member of the Board of Directors of the Sandzø Family Foundation, Project Chemicals, Swiss Mobiliar and Hefti AG. He has been a member of the Foundation Board of the Swiss Science Center Technorama in Winterthur since 2012.

Paul Herrling
* 1946, Swiss citizen, Prof. Dr phil. II
Member of the ETH Board since 2004 and
Vice-President since 2008
Chair Novartis Institute for Tropical Diseases since 2012

Paul Herrling obtained a doctorate in natural sciences at the University of Zurich. From 2002 to 2010, he was Head of Corporate Research at Novartis International, after which he was Head of the Novartis Institutes for Developing World Medical Research until the end of 2011. At the University of Basel, he has been professor of drug discovery science since 2001 and a member of the University Council since 2007. He is on boards of trustees at the Scripps Research Institute (California, USA), within the Novartis Group and at various foundations.

Ralph Eichler
* 1947, Swiss citizen, Prof. Dr sc. nat.
Member of the ETH Board since 2004 and
of the Executive Committee since 2008
President of ETH Zurich since 2007

Ralph Eichler studied physics at ETH Zurich and he returned there as a professor in 1989. From 1998 to 2002, he was Deputy Director of the Paul Scherrer Institute (PSI), where he then served as Director until 2007. Ralph Eichler is on the Boards of Directors of Belenos Clean Power Holding and Venture Incubator. He is a member of the Swiss Academy of Engineering Sciences. He is also Vice-President of the Rectors’ Conference of the Swiss Universities and a member of the board of the swissuniversities association founded in 2012.

Patrick Aebischer
* 1954, Swiss citizen, Prof. Dr med.
Member of the ETH Board since 2004 and
of the Executive Committee since 2008
President of EPFL since 2000

Patrick Aebischer studied medicine and neurosciences at the Universities of Fribourg and Geneva. He has worked as a professor at Brown University (Rhode Island, USA). In 1999, the Federal Council elected him President of EPFL. Patrick Aebischer conducts research on the molecular mechanisms of neurodegenerative diseases. He has founded three biotechnology firms and is a member of the Board of Directors at Lonza Group and Nestlé Health Service.

Joël Mesot
* 1964, Swiss citizen, Prof. Dr sc. nat.
Member of the ETH Board since 2010 (representative of the research institutes) and of the Executive Committee since 2010
Director of PSI since 2008
Dual professor at ETH Zurich/EPFL since 2008

Joël Mesot studied physics at ETH Zurich, obtaining a doctorate in solid-state physics. After residing abroad, he joined PSI, where he became Head of the Laboratory for Neutron Scattering in 2004 and was elected Director in 2007. Joël Mesot is a board member at the European Association of National Research Facilities and a foundation board member at Föderstiftung Technopark Aargau. He is also a member of the German Helmholtz Senate Commission, the Scientific Advisory Board of FRM II (Munich, Germany) and the Neutron Advisory Board of Oak Ridge National Laboratory in the USA.

Beatrice Fasana Arnaboldi
* 1969, Swiss citizen, Dipl. Ing. Lm
Member of the ETH Board since 2012
Owner of Befood Consulting since 2006
Business development manager at Sandro Vanini SA since 2012

Beatrice Fasana Arnaboldi studied food sciences 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 as manager of the “Chewing Gum” profit centre of Chocolat Frey and marketing manager at Coca-Cola. Since 2006, she has run her own company Befood Consulting SA and as of 2012 she simultaneously holds the position of business development manager at Sandro Vanini SA, a subsidiary of the Haecky Group.

Barbara Haering
* 1953, Swiss and Canadian citizen, Dr sc. nat., Dr h. c. sc. pol.
Member of the ETH Board and the Audit Committee since 2008
Managing Partner and Vice-President of the Supervisory Board at econcept AG since 1998

Barbara Haering studied natural sciences and geography and obtained a doctorate in spatial planning at ETH Zurich in 1996. From 1979 to 1983, she was a member of the Cantonal Council of Zurich and she served on the National Council from 1990 to 2007. Barbara Haering is Co-Chair of the European Research and Innovation Area Board of the European Commission and President of the Foundation Board of the Swiss Graduate School of Public Administration and the Geneva International Centre for Humanitarian Demining. She is also Vice-President of the Board of Directors at BAK Basel.
Beth Krasna
* 1953, Swiss and US citizen, Dipl. Ing.
Member of the ETH Board since 2003 and
President of the Audit Committee since 2008
Independent member of the Board of Directors
Beth Krasna has a degree in chemical engineering from ETH Zurich and a
master’s degree in management from the Massachusetts Institute of Technology (Cambridge, USA). Beth Krasna is a member of the Boards of Directors at Banque Cantonale Vaudoise, Bonnard & Gardel Holding, Coop and Raymond Weil. She is also a member of the Swiss Academy of Engineering Sciences and, since March 2010, president of Fondation en faveur de l’art chorégraphique in Lausanne.

Jasmin Staiblin
* 1970, German citizen, Dipl. Ing.
Member of the ETH Board since 2012
CEO of Alpiq AG since 2013
Jasmin Staiblin studied electrical engineering and physics at the Karlsruhe Institute of Technology (Germany) and the Royal Institute of Technology in Stockholm (Sweden). After joining the ABB Corporate Research Center in Dättwil as a research assistant in 1997, she advanced through various positions at ABB. From 2006 until 2012 she was Country Manager and President of the Executive Board at ABB Switzerland. Since 2013 she has been CEO of the energy company Alpiq AG. She is also a member of the Board of Directors at Georg Fischer AG, Rolls-Royce plc and Neue Aargauer Bank AG.

Markus Stauffacher
* 1952, Swiss citizen, Dr phil. nat.
Member of the ETH Board since 2007 and
of the Executive Committee since 2008
Delegate of the university assemblies of ETH Zurich and EPFL
Senior scientist at ETH Zurich
Markus Stauffacher graduated in zoology at the University of Basel and obtained a doctorate in zoology at the University of Berne in 1988. This recipient of prestigious research prizes and three-time winner of the Golden Owl teaching award has been senior scientist at ETH Zurich since 1994. From 1996 to 2011 he was responsible for special fields at the University of Zurich’s Vetsuisse School. He has been an animal protection expert on the Council of Europe since 1997 and the ETH Zurich Executive Board’s animal welfare delegate since 2010.

Olivier Steimer
* 1955, Swiss citizen, lic. Iur.
Member of the ETH Board since 2012
Chairman of the Board of Directors of Banque Cantonale Vaudoise since 2002
Olivier Steimer studied jurisprudence at the University of Lausanne. He is Vice-President of the Board of Directors of the Swiss Federal Railways and of the Bank Council at the Swiss National Bank. He presides over the Foundation Board at the Swiss Finance Institute and the committee of the Bureau de construction de l’Université de Lausanne-Dorigny. He is also on the Board of Directors at ACE Ltd in Zurich and a member of the Executive Committee at économiesuisse as well as the Foundation Board at Avenir Suisse.
Insight

Performance objectives and progress

Objective 1 – Teaching

Objective 2 – Research

Objective 3 – Knowledge and technology transfer

Objective 4 – International networking

Objective 5 – Working conditions, equal opportunities and the promotion of young talent

Objective 6 – Commitment to higher education in Switzerland

Objective 7 – Performance-based funding allocation

Objective 8 – National and international presence

Objective 9 – Stronger role in society

PSI Solar Simulator in focus: 10,000 suns (10,000 kW/m²) and 3,000 degrees Celsius for the manufacture of solar fuels and innovative materials.
Objective 1
Teaching

Facts and figures

Objective 1, performance mandate 2008–2011/12 (see enclosure): “The ETH Domain will provide teaching that is first-class in an international comparison and attractive to students.”

2012 reports from the institutions with examples and the ETH Board’s perspective.

ETH Zurich

The number of students at ETH Zurich is growing constantly. In autumn 2012, a total of 17,781 students (including doctoral students; 2011: 17,187) were registered at ETH Zurich. This means that the number of students has increased by 5% over the past decade. To maintain the first-class quality of its courses, ETH Zurich appointed 10 additional professors in 2012 for the three courses of study with the highest numbers of students.

At 3,022, the number of new bachelor students (including visiting and exchange students) increased again slightly (2011: 2,997). The biggest growth in new bachelor students (+50%) was recorded by the new Health Sciences and Technology course (see p. 78). Mechanical Engineering (442 new students) and Architecture (256 new students) still attract the largest numbers of students. With 160 to 200 new students, Electrical Engineering and Information Technology, Physics, Civil Engineering and Computer Science also attract large numbers of students.

Around 95% of all bachelor graduates also proceed to a master’s degree at ETH Zurich. This is the highest percentage of all Swiss universities and underlines the quality of the courses offered at ETH Zurich. In 2012, around 2,500 students with a bachelor’s degree from another university applied for admission to a master’s degree course at ETH Zurich. About 2,000 of these students obtained their bachelor’s degree in another country, which is slightly less than in 2011. This is also explained by the clear communication regarding the high standards that have to be met by students at ETH Zurich. 1,008 of these applicants were accepted and 672 of them started their courses in autumn 2012.

The high quality of the teaching offered at ETH Zurich is recognised internationally. Most of the ETH courses included in the QS World University Ranking by Subject 2012 ranked between 4th and 15th position. This international ranking of universities aims to provide future students with information on the quality of teaching in a total of 29 fields of study.

The new Rector of ETH Zurich, Prof. Lino Guzzella, took up his post at the beginning of August 2012. He replaced Prof. Heidi Wunderli-Allenspach, who was the member of the Executive Board in charge of all teaching issues since 2007.

EPFL

In autumn 2012, EPFL had 9,306 students (10.2% or 864 more than in 2011). In order to continue to guarantee good teaching conditions in spite of this growth, EPFL developed new strategies to maintain the quality of life on its campus and its top-class learning environment. To take one example, the opening of several new lecture halls led to a substantial improvement in capacity. Several courses were also either divided or offered twice.

A survey among bachelor’s and master’s students in 2012 showed that 93% say that they are proud of their university and 76% consider the teaching provided at EPFL to be very good or excellent (compared to 43% in 2004). As 88% of the students were extremely positive about their experience with tutorials, the latter were expanded to all first-year Analysis and Physics courses in order to facilitate the integration process for new students and strengthen their group work. A uniform selection of basic polytechnic courses was drawn up for the first year of study. These

* www.topuniversities.com/university-rankings/world-university-rankings/2012/subject-rankings
include the basic sciences (mathematics, physics, chemistry) as well as a course on global information and global challenges to prepare the budding engineers for the challenges they will face in future. This new approach of a preparatory year is expected to be introduced in September 2013.

The concept of Massive Open Online Courses (MOOCs) harbours promising prospects for supporting young people in their studies with online teaching courses and thereby opening the courses for everybody. The concept is currently being developed further, but some pilot courses are already online (see p. 36).

Doctorate quality is ensured by monitoring the quality of teaching by systematically evaluating every course and overall satisfaction after completion of the thesis. There is also a sponsorship system and the relationship between every doctoral student and his/her supervisor is monitored. In March 2012, a survey that allows the overall evaluation of the entire system was carried out among all doctoral students. According to the result, satisfaction among doctoral students is high.

**PSI**

A large number of the approximately 300 doctoral students who work at PSI and almost 800 doctoral students from external institutions made use of the SLS (Synchrotron Light Source Switzerland), SINQ (Swiss Spallation Neutron Source) and SmuS (Swiss Muon Source) large-scale facilities as well as the particle physics facilities. They are trained in the use of national and international large-scale research facilities by PSI employees, which guarantees the continued success of Swiss applications in an international comparison. More than 100 PSI scientists contributed over 4,300 hours to the teaching of students at PSI and various universities. The academic network was expanded through the selective establishment of additional joint professorships with the universities in the fields of materials research, energy research and structural biology.

**WSL**

In its teaching activities, WSL targets areas where it can expand on the teaching offered by the universities and universities of applied sciences in Switzerland. This applies in particular to applied and practical topics covered by the bachelor’s and master’s courses. Teaching and education throughout Switzerland on topics such as forests, landscape or snow and natural hazards is shaped here to a large extent by the efforts of around 100 WSL employees. As well as providing 3,057 courses, WSL also supervised 135 bachelor’s and master’s students and 134 doctoral students in the reporting year.

In 2012, WSL cemented its ties to the world of teaching by setting up two joint professorships each with EPFL and ETH Zurich in snow, ice and climate studies as well as a joint professorship in climate effects with the University of Neuchâtel. In addition to its teaching activities at the universities and universities of applied sciences, WSL offers a wide range of services for professionals and specialists.

**Empa**

In 2012, Empa once again made a substantial teaching contribution to both Federal Institutes of Technology with more than 2,000 hours of teaching. Currently, about 14 Empa researchers also serve as professors at the two Federal Institutes of Technology. Empa founded a formal cooperation programme with the establishment of the Health Sciences and Technology department (D-HEST) at ETH Zurich at the beginning of 2012, and Empa researchers now offer courses on materials for medical applications, sport science and nano safety, among others. Every year Empa supervises around 120 bachelor and master students as well as about 200 doctoral students, of which a large number study at the two Federal Institutes of Technology (almost 50% of the bachelor and master students and two thirds of the doctoral students). Empa is also involved in teaching and education at Swiss universities and universities of applied sciences (2012: 1,150 hours of teaching, up 24% from the previous year).

**Eawag**

In the field of university education, Eawag focuses on niche topics and includes the results of applied research in its teaching activities. Around 50% of the scientific staff teach and supervise students at EPFL and ETH Zurich as well as at the cantonal universities and universities of applied sciences – in 2012 mainly in Berne, Zurich, Neuchâtel and increasingly also in Basel. The number of supervised doctoral and master theses remained high and almost reached capacity limits. One hundred and fifty doctoral theses were supervised in 2012 and two completed theses received the ETH Zurich medal.

The international summer schools are an important teaching pillar. In 2012, a summer school on “Environmental Fluid Mechanics” was held jointly with international partners at the university of applied sciences in Horw, and a summer school on “Environmental Systems Analysis” took place in Dübendorf.

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**The ETH Board’s perspective**

The high demand for the teaching offered in the ETH Domain is very encouraging. This is particularly the case with the MINT disciplines (mathematics, informatics, natural sciences and technology). The new Health Sciences and Technology course offered at ETH Zurich is attracting large numbers. At the same time, ETH Zurich and EPFL have instigated measures to meet the demands of growing student numbers. Standards remain high. External rankings and internal surveys once again confirmed the high quality of teaching in 2012 and served as a basis for further development. The research institutions make a substantial and practical teaching contribution, both inside and outside the ETH Domain. The need for the ratio between supervisors and students that has been deteriorating for years to be improved at both Federal Institutes of Technology and for teaching and learning infrastructure to keep pace with both growth and the times remains a central issue. Finding new teaching resources therefore remains one of the core tasks of the ETH Board.
Online trends in teaching

New forms of conveying information are also being increasingly applied at EPFL and ETH Zurich: teaching is going online. ETH Zurich is supporting face-to-face teaching with web-based curricula. EPFL is focusing on freely accessible online courses. Both institutions consider it to be one of a university’s core tasks to develop innovative teaching solutions to keep themselves at the cutting edge. This is the only way in which the best new scientific talent can be educated for science and practice alike.
The latest innovation in university teaching comes from the World Wide Web. And this innovation has a name: “MOOCs”. The acronym stands for Massive Open Online Courses. “These online courses, free of charge and universally accessible, will fundamentally transform the educational landscape worldwide,” says Martin Vetterli, until the end of 2012 Professor for Communication Systems and Dean of the School of Computer and Communication Sciences at EPFL and from 2013 new Chairman of the National Research Council of the Swiss National Fund (SNF). At EPFL he championed interactive courses. Thanks to this enthusiasm and at the suggestion of Professor Karl Aberer, new EPFL Vice-President for Information Systems, EPFL became the first continental European university to be granted membership of the social entrepreneurship company Coursera in the summer of 2012. This platform for online courses in the tertiary education sector was founded in the autumn of 2011 by two professors at America’s private Stanford University. Thirty–three universities worldwide have since joined. Stanford’s Coursera spin–off currently comprises 207 courses available to internal and external students. EPFL is contributing three courses until the spring of 2013, including the only one so far in French. EPFL launched its first course on the Coursera platform in mid–September 2012. A total of 50,000 internal and external students registered for this seven–week course on Functional Programming Principles in Scala. Scala stands for Scalable Language – a programming technique developed at EPFL. Around 10,000 have since completed the course.

Early experience with this new form of online teaching convinced Martin Vetterli of its inherent advantages. “It marks a return to the Socratic teaching method with a subject being explored interactively by the teacher and pupils through questions and answers,” he says. This stretches both teachers and those taught. In online courses, the material is portioned out and delivered audiovisually. Compared with a conventional lecture, the individual steps involved in communicating the material need to be planned in significantly greater detail. The students are continuously set assignments between the individual modules. The quality of the answers also enables inferences to be drawn about the quality of the teaching method applied. “The implication for the lecturer is that he needs to prepare his courses far more intensively and communicate the content more rigorously. This enhances the quality of the teaching, because test assignments and other student responses provide him with constant feedback on his communication performance,” says Martin Vetterli.

Answer in 22 minutes
The online courses enable the students’ preparation to be more focussed while also allowing them to revisit material that has already been taught, thus filling gaps in their knowledge. And
the benefit for them is that queries with interactive feedback often let them know immediately whether their answers are correct. Mutual assessments between participating students, now members of a worldwide community, are also possible, as is assistance with tricky questions. The average blog response time is 22 minutes and this speed is understandable: with a potentially global audience, there is always a fellow student at his or her computer somewhere. This can also forge real teams among students on the same virtual course. “The ambition is very much to harness digital technology to make it possible to supervise students on an individual basis, thereby generating learning achievements that could otherwise only at best be attained with a private tutor. That is why it is so important that the students also play an active part in developing the Coursera platform,” says Martin Vetterli. Followers’ numbers are certainly growing apace. While the global Coursera community still comprised little more than 700,000 students in mid-2012, just half a year later there were almost two million “Courserians”. This is also mirrored by the range of topics covered by the course programme. These now cover twenty different categories spanning the academic teaching repertoire. They include courses on computer and social sciences, life sciences and audio engineering, jurisprudence and the nutritional sciences.

The Coursera platform has made significant progress in establishing itself as a teaching and learning tool within a short space of time. But will it endure alongside the traditional physical lecture? “Nobody can answer that,” says Martin Vetterli. “But no development has had such an influence on university teaching in years and for us at EPFL it was clear that we had to ride this wave from the outset.”

Interactive learning environment for students
The ongoing enhancement of teaching is a core task at ETH Zurich, where it is energetically pursued. Prorector for Education Professor Hans Rudolf Heinimann addresses a direct video message to lecturers on this topic via the website, saying: “We at ETH Zurich are constantly striving to improve teaching and learning. But we are also convinced that improvements are only possible on the teaching front, meaning you, my dear lecturing colleagues.” It is an appeal for sharing ideas, for cooperation, for active involvement. “We are in the midst of a change process which can be paraphrased as ‘from teaching to learning’,” says Hans Rudolf Heinimann. “At the same time, the challenge is to align the course curricula to clear competences that the students are required to acquire and develop.” The idea is for the skills that students take with them when they graduate to be described in a way that employers and other universities find transparent and comparable and to be continuously adapted to changing circumstances. “Surveys of former students tell us which skills are important and relevant in practice and this provides an impetus for the development of future curricula,” says Heinimann.

ETH Zurich is committed to web-based teaching and learning platforms that can be combined with classroom teaching, complementing and extending it and enhancing its overall quality. These teaching innovations often originate from the lecturing community itself. For ten years now, ETH Zurich has been using a special tool to promote innovative learning projects and course initiatives: Innovedum. Since 2000, more than one hundred such projects have satisfied the stringent teaching quality require-ments and been found worthy of promotion. The best teaching ideas to date were showcased in November 2012 over a two-week period at the ETC Centre and on the Hönggerberg campus, including the web-based teaching and learning platform eQuilibrium developed at the Institute for Technology in Architecture. The goal was to introduce students to the design of supporting structures. The interactive learning environment is accessed via the Internet, lectures are available as interactive presentations and additional information and explanations can be downloaded at the click of a mouse along with modules on private study or design problems. This way, students intuitively learn the basic techniques for the design of supporting structures.

Other examples as well illustrate the breadth of teaching innovations that have been promoted by Innovedum. Modules for programming with Java were developed at the Computer Science Department, enabling students to teach themselves the rudiments of programming with the assistance of an electronic tutor. New interactive elements enabling independent learning and self-assessment were constructed at the Department of Mathematics — in view of sharply rising student numbers, this has both complemented and relieved pressure on individual supervision, which remains a priority. The new Department of Environmental Systems Science founded at the beginning of 2012 unveiled its web-based visualisation platform called the Interactive Weather Analysis Laboratory which students can use to explore the complex structure and development of weather systems. ETH Zurich has thus ignited and put on a veritable firework display of teaching innovation.

Individual supervision being upheld
The strategy ETH Zurich is pursuing in the further development of teaching resources and techniques is evident from these examples: it is derived from lecturers’ and students’ everyday teaching needs. Technology and web-based elements play an important role here but not an exclusive one. “The focus is and remains on direct contact between students and lecturers, which is where the enthusiasm for a specialist area is kindled, and thus also on the lecturers’ individual supervision of students,” says Hans Rudolf Heinimann.

A dedicated Teaching Development and Technology staff department (LET) directly affiliated with the vice-chancellor’s office also offers teaching staff a comprehensive array of support resources on the subjects of teaching, examinations and curricular developments. In addition to this central support, a number of departments also employ teaching specialists on a decentralised basis. “On the one hand, this network ensures that specialist requirements feed directly into our development work and on the other hand lecturers receive direct support within their department,” says Konrad Osterwalder, Head of LET.
**ETH Zurich**  
**Health sciences in demand**

In autumn 2012, 217 young women and men enrolled for the “Health Sciences and Technology” bachelor’s course introduced in the previous year. This means that the new subject is already ranked third among the most popular fields of study after the two traditional front runners, mechanical engineering and architecture. ETH Zurich has launched a very successful educational programme with the new course. Following the enrolment of 145 students in the very first year, the university is now posting a remarkable growth of 50 %. A strikingly large number of women feel drawn by this technically oriented course; they account for almost two thirds of the students. The “Health Sciences and Technology” course combines biomedical fundamental research disciplines with classical engineering sciences in order to address medical issues and promote their application to clinical use.

**Empa**  
**Talented youngsters at “physics fights”**

Why does a golf ball jump out of the hole again? At the end of March, the Empa Academy hosted the Swiss Young Physicists’ Tournament where girls and boys with a passion for physics argued about “frustrating golf balls” and similar problems. Those physicists of the future – almost a third are girls – who in the eyes of a jury of experts put up the most persuasive defence of their solution in the face of critical questioning by the opposing teams travelled to the Physics World Cup in Germany in the summer where they took seventh place.

**PSI**  
**Hercules school for the next generation of researchers**

The Hercules school for the next generation of researchers is pitched at postdocs and doctoral students at European institutions (hercules-school.eu). Every year 70 participants are trained in using neutrons and synchrotron radiation for their experiments. They are drawn from the disciplines of biology, chemistry, physics, materials sciences, earth sciences and industrial applications. The one-month course comprises lectures that are delivered at various European institutes as well as practicals. In 2012, part of the practical component took place at PSI’s facilities. For three days, the SLS was available exclusively to the participants.

**WSL**  
**Training of local natural hazards advisers**

In recent years the federation and cantons have improved the forecasting of natural events and developed warning systems. The flood events of 2005 and 2007 demonstrated that there was scope for improving civil protection. What this requires is local experts to assess the current situation at critical locations and forward this information to the relevant authorities. That is why the Federal Office for the Environment (BAFU) is training local natural hazard advisers to take on this role in the municipalities. The WSL is in the monitoring group for this project and is advising the BAFU on the design of the training. The WSL is also involved in implementation: In conjunction with BAFU experts, it is developing a training module on the subject of slope instabilities. Here the local natural hazard advisers will learn what processes result in unstable slopes and how to recognise critical points in order to use this knowledge to provide even better support for municipal authorities with decisions during a storm.
Division of labour between universities and research institutes

The next generation of scientists: students at ETH Zurich (picture: Gerry Amstutz/ETH Zurich).
The close cooperation between research institutes and universities is manifested not only by joint professorships but in particular also by the numerous teaching and mentoring hours the research institutes dedicated to educating the next generation of scientists. This enables the students to benefit from direct contact with researchers at the internationally acclaimed research institutes. “The specific research institute teaching function is both desired and acknowledged in the ETH Domain,” says Rik Eggen, Eawag Directorate member and adjunct professor at ETH Zurich. The various research institutes assume a key teaching role with a holistic focus for a large number of topics. In the case of Eawag, for example, this topic is water, for PSI it comprises specific issues to do with energy, for Empa it is materials research and innovative technologies and for WSL it is the forest or snow. This results in a complementary, practical curriculum which enriches the universities.

This is also derived in particular from a wealth of consulting services that the research institutes provide for third parties. “WSL, for example, is strong in consulting for cantonal and federal authorities,” says Rolf Holderegger, WSL Directorate member and adjunct professor at ETH Zurich. “The primary focus here is on practical problems in which WSL possesses expertise, with this practical knowledge feeding back into teaching.” The expertise at WSL, for instance in forestry issues, in turn complements the curriculum for university students.

Close links between research and teaching
PSI Director Professor Joël Mesot succinctly sums up this synergy: “For PSI, joint professorships provide the opportunity to become more actively involved in the Swiss academic system. Taking part in teaching provides PSI with early access to the best students whom it can then target for promotion by offering them bachelor’s, master’s, doctoral and post-doc positions.” Joël Mesot has been championing the linking of elite research and excellent teaching since taking over the PSI Directorate in 2008 and last but not least he personally is an outstanding example of the synergies between universities and research institutes. When the physicist took over PSI, he also received a dual professorship at ETH Zurich and EPFL, at that time a novelty in the ETH Domain, “The primary focus here is on practical problems in which PSI possesses expertise, with this practical knowledge feeding back into teaching.” The expertise at PSI, for instance in consulting issues, in turn complements the curriculum for university students.

Research institutes guarantee strong practical focus
“Research and educating the next generation of scientists at our large-scale research facilities are core tasks at PSI,” underlines Dagmar Baroche, Communication Manager at PSI. A further focal point lies in the involvement of PSI researchers in teaching as assistants, associate lecturers or professors, with the latter often taking the form of joint professorships, e.g. with ETH Zurich or EPFL or the Universities of Basel, Berne, Zurich, Geneva or various universities of applied sciences. The combination of a leading role at a research institute with a professorship enables staff to gain access to the best resources – unique world-class research infrastructures at PSI and committed and highly intelligent young people at the universities. For filling such attractive positions PSI is represented on the appointment committee and bears a share of the costs for the joint professorship.

Contribution to Switzerland as a centre of research
The extent of the service the research institutes provide for the ETH Domain as a whole thanks to the close cooperation between science and teaching is of course far greater. “Empa as a research institute traditionally works in an interdisciplinary manner and is therefore also able to make a valuable contribution to teaching,” says Brigitte Buchmann, Empa Directorate member and Head of the Mobility, Energy and Environment department. For instance, Empa is engaged in teaching at a dozen of ETH Zurich’s 16 departments and teaches students basic theory as well as knowledge of applied research and practice. Let us take the example of air pollution control: Empa has been actively involved in teaching in this area for 25 years, largely at ETH Zurich which in turn runs an Institute of Atmosphere and Climate Science. This kind of complementary division of labour not only makes economic sense but also represents a major benefit for the students. Through their teaching activities the staff at Empa gain access to university networks and come into contact with master’s students. This often results in topics for master’s theses. “Empa also supervises around 180 doctoral students,” says Brigitte Buchmann, “We act as co-assessors together with a professor at ETH Zurich or EPFL.”

Sometimes the teaching activity of the research institutes extends far beyond the ETH Domain. Eawag researchers, for example, teach approximately 3,000 hours per year at ETH Zurich and EPFL, thus making a major teaching contribution to the environmental system and environmental engineering sciences. These are supplemented by around a thousand hours at other universities – in particular cantonal universities. Eawag researchers also supervise around 160 doctoral students and 150 bachelor and master’s students. “For many students, this provides an important insight into everyday life in applied research and the researchers are thereby making an important contribution to the cohesion of Switzerland as a place to conduct research,” says Jukka Jokela, Eawag Directorate member and ETH Zurich Professor in the Environmental Systems Sciences Department.
Objective 2
Research

Facts and figures

Objective 2, performance mandate 2008–2011/12 (see enclosure): “The ETH Domain will strengthen its position as a leader in international research.”

2012 reports from the institutions with examples and the ETH Board’s perspective.

ETH Zurich
In 2012, the researchers of ETH Zurich were once again extremely successful in obtaining the much-contested funds that they need for their research. Twelve researchers of ETH Zurich received an ERC advanced grant and eight received an ERC starting grant from the European Research Council (success rate: 46% and 35% respectively). Of the 10 proposals submitted by ETH Zurich as main leading house for National Centres of Competence in Research (NCCR) for the period from 2013 to 2016, five received an A, the highest mark. Four other project proposals in which ETH Zurich is involved as co-leading house also received an A.

The high quality of the research conducted at ETH Zurich is also recognised by private sponsors. In 2012, the ETH Zurich Foundation received donations of around 36m CHF for research projects in ETH Zurich’s key focal areas of energy, medical technology, global food security and risk. Donations also made it possible for ETH Zurich to set up four new professorships in its key focal areas, thereby speeding up the implementation of its strategy.

The excellent research performance of ETH Zurich is likewise reflected in the most important international university rankings and the awards received by ETH researchers. For instance, in 2012 Niklas Beisert received the New Horizons in Physics Prize and ETH Zurich was ranked in both THE and QS World University Ranking as the world’s top non-Anglo-Saxon university (THE: 12th position, QS: 13th position).

EPFL
The quality of research at EPFL is excellent, as confirmed once again by the 16 European research grants (ERC) received by EPFL in 2012. These include eleven junior grants for assistant professors, which underlines the quality and high standard of the assistant professorships with tenure track at EPFL. In the European university ranking by number of ERC grants since their introduction in 2007, EPFL ranks third after Oxford and Cambridge. This quality was also crowned by the appointment of Melody Swartz as a Fellow of the MacArthur Foundation, the awarding of the Latsis Prize to Jacques Fellay, the Albert Einstein World Award of Science to Michael Grätzel, the Cloetta Prize to Olaf Blanke, and the Russian Academy of Sciences’ Sakharov Prize to Mikhail Shaposhnikov. A technology developed at the Center of Plasma Physics Research in collaboration with laboratories in the US was voted one of the 100 best technologies in the field of nuclear fusion by R&D Magazine.

This year, EPFL received an important European contribution to finance an Excellence programme for post-doctoral students who wish to work at EPFL. In a first phase, this EPFL Fellows programme will allow the financing of twelve post-doctoral grants per year. In order to increase the number of annual grants, a supplementary request for financing has been submitted in Europe.
PSI
From their own research using the large-scale research facilities, the PSI researchers are familiar at first hand with the needs of the 2,700 or so external users involved in academic and industrial research. Their skills in using and developing the facilities serve to improve the attractiveness of the facilities in an international comparison. In the eleventh year after commencing operations, the Synchrotron Light Source reached its full capacity with 18 beamlines. The competitive capabilities of the total of 40 beamlines offered by the large-scale PSI facilities are maintained by regular upgrades. From 2016, SwissFEL, Switzerland’s X-ray free-electron laser, will provide the research community with additional and globally sought-after capacity. The new concepts needed for a compact build were verified with the research results obtained from the test facility. These results concluded the intensive preparatory work in 2012, so that building work on the new facility can start in 2013. PSI researchers published the results of their measurements using the only X-ray free-electron laser available for routine use in the US in leading journals. In 2012, PSI researchers published more than 1,000 articles on matter and materials, human beings and health, and energy and the environment, more than 10 % of which appeared in leading international journals.

WSL
With its research on terrestrial ecosystems and natural hazards, WSL has a very broad portfolio and is the only institution in Switzerland that can bridge the divide between elite research and practical application. Among other things, it researches the effects of climate change and the related changes in temperature and precipitation on forest ecosystems and the distribution of individual tree species. For example, it can be assumed that the spruce, a tree that has adapted to cold conditions and fairly wet ground, will be pushed out by beech and oak trees, which will affect the timber industry and therefore also the income earned by forest owners if no effective measures to prevent the displacement of the spruce tree can be found. The loss of economic value is expected to be up to 50 % by 2100. For WSL, the fact that the roots of the beech tree can reach deeper into the soil in pre-Alpine areas than the spruce shines some positive light on the change in tree species. Dying roots leave hollow spaces in the soil that can store more water, and the more the roots of the beech tree penetrate the soil and loosen it in the long run, the more water can be stored in the soil. In the end, such a forest lessens the flood risk.

Empa
In November, an international peer review team audited the research portfolio and scientific output of Empa. The initial upshot — the report was presented to the ETH Board in early 2013 — was that Empa has seen impressive development since the last evaluation in 2008 and has a first-class reputation which allows it to recruit excellent scientists such as Maxim Kovalenko, who in August received one of the renowned starting grants from the European Research Council (ERC) for his research on nanocrystals in solids. Maxim Kovalenko, who at 30 is not only the youngest ERC prizewinner but also a professor at ETH Zurich, will receive 1.8m CHF over the next five years. A bibliometric analysis of the scientific output of Empa carried out by Leiden University in the Netherlands returned a similarly encouraging result. In terms of the key indicators it achieves scores here that are comparable with the universities that come 20th in the Leiden ranking. Examples of Empa’s excellent research results include the development of the world’s first 3D nano chemical spectrometer and an atomic force microscope for the chemical, physical and topographic analysis of solid surfaces, and CLEVER, the world’s first natural gas full hybrid vehicle with manual transmission which emits up to 45 % less CO₂ than conventional internal combustion engines.

Eawag
As Eawag combines basic and applied research into solution-focused research, current practical problems with water were important research topics in 2012. For example, together with the University of Berne, Eawag researchers demonstrated the effects of lake eutrophication on speculation in Switzerland. Eawag also organised a workshop on invasive species in water systems where researchers could establish contact with practical experts and those working for the government and discuss practical topics as well as measures to combat invasive species in water bodies.

The interdisciplinary WRQ (Water Resource Quality) project concerning the treatment of the natural pollution of drinking water in developing countries was also completed in 2012. This project resulted in the online GeoData that can be used to locate the pollution and reduce the risk of contamination.

With the launch of the EcoImpact project, Eawag intensified its internal collaboration on the effects of hazardous substances from the cellular level to the level of the ecosystem. Almost all research departments at Eawag are involved in this multi-phase project, which is related to the upgrading of Swiss sewage purification plants and researches their connection with other aquatic ecosystems.

The ETH Board’s perspective
With their research output, all institutions of the ETH Domain once again proved their international leadership in the reporting year. This is documented at both Federal Institutes of Technology by international rankings, success in the acquisition of funding and international prizes. Thanks to their specific focus, the four research institutes have a unique global positioning and thus facilitate the successful transfer from international elite research to practical implementation by the Swiss economy and administration.
Research for the change in energy policy

The Federal Council and parliament have voted to abandon nuclear energy over the long term. The Energy Strategy 2050 of the Federal Council provides for the substantial development of renewable sources of energy. A plan of action comprises seven fields in which research and teaching are to be promoted with additional resources. The institutions of the ETH Domain will play a central role here. Their traditionally strong energy research is to provide innovative stimuli so that both the anticipated shortage of electricity can be managed and a sustainable change in energy policy established within the short time frame set out by the government.

Hydropower is also at the heart of efforts to bring around a sustained change in energy policy (picture: Alpiq).
The ETH Domain has for some years been pursuing various activities in basic and applied energy research. However, since the Federal Council and parliament voted on a gradual abandonment of nuclear energy these efforts need to be strengthened even further. Thus in the autumn of 2012 the Federal Council submitted a plan of action entitled Coordinated Energy Research in Switzerland – Measures in the years 2013–2016 to parliament for consultation. This plan calls for prioritising research and teaching activities in seven fields of action with regard to the topic of energy. In the first instance this involves the potential of energy efficiency for example in buildings or in the case of industrial processes. Secondly, there are the grids for the transmission and distribution of energy where know-how in the management of electrical grids must be developed in order to be able to integrate large quantities of electricity from renewable and decentralized sources. Thirdly, technologies for the storage of energy require strong support since the storage of heat and electricity will be crucial to implementation of the new energy policy. And fourthly, this applies to the production of electricity, where the focus is placed on geothermal, photovoltaic and hydropower technology. Fifthly, a change in energy policy is only possible if socio-economic and legal aspects as well as changes in behaviour are taken into consideration. Two further fields of action involve mobility and biomass.

The ETH Board already established the Competence Center Energy and Mobility (CCEM) back in 2006. The CCEM, under the leadership of the PSI, successfully initiated and subsidised 50 complex interdisciplinary projects in recent years with the participation of institutions from the ETH Domain, the universities of applied sciences and universities as well as industry. Together with the activities of Novatlantis, which in the meantime have been integrated into those of CCEM, the transfer of knowledge and technology to the cantons and municipalities is also ensured. In all of these fields of action the institutions of the ETH Domain carry out both basic and applied research. “For decades we have been excellently positioned throughout the entire energy research spectrum,” says Marco Mazzotti, professor at the Institute of Process Engineering and Chairman of the Energy Science Center (ESC) at ETH Zurich, “However, in view of the complexity of the issues pending, new research priorities are also being addressed that go beyond the Federal Council’s plan of action.” Here the ESC plays a central multidisciplinary role in research and instruction. Currently around 100 professors at ETH Zurich from 12 of the 16 departments are conducting research in energy-related areas. And since 2010 18 new professorships for energy research have been created at ETH Zurich. “Including the indirect costs, approximately CHF 76.5 million were invested in energy research at ETH Zurich in 2011 alone,” says Roland Siegwart, vice-president of research and trade relations at ETH Zurich, “We have also registered increased donations from private sources.”
New energy concept for both Federal Institutes of Technology

The knowledge gained from research is also successfully integrated into teaching. For the past five years there has been a masters programme in “Energy Science and Technology” with approximately 30 graduates each year. In addition, practical solutions are called for in the form of flagship projects that point towards new approaches in the energy debate. Such a project is being realised at ETH Zurich on the Hönggerberg campus. The new power supply on the campus will be provided by means of dynamic underground storage (a so-called energy grid) that is largely CO₂-neutral. Moreover, in the autumn of 2012 the Executive Board at ETH Zurich adopted a new energy concept with which ETH Zurich itself is committed to the efficient use of energy in teaching, research and infrastructure.

Together with the cities of La Chaux-de-Fonds, Lausanne, Martigny and Neuchâtel, software is currently being developed at EPFL which will provide for improved management of power supply and demand. There as well, teaching and research has also been placing a greater focus on energy research, for example at the School of Architecture, Civil and Environmental Engineering (ENAC). Thus with the support of industry a centre for energy storage and renewable energies has been established and the new “Distributed Electrical Systems” professorship created. In addition, a dozen EPFL institutes cooperate within the scope of the EcoCloud program in order to use their expertise at least to curtail the power requirement of computer science facilities. EPFL is to establish the “EPFL Valais Wallis” campus in Sion, Canton of Valais. Four professorships will come from EPFL and seven will be financed by the Canton of Valais. Ninety per cent of their planned activities will be dedicated to energy matters, with a special emphasis on hydropower, bio-mass and CO₂ compensation (see p. 82).

The largest centre for coordinated energy research is located at PSI in Villigen, Canton of Aargau. “PSI is the only place in Switzerland where research is conducted across the entire spectrum of energy sources – from solar to nuclear energy,” points out Philipp Dietrich, former managing director of the CCEM. “Throughout the ETH Domain two central technologies are investigated here: the enhancement of energy efficiency on the one hand and the reduction of greenhouse gas emissions on the other.” Within the scope of the “Energy Research” plan of action, PSI conducts research, for example, into transforming bio-mass (wood, liquid manure or sewage sludge) into electricity, heating and synthetic natural gas. “The advantages of generating power from wood are obvious,” notes Dietrich and adds: “It is carbon-neutral because renewable wood binds the resulting carbon dioxide.” As part of a pilot project, bio-mass is being analysed as a storable and transportable primary source of energy in order to produce not just electricity but also methane as fuel, which is likewise a storable source of energy. In the meantime, the “X-PDU” research and development platform (“Wood Gas Process Development Unit”) has been launched as a project aimed at further enhancing the marketability of wood energy systems. “The ‘X-PDU’ aims to prove that commercial operation of efficient technology for generating electricity and heat from wood is possible in this performance class,” says Dietrich. Commissioning of the pilot plant on the premises of PSI is planned for the year 2014.

Modular building laboratory at Empa

“The schedule for the change in energy policy calls for swift and practical results,” says Empa director Gian-Luca Bona. “Suitable platforms for research and the transfer of technology are required in order to test the practical applicability of scientific knowledge and implement it in the form of innovative, marketable solutions.” At Empa two such technology platforms are currently being developed for the mobility and construction sectors that account for almost three quarters of Switzerland’s energy consumption. The first of these comprises the so-called “Future Mobility” demonstrator with which new types of sustainable fuels such as hydrogen, synfuel (synthetic natural gas and/or petrol) and hythan (a mixture of natural gas/biogas and hydrogen) can be produced and tested in practical operation. These energy sources, that are extracted from wind power and surplus electricity through photovoltaics, are easier to store and manage and can be utilised locally for various types of vehicles with enhanced drive systems. This enables the benefits and drawbacks of the different technologies to be compared and developed further under real conditions.

The other platform involves the globally unique modular building laboratory called “NEST” that is being planned as a joint initiative on the part of Empa, Eawag, ETH Zurich and EPFL. The backbone of “NEST” is a reinforced concrete core with a central stairwell on the exterior of which the experimental modules are mounted. The planning application for this core part of the platform was submitted in August 2012. The goal is to compare different concepts with each other with regard to their technical performance and at the same time analyse the advantages and disadvantages from the perspective of the residents. In this manner the best applications can be selected. The aim is for mixed use with open-plan offices, conference rooms and apartments.

Renewable energy versus landscape protection

Any type of energy production also has its effects on the environment and its ecological systems. This is also the case in Switzerland particularly due to the intensive use of hydropower. “For this reason Eawag concentrates its research on methods of integrated water management, on the impact of environmental changes on the aquatic ecological systems and the development of new methods for waste water purification and nutrient recovery,” explains Alfred Wüest, who headed the Department of Surface Waters at Eawag until mid-2012. In particular this also involves consulting on the use of hydropower and thermal energy from bodies of water, for example with regard to questions of peaking and recession (high and low channel flow).

The forced development of renewable sources of energy also increases the scope of potential conflicts between industry and society. “The production of wind and hydropower, solar energy, geothermal energy or bio-mass has always had an impact on competing landscape services such as agricultural production and tourism, on the preservation of biodiversity and on the landscape,” says Anna Hershperger, Group Head of Landscape Ecology at WSL. For this reason WSL, together with other Federal Government agencies and the private sector, is compiling a national map to show where conflicts may arise between landscape services and the production of renewable energies – for example wind energy and photovoltaic systems. “This map should be completed by the autumn of 2013,” says Felix Kienast, Head of Landscape Dynamics at WSL and honorary professor of landscape ecology at ETH Zurich.
PSI/ETH Zurich

Breakthrough at CERN

At the beginning of July the moment had arrived: an international consortium of researchers at the European Centre for Nuclear Research CERN in Geneva announced that it had discovered a new particle. Whether it is the long sought after Higgs particle predicted by the standard model of particle physics but as yet uncorroborated will be clarified by further measurements.

The discovery at CERN is an important success for fundamental research, contributing as it does to answering the age-old question about the key building blocks of the physical world. It was only thanks to the exemplary international collaboration of around 4,000 researchers and engineers from 41 countries that it was possible to build the highly complex particle accelerator that made these sophisticated experiments possible in the first place. Scientists from PSI, ETH Zurich and the University of Zurich made an important contribution: since the 1990s, they have developed and constructed critical parts of the powerful detectors which have now proved the new particle’s existence. They are now playing a major role in evaluating the measurement data.

EPFL

Ultrasonography for diagnosing bridge defects

A new imaging technology makes it possible to evaluate the health of concrete bridges with frames that have a tendency to rust. Comparable to ultrasonography, this technique is fast, simple and accurate. Professor Eugen Brühwiler, responsible for this research, conducted conclusive tests on an engineering structure in Appenzell. This world première will make it possible to save both time and money in maintaining the road network. The Federal Roads Office has linked up with the researchers for further tests.

Empa

Research for clean air

Diesel engines will be with us for some time yet in lorries, building machinery and commercial vehicles. With a view to the efficient cleaning of diesel exhaust emissions, researchers in the Empa engine laboratory are developing proper little chemical factories for the engine compartment and optimising the rare metal coating in the diesel cat. And at the other end of the Empa campus, colleagues are using a special wind tunnel to investigate how nano particles behave in air and how they can be more efficiently filtered out of exhaust emissions and the ambient air.

Eawag

No fertilisation of lakes for larger fish

Lake Brienz provides a habitat for rare whitefish breeds (picture: Eawag).

At the beginning of 2012, the Angling Association called for a reduction in or even the discontinuation of the elimination of phosphorus in the Canton of Berne’s wastewater treatment plants in order to feed more phosphorus into Lake Brienz again and thereby stimulate fish growth. Eawag experts advised against this because active or passive fertilisation of a lake would reduce it to a fish farm and jeopardise the tried and tested precautionary principle. The National Council and Council of States accepted this recommendation and rejected the anglers’ request.

Fact sheet on the topic: www.eawag.ch/medien/publ/fbi/doc/fs_phosphor_brienzersee.pdf

WSL

Climate change results in loss of forest value

In future, the hotter and drier climate will cause a pronounced change in the composition of Europe’s forests. According to the first pan-European study on the economic impact of climate change on the forest published by an international team headed by Prof. Marc Hanewinkel (WSL) in the journal Nature Climate Change, the spruce will recede into Northern Europe and mountainous regions.

Driven by climate change, the economic value of Europe’s forested area is expected to decline by between 14 and 50 per cent by 2100. In the analyses of three climate scenarios, the losses vary between 60 and 680bn EUR. Drought-resistant spruce types will benefit from the climate change and push northwards. The change in tree species will probably have a serious impact on the wood industry in central Europe, which depends on the spruce. Without effective measures against the displacement of the spruce, forest owners must expect incomes to fall. In the more Mediterranean forest types, the CO2 reduction effect of the forest will decline.

Investigations in the Empa wind tunnel: Insights could result in more effective soot and particle filters (picture: Empa).
Data protection and security

Researches what is technically possible in terms of security: Prof. David Basin, Head of the Institute for Information Security at ETH Zurich.
Protection against cyber risks and protecting critical infrastructure against cyber criminality are of utmost strategic importance for the Federal Council. ETH Zurich has been actively engaged for years in the information security arena in both basic and applied research alike. The collaboration that has been established with industrial partners is especially valuable. It enables scientific insights to find their way quickly into commercial practice, with the added bonus that people in this field who leave ETH Zurich are exceptionally well trained.

The strategic objectives that the Federal Council adopted in its National Strategy for Protecting Switzerland against Cyber Risks in mid–2012 are unequivocal. At issue are the “early detection of threats and dangers in cyber space, increasing the resilience of critical infrastructure” and the “effective reduction of cyber risks, especially cyber criminality, cyber espionage and cyber sabotage.”

ETH Zurich’s “Zurich Information Security and Privacy Center” (ZISC) plays a key role in this respect. It was co-founded in 2003 with private sector companies. Today, Credit Suisse, Google, security technology provider Kaba and the Federal Department ArmaSuisse are partners in ZISC. Joint research projects are underway in fields such as cryptography, design methodology and network & system security. “The motivation for this collaboration originally came from industry,” says Professor David Basin, who holds the Chair for Information Security at ETH Zurich. “This means that when it comes to security research, ZISC is able to play a dual role that is probably unique in the world.” While the scientific perspective is concerned with basic research and proceeds according to the principle of what is possible in terms of security and what is not, the application of solutions focuses on engineering aspects such as the efficiency, cost, usability and maintainability of security systems. “This feedback between theory and practice is extremely valuable for both sides because in addition to collaborating with project partners, it is one of the prerequisites for bundling forces and thus increasing their impact, which is what politicians are calling for,” says David Basin.

Joint research projects with industry

One of ETH’s doctoral students spent two months working on site with ZISC partner company Google on the ongoing project “Monitoring and Supervision of Data Use” and an ArmaSuisse expert was involved with another project, also not yet concluded, on specific risks posed by the shared use of file servers. A number of projects, however, are also directly linked to everyday matters. One of these is the “Data Deletion” project launched in the autumn of 2011 in what was then ZISC’s newly established Institute for Information Security. The issue here is whether and how data in Smartphones and Clouds can be deleted securely. In the process, the researchers not only encountered major gaps in security but also looked for ways and means of closing them. Ordinary deletion processes that are currently featured as standard on Smartphones offer no real protection. The ETH Zurich researchers therefore developed an application based on Android devices which ensures that the data both in the Smartphone’s memory and on external storage media are completely overwritten. This application is now available to users free of charge.

Numerous IT applications are now unimaginable without cryptography such as in all instances where individuals need to be reliably identified and data safely transmitted. This is a complex problem: data are transferred between computers connected with one another in a computer network by means of so-called protocols which are being programmed in increasingly complex ways in order to satisfy more stringent security requirements. This, however, is a two-edged sword: increasing complexity also brings with it possible sources of error and this in turn produces new gaps in security. One way of preventing this may lie in reducing the protocols’ complexity. ETH Zurich researchers are therefore working on modular data transfer solutions. “Cryptography needs to become a design discipline like many engineering disciplines such as automotive or software construction,” says Ueli Maurer, Professor at the Computer Science Department and Head of the Information Security and Cryptology Research Group. “We hope in this respect to be able to bring about a fundamental paradigm shift in cryptography.”

Industry supports new Chair

The industrial partners providing financial support to ZISC gain fruitful connections from this collaboration. Both sides benefit from the exchange of knowledge and gain insights into research work and practical applications. The partners also sometimes initiate scientific projects. The telecommunications group Swisscom, although not a ZISC partner, also provided start–up funding to support the establishment of a new Chair for Information Security. The telecommunications provider converted a loan of ten million Swiss francs to the ETH Zurich Foundation into a donation. In the autumn of 2012 this enabled ETH Zurich to make a direct appointment of Professor Adrian Perrig, one of the world’s leading scientists in the field of system security. Professor Perrig is a former computer science student at EPFL and completed his doctorate at the Carnegie Mellow University in Pittsburgh, where since 2002, in addition to his professorship, he has also headed Cylab, one of the world’s largest research centres for information and computer security.

This increases the number of professors in the information security field in ETH Zurich’s Computer Science Department to four. “With the four professors, other colleagues and the high quality of its work, ETH Zurich is establishing itself as a leading centre for information security,” says David Basin. This is also apparent in the fact that ETH Zurich now offers more than 15 courses in this advanced discipline. Graduates are specialists who are sought after by the private sector ZISC partners, industry in general and the public sector.
The brain is being decrypted

Prof. Olaf Blanke with the ultra-high field (7T) MRI scanner at the CIBM at EPFL.
The images broadcast on Swiss television’s prime time Tageschau news programme on 24 April 2012 showcased spectacular science. A robot appeared to move without human control, wandering into an EPFL meeting room and skirting around people, furniture and pot plants. It did so with total accuracy and without any collisions. It was controlled by Marc-André Duc, a tetraplegic who at that very moment was in his treatment room in hospital in Sion. How is that possible?

The man controls the robot using thought power alone. This entails a specific region of his brain being activated. Electrodes measure his brain waves and transmit their activity to a computer. This in turn transforms the waves into technical control signals. The tetraplegic can thus cause the robot to move. These so-called neuroprosthetics have been developed by a team of researchers headed by Professor José del R. Millan at EPFL. It is one of the latest scientific successes at EPFL’s Center for Neuroprosthetics (CNP). This example illustrates that in Lausanne, Geneva and Sion the neurosciences, engineering sciences and medicine are becoming more and more closely integrated. The researchers have already developed prototypes that neurological patients can use to control their wheelchair or move prosthetic arms or legs by thought power alone. “Intelligent computers are being used to overcome some of the functions lost due to a stroke or paraplegia and send the signals directly to the wheelchair, thereby making it a part of the body, a muscle so to speak,” says Olaf Blanke, Director at EPFL’s Center for Neuroprosthetics.

Body perception and awareness are being investigated

This is only one area being intensively investigated at the CNP. The Center for Neuroprosthetics was established in 2009 with private support from foundations operated by local entrepreneurs such as Ernesto Bertarelli and Logitech founder Daniel Borel. Professor Olaf Blanke conducts research into the brain mechanisms of neurologically and experimentally distorted own body perceptions that is intended to expand our knowledge of human physical consciousness. There is more to this than the mere scientific curiosity of discovering how physical self-awareness is created. “Controlling prosthetics, for example, could be made far easier if the wearer saw it not as a foreign body but as part of his body,” says Olaf Blanke.

Other revolutionary research initiatives on the topics of paraplegia (Professor Grégoire Courtine), the bionic arm (Professor Silvestro Micera) and artificial skin (Professor Stéphanie Lacour) are making the CNP unique in the world: the merging of neurosciences and engineering sciences such as robotics, microengineering, signal processing and computer science make it possible to create an interface between basic research, clinical applications and industrial use. This combination permits the development of neuroprosthetics enabling patients to recover capabilities that are either missing or were lost through illness or accident, independently of the damaged or non-functioning organ. It is not the organ that is repaired, as with many medical approaches, but instead, like a bypass, the injury is circumvented, replaced and robotically strengthened through precise measurements and brain stimulation.

“Neuropolis” is situated on Lake Geneva

In view of the scientific capabilities already available locally, EPFL, in conjunction with the University of Geneva and University of Geneva Hospital and the cantons of Geneva and Valais announced the next step in the development of the neurosciences in mid-2012. “Neuropolis” will be created in the Lake Geneva region as a cluster dedicated to brain research and the simulation sciences. Neuropolis envisages the establishment of two sites in Geneva and Lausanne, which will in future employ approximately one thousand scientific and technical staff. Neuropolis is also intended to act as a simulation platform for the “Blue Brain” project that has been running since 2005. EPFL researchers have been working for years on a pioneering project to understand how the human brain functions. The goal is to develop a computer model recreating the human brain with its 100 billion cells. Immense computing power is required for this computer simulation. “Because of its complexity, it will not be possible to explore the brain experimentally for the foreseeable future,” says Blue Brain project manager Felix Schürmann, “which is why we are having to take the roundabout route of computer simulation and recreate the brain there.” This is why IBM, specialised in mainframe computers, is also involved in the Blue Brain project. Even if the goal is still in the distant future, the EPFL researchers are repeatedly able to reveal spectacular insights into the inner workings of the brain. For example, last September Blue Brain researchers published new findings on the synaptic links between the neurones in the prestigious scientific journal PNAS of the United States National Academy of Sciences (NAS).

Neuropolis and the Blue Brain project also play a role for EPFL in a wider context. The former is expected to become the headquarters of the “Human Brain” project that has been declared one of two EU European Flagship initiatives. “The Blue Brain project will be incorporated into it as the Swiss contribution,” says Felix Schürmann.
Fuel from solar power

Chemical storage of solar energy: Anton Meier, deputy head of the Solar Technology Laboratory at PSI’s solar reactor.
For years, PSI has been researching thermochemical high-temperature processes that can be used to convert concentrated solar energy into storable and transportable chemical fuels such as hydrogen. The latest test series took place in the summer of 2012 in one of the world’s largest solar furnaces in the French Pyrenees – impressive insights for the researchers and a further small step towards achieving the key objective: the production of synthetic liquid fuel.

This is the goal the researcher aspires to after developing prototypes in the laboratory: to be able to test a scientific concept for process reliability and effectiveness in a large field trial. Only this opens the door to developing a pre-industrial prototype and achieving market maturity in the not too distant future. Anton Meier, deputy head of the Solar Technology Laboratory at the PSI is not a man of many words but instead inclines to sober analysis. But the fact that in 2012 he and his team quite literally spent a hot and instructive summer in the service of science is evident from his descriptions. The researchers were able to spend two months testing a 100 kW solar reactor developed at PSI on one of the world’s largest solar furnaces in the French town of Odeillo – a gigantic concave mirror onto which the sun’s rays are directed by an impressive number of mirrors. The test facility enables temperatures in excess of 2,000 degrees to be generated by concentrating solar radiation 10,000 times over.

Heat from concentrated solar energy

Anton Meier depends on temperatures of this magnitude for his research. “What this is about is the chemical storage of solar energy,” he says, “High temperatures are always a major challenge here.” Since the 1990s, Anton Meier’s research at the Solar Technology Laboratory has included thermochemical, high-temperature processes by means of which concentrated solar energy can be efficiently converted into storable and transportable chemical fuels such as hydrogen. Just recently, Aldo Steinfeld, head of the Solar Technology Laboratory at PSI and Professor of Renewable Energy Carriers at ETH Zurich, managed to convert water and carbon dioxide into a mixture of hydrogen and carbon monoxide based on cerium oxide and concentrated sunlight. This gas mixture, known as syngas, is a precursor for liquid fuels such as petrol, methanol or diesel. When Aldo Steinfeld and his team published these research results in the prestigious scientific magazine *Science* they attracted worldwide attention. However, more than 99 per cent of the solar energy used was still being lost in the first fuel production trials of this type.

“At maximum solar concentration and with the ground acting as a heat sink, 95 per cent of the solar energy could theoretically be converted into chemical energy from fuels,” says Meier, “20–25 per cent is technically achievable if one takes account of all the sources of loss. The economics of the process then have to be demonstrated on a technical scale.” This is what he is working on in his most recent research. The PSI researchers have developed a two-stage process based on zinc oxide for producing zinc, hydrogen and syngas. In an initial step zinc oxide reacts at approximately 400 degrees Celsius in a special chemical reactor with the admixture of water and carbon dioxide. The final objective is thereby achieved: the production of pure hydrogen and syngas. This part of the process is currently being researched at the Chair of Renewable Energy Carriers at ETH Zurich. It is still at the laboratory stage. In the meantime, the researchers have managed to achieve hydrogen yields of up to 80 per cent. There is a simple reason for the fact that pure hydrogen is not produced directly by water splitting but via a two-stage thermochemical metal oxide process. “Direct water splitting would be a brilliant concept”, says Anton Maier, “But so far there is no effective technology for splitting the hydrogen from the oxygen without the risk of ending up with an explosive mixture.” The roundabout route involving two separate process steps means that oxygen and hydrogen are not produced simultaneously; the two gases do not therefore need to be separated and there is no danger of an explosion.

The indirect method is worth the effort for another reason: it is a closed circuit in which the initial substance zinc oxide is created in the second process step and can therefore be reused. “The benefits of this new reactor technology are simplicity, scalability and controllability in the way the process is managed,” says Anton Meier, “The solar hydrogen can be used directly in fuel cells and the syngas can be converted into liquid fuels using a familiar process.” The question is when what is now a scientifically analysed manufacturing process can be brought into industrial production. But this much is clear: it will be a few years yet before solar manufactured synthetic fuels are flowing from the pumps in present-day use.
Objective 3
Knowledge and technology transfer

Facts and figures

Objective 3, performance mandate 2008–2011/12 (see enclosure): “In order to promote Switzerland’s innovative strength, greater technological and commercial use will be made of the knowledge created in the ETH Domain and cooperation with industry will be strengthened.”

2012 reports from the institutions with examples and the ETH Board’s perspective.

**ETH Zurich**

As an important partner of Swiss industry, ETH Zurich concluded 718 research contracts with third parties (268 of which were with Swiss companies) for a total volume of 153m CHF (+3%) in 2012. Among other things, it organised 20 comprehensive laboratory tours and prepared 20 skills analyses for companies. It held seven events focusing on energy, risk, food security and sustainable building methods for its strategic industry partners. At the Industry Day, more than 150 industry representatives met with 100 researchers and spin-off founders of ETH Zurich to discuss their ideas on energy, production and automation, electronics and sensors, and materials and medicine.

In 2012, spin-off companies of ETH Zurich once again counted among the most successful technology start-ups in Switzerland: three of the de Vigier Awards, the ZKB Pioneer Award and the Swiss Technology Award were given to spin-offs of ETH Zurich. Twenty-eight spin-offs of ETH Zurich rank among the top 100 companies in Switzerland, nine of which are among the top 15. Twelve new spin-off companies of ETH Zurich received support from Venturekick in 2012. Alexander Ilic, CEO of ETH spin-off Dacuda (“scanner mouse”), was voted Entrepreneur of the Year.

In 2012, ETH Zurich recorded the establishment of 22 new spin-offs, 87 patent applications (priority applications only) and the conclusion of 35 new licence and transfer agreements.

**EPFL**

In 2012, EPFL further strengthened its collaboration with industry both in the form of joint research projects and through scientific services that were financed directly by the partners or with funds from the Commission for Technology and Innovation (CTI). The contractually pledged amount increased on the previous year to 15.2m CHF (2011: 8.4m CHF). However, the contracts financed directly by industry declined substantially in 2012. This was compensated by a strong increase in the CTI projects, mainly as a result of the measures initiated by the Federal Council to combat the strong franc at the end of 2011.

Under the auspices of EPFL, the Consortium Alliance reached the milestone of 100 CTI projects in its seventh year. With around 30 projects approved in 2012 compared with 55 projects in the previous year, EPFL maintained its high standard in this regard.

In 2012, the number of new patent applications (priority applications only) increased to 75 (previous year: 52). However, the number of licence and option agreements (31) declined on 2011 (50). This calls for proactive promotion measures. Ten EPFL start-ups were established in 2012, and the EPFL start-up programme issued nine innovation grants.

Innovation Square continued its success and added a research and development unit of the Japanese company Nitto Denko. This company is a leader in the adhesive sector and also very active in the field of materials development (see p. 59).
Objective 3  I  Knowledge and technology transfer

The ETH Board’s perspective

The transfer of knowledge and technology in the ETH Domain takes place at numerous levels. Particularly crucial is the progression of very well qualified graduates to Swiss business and administration. Collaboration with industry was further intensified in both teaching and special projects, often with the financial support of the CTI. Important practical services were provided for public administration, for instance. A new publication illustrates the range of KTT activities in the ETH Domain. However, a closer networking of KTT activities within the ETH Domain is difficult as the focus is placed mostly on projects and regions.

PSI

The focus of PSI’s knowledge and technology transfer (KTT) activities falls on collaboration with the business sector and advisory services to the national government. In 2012, such collaboration with PSI was agreed in around 300 contracts. The operation and development of the large-scale research facilities of PSI require the continued development of components that can also potentially be used outside the research environment. Here, PSI consciously promotes the transfer of knowledge to the business sector, which can reach new markets with adjusted products. The commercial exploitation of new ideas can be prepared by the registration of industrial property rights. In 2012, PSI earned an attractive licence income (more than 2m CHF), most of which was rerouted to other research projects. The framework conditions for the planned high-tech zone to adjoin PSI were revised and an economically viable concept was drawn up to attract new companies.

WSL

WSL researches the protection and use of the diversity of our environment and planet. Other focal points include water and snow as resources and natural hazards such as avalanches, rockslides and mudflows. These key focal areas share one feature: They are public property or the responsibility of the community. As a result, the knowledge and technology transfer (KTT) of WSL does not focus primarily on industry like our sister institutions but targets public administration customers and individual citizens.

An example of knowledge transfer in this context is the Avalanche Bulletin which has been appearing twice a day in the three official languages plus English as of winter 2012/13. The resulting challenges from a translation perspective could only be met by the automatic catalogue developed with the help of Kurt Winkler of the Institute for Snow and Avalanche Research (SLF): The warning is “clicked together” from a fixed set of sentence fragments, all of which are listed as predefined terms in the four different languages. This way the time and financial budget for the Avalanche Bulletin can be met while users are at the same time provided with timely and comprehensive information.

Empa

Empa’s excellent ties to industry were strengthened again in 2012 with more than 100 new research contracts with industry partners. Around 60 % of these concerned market-centric R&D projects promoted by the Commission for Technology and Innovation (CTI). Empa’s patent portfolio currently consists of almost 50 patents. In 2012, Empa registered more than 10 new patents and concluded 20 new licence and transfer agreements. Empa’s business incubators supported a total of 24 spin-offs and start-up projects, including the company CT Systems GmbH established by Empa researchers that aims to commercialise EAP technology: Electroactive polymers – “artificial muscles” – are to be used in small actuators, for example in the automation, robotics or automobile manufacturing sectors. The compliant concept spin-off of Empa and ETH Zurich is somewhat further along the road to success and recently brought its first product to market – a “mobility monitor” to measure the mobility of bed-ridden patients and inform nursing staff when they need to be moved to prevent bedsores (see p. 62). The transparent, noise-absorbent curtains developed by Empa in collaboration with industry partners are likewise already being marketed internationally and won several design awards in 2012.

Eawag

Eawag’s KTT activities primarily target national and cantonal authorities, consulting and engineering companies as well as the transfer of knowledge to emerging and developing countries in view of the fact that water is public property. Eawag and Empa have a joint technology transfer office to support the transfer of knowledge and technology to the business sector and society. Among other things, a method developed by Prof. Thomas Egli at Eawag to identify microorganisms was included in the Swiss Food Code in 2012 as a method for analysing drinking water. Another project on the potential for the microbial contamination of synthetic materials in contact with drinking water financed by the Commission for Technology and Innovation (CTI) was completed in 2012 and resulted in important new methods of analysis for use in practice.

Eawag’s practice-oriented PEAK courses have provided vocational further education since 1993. Here, Eawag works closely with the Swiss Water Association. In 2012, the PEAK programme focused on the protection and revitalisation of water bodies. Eawag also strengthened its cooperation with the Swiss Gas and Water Association (SVGW) with regard to training in the field of drinking water in 2012.
Objective 3
Knowledge and technology transfer

New life for rivers

Flood protection and measures to rehabilitate watercourses are complementary components of the revised Water Protection Act. The interdisciplinary research project “Integrated River Basin Management” that is being conducted by ETH Zurich, EPFL, WSL and Eawag highlights specific ways in which biodiversity in streams, rivers and wetlands can be preserved and enhanced through watercourse widening and new structural design solutions. The results of the project, concluded in 2012, also serve as guidance for the cantons implementing them.
Because of its topography and a comparatively high annual precipitation, Switzerland possesses an extensive network of streams and rivers. Increasing settlement and the country’s growing industrialisation as well as urbanisation over the past 150 years massively transformed the face of the watercourses. Numerous factors had a cumulative impact on the watercourse structure. The need to protect settlements and infrastructure against flooding and the use of hydropower resulted in the widespread construction of river and stream control structures. More intensive agriculture and the associated riverside land improvements resulted in widespread destruction of the natural floodplains. Flood protection also entailed the narrowing of numerous watercourses and the construction of sills of various heights to prevent incisions in the watercourse bed. Today there are around 101,000 artificial lateral structures nationwide with a height of 50 centimetres or more.

All this has undesirable side effects. “Lateral structures are obstacles to the movement of aquatic fauna, thereby preventing the connectivity of water courses which play an important environmental role,” says Eawag fish ecologist Armin Peter. This results in morphologically monotonous and environmentally impoverished areas. A canalised and thus narrowed river also poses the risk of bursting its banks during flood peaks, which can have devastating consequences in Switzerland’s densely populated areas. Other extreme flooding events have occurred in Switzerland since the worst flooding in a century in 1987: this has caused the relevant authorities to reassess their flood protection priorities. “Previously, flood protection was primarily the preserve of river engineers. Nowadays flood protection and rehabilitation are like Siamese twins in protecting nature and man,” says Professor Anton Schleiss of EPFL’s Hydraulic Constructions Laboratory in Lausanne. A new Water Protection Act requires the cantons to set up rehabilitation programmes that are largely funded by the Federal Government. The goal is to rehabilitate around 4,000 of the 15,000 kilometres of man-made watercourses over the next eight decades.

Innovative concepts for flood protection
To date, this objective has produced two transdisciplinary research projects in the water protection arena, each with a four-year time limit. Researchers from ETH Zurich, EPFL, WSL and Eawag were involved, with expert mentoring and strong financial support from the Federal Office for the Environment (FOEN). The first “Rhone-Thur project”, now concluded, investigated issues such as hydropoeaking – a change in a watercourse’s flow velocity caused by pumped storage power stations responding to requirements. Other subprojects investigated the impact of extending canalised river courses on fauna, flora and human recreational requirements or issues surrounding the decision-making process pertaining to rehabilitation projects and monitoring their success. “Many watercourses are in need of
environmental upgrading while at the same time complying with flood protection requirements, which is why hydraulic engineering calls for innovative concepts and measures,” says Schleiss.

The follow-on project “Integrated River Management” concluded in the 2012 reporting year was set up by the same sponsors with a view to applying the findings of the “Rhone–Thur project” in a practical environment. The study investigated issues such as the interaction between the building works necessitated by flood protection and the need for watercourse habitat diversity as well as the impact of watercourse connectivity, both longitudinal and transverse, on the ability to permit the passage of migratory organisms. This affects the flow and intermingling of genes among fish, insects and plants.

“Achieving these objectives requires a holistic hydraulic engineering perspective; if, for example, the goal is to increase biodiversity by widening rivers then this will also entail an increase in flood protection requirements,” says ETH lecturer Roland Fäh. The parameters influencing these various watercourse use and protection interests are legion. “The behaviour of the water current is of critical importance here; the interplay, for example, between water flow, the bedload transported by the current and the structure of the watercourse bed has to be factored into each and every building activity.” To underpin this with a hard and fast basis for decision-making, researchers at ETH Zurich’s Laboratory of Hydraulics, Hydrology and Glaciology developed computer-aided numerical models for simulating watercourses. These models make it possible to calculate watercourse flow velocity, widening dimensions and sediment transports. This resulted in the “Basement” simulation software, now available free of charge to interested parties. Physical models as well were constructed in the experimental laboratories at EPFL and ETH Zurich, both as a complement and alternative to the sometimes complex numerical simulation. “In practice, both approaches are frequently combined in a so-called hybrid model; the numerical calculations are used to specify the design and constraints of the physical model as accurately as possible,” says Schleiss. “The physical model is then used to fine-tune the dimensions of a structural component.” After extensive field research on the Bünz, Sense and Venoge rivers in Switzerland, Schleiss and his team developed the so-called Hydro-Morphological Index of Diversity (HMID). Numerical discharge models and statistical analyses of hydraulic variables characteristic of the structural diversity can thus be used to determine the variant with the best objective environmental impact by applying the HMID value.

Rivers and streams are dynamic systems

Technical and mathematical tools such as these are an important element in preserving and developing natural living spaces, so-called habitats, for typical fauna and flora throughout the watercourses. Rivers and streams in a near natural state are dynamic systems: the bed and banks of these watercourses are regularly reshaped by flooding, constantly creating new habitats in the process. “Recreating the dynamics is critical to creating new habitats; river engineering activities must therefore be designed in such a way as to generate the greatest possible diversity of aquatic and terrestrial habitats,” says Christoph Scheidegger, Professor at the University of Berne and Head of WSL’s Biodiversity and Conservation Biology group.

The connectivity of high quality habitats throughout the length of the watercourses is critical to the dispersal of aquatic, amphibious and terrestrial organisms. Artificial barriers should be designed in such a way that they do not present any insuperable obstacles. The researchers investigated this link based on three aquatic and two terrestrial species: the mayfly, the freshwater shrimp and the bullhead together with the grasshopper (Chorthippus Pullus) and German tamarisk. This clearly showed that species’ and genetic diversity, and thus also populations’ long-term survivability, improve if rehabilitated stretches of a watercourse are connected with sections in a natural or near-natural state. “It takes something akin to a high biodiversity habitat hotspot from which organisms can spread; in the case of the Sense, for example, the tributary of the Saane, we found that in terms of biodiversity, the canalised lower reaches benefit from the upper reaches that have been left to nature,” says Eawag Group Leader Armin Peter. Similar interactions can also be noted with the lateral connection of a watercourse in the littoral zone. Connectivity between the water and riverside forest via the gravel banks is critical to the survival of amphibians or aquatic insects as they depend on different habitats during their life cycle. If, for example, this connectivity is severed by building works, there is a negative knock-on effect on numerous organisms such as birds, fish, invertebrates and the freshwater shrimp as well. One objective when rehabilitating heavily canalised watercourses can therefore be the progressive removal of hard-built bank structures, for instance with small-scale initiatives to reduce the speed of the water current. The extreme variant would be full widening: both banks would be dismantled and fully dynamic banks implemented without any lateral restriction.

Fish upstream movement must be ensured

In the case of lateral structures to prevent channel erosion, so-called block ramps, there is likewise a wealth of variants depending on the objective being pursued. These ramps were tested in laboratory models depending on their intended use. “As a matter of principle, structured ramps provide better conditions for fish upstream movement owing to a wider speed distribution,” says Schleiss, “That means that block ramp gradients exceeding six per cent can be constructed in streams with the most commonly encountered fish species, the trout.” However, this is only to be recommended if the brown trout is the only species in the watercourse. If other fish species are present, it is advisable to opt for a significantly smaller ramp gradient.

This second project carried out under the federal rehabilitation policy yielded valuable, interdisciplinary insights. Another one will follow in 2013. Scheidegger believes that this will make an important contribution towards laying the scientific foundations for the forthcoming “Project of the century for watercourse rehabilitation” while at the same time it is important to “set realistic expectations of what rehabilitation can achieve.” Also in 2013, Eawag is launching the “Swiss watercourses” research programme, assisted by the Federal Office for the Environment (FOEN).
**Examples of the institutions**

**ETH Zurich**  
**Accelerating transfer**

Nurturing smart entrepreneurial talent and seeing it through to success – this is the goal being pursued by ETH Zurich with the “Innovation and Entrepreneurship Lab” (ieLab) inaugurated this year. The ieLab closes an important gap in the knowledge and technology transfer arena. It offers students and researchers modern accommodation in two locations where they can work on their ideas with industrial partners. As a result, research results are more quickly available for the economy and society.

**Empa**  
**CTI special measures boost cooperation**

The special measures against the strong franc for which the Federal Council granted the Commission for Technology and Innovation (CTI) an additional 100m CHF in September 2011 enabled Empa to launch a total of 24 new projects. In terms of subsidies received, Empa came third with 12.5m CHF after EPFL and the Centre Suisse d’Électronique et de Microtechnique. A particularly pleasing development is that around 40% of the projects established contacts with companies with which Empa had not previously collaborated. Many of these are SMEs, such as Douglas Textiles, an innovative one-woman enterprise that has developed transparent and at the same time sound-absorbing curtains with Empa and the company Weisbrod that are now sold successfully throughout the world under the “Silent Space” brand. Company owner Annette Douglas: “In my experience, even small companies can implement CTI projects successfully. I can but recommend these development projects.”

**EPFL**  
**A Japanese group is setting up at Innovation Square**

On 19 July, Nitto Denko Corporation, one of Japan’s leading materials manufacturers, announced the establishment of a research and development unit at EPFL’s Innovation Square. The “Nitto Denko Europe Technical Centre” (NET) will support the R&D centres that the company already operates in Japan, the US and Singapore and specialise in materials based on the life sciences. This first major Asian presence confirms Innovation Square’s international attractiveness.

**Eawag**  
**Monte Rosa hut: Clean water again**

The Monte Rosa hut in the Valais Alps has been popular with tourists since it opened in 2009. However, the numerous visitors also affect the performance of the small sewage treatment plant in the remote hut belonging to the Swiss Alpine Club (SAC). The decentralised waste water purification plant was significantly overloaded with the almost 120 visitors it received daily in the summer of 2010. The washing-up water, much of it derived from the waste water, was malodorous and strongly discoloured. Working with the hut staff, Eawag researchers succeeded in devising a sustainable solution. They expanded the plant’s cleaning capacity by converting an existing intermediate storage tank. An ozonation stage was also incorporated to remove the smell and discolouration from the washing-up water. The sewage treatment plant’s energy consumption was also optimised. The project was concluded in spring 2012. The result is impressive: an enhanced and stable sewage treatment plant cleaning performance and somewhat lower energy consumption than before.

**WSL**  
**Ice cream in the computer tomograph**

**Objective 3 | Knowledge and technology transfer**

The Monte Rosa hut in the Valais Alps has been popular with tourists since it opened in 2009. However, the numerous visitors also affect the performance of the small sewage treatment plant in the remote hut belonging to the Swiss Alpine Club (SAC). The decentralised waste water purification plant was significantly overloaded with the almost 120 visitors it received daily in the summer of 2010. The washing-up water, much of it derived from the waste water, was malodorous and strongly discoloured. Working with the hut staff, Eawag researchers succeeded in devising a sustainable solution. They expanded the plant’s cleaning capacity by converting an existing intermediate storage tank. An ozonation stage was also incorporated to remove the smell and discolouration from the washing-up water. The sewage treatment plant’s energy consumption was also optimised. The project was concluded in spring 2012. The result is impressive: an enhanced and stable sewage treatment plant cleaning performance and somewhat lower energy consumption than before.

**EPFL**  
**A Japanese group is setting up at Innovation Square**

On 19 July, Nitto Denko Corporation, one of Japan’s leading materials manufacturers, announced the establishment of a research and development unit at EPFL’s Innovation Square. The “Nitto Denko Europe Technical Centre” (NET) will support the R&D centres that the company already operates in Japan, the US and Singapore and specialise in materials based on the life sciences. This first major Asian presence confirms Innovation Square’s international attractiveness.

**WSL**  
**Ice cream in the computer tomograph**

The air bubbles (brown) in ice cream are made visible after storage with computer tomography (picture: SLF/B. Pinzer).
Objective 3 – Knowledge and technology transfer

Joint effort between science and industry

MDC Max Daetwyler AG in Bleienbach, Canton of Berne, supplies key components for SwissFEL: Hans Braun, co-project manager for SwissFEL at PSI, Thomas Schmidt, head of undulator development for SwissFEL at PSI and René Hartmann, head of special projects at MDC Max Daetwyler AG (from left to right).
In the guise of the Free-Electron Laser SwissFEL, an entirely new type of large facility is taking shape at PSI to investigate the dynamic chemical or biochemical processes that occur at atomic level. The construction of this highly complex X-ray laser is based on partnerships with Swiss industrial companies. It is a technology transfer that benefits research and private industry alike.

The Free-Electron X-Ray Laser SwissFEL is being developed out in the forest near Würenlingen and a stone’s throw from PSI. An approximately 700-metre-long tunnel will accommodate the high-tech acceleration facility when it enters scheduled operation in 2016. The project is at the cutting edge of physics: electrons are first liberated from a metal in an injector by a laser flash and accelerated to a high speed as compact electron bundles. These are then passed through a wave-like magnetic field as if on a roller-coaster, causing X-ray light to be created. At the end of this journey, the facility produces extremely short and enormously intensive X-ray light pulses of up to one hundred times per second. “This permits the detection of dynamic chemical or biochemical processes that occur so quickly that they would remain invisible if conventional analytical methods were used,” says Hans Braun, accelerator project manager at SwissFEL.

Technical challenges awaiting resolution are mainly evident at two critical points within the facility: on the one hand with the acceleration modules which enable electrons to be accelerated to the required speeds for generating ultra-short and intensive light pulses. “We need a powerful particle accelerator at the front-end of the facility that will impart a high kinetic energy to the electrons,” says physicist Hans Braun. The second technical crunch point concerns the so-called downstream undulators. “In these devices, two rows of strong magnets force a stream of electrons passing by at high speed onto a sinusoidal trajectory which results in them generating X-ray light in laser quality,” explains Hans Braun. Both require high precision components and in both cases PSI has found specialised manufacturers. Two Swiss industrial companies were involved.

**Industrial partners from Swiss industry**

“What drives the cost of an X-ray laser is clearly the linear accelerator,” says Hans Braun. An exacerbating factor in the case of SwissFEL is that an acceleration facility spanning several kilometres as is the case with comparable projects abroad is out of the question in Switzerland due to the costs. To generate X-ray light of sufficiently short wavelength despite a significantly shorter acceleration distance, all the components from the injector to the undulator must be optimally attuned to one another. Especially in the latter case, the magnets have to be positioned with a tolerance of one thousandth of a millimetre. “On top of this, it is also not possible to correct their position once a cavity has been assembled,” says Hans Braun. TEL Mechatronics is now setting up a bespoke production line for this order at the parent company, where the copper cups will be joined together after machining in a special soldering furnace and then assembled into the finished acceleration modules.

MDC Max Daetwyler AG in Bleienbach, Canton of Berne, is involved at the back end of the X-ray laser as the manufacturer of an initial consignment of one dozen undulators. The company is specialised in precision machinery for gravure printing for the packaging and publication industry. This order too is about precision. Magnets have to be positioned with a tolerance of less than one thousandth of a millimetre over the sinusoidal path with a total distance of 60 metres. Immense forces are at play between the magnets. The structure therefore needs to be held together with great force and the components precisely calibrated at the same time. Following the signing of the contract at the end of 2011, TEL Mechatronics will use it for series production. Simply manufacturing the cavities is in itself a complex process: they are copper voids in which an electronic field can develop that corresponds precisely to the accelerated force. 104 such cavities are required, each of which comprises 113 differently shaped discs, so-called “copper cups”. A complicating factor is that because of the greatly reduced length of the linear accelerator, the material loading of the individual components is high and the individual cups need to be lathed to a tolerance of one thousandth of a millimetre. “What was crucial was the body of experience in metalworking, soldering and clean room technology,” says Hans Braun, “These are the competences required to produce the high-precision cavities in the approximately 300-metre-long accelerator.” PSI developed the process for manufacturing these cavities and under the terms of a master agreement signed at the beginning of 2012, TEL Mechatronics will use it for series production. Simply manufacturing the cavities is in itself a complex process: they are copper voids in which an electronic field can develop that corresponds precisely to the accelerated force. 104 such cavities are required, each of which comprises 113 differently shaped discs, so-called “copper cups”. A complicating factor is that because of the greatly reduced length of the linear accelerator, the material loading of the individual components is high and the individual cups need to be lathed to a tolerance of one thousandth of a millimetre. “On top of this, it is also not possible to correct their position once a cavity has been assembled,” says Hans Braun. TEL Mechatronics is now setting up a bespoke production line for this order at the parent company, where the copper cups will be joined together after machining in a special soldering furnace and then assembled into the finished acceleration modules.

For both the Swiss companies involved, this order consolidates their expertise as manufacturers of highly complex components and their positioning as partners that are internationally sought after by research institutes. For PSI, the components they manufacture are critical building blocks in a major new kind of facility with which researchers will one day scientifically analyse extremely fast processes such as the creation of molecules in chemical reactions, the detailed structure of vital proteins or the precise structure of materials.
Objective 3 – Knowledge and technology transfer

Tomorrow’s nursing bed is intelligent

Mobility Monitor for bedridden patients: Michael Sauter, founder and CEO of Empa/ETH Zurich spin-off compliant concept.
Mrs M. is eighty-one years of age, bedridden and particularly suffers at night when she really wants to sleep. The reason for this is that she constantly needs to be moved. By moving her, the nursing staff promote her blood circulation. Unfortunately, this means that Mrs M’s nighttime rest is constantly being disturbed. This also creates work for the nursing staff. It is not a nice situation for either party. So what is the answer?

A technical device has recently been promising relief – the so-called Mobility Monitor. A sensor under Mrs M’s bed measures the slightest movement and evaluates it. Surprisingly, it transpires that her movement while asleep is usually adequate, namely between two and four times each hour. Occasionally, however, the sensor records no movement over an extended period. This is alarming because if body positions are stressed for too long by being prone, the microcirculation there is disrupted. A painful pressure sore can result – referred to technically as “decubitis”. This is to be avoided at all costs. The staff discuss the evaluation with Mrs M, who now consents to being moved into a new position occasionally but only if she is not moving sufficiently of her own accord and the Mobility Monitor summons the staff. Since then her sleep has been less disrupted. The associated conflicts are avoided and the nursing staff’s workload is lightened.

A spin-off of Empa and ETH Zurich

The Mobility Monitor is the first product of a company called compliant concept founded by young entrepreneur Michael Sauter that is a spin-off of Empa and ETH Zurich and still in its infancy. Stories such as these please Sauter, now the company’s CEO. “We have always learned the most from real life situations,” he says. During his degree course at the Institute of Mechanical Systems at ETH Zurich, the young mechanical engineer would never have dreamt of being involved with care issues. In the “Compliant Systems” sub field, he applied himself to especially strong ice hockey sticks and car seats capable of adapting to the individual and driving situation. And suddenly, as Sauter recalls, it struck him that “this should also be possible with beds...” The idea did not leave him alone, even after he began to work at Empa after finishing his doctoral thesis in 2009.

It might have remained just an idea if Sauter had not taken part in the “Venture Challenge” course supported by the Commission for Technology and Innovation (CTI) in which university graduates learn how to develop business ideas from innovative technologies. There it dawned on him that an “intelligent” adaptive bed would be enormously helpful to bedridden people and healthcare staff. A new kind of jointless slatted frame made of intelligent materials and integrated sensors and a modified mattress imitate the movements of a healthy individual, gently and continuously changing his or her position and thereby preventing the dreaded decubitus ulcers.

This was technically feasible, but required specialists to clarify the medical background and market situation. Sauter systematically familiarised himself with the decubitus problem and even successfully completed a work placement at a healthcare facility. There he experienced just how great the workload is for the individual carers and the pressure put on all to make savings. “I was now certain,” says Sauter, “that intelligent solutions were called for. Their purpose would be to relieve pressure on staff while ensuring that patients received the very best care.”

In May 2009 Sauter founded his own company. The Empa and ETH Zurich spin-off established itself on the Empa campus in Dübendorf in the glaTec technology centre. “In Switzerland the conditions are optimal; the support is excellent,” says Sauter. “But it’s also important to make use of what’s on offer,” he continues. He therefore sought advice from glaTec and CTI experts on matters relating to contracts, the business model, marketing and finance. glaTec Managing Director Mario Jenni vouches for Sauter’s sound instincts for what the market wants.

Positive feedback from initial customers

Over the years Sauter forged collaborative relationships with numerous partners and was able to conduct the first practical tests of the new solutions at the Swiss Paraplegic Centre Nottwil and the Bürgerspital St. Gallen care home and residence for the elderly. The young company’s progress did not go unnoticed. Sauter and his team walked off with several young entrepreneur prizes, receiving the “CTI Medtech Award 2010” for example, and were honoured with the “Venture Idea 2010”.

The many meetings with people from the nursing sector and feedback from numerous tests in nursing homes and infirmaries prompted Sauter to launch the Mobility Monitor system in July 2012. He was convinced that the use of this device alone, which can be affixed to any bed, made sense. Care professionals told him they used the monitor to record sleeping behaviour or to check that the correct dose of medication was being administered.

“The feedback from the many initial customers is extremely positive and completely overwhelmed us,” says Sauter. In the first quarter after sales began, his company, which now employs ten people, had already achieved over 50 per cent more revenue than that envisaged by the business plan. Some customers had already purchased additional units and a well-known Swiss nursing home group was equipping its homes for the elderly with the Mobility Monitor. Demand from abroad was also increasing. Next year, the Mobility Monitor will be on sale in Germany; a distributor has already been found. And the contract with a Scandinavian bed manufacturer that will in future be selling the active bed has already been signed. The launch is scheduled for the end of 2013. Nothing further now stands in the way of tomorrow’s intelligent bed.
Objective 4
International networking

Facts and figures

Objective 4, performance mandate 2008–2011/12 (see enclosure): “The
ETH Domain will commit itself to
bilateral international cooperation.”

2012 reports from the institutions
with examples and the ETH Board’s
perspective.

ETH Zurich
On behalf of the State Secretariat for Education and Research
(SER), ETH Zurich coordinates the bilateral research cooperation
programmes with China, Japan and South Korea. In addition to
the ongoing programmes with these countries, ETH Zurich
organised, among others, two stepping stone symposia as part
of the cooperation programme with China in 2012, one on can-
cer and neurodegenerative diseases and one on medical tech-
nology. The first symposium was attended by around 70 Chi-
nese and 100 Swiss participants, while the medical technology
symposium attracted 13 Chinese and around 65 Swiss partici-
pants. To intensify cooperation with Japan, ETH Zurich,
together with Empa and the Swiss National Science Founda-
tion, organised the ETH–Japan Symposium for Academic
Exchange which was attended by 10 Japanese universities.

The two Federal Institutes of Technology organised the ETH–
EPFL Joint Symposium on Biomedical Engineering in Seoul in
April 2012 to strengthen their ties with Seoul National University
and the Korea Advanced Institute of Science and Technology
(KAIST). On behalf of the SER, ETH Zurich is also a partner in the
EU’s CONCERT–Japan project which aims to promote multilateral
cooperation between Europe and Japan. In 2012, a first joint call
was made for projects on efficient energy storage and distribu-
tion and resilience against disaster.

EPFL
EPFL coordinates all the SER’s bilateral research programmes for
Switzerland with India, Brazil and Chile as the leading house
and is also involved in the Russian programme as co-leading
house. As part of this collaboration, 12 Brazilian–Swiss research
projects, 11 further new research projects and 10 exchange pro-
grames were launched in 2012. Together with India, EPFL
helped to design the new Indian–Swiss cooperation pro-
grame 2013–2016 with renewable energies and biomedicine
as its focal points. Pilot projects were also launched in Mexico
and Colombia.

In 2012, scientific cooperation with emerging and develop-
ing countries was shaped by the Second International Confer-
ence of the UNESCO Chair on Technologies for Development
organised by EPFL on the theme of Technologies, a way to
reduce poverty. In October 2012, the Head of the Federal
Department of Foreign Affairs and EPFL jointly presented the
Massive Open Online Courses (MOOCs) project for Africa and
emerging countries at the Francophone Summit in Kinshasa.
This project will expand on the work done by the Réseau d’ex-
cellence des sciences de l’ingénieur de la Francophonie
(RESCIF), which was established in 2010.
**psi**

With its wealth of experience, PSI is a popular partner for the development of international large-scale research facilities. PSI is involved in the development of the European X-ray laser EUIxFEL which is currently being built in Hamburg and the European Spallation Source (ESS) which is to be constructed in Lund, Sweden. Working on these projects, PSI can apply know-how and technologies that were primarily created to solve problems that cropped up while developing its own accelerator facilities, beamlines and measurement methods. In the reporting year, PSI successfully promoted the organisation of two large international conferences. Both the Free Electron Laser Conference FEL 2014 and the Conference of the International Union of Crystallography in 2014 are expected to attract more than 500 participants from all over the world. With its large-scale research facilities, PSI, in addition to almost 2,000 foreign users, each year attracts around 60 post-doctoral students from abroad whose research residence at PSI normally lasts two years. As around 50% of these post-doctoral students return to their home countries (of which 85% to the scientific sector and 15% to private industry), they make a significant contribution to the expansion of the international network of PSI and of Switzerland as a centre of research.

**WSL**

In the field of natural hazards, WSL offers various services such as expert opinions and advisory support, e.g. with regard to avalanches. Its software programs, such as Snowpack (a simulation of how snow cover will develop), AVAL-1D (a numerical avalanche dynamics program) and RAMMS (a modelling system for natural hazards) are also very popular in Switzerland and abroad. The need for expert skills is great and allows WSL to make an important international contribution to the protection of lives and property. Its customers include government authorities as well as the private sector. Its international experience enables WSL to define new, globally important research topics. WSL’s software products have found ready acceptance and are used around the world in North and South America, Europe and Asia to solve practical problems related to protection against natural hazards. The software products are often presented to engineers, security officers and land planners at capacity building workshops and training seminars where current real-life problems are analysed and discussed.

**Empa**

A bibliometric analysis carried out by Leiden University in the Netherlands shows that the number of publications with foreign partners has increased substantially. An audit of ongoing EU projects in Switzerland carried out last year by the SER highlights Empa's international integration; in Switzerland, only EPFL in Lausanne is involved in more EU projects than Empa. The Winsmart project for the development of intelligent windows for the buildings of tomorrow, which is supported with around 4m EUR, was launched by Empa researchers. In the photovoltaics sector, Empa is involved in several EU projects: the 10m EUR SCALENANO project, the 7m EUR R2R-CIGS project for the development of cost-effective, efficient solar cells, and the 14m EUR TREASORES project which researches organic electronics and is managed by the Empa researcher Frank Nüesch. In nano safety research Empa plays a special role in the collaboration between the EU and US that harks back to the long-standing cooperation with the National Institute of Standards and Technology (NIST). Under the authority of the US government, NIST has since 2012 been the leading house for cooperation with the EU, for which Empa is one of its most important partners.

**Eawag**

The researchers at Eawag are active in more than 100 international committees and networks. Around one third of its external funding comes from international projects. Eawag was also involved in the enlargement contribution for the new EU member states (cohesion) with a total of eight projects (1.6m CHF). It successfully participates in EU projects that help to strengthen cooperation. These in particular include projects of the European Cooperation in Science and Technology - COST and the Marie Curie Fellowships. In the field of social sciences, Eawag entered into a strategic alliance with Vrije Universiteit Amsterdam (VU).

It also has particularly strong cooperation ties with South Africa, where an Eawag team is researching new sanitary systems for the recovery of nutrients from waste water. The team received the 2012 Engineering Award of the University of KwaZulu–Natal in Durban for this project.

In 2012 Eawag was also appointed a World Health Organization WHO collaborating centre for supporting the WHO with its expertise. The maps of the levels of arsenic and fluoride in groundwater throughout the world prepared by Eawag researchers as part of the Water Resource Quality (WRQ) project were included in a joint report of the WHO and the children’s charity UNICEF called “Drinking water equity, safety and sustainability”.

www.eawag.ch/vuna

www.wrq.eawag.ch

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**The ETH Board’s perspective**

The institutions of the ETH Domain are strongly networked internationally through institutionalised contacts with similar teaching and research institutes, through joint projects and through bilateral cooperation between researchers. This network is also important when an institution serves as leading house under the authority of the SER. Numerous requests from abroad for cooperation with one or more institutions of the ETH Domain also confirm their reputation, with very different types of cooperation in a wide range of disciplines conceivable here.
Swiss experience for China

Swiss researchers analyse the concentration of pollutants in Chinese rivers: Michael Berg, Eawag expert for water resources.
In the Middle Kingdom, the vibrant BRICS country, the breakneck economic and population growth is not just having positive consequences. There are also concentrations of pollutants in the rivers and algal blooms in the lakes. In a joint project with Chinese colleagues, Eawag researchers have now for the first time established concrete measurements of the scale of the problem. This is not only conducive to knowledge transfer but also serves as the basis for a technological upgrade of the sort that also took place in Switzerland in the 1970s.

Bilious green was the colour of the photo adorning the cover of the American technical journal Environmental Science & Technology as it rolled off the press in mid-May 2012. It portrayed the wildly proliferating algal blooms, the result of a massive over-fertilisation in China’s Shahe reservoir upstream of the metropolis of Beijing with its millions of inhabitants. Below it was the headline: “Aquatic hypertrophication”, which – loosely translated – essentially means “over-fertilisation in the water”. The fact that this topic appears on the front page of what is probably the most important publication in the world for environmental sciences gives it a high profile within the relevant academic research community. What is also remarkable is that the research results presented in the specialist journal are a Sino-Swiss co-production. The parties involved are scientists from the Research Center for Eco-Environmental Sciences in Beijing, an institute of the Chinese Academy of Sciences, and the aquatic research institute Eawag. It was the first time that there was to be an overall evaluation of the nutrient flows in the Haihe river system in north-eastern China between the Shahe Reservoir and the Gulf of Bohai. In this settlement area with the highest economic and population growth in the Chinese People’s Republic there are to be found not just urban centres such as Beijing with its 20 million inhabitants and Tianjin with five million, but also areas under intense agricultural cultivation in which one third of China’s annual production of wheat and one fifth of its maize are grown and which are home to a further eight million people.

New territory for Chinese researchers
With funding from the bilateral Sino-Swiss programme of the State Secretariat for Education and Research and Innovation, the composite research team set to work. Michael Berg, Eawag expert for water resources and drinking water, on the envisaged objective of this international collaborative venture: “The investigations should provide a sound scientific basis that will enable the region’s authorities to develop sensible and effective measures to reduce the nutrient problem.” The project, scheduled to run for two years, was a productive research project for both sides. Much of it was new to the Chinese scientists such as seeing how important it is to include the current river water flows and how the nutrient load of nitrogen or phosphorus can be accurately calculated over the length of a watercourse. For the experts involved on the Eawag side, this meant not just a practically-based transfer of knowledge and scientific insights capable of being applied to other fast-growing metropolises in developing countries but also the publication of the relevant research results in internationally reputed specialist journals in order to make them accessible to a wider scientific audience.

“To gain an initial overview of the occurrence and frequency of the nutrients, we began by studying water samples from sixteen sections along a 240 kilometre stretch of river during both the dry and rainy seasons,” recalls Michael Berg. “Based on these initial analyses, we selected five permanent measurement stations for more accurate investigations where we took monthly samples over the course of a year.” Also included in the investigation were four tributaries via which the Chinese capital’s waste water is fed into the river system, along with the waste water of the five most important local sewage treatment plants. The measurement results astonished the scientists. In the Shahe Reservoir upstream of Beijing, a public local recreation area covering 1.8 square kilometres, the researchers discovered concentrations of nitrogen and dissolved inorganic phosphorus that exceeded the levels measured in Switzerland during the highest concentrations of pollutants in the 1970s and 1980s by as much as ten times. Downstream, however, as the measurements went on to show, the nutrient loads steadily declined, although these areas are heavily urbanised and farmed. What is the explanation, the researchers wondered, for the nutrient load in the local recreation area being higher than in the city and intensively farmed areas? Environmental chemist Michael Berg explains why: “In the Shahe local recreation area, the river and lake water is so polluted that the green algae proliferate and even the waste water that is fed in causes a dilution of the concentration of pollutants.”

Sewage treatment plants not sufficient
However, the pollution in the Haihe river system remains as high as ever and further measurement data have revealed that the cleaning capacity of the existing sewage treatment plants is far from adequate. “The most effective way of countering the region’s drastic eutrophication is to build additional, modern waste water cleaning plants with sufficiently large capacity to be able to remove the nitrogen efficiently as well,” says Michael Berg. This is how the problem was tackled in Switzerland and Europe in the 1980s.

The results of the Sino-Swiss joint study were then presented to the affected parties and discussed at workshops in Beijing. The upshot is that by way of trial, Beijing has made improvements to five sewage treatment plants to make them more efficient. In a second step, they are then to be fully upgraded. Such decisive action is also advisable for another reason revealed by the investigation: most of the water in the river system is diverted into an extensive network of irrigation canals from which it is pumped by farmers to irrigate their fields. However, the water is so polluted that according to the national quality standards in force, no further use should be made of it whatsoever.

Annual Report 2012 on the ETH Domain

Objective 4  I  International networking  67
Examples of the institutions

ETH Zurich
Joint doctorate programme

It is yet another step in consolidating the partnership: the five technical universities of the IDEA League, of which ETH Zurich is also a member, are conducting a joint doctorate programme for the first time. In four modules over two years, 25 students from various fields of study will address the topic of “Ageing and Sustainability”. The doctoral students discovered on site in Japan how this country deals with its advanced age structure. Two coaches and several professors from ETH Zurich are supporting the programme.

EPFL
EPFL and the Max Planck Society open joint laboratory

The Max Planck Society possesses eleven international research centres, notably at Stanford and the Weizmann Institute. It chose EPFL to open its centre dedicated to nanosciences. The partnership comprises the establishment of a joint laboratory in Lausanne, running joint summer schools and conferences, project finance and theses co-directed by the two institutions. This partnership underlines the international recognition that EPFL has acquired in the nanosciences arena.

PSI
EU co-financing for young researchers

As part of the EU’s Marie Curie Initiative, PSI is for the first time taking part in the “COFUND” programme. Postdoctoral students can undertake two years of research at PSI as a “PSI FELLOW” and are supported by a mentor in the process. The EU pays 40 per cent of the salary and material resources for a total of 60 places. The participants can also attend training courses, including a career start workshop, external funding, support with applying for EU research programmes and company start–up courses. Thirty–one fellows were selected from among the initial applicants and will take up their posts at the beginning of 2013. Twenty-six per cent of them are women. The status of “PSI FELLOW” is to become a trademark for a research position offering excellent working conditions and to provide PSI with a further boost when competing for the best researchers. At Empa, which like ETH Zurich has been involved in the programme for some time, the first 22 “EMPA POSTDOCS” started at the beginning of 2012; Empa will be advertising 22 more “COFUND” positions in January 2013.

WSL
Cryosphere and climate

Cryosphere is the name given to that part of the earth’s surface which is covered with ice – sea ice, ice sheets, glaciers, snow, permafrost. It stands to reason that the climate influences the cryosphere, for example through temperature. Conversely, however, the cryosphere also influences the climate, primarily because it exhibits a high reflective capacity (Albedo). CliC – Climate and Cryosphere is a central pillar of the World Climate Research Programme and promotes and coordinates research into this interdependence and its effects. To this end, it brings together researchers from around the world, organises conferences, publishes reports and provides authorities and politicians with information. For example, scientists from the CliC environment drafted the cryosphere chapter in the last IPCC report.

As of this year, the ETH Domain has been prominently involved in CliC: WSL Director Konrad Steffen heads the scientific steering group made up of world–famous researchers.
Eawag

First Euroecotox conference at Eawag

Animal experiments with fish are on the chemical industry’s agenda. But in research as well, animal experiments are increasingly being used for testing substances. For some time now, Eawag environmental toxicologists have been developing alternative tests that yield comparable results and require even less space. The first European conference on the replacement, reduction and improvement of animal testing in ecotoxicological research (Euroecotox) now took place in June 2012 at Eawag. The conference served as a forum for young scientists and experts from science, industry and government agencies who are involved with animal testing in environmental risk analysis. The aim of these specialists is to reduce animal testing in environmental research. Around 70 experts from all over Europe responded to the Organising Committee’s invitation. The conference put a spotlight on the current state of affairs and future developments and provided a networking opportunity for experts in this field.

www.euroecotox.eu

Empa

No future technologies without resources

Not only iPads, mobile phones and LED screens contain rare metals such as gallium, indium or tantalum; solar cells and batteries do as well. Empa researchers have joined forces with the Fraunhofer Institute in Hanau, the University of Augsburg and the TU Berlin to investigate how to substitute rare metals and reclaim them from products. Under the direction of the UN University, they are developing bespoke recycling strategies, for example in Ghana, South Africa and Colombia, to combat the growing mountain of electronic waste in developing countries.

Recycling: Worker in Delhi, India, prepares printed circuit boards for copper etching solution (picture: Empa).
Objective 5  
Working conditions, equal opportunities and the promotion of young talent

Facts and figures

Objective 5, performance mandate 2008–2011/12 (see enclosure): “The ETH Domain will create attractive and family-friendly working conditions, promote equality of opportunity and develop young scientific talent.”

2012 reports from the institutions with examples and the ETH Board’s perspective.

ETH Zurich

In recent years, the proportion of women professors has increased constantly and amounted to 12.6% in 2012 (2007: 9.0%), while the proportion of women assistant professors was 30% (2007: 16.6%). In 2012, 35 full professors were appointed, seven of whom were women (20%). This reflects the effectiveness of the measures implemented for years by ETH Zurich and intensified once again in 2012 to improve equality of opportunities in the nomination process.

While the proportion of women assistants increased slightly since 2007 (2012: 30.5%), both the share of women among the permanently employed scientific personnel (2007: 7.8%, 2012: 14.2%) and the share of women in non-scientific managerial positions (2007: 22%, 2012: 30.0%) increased substantially.

In personnel management, the promotion of health took centre stage in 2012. Among other things, this took the form of events and workshops on topics such as burnout prevention and movement and back pain as well as individual advisory sessions for persons under stress.

ETH Zurich is currently training two interns together with the Information for Autism Foundation. In cooperation with the Psychiatric University Hospital Zurich, ETH Zurich enabled a young female psychiatric patient to enter professional life with an internship in 2012.

As one of the largest training centres for young professionals in the Canton of Zurich, ETH Zurich trained 166 apprentices in 13 different professions in 2012. The number of apprentices at ETH Zurich has increased by almost 25% since 2007.

EPFL

In 2012, EPFL carried out a satisfaction survey among its staff. Both women and men ranked their general satisfaction with their professional situation at 4.7 out of 6, while women were slightly more satisfied with the compatibility of career and family life than men (5.1 and 4.9 respectively). Women (4.7) were also slightly happier with their working hours, whether working part-time, in jobsharing or as teleworkers, than men (4.5). Women, however, gave lower marks (4.1) for equal opportunities in terms of promotion and establishing a career than men (4.8). Although the result is satisfactory, there is still much scope for improvement. General satisfaction has improved from 4.1 in 2004 when the last survey was carried out.

More than 7,500 young people (mostly girls) made use of the activities offered in the MINT sector. An event to encourage female students and scientists to continue their careers was organised at least once a month. New sessions of the mentoring programmes were started in collaboration with the universities in French-speaking Switzerland and Ticino.
**PSI**

PSI is continuing its successful Resuming a Career at the Paul Scherrer Institute programme with which it helps female scientists who have temporarily left professional life to return to the workforce. In 2012, HR Management engaged in close dialogue with the staff council on the continued development of diversity management at PSI. This term is consciously interpreted in its broader sense to include equality of opportunities in order to take account of the increasing heterogeneity of workers in the research environment.

The promotion of young talent in the MINT disciplines remains one of the central tasks of PSI. Since its opening in 2008, more than 11,000 young people have visited Lab, the School Lab that provides learners with a key experience that could be critical to their choice of a profession or course of studies. PSI also supports young talent in the MINT disciplines with joint projects with the Swiss science foundation “Schweizer Jugend forscht” and sponsors this foundation together with the other research institutes of the ETH Domain. PSI is involved in NaTech Education in order to improve the status of the MINT subjects in the educational concepts of Switzerland.

The second holiday research camp was attended by 36 children of PSI employees, and the Future Day was once again attended by more than 100 teenagers.

**WSL**

What must I do to achieve success in my career as a researcher? WSL started a career planning project in 2012 in order to identify the need for support in this area and find initial answers to some key questions. Prior to this, answers provided by internal WSL doctoral students underlined the importance of this topic, and the internal Workplace Diversity advisory office confirmed that enquiries and coaching events on career opportunities in research and industry had increased in 2012. Young researchers in particular are increasingly concerned about the opportunities for ensuring a satisfying personal and professional life.

In addition to the well-established Fix the leaky pipeline! project to promote women in the ETH Domain, WSL is also involved in the international Gender and sustainability project of the Leuphana University. Researchers participating in this project obtain new personal insights and gain specialist and methodical know-how as well as social skills. The feedback from the participants is very positive.

**Empa**

With the appointment of Brigitte Buchmann as a new member of the Directorate, Empa is now also represented on this body by a woman. Empa devotes much effort towards increasing the proportion of women at all hierarchical levels and women already make up 36 % of its scientific staff. The relaunch of the “Women meet Women” business lunches also strengthened the network of women at Empa and Eawag in 2012. In addition, Empa is involved in Fix the leaky pipeline!, the joint career promotion programme for young female scientists of the ETH Domain. Together with Eawag, Empa for the first time organised a career planning workshop for its post-doctoral students in 2012. To promote young talent, Empa organised a summer camp for primary school children, a Swiss National Future Day for children in grades 5 to 7, and a Swiss Young Physicists’ Tournament for cantonal school students. Empa also supports various activities of the Swiss Academy of Engineering Sciences (SATW) such as TecDays/TecNights at the cantonal schools and More women in MINT – more value for science and industry.

**Eawag**

With the support of the Director, the Equal Opportunities Commission (EOC) in 2012 adopted new focal points for the promotion of women as young scientific talent and for measures to improve the work–life balance. The proportion of women in managerial positions at Eawag remains relatively high (25 %). To make sure that women are considered fairly for vacant positions, binding rules have been adopted for all selection boards. Compliance with these rules is monitored consistently and active intervention in the recruitment process takes place whenever necessary. A joint coaching programme with Empa has also been set up to help young female scientists with their career planning (see p. 75). To improve the informal exchange of experiences among women, the regular business lunches for women employees at Eawag and Empa were reinstated in 2012 following a break of several years. The EOC also adopted measures to provide employees with better information on the options for effectively combining career and family life. Eawag provides financial support for childcare to low-income parents and runs a crèche together with Empa. It is also involved in the integration of sick or disabled employees into the workforce.

**The ETH Board’s perspective**

The ETH Domain has good working conditions as shown by internal surveys. However, staff associations complained that compared with the Federal Government there is a shortfall in salary development. The ETH Board reduced this at the end of the year despite the strained financial situation. There is a wide range of instruments for the promotion and achievement of equal opportunities between men and women. For instance, all institutions of the ETH Domain participated in the joint career promotion programme for young female scientists Fix the leaky pipeline! that is being continued with additional funding in the 2013–2016 planning period. Nevertheless, the quantitative targets for women in senior and middle management positions in the ETH Domain have not yet been reached. The ETH Board is stepping up its efforts by increasing the institutions’ funds for individual advisory and coaching sessions. Many well attended events were directed at children and young people with an interest in science and the promotion of up-and-coming MINT talent.
Consensus reigns in the ETH Domain that there must be equal career and salary opportunities for both sexes in the academic world and that the up-and-coming generation of talented researchers must be promoted. This is the only way of attracting the best international brains to ETH Zurich, the EPFL and the research institutes. Every institution sets great store on this objective and pursues it vigorously. The offering is diverse, as a brief review illustrates.

Career bottlenecks after completing doctorates: The Children’s Pavilion, the child daycare centre of Eawag and Empa, is also a great help to postdoc scientist Alexandra Kroll.
The ETH Domain will create attractive and family-friendly working conditions, promote equality of opportunity and develop young scientific talent. This is the key sentence in the performance mandate for Objective 5 “Equal Opportunity and Promoting New Talent”. What, however, is the situation in everyday practice? A selection of examples offers a small insight.

The first stop for gaining an insight into the promotion of young talent is with Sonja Negovetic, Deputy Head of the Research Coordination Unit at ETH Zurich. “In promoting the next generation, we support people and projects at all stages of their academic career, from master’s degree to doctorate, postdoc or assistant professorship,” she explains. For example, students wishing to complete their master’s degree at ETH Zurich can apply for the “Excellence Scholarship & Opportunity Programme (ESOP)”. This scholarship system is open to internal and external applicants alike, regardless of nationality. The grants are financed by external funds. By the end of 2012, a total of 143 students had enrolled in an ESOP Programme, 51 of them women. Sixty of them, a total of 62 per cent, previously acquired their bachelor’s degree at ETH Zurich.

Complementing both Swiss National Fund (SNF) and EU programmes, researchers at ETH Zurich can submit projects under the competitive “ETH Research Grants” programme that serves to support doctoral students. The focus here is on innovative or unconventional research projects, primarily in basic research, that have the potential to yield exciting results and for which it would be difficult to obtain funding from external support schemes. The ETH Postdoctoral Fellowship Programme is targeted at young researchers with excellent international references from outside ETH Zurich. “This way ETH Zurich distinguishes itself as an attractive research location for excellent scientists from around the world,” says Sonja Negovetic. The programme is co-financed by the EU (COFUND). Pioneer Fellowships have been created at the interface between science, research and industry, their purpose being to develop promising results from a research activity into an innovative product or service. This Pioneer Fellowship Programme is open to master’s degree and doctoral students and is financed by third-party funding.

Special support: the Branco Weiss Fellowship

The “Society in Science – The Branco Weiss Fellowship” is a special kind of talent promotion programme founded by entrepreneur and philanthropist Branco Weiss at ETH Zurich to promote postdoc scientists irrespective of their background, future place of work and expertise. In 2012 ETH Zurich was able to announce that it would be receiving a further 100 million CHF for this talent promotion programme from the estate of Branco Weiss, thereby securing the programme’s existence for years to come. In 2012, eight new fellows were selected from around 450 applicants. Young researchers choosing to pursue a scientific career can apply for assistant professorships. As part of its professorship planning, ETH Zurich fills some of its vacancies with assistant professors, normally with tenure track. Furthermore, young researchers can apply for sponsored professorships from the SNSF or for an ERC Starting Grant.

From Zurich we now turn to Lausanne where at EPFL Equal Opportunity Officer Farnaz Moser-Boroumand shows us several measures for promoting equality of opportunity across all age groups. For girls aged seven to 15 there are courses such as “Internet for girls” or “Robots are for girls” as well as science weeks especially for girls. This provides them with an initial insight into the fascinating world of engineering sciences. The university bus “Les sciences, ça m’intéresse!” has been doing the rounds in French-speaking Switzerland since 2009, raising scientific awareness among young people and girls in particular. The activities were expanded in 2012 and are now also available to pupils at lower secondary school level. Each year, over 4,000 girls benefit from the programme of the EPFL’s Equal Opportunities Office that aims to make the MINT subjects attractive for young people. “To ensure that the students and scientists have the necessary tools to make the right decision at the right time and make use of all opportunities for a successful academic career, a wide range of offers has been drawn up that includes several mentoring and coaching programmes,” explains Farnaz Moser-Boroumand.

Women "vanish" during their career

A glance at the figures confirms the need for these efforts to promote the next generation of women. The proportion of women students, doctoral candidates and postdocs at EPFL fluctuates at around 27 per cent and at professor level is just 12 per cent. The measures taken include the ongoing development of childcare infrastructure in order to enhance the compatibility of family life and a career. New places are regularly created at the two day nurseries on the campus. There has also been a structure with a kindergarten and additional supervision outside school hours for almost 10 years. Flexible working hours at EPFL are very popular. According to a recent poll, 78 per cent of interviewees are "satisfied" with the provision in this area and 39 per cent "very satisfied".

The next stop is with Ines Günther-Leopold. The graduate Doctor of Chemistry is group leader in the nuclear energy and safety research field and spokeswoman for the Equal Opportunity Committee at the Paul Scherrer Institute (PSI). The discussion initially centres on the observation that promoting the next generation essentially cannot begin early enough and that this is often closely bound up with equality of opportunity. The fact that although the proportion of girls among sixth form...
leavers is significantly higher than it was a few years ago this is not reflected among students of technical and scientific disciplines and that despite numerous measures the PSI consistently fails to achieve its set objectives in terms of the proportion of women in management positions points to two things for Ines Günther-Leopold: “Awareness of the so-called MINT subjects of mathematics, information technology, natural sciences and technology needs to be raised at an early stage. We are still losing too many women on the way up.” PSI is exploring various avenues to combat this. To make it easier for women to return to work after a family-related break, PSI has launched a returnee project for young women scientists. The so-called “Daughters’ Day” (for the past two years part of the “Future Day” for both girls and boys) is where girls at PSI receive their first insight into their parents’ scientific and technical working environment. The “iLab – the laboratory for the iPod generation”, as it says on the PSI homepage, aims to “kindle a scientific flame in young people.” The children’s laboratory with experimental accommodation for two dozen children is located directly at the PSI site in Villigen, Canton of Aargau. Visitor groups are immortalised with a link and photo on the PSI homepage and numbers have now reached the hundreds.

Desire for annual working time

“The central issue remains this: how can PSI be and continue to be an attractive employer? Only by succeeding here can we continue to attract the best minds. Linked to this, attention then turns to the other issues,” says Ines Günther-Leopold. At issue is part-time work for young researchers of either sex wishing to combine childcare with their career as well as flexible working models for older scientists and career planning for younger ones. PSI is striving for solutions in all these areas. Back in 2009, PSI initiated a survey on the subject of flexible working time and complementary childcare. What emerged was that women in particular wished to have models such as annual working hours or teleworking and institutional childcare facilities for when their children were ill as well as improved holiday facilities. Once a year during the school holidays there is now a holiday camp for the children of PSI employees which enables children’s enthusiasm for the world of science and engineering to be fired at the earliest possible opportunity. A vital component in the “compatibility of family and career” issue is the child daycare centre currently attended by around 75 children that has existed for many years on the research institute’s premises.

The official job title of the role filled at WSL by graduate organisational psychologist Ursula Gut, which comprises a 70 per cent employment relationship, is “Workplace Diversity Coordinator”. She describes her job as follows: “I deal with subjects and implementation projects that aim to promote equality of opportunity in the workplace between men and women, people of different ages, different ethnic backgrounds and philosophies of life and who differ in terms of their health and sexual orientation.” Here too the focus is on gender issues and raising girls’ awareness of scientific and technical fields.

Promoting postdoc researchers

In pride of place at the top of Empa’s website on equality of opportunity is a single word in red and black letters: “together”. This is the buzzword Christiane Löwe uses to summarise all the measures associated with her job as Empa’s equal opportunity and diversity representative; if it helps the cause, she is happy to offer her own services as presenter as she did last September, when the Women meet Women business lunch was relaunched together with Eawag. On that occasion, Christiane Löwe asked Eawag’s assistant professor Lenny Winkel about her experiences as a postdoc scientist at various scientific institutions in Europe. For the members of the audience, this was first-hand information on the importance of mobility for a scientific career. Shortly beforehand, Lenny Winkel had been awarded an SNF professorship for her outstanding achievements – a nice example of the efficient promotion of women. Now in 2013, as part of the COFUND career promotion programme EMPA POSTDOCS, Christiane Löwe intends to offer new courses for young scientists – taking their lead from examples such as that of Lenny Winkel.

This event was co-organised by Alexandra Kroll, a postdoc scientist in Eawag’s environmental toxicology department and spokeswoman of the Committee for Equal Opportunity and Promoting Young Talent. The mother of a three-year-old child – who attends the in-house day nursery – knows from personal experience about the career bottleneck that affects many up-and-coming scientists, and especially women, after completing their doctorates. “At Eawag, for example, permanent vacancies are pretty scarce. Postdocs essentially have to consider how they intend to cope with the insecurity of a scientific career or otherwise look for alternatives in private industry,” says Alexandra Kroll. Here too Eawag offers assistance. For example, since the autumn of 2012 coaching programmes for postdocs have been resumed. At the opening event, Dr Monica Clausen, formerly a scientist and now a freelance human resource developer, spoke on the topic “From luck to mastery: Women and their academic careers”.

Desire for annual working time

“Before their contract expires, we get in touch with those concerned and offer them support on a voluntary basis. This often involves practical things such as putting together a faultless application portfolio,” says Ursula Gut. The serves to maintain their employability.
**ETH Zurich**  
**Satisfied employees**

In March, the third staff survey gave ETH Zurich employees and doctoral students the opportunity to express their views in terms of satisfaction with their working or study and living conditions. Compared with the two previous surveys in 2004 and 2008, a significantly higher response rate was achieved on this occasion. Overall, both employees and doctoral students proved to be satisfied or very satisfied with their workplace situation. However, the surveys also highlighted the need for action in a number of areas. As regards employees, more emphasis needs to be targeted towards promoting health and opportunities for personal development. The employee appraisal should accordingly be conducted more as a development meeting. Among the doctoral students, there is scope for improvement in terms of academic support and preparation for teaching activities. A major problem for doctoral students is also the fraught situation on the Zurich housing market.

**EPFL**  
**Computer science made fun**

Computer Science from A to Z: Children and young people at the exhibition (picture: EPFL/Alain Herzog).

More than 50 school classes totalling some 1,200 children and young people visited the exhibition “Computer Science from A to Z”, which ran from 22 October to 2 December in the lobby of the BC building at EPFL. These visitors were guided along a route illustrating the basic concepts of computer science in a light-hearted manner: algorithm, code, software, programming, etc. They were also invited to discover the individuals, both men and women, who have contributed to the development of this science.

**PSI**  
**Getting to grips with MINT subjects: a day in the iLab**

The iLab offers a one-day programme for school classes that enables them to experience the fascination of research and provides access to modern research working material and methods. The young people conduct supervised experiments with sound waves or a vacuum apparatus to create a connection with everyday life. For example, the young people learn how a car’s parking assistant or a distance meter works. They then visit PSI’s research facilities and gain a real impression of the scientific working environment. After visiting the iLab, all the young people are asked about their interest in the experiments and in particular about physics. The following picture emerges from more than 11,000 questionnaires: more than 80 per cent consider the experiments to be interesting and comprehensible, 50 per cent are fascinated by physics.

**Empa/Eawag**  
**Joint programme for next generation of researchers**

In June 2012, approximately 45 Empa and Eawag post-doctoral students had the opportunity at the inaugural event of a joint programme for nurturing new talent to find out about career development in the ETH Domain and plan their own further training needs. The participants also benefited from discussing with others problems and solution strategies from their everyday research. The invitation to the half-day career event came from Eawag’s Equal Opportunities Committee (EOC), Empa’s Equality Representative and the “COFUND” project management. The objective of the joint support programme is to make it easier for young researchers to advance to management positions. They have therefore been receiving coaching support at Eawag with individual career planning since autumn 2012. Over the same period there have also been courses for post-docs at Empa under the EU COFUND project. The first call will be concluded in May 2014 and the second is already being prepared.

**ETH Zurich**  
**40 years of the ETH crèche**

In 1972, dedicated students and employees at ETH Zurich founded the crèche, known as the “KiKri”. What began 40 years ago as a pioneering act by a dedicated parents’ association is now a professionally managed institution offering ETH members modern childcare. In time for its 40th anniversary, the year started with the “KiKri” successfully moving into a new building on Claudiusstrasse commissioned by ETH Zurich as the client and site owner.
Objective 6
Commitment to higher education in Switzerland

Facts and figures

Objective 6, performance mandate 2008–2011/12 (see enclosure): “The ETH Domain will be actively committed to the establishment of the Swiss higher education landscape.”

2012 reports from the institutions with examples and the ETH Board’s perspective.

**ETH Zurich**

ETH Zurich intensified its cooperation with its partner institutions at its locations in Zurich, Ticino and Basel. In the Zurich higher education environment it particularly wishes to improve its cooperation in the area of university medicine with the University and the University Hospital (see p. 78). The Language Center of ETH Zurich and the University celebrated its 10th anniversary in 2012. The Language Center now offers more than 400 language courses in 14 languages attended by over 8,500 students and employees at both Zurich-based universities. Students at the Zurich universities of applied sciences may now also take courses at the Language Center. In Basel, ETH Zurich will collaborate with the University of Basel to expand the laboratory animal facilities of its Biosystems Science and Engineering department (D–BSSE) (see p. 80). The future location of D–BSSE on the Schäilemmatteli grounds in the immediate vicinity of the University and the Biozentrum Basel is already being planned in close cooperation with its future neighbours in order to optimise the future use of the infrastructure for teaching and research purposes. ETH Zurich and Università della Svizzera Italiana (USI) successfully submitted a joint application for the establishment of a Platform for Advanced Scientific Computing (PASC) to the Swiss University Conference (SUC). This project is one of the central building blocks in the ETH Board’s high-performance computing and networking (HPCN) strategy.

**EPFL**

With the support of the ETH Board, an exchange programme for students within the ETH Domain was started in 2012. This programme covers student exchanges at the bachelor, master and doctoral levels. Funding ranges from mobility grants to support for summer schools. Eleven EPFL students received grants from the ETH Board for the 2012 autumn semester.

The partnership agreement between EPFL and the Canton of Valais for the establishment of a satellite campus in the Valais creates the necessary conditions for EPFL to expand its reach, particularly in areas such as energy and biotechnology that are very important to the economy of the Canton of Valais (see p. 82). The project involves cooperation and exchange in the fields of teaching and research with the HES–SO Valais University of Applied Sciences.

In Neuchâtel, the consolidation of research in the field of microtechnology at Micivity is strengthening mutual relations between the different academic and business players. The result is a sustainable knowledge platform shared by EPFL, Neode, the Centre Suisse d’Électronique et de Microtechnique (CSEM), the Haute Ecole Arc and the University of Neuchâtel.

The reorientation class for graduates of a university of applied sciences that was introduced in 2009 has proved its worth and in autumn 2012 37 students were admitted for a master’s degree. The success rate is increasing: after 41% in 2010, 64% of the participants in the university of applied sciences reorientation class (60 ECTS credits) graduated in 2012.
PSI
PSI develops and operates complex large-scale research facilities which it places at the disposal of researchers at Swiss universities and the industrial sector. PSI employees provide specialist support when measurements are taken. In 2012, around 530 external Swiss researchers, most of whom visit PSI two to three times a year on average, made use of these facilities. Thanks to the increase in the number of available places for measurements, in particular for the Synchrotron Light Source, the number of users from the ETH Domain rose by 11% annually. PSI continuously invested in the development of the measurement stations in order to ensure that the Swiss scientific community has access to an internationally competitive and partially unique research infrastructure in the future. From 2016, the X-ray free-electron laser SwissFEL will also contribute to the success of the large-scale research facilities. PSI received the performance mandate to build this laser with the 2013–2016 message on the promotion of education, research and innovation issued in the reporting year.

PSI is also strengthening its ties with the Swiss higher education landscape by selectively setting up joint professorships. In 2012, 21 out of a total of 23 PSI research laboratories were linked to at least one other university, and five of them were even linked to at least two other universities.

WSL
WSL makes an important contribution to the continued development of the Swiss higher education landscape. With its broad network, which includes almost all universities and many universities of applied sciences in Switzerland, WSL intensively nurtures its contacts in teaching and research. In 2012, nine professors and seven private lecturers taught at ETH Zurich, EPFL and the cantonal universities and various lecturers taught at four universities of applied sciences.

36 new projects with partners from the Swiss university environment were started in 2012. In one of these projects, WSL and the School of Agricultural, Forest and Food Sciences (HAFL) in Zollikofen used the latest technologies to develop support products for practical forest management. Smartphones are used to record specific parameters on the status of the forests so that forest growth over the next 50 to 150 years can be modelled, taking account of agricultural measures and future trends on the timber markets. New forest growth models make it possible to simulate future management scenarios, and experienced forestry experts can take decisions on site today that are important for the forests of tomorrow.

Empa
The MNT Micro & Nanotechnology course, a part-time master’s degree offered by Empa in cooperation with Zurich University of Applied Sciences (ZHAW), the NTB Interstate University of Applied Sciences of Technology in Buchs (NTB) and the Vorarlberg University of Applied Sciences, was once again selected as the most promising technology course at a university of applied sciences in Austria. Empa also provides many hours of teaching at both Federal Institutes of Technology and other Swiss universities and universities of applied sciences (around 2,900 hours of teaching per year); seven Empa researchers also work as professors at Swiss universities and universities of applied sciences and 14 researchers teach at the two Federal Institutes of Technology. Empa is also involved in the Tissue Engineering for Drug Development centre of competence (TEDD) at ZHAW, where it is a member of the Steering Committee and participates in joint research projects. The objective of the competence centre is to develop organoid human tissue models that can be used to test the (side) effects of new materials and drugs. Other cooperation programmes with Swiss universities and universities of applied sciences take the form of joint bachelor and master’s dissertations (65 out of a total of around 120) and PhD theses (almost 80 out of a total of around 200).

Eawag
In addition to nine professorships at ETH Zurich, EPFL and the University of Berne, 16 Eawag researchers hold adjunct professorships at Swiss tertiary institutions. Another two professorships are financed by the Swiss National Science Foundation. Cooperation with the University of Basel was strengthened in 2012 with an adjunct professorship. Eawag researchers offer courses in Basel on the globalisation of water resources and collaborate with the researchers of the University of Basel. Cooperation was also intensified with the University of Berne in the fields of fish ecology and evolution as well as political sciences, with the University of St. Gallen in the area of innovation management, with the University of Neuchâtel in hydrogeology and with the University of Zurich in environmental psychology.

At an Eawag seminar organised as part of the practice-oriented PEAK courses, the latest results from the national research programme NFP 61 Sustainable Water Management on the effects of climate change on ground and surface water resources were presented and discussed. These cooperation programmes with other Swiss tertiary and research institutions in transdisciplinary research make an important contribution to the development of Swiss higher education networks.

The ETH Board’s perspective
The ties of the ETH Domain with the Swiss higher education landscape have become even more close-knit in the reporting year as evidenced by the large number of professorships and teaching mandates executed by employees of the research institutions at universities and universities of applied sciences and joint projects of ETH Zurich at its locations in Ticino and Basel. The activities of EPFL in the Valais and Neuchâtel promote local scientific and business momentum. On top of this, the institutions of the ETH Domain are also present almost everywhere in Switzerland. However, they always aim to concentrate on sensible scientific focal points so that it neither makes sense nor is possible to consider every single request.
Research in the service of medicine

The founding of the “Zurich University Medicine” initiative is a milestone. Switzerland’s largest medical faculty at the University of Zurich, the engineering and scientific excellence of ETH Zurich and the top-notch medical competence of Zurich University Hospital are pooling their expertise ranging from fundamental and clinical research through to medical care. The three institutions’ knowledge and an interdisciplinary research approach are to be brought to bear on key issues such as the development of artificial hearts, personalised medicine and biomedical imaging and put to productive use in hospital practice.

Biomedical imaging as an interdisciplinary research area within the “Zurich University Medicine” alliance: Markus Rudin, ETH Zurich/UZH Professor at the Institute for Biomedical Technology.
The name is simple, almost modest: “Zurich University Medicine.” However, the goal that the Zurich institutions ETH, University and University Hospital associate it with is ambitious: developing medical research in the Zurich higher education environment into an international heavyweight. This was the message sent out at the end of September 2012 when the three partner institutions went public with this new kind of research alliance for Switzerland.

This is a major project that is being initiated here and its effects are being felt strongly within the participating institutions. ETH Zurich has for years been promoting the development of research areas within the health arena – especially in medical technology. ETH’s Institute for Biomedical Technology was co-founded with the University of Zurich as long ago as 1971, one of the world’s first joint institutes in this area. “Health sciences and technology” have been combined within the new department bearing this name (D-HEST) since the beginning of 2012. Interdisciplinary research from basic to applied research is now being stepped up on a targeted basis within the new “Zurich University Medicine” partnership. To this end, strategic focal areas have been defined based on already existing competencies. An integral part of the collaboration between UZH, USZ and ETH Zurich is also the construction of the new GLC research building of ETH Zurich in the city centre, which from 2017 is due to accommodate research groups from ETH’s “Health Sciences and Technology” and “Information Technology and Electrical Engineering” departments over a usable floor space of more than 13,000 square metres. “The GLC’s immediate proximity to clinical research at the University Hospital is a decisive benefit here,” says Roman Boutellier, ETH Vice-President for Human Resources and Infrastructure. “This is where patients and test subjects can be received, measurements and experiments prepared and investigations conducted on the technology platforms that are available there.”

Harvard MIT as a model
That such a combination of excellent scientific expertise also in geographical terms can bear fruit is proved by the Harvard–MIT Division of Health Sciences and Technology (HST) in Boston, an alliance between Harvard University and the Massachusetts Institute of Technology (MIT) dating back decades. The use of medication to treat the infectious disease Aids, for example, can be traced back to their research work. This model was also the driving force behind the vision of the “Zurich University Medicine” project. This, of course, called for the laying of foundations dependent on decision-making powers extending beyond those of the participating universities. The cantonal political authorities fortunately decided in favour of a new university hospital building right in the heart of the city. The revised university district master plan creates the prerequisite for ETH, UZH...
and USZ to be able to collaborate closely. An extremely welcome near-term side effect of this will also be the revival of a greater city centre social mix. The geographical concentration of scientific jobs in ETH’s new GLC research centre on Gloriastrasse as part of the “Zurich University Medicine” strategy enables space that is currently used by the universities as office buildings to be converted back to residential use.

“For ETH Zurich as a technical university, the interface between medicine and engineering and sciences is gaining increasing importance,” says Roland Siegwart, ETH Vice-President for Research and Corporate Relations, in summary of the research alliance’s goal. “Interdisciplinary research and training, networked thinking and access to clinical data are central elements in biomedical research and practice. Zurich University Medicine’s objective is to promote these approaches.” The paradigm of technology-driven medical research is being replaced by a more problem and solution-oriented approach. Medicine has achieved great progress in the diagnosis and treatment of diseases in recent decades. That is why the exchange of knowledge between fundamental research, applied research and clinical care has also assumed vastly increased importance. The rapid transfer of knowledge from fundamental research into clinical practice is also a central motive for establishing the alliance. “Biomedical fundamental research, the engineering sciences and clinical research are thus converging,” says Markus Rudin, ETH Zurich/UHZ Professor of biomedical technology, “and the university clinic is benefiting from new potential therapies targeted at disease patterns.” The hospital is hoping this will deliver a technological leap within five to ten years,” says Roland Siegwart. All this is in line with the performance objective defined by the Federal Council of “commitment to the Swiss higher education landscape” and according to Wolfgang Langhans, ETH Professor of Physiology and Behaviour, also calls for “new professorships, some of them at the interface between traditional disciplines, and an increase in third-party funding from private industry”. “This way we can also pursue the goal in various degree courses of training up a new generation of specialists with medical expertise for science and practice,” underlines Wolfgang Langhans. ETH Zurich’s still fledgling “Health Sciences and Technology” course got off to a very successful start – with the first bachelor students in autumn 2011 and the first masters a year later. (see also example on p 39).

Close collaboration between researchers
One focal project of “Zurich University Medicine” that has already been defined in the translational research arena, the interface between preclinical research and clinical development, is personalised medicine. This is about developing an optimum therapy and customised, more effective medication for a patient based on individual genetic information. This requires close collaboration between geneticists and biologists, pharmacologists, computer scientists and pathologists. “Modern molecular genetics makes it possible to tackle disease patterns precisely and on a customised basis,” says Wolfgang Langhans, “Diagnosis and therapy are becoming more and more sophisticated.” The objective is to develop a Centre for Personalised Medicine that will achieve international reach.

A second thrust is focusing on the development of a new generation of artificial hearts. “For quite some time now there has been an excellent heart transplant centre in Zurich on which we can build,” says Wolfgang Langhans. “Developing a new generation of artificial hearts requires engineering knowledge in the pump technology, sensor or materials science areas as well as the know-how of heart surgeons and cardiologists.” In view of the ongoing shortage of donor organs, new advances in this area are an urgent medical necessity.

Solutions for practitioners
The research alliance between the three Zurich institutions is also intended to give rise to a Centre for Biomedical Imaging which will further concentrate and reinforce already existing competencies. Traditionally, clinics and universities possess excellent research groups in areas such as magnetic resonance tomography (MRI). In this area, technical development and diagnosis typically go hand-in-hand. “The objective must be to provide imaging solutions that enable doctors to achieve the best possible therapy for their patients based on an accurate diagnosis,” says Markus Rudin.

Examples of the institutions

ETH Zurich
Consolidation of ETH Basel location
ETH Zurich continued to develop its Basel location again in 2012. The BioSystems Department founded a few years ago in Basel has been enhanced with additional research groups. Thirteen of the planned 17 professorships have now been filled with top-class scientists from the fields of experimental and theoretical biology, biotechnology, biophysics and microelectronics. The researchers adopt a holistic approach to the study of biological systems that transcends the boundaries of the classical disciplines. An important factor in the success of the research is the close collaboration with other institutions, in particular the University of Basel. ETH Zurich and the University of Basel have therefore decided to extend their partnership further and set up a joint facility for laboratory animals. It is scheduled to come into operation in the summer of 2013.

EPFL
Commitment to Neuchâtel
EPFL had undertaken to expand the Institute of Microtechnology of the University of Neuchâtel (IMT) and embed it even further in the local industrial fabric. There has been progress since the institute...
Information between the research locations of Zurich and Neuchâtel. Following WSL's joint professorships already in place with ETH Zurich and EPFL, a joint professorship with a cantonal university is a novelty.

WSL is also interested in universities of applied sciences: An initial meeting at directorate level took place with Zurich University of Applied Sciences in Wädenswil (ZHAW) to clarify the potential for collaboration.

Eawag
New Environmental Social Science Department

In September a new Environmental Social Science Department commenced work at Eawag. The new Eawag unit’s research is focused on three important social science topics: the analysis of individual behaviour and decision-making processes as they relate to environmental and health matters, the analysis of institutions, networks and governance structures regulating and addressing environmental issues, and understanding a sustainability-oriented transformation process in the main sectors of industry. This research contributes to better understanding, evaluating and managing environmental issues such as the acceptance and use of water technologies conducive to health or sustainability-oriented reforms of the urban water sector. Also included are water-related ecosystem services and the design of new political approaches for dealing with environmental pollution in aquatic ecosystems.

Empa
New innovation centre in the Rhine Valley

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Joint professorship with the University of Neuchâtel

In May 2012, the State Council of Neuchâtel appointed WSL researcher Martine Rebetez as associate professor in applied climatology at the University of Neuchâtel. Martine Rebetez has won accolades in Switzerland and abroad for her studies into climate change and analyses climate development with regard to its social impact, for example on forest ecosystems or tourism. She now conducts her research, teaching activity and supervision of doctoral students at the Geographical Institute of the University of Neuchâtel and at WSL. She thereby promotes the exchange of information between the research locations of Zurich and Neuchâtel. Following WSL’s joint professorships already in place with ETH Zurich and EPFL, a joint professorship with a cantonal university is a novelty.

WSL is also interested in universities of applied sciences: An initial meeting at directorate level took place with Zurich University of Applied Sciences in Wädenswil (ZHAW) to clarify the potential for collaboration.

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New Environmental Social Science Department

In September a new Environmental Social Science Department commenced work at Eawag. The new Eawag unit’s research is focused on three important social science topics: the analysis of individual behaviour and decision-making processes as they relate to environmental and health matters, the analysis of institutions, networks and governance structures regulating and addressing environmental issues, and understanding a sustainability-oriented transformation process in the main sectors of industry. This research contributes to better understanding, evaluating and managing environmental issues such as the acceptance and use of water technologies conducive to health or sustainability-oriented reforms of the urban water sector. Also included are water-related ecosystem services and the design of new political approaches for dealing with environmental pollution in aquatic ecosystems.

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EPFL expands into Wallis

The planned “EPFL Valais Wallis” campus will also host professorships in the energy and healthcare arena: Philippe Gillet, Vice President EPFL (foreground), Anton Schleiss, EPFL Professor at the Hydraulic Constructions Laboratory.
The Canton of Valais and EPFL have agreed a joint education and research project. The permanent scientific and academic outpost “EPFL Valais Wallis” is to be built in Sion. A campus including eleven new professorships for energy and health is planned. This will intensify technology transfer from research into industry, strengthen Valais as a research location and make it more attractive for an international professorial and student body. The State Council, the City of Sion, EPFL and the HES-SO Valais University of Applied Sciences held an architectural competition for the future university campus in early February 2013.

For both the Canton of Valais and EPFL, 19 December 2012 was a special day. It was on this day that both parties signed an agreement definitively confirming the “EPFL Valais Wallis” project launched the previous January together with the plan to create a research site with an international reach as a flagship symbol of the innovation and repositioning to which the Canton of Valais aspires. It is now also clear where the campus is to be built: the generously sized site will stretch from the neighbourhood south of Sion railway station to Central Valais Hospital Centre in Sion-Champsec. There will be space for extensive research and a total of 11 professorships for energy and health to be created here. On top of this will come the “Energypolis” experimental research platform and an innovation park co-funded by the Ark Foundation. This is intended not only to serve as a role model for technology transfer from science to Valais business practice but also to exemplify Switzerland’s innovative strength.

Launch of an international architectural competition
The new “EPFL Valais Wallis” campus, already due to open in 2014, will host EPFL’s Valais outpost as well as the HES-SO Valais University of Applied Sciences which is to commence operations a year later in 2015. This way EPFL is creating ISO knowledge-based and hence high-quality jobs with a sustained impact. An international architectural competition has now been held, thereby underlining the objective of constructing a campus that shines out well beyond the cantonal borders and comprises buildings that are able to meet the highest technical and aesthetic standards. Investments of around 335m CHF over 10 years are envisaged for the various development stages. The fundamental idea and objective is to breathe new life into the social and economic momentum of the Canton of Valais and also to redesign and strengthen its links with the rest of Switzerland and with other cantons. This will result in a unique project for Switzerland, a cooperation platform between a Federal Institute of Technology and a university of applied sciences like no other that brings together basic and applied research and innovation to a cohesive whole.

Four out of a total of eleven planned professorships and two research groups will be transferred from their current site at EPFL to Sion. The Canton of Valais itself is creating seven new professorships. An important factor here is that a focus of the research will be on the hydrodynamics of turbines in order to enhance energy production with its strong roots in Valais as well as water management and the use of lakes and watercourses. Further focal points of the research activities will lie in the area of green chemistry and include research into the use of alternative energy sources such as bio-mass and algae cultures, for example. In the broad field of healthcare, topics such as biotechnology and bioengineering as well as questions concerning healthy nutrition will be investigated. Here too it is important that the local and regional network is integrated into these activities. There will therefore be collaboration with the Swiss Accident Insurance Fund (SUVA), Valais Hospital and the Institute of Research in Ophthalmology (FIO), for example. According to the current budget, the annual costs for the research centres in the first seven years of operation will amount to 18.3m CHF. EPFL will bear 9.9m CHF of these costs in order to finance the professorships transferred from Lausanne to Valais. The Canton of Valais will invest a total of 8.4m CHF in the funding of new professorships. The Canton will also finance the provision of the underlying infrastructure for the campus, after which EPFL will take over responsibility for its operation.

Unique testing facilities, innovation park and showpiece model
The “Energypolis” experimental research platform comprises testing facilities that are unique in both Switzerland and the European context. Here it is possible to carry out complex experiments with hydropower turbines, dams and drainage in natural and artificial environments. Thanks to the planned innovation park in Sion, the entire research infrastructure is also directly connected with industry on site. What is more, the innovation park is linked to EPFL’s Innovation Square, which therefore makes it an ideal regional centre of the Swiss Innovation Park that the Federal Government has already decided to establish for the promotion of technology transfer and economic output. The project in Valais will thus serve as a showpiece interdisciplinary and multidisciplinary model at a wide range of levels and for the core decisive issue of the future: the provision of energy. Here too it is a question of networked research, thinking and actions alongside the energy carrier of the future. Taking an entire region including the Rhone valley from Gletsch to St-Gingolph as an example, the aim is to show how energy producers and consumers could potentially interact in order to optimise energy flows and reduce greenhouse gas emissions in the future.
Objective 7

Performance-based funding allocation to both Federal Institutes of Technology and the four research institutes by the ETH Board

In accordance with the dispatch on the promotion of education, research and innovation for 2008–2011, Objective 7 (ERI Dispatch 2008–2011, p. 1277), the ETH Board has developed a performance-based model for funding allocation and in 2012 for the first time used it as a discussion basis for funding allocation.

Model with several dimensions

In its model for performance-based funding allocation, the ETH Board pays particular attention to its strategic objectives (“Strategy”) as well as the academic performance (“Performance”) and financial loads (“Load”; see Fig. 7) of the individual institutions.

Strategy

The strategic factors refer to the political guiding and strategic objectives (top-down) and to the specific development objectives periodically derived from the strategic development plans of both Federal Institutes of Technology and the four research institutes (bottom-up). The strategic factors constitute the most variable performance dimension.

Performance

The result and effect factors reflect academic performance in the core areas of teaching, research and knowledge and technology transfer with regard to the fulfillment of objectives and tasks. Correct measurement, assessment and interpretation require not only quantitative but above all qualitative information. Therefore, performance in teaching and research as well as in knowledge and technology transfer must be characterized in a comprehensive and sophisticated way.

Load

Load factors primarily measure performance elements alongside the long-term structural characteristics of both Federal Institutes of Technology and the four research institutes. They refer to specific facts (e.g. different size and complexity of the teaching and research portfolio, supervision ratio, specific national tasks and the age and condition of real estate) and to largely exogenously predetermined framework conditions (e.g. wage policy measures and expenditure on the preservation of the value and functionality of federally owned real estate) which affect the capacity to perform and development of performance in teaching, research and knowledge and technology transfer. Load factors apply to input and process dimensions which cannot be influenced greatly or rapidly.

Specific funding allocation in 2012

At its meeting on 2–3 March 2011, the ETH Board concluded that, when viewed as a whole, all of the institutes display a comparatively high standard with regard to the quality and attractiveness of teaching, research and the transfer of knowledge. This
conclusion is derived from the qualitative and quantitative indicators, the monitoring data, the dialogues conducted in 2010 (controlling discussions) as well as other information from the respective institutes, e.g. with regard to national tasks. Consequently, the scope for the ETH Board to make performance-based distinctions during funding allocation was therefore limited. Thus strategic criteria – within the scope of the model described above – moved into the foreground when it came to the allocation of funding. From the perspective of the ETH Board the principal task and priority of the ETH Domain consists of educating highly-qualified students to meet the demands of Swiss society and industry. The extension of the performance mandate and term of the payment framework by one year (2012) entailed an increase of 2,164.3 million CHF. The ETH Board was thus required to allocate both these funds and 10.0 million CHF which had not been reduced within the scope of the 2011–2013 consolidation programme. While doing so it took account of the stipulations of the 2008-2011 and 2012 ERI dispatches as well as contributions already approved with regard to implementation of the strategic planning for 2012–2016. Figure 8 shows the allocations in detail.

**Fig. 7: Basis for funding allocation decisions**

**Fig. 8: Funding allocation to the institutions of the ETH Domain in 2012**

<table>
<thead>
<tr>
<th>Institution</th>
<th>CHF</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETH Domain</td>
<td>2,174.3</td>
<td>100.0</td>
</tr>
<tr>
<td>ETH Zurich (1.2)</td>
<td>1,096.7</td>
<td>50.4</td>
</tr>
<tr>
<td>EPFL (1)</td>
<td>533.3</td>
<td>24.5</td>
</tr>
<tr>
<td>PSI (2)</td>
<td>261.8</td>
<td>12.0</td>
</tr>
<tr>
<td>WSL</td>
<td>52.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Empa</td>
<td>93.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Eawag (1)</td>
<td>52.6</td>
<td>2.4</td>
</tr>
<tr>
<td>ETH Board (1.3)</td>
<td>84.1</td>
<td>3.9</td>
</tr>
</tbody>
</table>

**Additional information on the budget for 2012:**

1. Including specific stipulations in accordance with ERI dispatches 2008–2011 and 2012
   - ETH Zurich: D-BSSE: 25.0
   - EPFL: ISREC: 10.0
   - EPFL: EPFL in Neuchâtel: 8.0
   - Eawag: ecotoxicology: 2.0
   - ETH Board: Strategic projects, competence centres, IKP–SUC: 59.1

2. Including increase in funding for the implementation of national research infrastructures
   - ETH Zurich: strategy for high-performance computing and networking (HPCN): 20.0
   - PSI: SwissFEL: 19.0

3. Including increase through the return of funds from the federal consolidation programme
   - ETH Board: 10.0
Objective 8
National and international presence

Facts and figures

Objective 8, performance mandate 2008–2011/12 (see enclosure): “The ETH Domain will strengthen its national and international profile by exploiting the dynamism of its autonomous institutions, and in so doing increase its presence in society and the scientific community.”

2012 reports from the institutions with examples and the ETH Board’s perspective.

**ETH Zurich**
The opening of the Singapore ETH Centre for Global Environment Sustainability in 2012 (see p. 88) was a milestone for the international presence of ETH Zurich. Together with renowned Indian partner institutions, ETH Zurich, EPFL and Empa organised a Nuclear Magnetic Resonance NMR workshop in India in January 2012 in a bid to strengthen cooperation between Switzerland and India in this field. In April 2012, the two Federal Institutes of Technology presented a seminar in New York entitled “Urban Planet: Emerging Ecologies” where they showcased the expertise of the ETH Domain in the field of sustainable urban construction.

In June 2012 the President of ETH Zurich visited several universities, companies and organisations that sponsor research in Brazil. Two agreements were signed with the latter to simplify the exchange of students and cooperation with the Brazilian partners.

In 2012, ETH Zurich strengthened its national presence with two local presentations by the President on medical technology and geothermal extraction where around 100 representatives of the business, political and social sectors were informed of the latest research results and future plans of the university. The “ETH Zürich in Bundesbern” (ETH Zurich in the Swiss Parliament) events on “The city of the future” and “Risks in cyberspace” each provided background information to around 35 selected guests from the political, administrative and business sectors.

**EPFL**
As the first institution on the European continent, EPFL offered a course based on the Massive Open Online Courses (MOOCs) concept of the best American universities in 2012 (see p.36). Three other large projects were launched: Centre de Neuroprothèse, Energypolis in the Valais and Neuropolis in the Lake Geneva region (see pp. 51 and 82).

At the European level, EPFL in 2012 received its 71st European research grant (ERC) and inaugurated the Eurotech network in Brussels. It also submitted two applications for FET flagship projects of the European Commission: the Human Brain Project and the Guardian Angels consortium that is coordinated jointly with ETH Zurich (see p. 23). EPFL was also involved in capacity building at Eastern European universities and entered into two strategic partnerships with the Max Planck Institute and the École normale supérieure in Lyon.

With regard to the Asia/Pacific region, EPFL has hosted the European research centre of the Japanese company Nitto Denko since summer 2012 and in November 2012 held the second UAE-Swiss Research Day in Dubai. To improve the attractiveness of the international student exchange programme, EPFL, with the support of the Bertarelli Foundation, entered into an agreement similar to its partnership with Harvard Medical School with the A-Star Agency in Singapore, Seoul National University and the University of New South Wales in Australia in 2012.
PSI
With the broad range of topics covered by its own energy research activities and the research conducted by the PSI-affiliated Competence Center Energy and Mobility of the ETH Domain (CCEM), PSI provided valuable input for the “Coordinated Energy Research Switzerland” plan of action which represents the research community’s contribution to the Confederation’s energy strategy. Internationally, PSI in cooperation with the World Energy Council (WEC) is developing transparent models for future global energy systems. The findings of this project should support the decision-making processes of energy companies, governments and NGOs. The programmes developed for this purpose are available to third parties as open source programmes.

The upcoming inauguration of the X-ray free-electron laser SwissFEL is much anticipated both nationally and internationally. In 2012, more than 20 national groups of researchers took part in more than seven workshops on this topic organised by PSI to discuss possible applications of this new research infrastructure. Internationally, SwissFEL is attracting much attention by its compact and cost-effective build that has enabled the realisation of a national research infrastructure project. The project therefore serves as a model for future nationally realisable X-ray free-electron lasers.

WSL
Thanks to its broad portfolio of research and implementation topics, WSL has a strong presence at both the national and international levels. Every year at its “FORUM for Knowledge” it informs a broad Swiss public from research, practice and the media of its activities. With its regular international conferences in Birmensdorf and Davos, WSL provides Swiss and foreign researchers with a scientific exchange platform. Many of its subject specialists are active in international organisations, thereby making an important contribution to the transfer of knowledge to various scientific communities around the world. For example, Prof. Felix Kienast has since 2011 been president of the International Association for Landscape Ecology (IALE), a global association of ecologists. Since its establishment, WSL researchers have also been active in many work groups of IUFRO, the International Union of Forest Research Organizations representing more than 700 institutions in over 100 countries. For more than a decade WSL has been represented in the programme steering group of ICP Forests which coordinates global research on the effects of environmental change on forests. WSL also presides over IACS, the International Association of Cryospheric Sciences, which serves as a platform for research and teaching.

Empa
The World Resources Forum (WRF) initiated by Empa was presented for the first time in Peking in 2012 in cooperation with the Chinese Academy of Sciences (CAS). This annual event, which will take place in Davos again next year, focuses exclusively on the increasing scarcity of raw materials and how we can improve our use of these resources. This is important because several of the so-called futuristic technologies such as high-performance batteries or magnets for wind turbines rely on rare metals. Empa also tabled this explosive topic at one of its Technology Briefings attended by representatives of Swiss industry. In September Empa also organised several presentations at the “First World MedTech Forum” in Lucerne. In 2012, Empa was involved in no less than two flagship projects in the energy sector: the visionary NEST project, a modular research and laboratory building to promote experimentation with innovative building technologies which has progressed successfully in close cooperation with partners from the construction industry to the point where the application for a building permit has been submitted, and the Future Mobility demonstrator, the detailed planning of which has already progressed quite far. This research and technology transfer platform will identify ways in which excess electricity can be used sensibly to put future mobility on a sustainable footing.

Eawag
In 2012, Eawag continued to exploit a large number of opportunities to improve its national and international presence. Eawag is a founding member of the “Swiss Water Partnership” established in 2011. This association of partners from the scientific community, the administration and business sectors aims to strengthen the international profile of the Swiss water industry. At Eawag’s public information day on “The aquatic environment – what it provides and what it needs” in the main building of ETH Zurich, the researchers presented their findings on current research topics. Eawag and the five other institutions of the ETH Domain were also present at the first Swiss “Cleantec City” fair in Berne. Switzerland’s stand at the World Expo in South Korea featured the SODIS method for clean drinking water developed by Eawag. Eawag is also a meeting point for external partners. In addition to many visitors from Switzerland and other countries, Eawag also hosted the 2012 Nano Authorities Dialogue between Germany, Austria and Switzerland at its site in Dübendorf. Eawag also initiated and organised an international symposium on evolutionary ecology and the management of aquatic ecosystems in which the Federal Office for the Environment also participated.
This year saw the ceremonial inauguration of the “Singapore ETH Centre for Global Environmental Sustainability” (SEC). It is now home to approximately 120 scientists conducting research into the sustainable city of the future within an initial interdisciplinary research programme. ETH Zurich is thereby reinforcing both its international presence in an important region of the world as well as its scientific expertise in disciplines relating to this issue. This also benefits Switzerland as an industrial and service location.
On 16 March 2012, Swiss Interior Minister Alain Berset was in the south-east Asian city-state of Singapore surrounded by colourfully clad Singaporean dancers to attend the ceremonial opening of the Singapore ETH Centre for Global Environmental Sustainability (SEC). “This is ETH Zurich’s first research centre in Asia and sends out an important signal about the high quality of Swiss research,” observed the Federal Councillor. Then at the beginning of November 2012, Johann Schneider-Ammann, the Education and Research Minister designate, paid a visit to the SEC, during which the focus was on the activities of the first SEC research programme, the Future Cities Laboratory. The visit by two Federal Councillors in one year underlines the strategic importance of the research hub in Asia for Switzerland as a scientific location.

Nucleus of interdisciplinary research

The initiative for this collaboration came from Singapore’s President Tony Tan. While still Deputy Prime Minister, he visited Switzerland and ETH Zurich in 2004. Following this, Tony Tan consistently promoted relations between the Swiss universities and the National University of Singapore (NUS) as well as Nanyang Technological University (NTU). These activities are part of the National Research Foundation (NRF), established in 2006, the objective of which is to make Singapore a leading scientific location. Today, EPFL, NTU and NUS are partners of ETH Zurich’s SEC on the newly built Campus for Research Excellence and Technological Enterprise (CREATE). Other research centres belonging to world-leading universities such as the Massachusetts Institute of Technology (MIT) and the University of California Berkeley, with which ETH Zurich likewise cultivates good relations, are also located there. This means that within a small area a completely new type of nucleus of interdisciplinary research spanning continents and disciplines is emerging. SEC Director Gerhard Schmitt is definitely inspired by the opportunities arising here. “We are laying the foundations for and opening up new ways of interaction by focusing not on disciplines but on topics, on research results, and on interaction between the world’s best scientists at a shared location,” he explains, “This new model is an important supplement to the conventional university structures.”

It is no coincidence that here, of all places, the centre’s first research programme is addressing itself to the city of the future. Since its independence from Malaysia in 1965, Singapore has grown into a metropolis with more than five million inhabitants, the world’s second largest container port, four universities, extensive high-tech factories, biocentres and nature parks and all this within an area not much larger than Lake Geneva. It is here, on this tropical island, that a number of the problems faced by the modern, multicultural city are made manifest. Geographically, Singapore lies in that belt of rapidly growing
Examples of the institutions

EPFL
A consortium of technological universities in Brussels

The Eurotech network aspires to represent the technical universities in Brussels. In October 2012, the EPFL, Eindhoven University of Technology, the Technical University of Denmark and the Technical University of Munich inaugurated their presence in the European capital. The partners intend to join forces to make their voices heard and create the strongest and most innovative research and teaching programme in Europe.

WSL
Climate measurements in Greenland

In 1990, a young ETH researcher set up a research station on the Greenland ice sheet. Because of the cooling that took place after the eruption of Mount Pinatubo in the Philippines, it became snowed in; dismantling it was impossible. The researcher's new American employer took it over. That was the beginning of the “Greenland Climate Network”, which today comprises 18 stations and supplies valuable climate data. The network is financed by the US National Fund and NASA, which uses the measurements to understand the impact of climate change on ice sheets and the greenhouse effect.
**Empa**

**Safety research on nano materials**

In the past ten years, numerous projects have investigated how nano materials can be used without endangering the environment and health. The (provisional) conclusion of two international reports in which Empa nano toxicologists were heavily involved is that even if no specific risks from free nano-particles have been described to date, it is still not possible to give them a clean bill of health across the board. In case of doubt, a new nano product would have to be studied throughout its entire life cycle, according to the report by the Society for Chemical Engineering and Biotechnology (DEHEMA) and the Association of the German Chemical Industry (VCI). However, the report by the European Academies Science Advisory Council (EASAC) warns that there is a lack of experts to undertake further urgently required studies in the nano(eco)toxicological arena. In addition, there are still several gaps in our knowledge, some of them substantial, which need to be closed.

**Eawag**

**SODIS founder receives important Swiss award**

In 2012, Martin Wegelin was honoured with the Prize of the Foundation Dr J.E. Brandenberger. Wegelin has championed awareness of the simple method for solar water disinfection in developing countries. The SODIS method is now in everyday use by more than five million people. In 2012, the Eawag SODIS Reference Center also entered into an important partnership with Helvetas. Helvetas will incorporate the SODIS method in its drinking water projects. Eawag is supporting the work with research, technical consultation and international advocacy activities.

More about SODIS at: www.sodis.ch

**PSI**

**Global energy systems**

In January 2012, PSI signed a partnership agreement with the World Energy Council (WEC) for the development of an energy system analysis model. Beyond investigating individual energy technologies, the PSI researchers aim to achieve a holistic consideration and comparison of nuclear, fossil and renewable energy technologies. They are analysing the structures and impacts of national and international energy systems in order to understand better the relationships between energy, the economy, the environment and technology and are investigating different energy supply options. The resulting insights are intended to support energy companies, governments and non-governmental organisations in their decision-making such as for finding the correct energy mix for the future. What is special about it is that it will be a so-called open source model. Experts and other interested parties can obtain access to the program as well as information about the researchers’ assumptions.

The network is financed by the US National Fund and by NASA, which uses the measurements to calibrate its satellites (picture: WSL).

Moreover, since measurements began, the average temperature has risen by 4.5°C – one of the largest increases in the world.

SODIS founder Martin Wegelin at the prize ceremony of the Foundation Dr J.E. Brandenberger (picture: Eawag).
Objective 9

Stronger role in society

Facts and figures

Objective 9, performance mandate 2008–2011/12 (see enclosure): “The ETH Domain will strengthen the role played by its institutions in society.”

2012 reports from the institutions with examples and the ETH Board’s perspective.

ETH Zurich

The Zurich Scientifica science days on the topic “Get healthy – stay healthy” took place at the beginning of September. The ETH and University of Zurich presented various research projects, short lectures, podium discussions and guided tours to around 21,000 visitors. In 2013, Scientifica will focus on the topic of risk.

In spring 2012, the Meeting Point Science City «Science for All» programme focused on the global food system and in the autumn it investigated cities and the way in which we are urbanising the world. On 1 September 2012, the high-performance computing centre CSCS opened the doors of its new building in Lugano–Cornaredo to the public (see p. 11).

With a number of different information events, ETH Zurich aims to motivate young people to study natural or engineering sciences. In 2012 it visited twelve grammar schools throughout Switzerland as part of its “ETH unterwegs” (ETH on tour) initiative. At the information days for prospective students in September, around 5,000 grammar school pupils found out about the courses of study offered at ETH Zurich. At the study weeks in June 2012, around 120 pupils gained an insight into the research carried out at ETH Zurich.

ETH Zurich expanded its extensive range of continuing education courses in 2012 with six MAS and one DAS programme.

EPFL

EPFL has close ties to the population in French-speaking Switzerland. Together with the University of Lausanne, EPFL developed a comprehensive programme of continuing education courses. The 80 courses that were offered were attended by more than 2,800 participants. This way EPFL makes an important contribution to both the quality of education and the competitiveness of local companies and the community.

EPFL also takes its public communication mandate seriously. The excellent annual Robotic Festival attracted over 15,000 visitors in 2012. More than 2,000 children participated in the workshops where they constructed and programmed robots and more than 6,000 people attended the presentations and demonstrations at the Festival.

Robots are also the best ambassadors for EPFL and the world of science to the schools in French-speaking Switzerland. The Thymio II robot developed with the support of ECAL and the teacher training colleges in the Canton of Vaud is meeting with growing success in school classes where it is used to teach programming skills. More than 1,000 of these robots have been sold.

A large number of cultural events took place on the EPFL campus in 2012, all of them designed to establish close ties between science and the arts. Performances in the fine and scenic arts, music and theatre, transitory installations and meetings with artists attracted a wide audience.

PSI

PSI fosters close contact with society with popular scientific information in printed and electronic media and events held on its own research premises. The fascination, respect and appreciation displayed by visitors for an area of research that makes use of the largest instruments to shed light on the smallest structures and to make them useable was particularly noticeable at four events in 2012.
PSI is also actively involved in the discussion of the future of energy supply and the possible answers to these problems provided by energy research and in spring 2012 organised an energy seminar to promote dialogue between researchers, politicians and the business world. The Energie Spiegel newsletter published by PSI in 2012 provides an easy-to-understand, general overview of the energy system analyses carried out at PSI which make it possible to prepare a comprehensive and detailed assessment of current and future energy systems. Energie Spiegel has a circulation of 15,000.

A 3D cartoon film illustrates the benefits of the future SwissFEL research facilities to a broad audience in a light-hearted manner. The premiere took place at an open day at which the producers reported on how the film was made, PSI researchers explained the research planned for SwissFEL and the initial stage of the facilities could be visited.

PSI creates incentives for finding out more about research topics by means of unconventional combinations: At the Classic meets Science event (entry charge), a renowned classical music orchestra performs in a research hall and a scientist explains the relationship between physics and music over a four-course meal. The PSI Photo Award provides amateur photographers with the opportunity to spend a day photographing at PSI’s research halls, with prizes awarded for the best photos.

WSL

The expectation for research to focus on topics relevant to society and to ensure the practical implementation of the results is increasingly growing in the face of current ecological and social crises. WSL has long-standing experience with implementation projects that involve the stakeholders. The joint research project “AlpFUTUR – the future of summer pastures in Switzerland” that is managed and coordinated by WSL and Agroscope ART is a current example of transdisciplinary research. Central aspects of Alpine farming are researched in 22 subprojects at around 15 Swiss research institutions. The research topics includes, among others, overgrowth of pastures, the future of Alpine biodiversity, the economic importance of Alpine products, the role played by tourism, regulation of collective Alpine farming and the motivation and qualification of people working in Alpine farming. The research topics were drawn up with the help of the people engaged in the practice of farming who are involved in the research via a supporting group of experts and third-party providers of external funding. Local workshops involve local players in the discussion of the results which are specially prepared and made accessible (e.g. information published on the web, presentations, reports, cooperation with consultants on Alpine farming).

Empa

The social relevance of the research carried out by Empa was underlined again in 2012 by various studies on current topics. These included a UN report on the problem of electronic waste in developing countries for which Empa researchers carried out field studies in the suburbs of large African cities. They also developed suitable strategies for the local recycling of electronic waste in collaboration with local experts. As part of a study for TA-SWISS, the Swiss Centre for Technology Assessment, Empa researchers investigated the possible consequences of the spread of locating technology and drew up measures to protect privacy. For a study on behalf of the Swiss Federal Office of Energy, Empa researchers analysed the ecological balance sheet of various biofuels, the majority of which are no more environmentally friendly than petrol. Empa also played an important role in the Swiss action plan on nanomaterials; on behalf of the Federal Office for the Environment, Empa researchers prepared a report on the production and transport of nanomaterials for the Major Accidents Ordinance. Empa also advises the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management and the German Federal Ministry of Education and Research on nano security.

Eawag

Eawag helps to make sure that decision-makers in the field have access to important new findings on the issue of water management. This was confirmed again in 2012. After Eawag’s research contributed substantially to the amendment of the law on the control of water pollution, the foundation stone for the first ozone plant for the removal of micro-pollutants in sewage was laid at the Neugut sewage plant in Dübendorf.

Eawag will continue to support this project with research activities. Much will also be invested in river revitalisation in Switzerland in the near future. Here too, Eawag is contributing its expertise by developing a concept for Swiss watercourses with the support of the Federal Office of the Environment. Under the leadership of the Canton of Zurich, Eawag is involved in the restoration of the Chriesbach river flowing past its doors. This project was initiated by Eawag and is supported financially by the Confederation and the Municipality of Dübendorf. Implementation work started in 2012.

Eawag also plays an exemplary role in society when it comes to building design. In its own buildings it took additional steps to promote the use of renewable energies and expanded the use of solar energy.

The ETH Board’s perspective

The ETH Domain’s social responsibilities are reflected in its activities in a variety of ways. For instance, the institutions are engaged in the direct research of topics with social relevance and therefore actively involve the social environment in their research activities. The research results are used in return for the indirect benefit of society in the form of advisory mandates for government authorities. Not least thanks to this and supported by far-reaching communication activities, the institutions are also frequently mentioned in the media and their campuses are increasingly used as meeting places and venues for public events.
New harmful organisms threaten the forest

For Switzerland, the forest has an eminently important protective function. Its health is threatened by all sorts of tree diseases and pests – both indigenous and those introduced from abroad. The most recent case is the Asian longhorn beetle from East Asia, which has reached Europe and Switzerland as a result of international trade flows. The demand for WSL’s expertise in harmful forest organisms, their spread and how to combat them is all the greater in an era of globalisation.

Advises on fungal infestation in Swiss forests: Roland Engesser, forest pathologist at WSL.
The body measures no more than 35 mm, is glossy black with almost two dozen irregular light spots on the back and the antennae of the male are up to approximately twice the length of the body. It seems relatively harmless. But the energy of Anoplophora glabripennis, namely the Asian longhorn beetle, is destructive and its capacity for harm enormous.

The pest attacks various hardwood species such as the maple, the horse chestnut or the willow and the symptoms after the attack are obvious. Craters measuring up to two centimetres in diameter can be found eaten into the bark and leaking sap and visibly expelled borehole shavings on the trunk and branches. There are round exit holes of approximately ten millimetres in diameter or bark can be spotted that has been cropped from the branches. “These symptoms,” says Beat Forster, forest entomologist in WSL’s Forest Dynamics research unit, “are the infestation markers of the various developmental stages of the Asian longhorn beetle.” The sexually mature insect lays the eggs one at a time in the cambium (the growth layer) by chewing little craters in the bark. Initially, the larvae then feed off the bast, the living tissue of the tree below the bark. Later, they bore into the heartwood of the tree. After pupation, the adult beetles hatch out between May and September, leaving a circular hole as a mute witness. For the expert, this signals the highest state of alert because it is an indication that there are beetles in the vicinity looking for new nesting trees. The pest’s developmental cycle is a long two years; the flight radius less than half a kilometre. “If exit holes like this are discovered, it means that other trees may already be infested, with the next generation of the pest in development,” says Beat Forster, “What is more, the Asian longhorn beetle doesn’t just attack weakened or sick trees but also ones that are sound as a bell.”

For WSL, educating and passing on information, monitoring and advising are among the most important tasks within the scope of its statutory remit. “The consulting activities that are also enshrined in our performance mandate serve to benefit the one thousand or so foresters and forest owners as well as cantonal forestry protection officers in Switzerland,” says Roland Engesser, head of WSL’s Swiss Forest Protection group, “However, they are also increasingly in demand among tree surgeons, gardeners and private individuals.” The reason is simple: pest infestation can occur anywhere where plants are involved. The Asian longhorn beetle is an ideal example of WSL’s social role and the responsibility that goes with it.

The Asian longhorn beetle was first discovered in Switzerland in 2011 in Brünisried, Canton of Fribourg. The exotic beetle flying around with remarkably long antennae had caught the attention of a private individual and this information finally found its way to WSL. Thanks to the research institute’s international networking, the experts there were already aware that this unusual pest for these latitudes had turned up in neigh-
bouring countries and that it could therefore only be a question of time before the beetle made its presence felt in Switzerland as well. In Brünisried it had already attacked adolescent forest trees and hedges growing in the municipality’s gardens. A year later, exit holes were found in an avenue of trees in Winterthur, which upon closer inspection by WSL experts yielded the indisputable finding that a third generation of Asian longhorn beetles must already have infiltrated. As such, this infestation discovered in 2012 turned out to be the most significant event to date involving this pest. The WSL experts are of course also aware of the potential consequences of the disease for the affected trees. For individual branches weakened by the infestation there is the danger of wind damage; parts of the crown or entire trees can die.

This knowledge about the correct diagnosis is one of WSL’s core tasks. In the case of the Asian longhorn beetle, the expert talks about an “invasive insect” which in the first instance simply means that its reproduction or proliferation can increase markedly. The consequences are usually undesirable, be it that a tree population suffers economic or aesthetic damage or that an ecosystem goes off the rails. An additional factor in the case of the Asian longhorn beetle is that this – as its name suggests – is a pest that has been introduced from outside Switzerland: “A typical consequence of globalisation and increasingly internationally integrated trade flows,” remarks forest entomologist Beat Forster. This field therefore also includes knowledge of possible introductory routes. For example, the WSL experts were aware that this pest, originally indigenous to East Asia, had reached the USA in wood packaging from China and been introduced to Austria in 2001 and subsequently to other European countries. The federal and cantonal plant protection agencies also managed to reconstruct its invasion routes into Switzerland. It transpired that six years earlier, in Winterthur, standing on wooden pallets at exactly the site of the first infestation to be detected, there had been a consignment of Chinese granite blocks that were fitted as kerb stones at a public crossing.

“Once the initial locus of the disease has been pinpointed,” says Beat Forster, “In the case of the Asian longhorn beetle the only option is to destroy the infested trees immediately.” Whereas under its statutory terms of reference, WSL collates information about organisms harmful to the forest and makes this accessible to third parties alongside providing consultancy services, it is the Swiss Federal Plant Protection Service (EPSD) that is responsible for arranging specific defensive measures. Internationally, the Asian longhorn beetle is assessed to be a quarantine organism subject to notification and eradication. Infected plants are dug out, chopped up and finally burned; neighbouring trees are subjected to a rigorous inspection, including the use of sniffer dogs.

Education about forestry diseases and pests, as conducted by WSL since its inception, is and remains an ongoing task irrespective of whether the species is introduced or indigenous as every alien becomes indigenous at some point. According to the annals, as far back as 1880, five years before WSL’s first predecessor organisation was founded, the silver fir weevil had been introduced into Switzerland’s indigenous forests from the Caucasus. More than a century later, the spruce bark beetle, the best-known indigenous bark beetle, had infested entire swathes of forest in the Alpine valleys after Hurricane Lothar. “Freshly felled wood, broken tree trunks after a storm act as a breeding ground for bark beetles,” says Roland Engesser. For the head of the Swiss Forest Protection service at WSL, it is therefore obvious that in the current environment the education, consultancy and research work should if anything be stepped up. A good example of this is the ash dieback currently spreading in Switzerland. Caused by an introduced fungus first discovered in Poland in the 1990s, the pathogen now threatens ash stocks virtually throughout Europe. The global trade in all types of ornamental plants and commercial goods is the main reason for the increasing introduction and spread of new harmful organisms. Experience teaches us that once they are in the country, they will be encountered in the forest a few years later. Climate change and natural catastrophes further weaken the forest and where there is weakness, diseases and pests naturally spread. In a country such as Switzerland in which the protection forest plays an eminent role, monitoring and accumulating knowledge of organisms harmful to the forest and the spread of these assume a literally vital function. This represents far more than simply quenching the scientists’ thirst for knowledge. It is in the best sense a service to the population in a country with a naturally inhospitable topography.
Objective 9  |  Stronger role in society

Examples of the institutions

**ETH Zurich**

**Dialogue with secondary schools**

The second University Day for Zurich’s secondary schools at the beginning of February was an opportunity for 530 Zurich secondary school teachers to find out about current research at ETH and the University of Zurich. Following an awesome interdisciplinary opening event in the morning organised by the transdisciplinary ideas laboratory Collegium Helveticum run by ETH and the University of Zurich, the teachers visited the various institutes in the afternoon. There they were able to get an idea of how the fields have developed since they were students.

For a number of years now, ETH and the University of Zurich have been engaged in close dialogue with Zurich’s secondary schools within the HSGYM project. The common platform has established itself as a successful model for improving coordination between secondary school and university education. The Swiss Conference of Cantonal Ministers of Education (EDK) has therefore decided to apply this approach at national level as Good Practice.

**EPFL**

**A “moon” to protect a festival**

A 25-metre diameter balloon enabled the public and performers at the St Prex Classics festival to enjoy the music and dance sheltered from the rain. “Luna”, designed by the EPFL’s ALICE laboratory directed by Dieter Dietz, will return to Saint-Prex each summer. As from 2013, the balloon will be inflated with helium and will float above the historic town in good weather.

**PSI**

**Great cinema**

The Swiss Free-Electron X-Ray Laser SwissFEL, the new major research facility of the Paul Scherrer Institute, is to enter operation in 2016. The approximately 700-metre-long tunnel will produce extremely short X-ray light pulses in laser quality and in doing so enable completely new insights into substances and materials to be gained. However, SwissFEL has already been available for viewing since April 2012 in the form of a 3D cartoon film at the cinema of the psi forum Visitor Centre. The tradition of 3D films has been cultivated at PSI since the 1990s. It enables science to be imparted in a light-hearted manner while entertaining an audience that is by and large not greatly interested in research issues. In the third film produced by PSI, “Einmal Weltall und zurück” (A short trip into space and back), history is ahead of time: SwissFEL is already in operation. News of its outstanding qualities has spread extremely fast. Strange spies appear at PSI. Can Professor Femto prevent an act of sabotage?

**Empa**

**Handbook and guideline set standards**

A new standard work has been published under the auspices of Empa with the aim of standardising analytical-toxicological research into nano particles: the *Quality Handbook: Standard Procedures for Nanoparticle Testing*. Precise laboratory instructions on the manufacturing of defined nano particles and their analytics put the work in this field on a new footing and for the first time make one piece of work comparable with another. It was drawn up by the Nanommune consortium, an EU-funded group of prestigious European and US research institutes. In parallel with this, Empa, in conjunction with the Swiss Textile Federation, has brought out the “Nano Textiles” guideline. This is intended to make it easier for Swiss textile and clothing companies to access and handle nanotechnology safely. The guideline, a concrete development of the Precautionary Matrix for Synthetic Nanomaterials of the Federal Offices of Public Health (BAG) and for the Environment (BAFU), can thus serve as an example for other sectors.
A squat toilet with a closed water circuit for slums – this is the goal of Eawag project manager Tove Larsen.
One in every three people has no access to a completely hygienic toilet. The result is intestinal diseases and polluted groundwater in less developed countries. Within the scope of an international competition by the Bill & Melinda Gates Foundation, Eawag has developed a squat toilet that manages without a sewage system or external power. It is a self-contained, autonomous system in which water is reused and raw materials can be processed from human waste.

There it is, the very first model in the Eawag foyer in Dübendorf, Zurich. It is a design piece, more than two metres high and made of blue coloured polyethylene. It was dubbed the “poor man’s privy” in a TV feature. Eawag opted for the characteristically scientific style in its own press release: “Swiss researchers invent a new toilet”. This innovation is a response to an appeal launched by the American Bill & Melinda Gates Foundation under the slogan “Reinvent the Toilet!” In mid-2012, Eawag received a prize in recognition of its proposed solution.

Approximately 2.6 billion people, namely one in three of the world’s inhabitants, have no access to a hygienic toilet. The result is diarrhoea and infectious diseases as well as the constant risk of groundwater pollution. In order to help mitigate such degrading and illness-inducing conditions, the Microsoft founder and his wife wrote to 22 universities and research institutes in 2011 asking them to propose a solution. The competition requirements were challenging. The toilet to be developed should be usable in the poorest parts of the world, function without a sewage system or external power and cost no more than five US cents per day and person. Moreover, to enable valuable raw materials in urine and faecal matter to be processed, the toilet should be integrable into a material cycle.

A squat toilet as a status symbol
For project manager Tove Larsen it was clear that such a complex task could only be solved by an interdisciplinary team. She herself is a chemical engineer specialising in process engineering in the waste water sector. She gathered together additional researchers from different Eawag departments. Among them, in the guise of Austrian Harald Gründl, came a highly respected designer who usually works in furniture or shop design for clients such as Armani or Bulthaup. “A toilet with appealing looks is a status symbol in less developed countries,” says Tove Larsen, “and that is also why it is used.” And it was this aspect too that won Gründl’s Vienna design studio EOOS and Eawag the 40,000 US dollar prize. The Bill & Melinda Gates Foundation certificate says: “Special recognition for outstanding design of a toilet user interface”.

Concealed behind the attractive facade of the squat toilet dubbed the “Diversion” is to be found ingenious science and the fruits of intensively researched process engineering. Water filtration tests in a closed circuit were conducted at the Eawag laboratory. In the research institute’s cellar there are test facilities for extracting manure from human waste. So that everything meshes together in this stand-alone, self-contained system, each individual part of the whole must be fully thought through and refined.

“The key to this is the separation of urine and faeces,” says Tove Larsen, “because only this enables the efficient recovery of raw materials while at the same time reclaiming clean water within a closed circuit.” The project manager explained how this works using the exhibited model. Approximately one to one and a half litres of water are available for each use. This has to suffice for cleaning the toilet and washing the user’s hands – for the latter there is a small wash hand basin. There is also a small hand-held shower for efficient anal hygiene. As such, this separating toilet can be used in all cultural circles throughout the world.

A water reclamation circuit
All this is made possible by compact engineering. At the same time as a user of either sex pumps clean water into the toilet’s water tank by means of a small foot pedal, soiled water is led into a biological reactor on the reverse side. In this reactor, the water flows through a membrane filter under the force of gravity, cleaning it in the process. Additional electrolysis by a solar-powered electrode ensures that the end product really is sterile water and can thus be reused. “Perfectly hygienic water for washing hands is critical,” says Tove Larsen, “It also means that the separating toilet can be used by Muslims or Hindus who habitually use water for anal hygiene.”

But how can the cost of five US cents per day and person specified by the Gates Foundation be achieved? Here too, the team headed by Tove Larsen has come up with answers. The researchers developed ingenious transport logistics adapted to the booming hut settlements in developing countries. This involves a toilet, used by two families, being emptied twice a week by an employee. “The whole thing is a modular system comprising self-closing faeces containers and urine collection vessels capable of being efficiently collected by a vehicle. This makes collection just as safe hygienically as the toilet itself,” says Tove Larsen. “We have also tested processes enabling urine and faeces to be processed at decentralised installations into saleable products such as manure or biogas.” This therefore completes the economic cycle: indigenous entrepreneurs rent the toilets to local families. The purchase and maintenance of the toilet costing 500 US dollars are financed by the sale of the products derived from it.

The project is now entering the next round. The Gates Foundation has made more than one million US dollars available for further development. This money will enable production of a prototype to be tested in the slums of Kampala in Uganda in April 2014. “If this goes successfully then the next step will be a short production run,” says Tove Larsen.
View of the outlet tunnels of the bottom outlet of Kárahnjúkar power station in Iceland. The bottom outlet is equipped with a sluice that in case of emergency can be opened at full reservoir with almost 200 m of pressure. This important emergency outlet was therefore reconstructed and tested at EPFL with a model on the scale 1:10.
Fig. 9: Monitoring table

<table>
<thead>
<tr>
<th><strong>Number of doctoral and non-doctoral students at both Federal Institutes of Technology</strong>*</th>
<th>2000</th>
<th>2004</th>
<th>2008</th>
<th>2009</th>
<th>Reference values</th>
<th>2010</th>
<th>2011</th>
<th>Monitoring 2012</th>
</tr>
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<tbody>
<tr>
<td>Number of students</td>
<td>15,592</td>
<td>18,341</td>
<td>21,056</td>
<td>22,540</td>
<td>24,104</td>
<td>25,629</td>
<td>27,087</td>
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</tr>
<tr>
<td>Percentage women</td>
<td>22.9</td>
<td>26.7</td>
<td>29.1</td>
<td>29.4</td>
<td>29.7</td>
<td>29.6</td>
<td>29.4</td>
<td></td>
</tr>
<tr>
<td>Percentage foreigners</td>
<td>24.5</td>
<td>28.0</td>
<td>35.4</td>
<td>37.2</td>
<td>39.4</td>
<td>40.8</td>
<td>42.2</td>
<td></td>
</tr>
<tr>
<td>Diploma programme*</td>
<td>12,032</td>
<td>7,741</td>
<td>751</td>
<td>395</td>
<td>191</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Bachelor's programme*</td>
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<td>10,138</td>
<td>10,970</td>
<td>11,716</td>
<td>12,600</td>
<td>13,359</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of students</td>
<td>32.5</td>
<td>48.1</td>
<td>48.7</td>
<td>48.6</td>
<td>49.2</td>
<td>49.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master's programme*</td>
<td>4,649</td>
<td>5,326</td>
<td>5,997</td>
<td>6,568</td>
<td>6,981</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Postgraduate programme*</td>
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<td>644</td>
<td>695</td>
<td>676</td>
<td>792</td>
<td>801</td>
<td>911</td>
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</tr>
<tr>
<td>Professors at both Federal Institutes of Technology (in full–time equivalents)**</td>
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<td>565.0</td>
<td>619.4</td>
<td>649.4</td>
<td>686.6</td>
<td>715.1</td>
<td>744.0</td>
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</tr>
<tr>
<td>Percentage women</td>
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<td>6.6</td>
<td>10.6</td>
<td>10.7</td>
<td>10.9</td>
<td>11.7</td>
<td>11.8</td>
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<tr>
<td>Percentage foreigners</td>
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<td>55.1</td>
<td>61.8</td>
<td>63.3</td>
<td>64.2</td>
<td>67.2</td>
<td>66.7</td>
<td></td>
</tr>
<tr>
<td>Staff-student ratio (students per professor)**</td>
<td>31.9</td>
<td>32.5</td>
<td>34.0</td>
<td>34.7</td>
<td>35.1</td>
<td>35.8</td>
<td>36.3</td>
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<td>Bachelor's degrees awarded</td>
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<td>1,656</td>
<td>1,835</td>
<td>1,900</td>
<td>1,988</td>
<td>1,988</td>
<td>1,216</td>
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<td>Percentage women</td>
<td>27.1</td>
<td>28.0</td>
<td>29.2</td>
<td>28.2</td>
<td></td>
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</tr>
<tr>
<td>Percentage foreigners</td>
<td>16.8</td>
<td>18.0</td>
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<td>20.7</td>
<td></td>
<td></td>
<td>21.8</td>
<td></td>
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<tr>
<td>Master's degrees and diplomas awarded</td>
<td>1,702</td>
<td>1,723</td>
<td>1,978</td>
<td>1,988</td>
<td>1,898</td>
<td>1,898</td>
<td>2,159</td>
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<tr>
<td>Percentage women</td>
<td>20.3</td>
<td>23.0</td>
<td>27.0</td>
<td>28.7</td>
<td>28.7</td>
<td>29.6</td>
<td>30.8</td>
<td></td>
</tr>
<tr>
<td>Percentage foreigners</td>
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<td>15.1</td>
<td>21.3</td>
<td>25.2</td>
<td>31.4</td>
<td>33.9</td>
<td>36.0</td>
<td></td>
</tr>
</tbody>
</table>

**Teaching by research institutes**

| Number of hours taught p. a.                                                        | 10,145 | 15,569 | 15,713 | 15,950 | 16,170          | 14,735 |
| Bachelor's, master's and diploma theses supervised at research institutes           | 123    | 286    | 391    | 420    | 452             | 506    | 542    |
| Doctoral students at both Federal Institutes of Technology*                          | 2,963  | 3,987  | 4,823  | 5,173  | 5,408           | 5,660  | 5,836  |
| Percentage women                                                                     | 22.8   | 24.5   | 28.6   | 29.3   | 30.4            | 29.4   | 29.8   |
| Percentage foreigners                                                                | 50.7   | 57.1   | 62.7   | 64.5   | 67.2            | 69.1   | 70.6   |
| Doctorates (degrees awarded)                                                        | 731    | 719    | 832    | 962    | 986             | 1,027  | 1,095  |
| Percentage women                                                                     | 28.0   | 25.2   | 27.5   | 29.4   | 29.4            | 29.8   | 30.1   |
| Percentage foreigners                                                                | 54.9   | 59.1   | 59.6   | 59.7   | 66.7            | 67.6   | 63.8   |
| Doctoral students supervised at research institutes                                  | 239    | 545    | 700    | 717    | 741             | 782    | 807    |
| Percentage women                                                                     | 36.1   | 35.6   | 38.5   | 35.3   |                 | 34.6   |        |
| Percentage enrolled in the ETH Domain                                                | 66.1   | 66.9   | 69.2   | 65.7   |                 | 67.2   |        |
| Percentage enrolled at a foreign university                                         | 17.3   | 15.2   | 13.6   | 14.8   |                 | 13.5   |        |

**Third-party funding in m CHF**

| Percentage of total funding                                                          | 17.4   | 20.3   | 26.6   | 25.7   | 26.4            | 28.1   | 29.5   |
| of which SNSF                                                                        | 100.0  | 141.6  | 153.7  | 192.5  | 212.1           | 216.3  |        |
| of which CTI                                                                         | 28.3   | 26.1   | 40.7   | 33.1   | 21.3            | 53.9   |        |
| of which EU                                                                          | 49.0   | 97.7   | 114.2  | 110.4  | 128.3           | 126.5  |        |
| Patents                                                                              | 161    | 166    | 125    | 155    | 128             | 147    | 195    |
| Licences                                                                             | 84     | 111    | 178    | 176    | 178             | 194    | 230    |
| Spin-offs                                                                            | 36     | 25     | 46     | 45     | 38              | 40     | 38     |

**Federal financial contribution in m CHF**

| Percentage of total funding                                                          | 17.4   | 20.3   | 26.6   | 25.7   | 26.4            | 28.1   | 29.5   |
| of which SNSF                                                                        | 100.0  | 141.6  | 153.7  | 192.5  | 212.1           | 216.3  |        |
| of which CTI                                                                         | 28.3   | 26.1   | 40.7   | 33.1   | 21.3            | 53.9   |        |
| of which EU                                                                          | 49.0   | 97.7   | 114.2  | 110.4  | 128.3           | 126.5  |        |
| Patents                                                                              | 161    | 166    | 125    | 155    | 128             | 147    | 195    |
| Licences                                                                             | 84     | 111    | 178    | 176    | 178             | 194    | 230    |
| Spin-offs                                                                            | 36     | 25     | 46     | 45     | 38              | 40     | 38     |
Demand for skilled workers from the ETH Domain – number of graduates increases

The ETH Domain makes a significant contribution towards easing the shortage of specialists in the fields of the natural sciences and technology in Switzerland. This is confirmed by both the number of students graduating from both Federal Institutes of Technology, which increased significantly again in 2012, and the number of new students registering for bachelor's degrees, which has been rising for years. The development of new student numbers indicates that this positive trend is also set to continue in terms of students graduating. The rise in the number of new students is largely attributable to the growing share of students holding foreign qualifications at all degree levels. This growing group of students underlines the appeal of both Federal Institutes of Technology throughout the world.

Teaching
The total number of students at both Federal Institutes of Technology in Zurich and Lausanne continued to increase in 2012 and reached a total of 27,087 registered students, including 13,359 bachelor's students, 6,981 master's students and 5,836 doctoral students (see figs 9 and 12). This results in an overall year-on-year increase of 5.7%. While the growth in student numbers at ETH Zurich has slowed down in recent years, at EPFL it reached a peak of 10.2% year on year.

Development of teaching activities
The number of students at both Federal Institutes of Technology rose in all disciplines with the exception of slight decreases in the field of system-oriented natural sciences and in the humanities, social and political sciences (see fig. 10). Increases of 6.0% at bachelor's level, 6.3% at master's level, 3.1% at doctoral level and 13.7% among MAS/MBA students were observed (see fig. 13). At 5.7% overall, the increase in student numbers is well above the average of 2.4% recorded for tertiary institutions in Switzerland and reflects the prevailing attractiveness of courses at ETH Zurich and EPFL. Since 2004 both Federal Institutes of Technology have seen a total increase of 48.4% in the number of bachelor's, master's and diploma students (ETH Zurich: 46.2%, EPFL: 52.6%).

Both Federal Institutes of Technology have for several years been making major efforts to attract more women to the MINT subjects (mathematics, informatics, natural sciences and technology). Despite this, the proportion of women among students at bachelor's level remained virtually unchanged on the previous year and fell slightly at master's level from 29.2% in the previous year to 28.7%. Among doctoral students, the proportion of women levelled out at around 30% (see fig. 11).

The percentage of foreign students increased further at all study levels in 2012. At bachelor's level it rose to 29.5% and at master's level to 42.8%. Growth among doctoral students has slowed down and resulted in a percentage of foreign students of 70.6% at the end of the year. These students are mostly foreign-educated foreign nationals, i.e. foreign nationals who enter Switzerland for study purposes and who resided abroad when obtaining the relevant education qualifications. There was a strikingly sharper increase of 3.5% in foreign-educated foreign nationals at bachelor's level compared with previous years (2008–2011 around 1.5 percentage points annually: see fig. 12).

The number of students graduating at master's level rose significantly on 2011 as was also the case in the previous year (see fig. 14). Owing to the prevailing growth of new student numbers in recent years a further increase in the number of students graduating is to be expected in the future. This is a pleasing trend as MINT graduates remain in strong demand as skilled workers for the economy. This is also reflected in the study on MINT graduates and the labour market study conducted by the Federal Statistical Office (FSO) in 2012. One year after graduation, students of a MINT discipline are able to integrate better into the labour market than those of other disciplines. The unemployment rate among MINT specialists amounted to 3.8% while for graduates of other disciplines it came to 5.5% (2009 figures). MINT graduates also assumed management positions more often.

At 4.8%, the growth rate in the number of new bachelor's students remained at a consistently high level in 2012. Compared with 2005 it now comes to 50.3%. Above-average growth of 21.1% is to be observed for new admissions to the life sciences. Part of this is attributable to the founding of the new Health Sciences and Technology department at ETH Zurich. With a growth rate of 9.2%, the engineering sciences also outperformed the two preceding years (see fig. 15). For the third year in succession, a decrease (7.3%) can be observed in new admissions to architecture – for years a heavily oversubscribed discipline. The decline in new admissions to civil and geomatic engineering amounts to 2.8%, whereby it should be noted that there was an unusually high number of new entries here in 2011. New admissions are therefore still above the long-term trend.

In 2012, the number of professors working at the two Federal Institutes of Technology saw an increase similar to that of
### Fig. 10: Students including doctoral students by discipline

<table>
<thead>
<tr>
<th>Discipline</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>∆2011/2012 in %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Architecture</strong></td>
<td>1,941</td>
<td>2,035</td>
<td>2,113</td>
<td>2,226</td>
<td>2,388</td>
<td>2,553</td>
<td>2,743</td>
<td>2,994</td>
<td>3,098</td>
<td>3,177</td>
<td>79</td>
</tr>
<tr>
<td>ETH Zurich</td>
<td>1,271</td>
<td>1,289</td>
<td>1,329</td>
<td>1,385</td>
<td>1,502</td>
<td>1,679</td>
<td>1,868</td>
<td>1,900</td>
<td>1,950</td>
<td>1,950</td>
<td>50</td>
</tr>
<tr>
<td>EPFL</td>
<td>670</td>
<td>746</td>
<td>874</td>
<td>986</td>
<td>1,066</td>
<td>1,176</td>
<td>1,350</td>
<td>1,498</td>
<td>1,664</td>
<td>1,727</td>
<td>29</td>
</tr>
<tr>
<td><strong>Civil and Geomatic Engineering</strong></td>
<td>1,533</td>
<td>1,623</td>
<td>1,650</td>
<td>1,763</td>
<td>1,980</td>
<td>2,170</td>
<td>2,405</td>
<td>2,727</td>
<td>2,900</td>
<td>2,900</td>
<td>173</td>
</tr>
<tr>
<td>ETH Zurich</td>
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<td>833</td>
<td>910</td>
<td>975</td>
<td>1,041</td>
<td>1,278</td>
<td>1,434</td>
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<td>53</td>
</tr>
<tr>
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<td>866</td>
<td>955</td>
<td>1,046</td>
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<td>1,198</td>
<td>1,271</td>
<td>1,271</td>
<td>120</td>
</tr>
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<td>4,399</td>
<td>4,464</td>
<td>4,564</td>
<td>4,732</td>
<td>5,081</td>
<td>5,597</td>
<td>5,985</td>
<td>6,391</td>
<td>6,816</td>
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<tr>
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<td>2,771</td>
<td>2,859</td>
<td>3,033</td>
<td>3,301</td>
<td>3,677</td>
<td>3,901</td>
<td>4,167</td>
<td>4,341</td>
<td>174</td>
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<tr>
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<td>1,724</td>
<td>1,693</td>
<td>1,705</td>
<td>1,699</td>
<td>1,780</td>
<td>1,920</td>
<td>2,084</td>
<td>2,224</td>
<td>2,475</td>
<td>251</td>
</tr>
<tr>
<td><strong>Information and Comm. Technology</strong></td>
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<td>2,347</td>
<td>2,188</td>
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<td>1,939</td>
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<td>2,367</td>
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<td>1,017</td>
<td>999</td>
<td>977</td>
<td>981</td>
<td>1,029</td>
<td>1,082</td>
<td>1,083</td>
<td>1,083</td>
<td>1</td>
</tr>
<tr>
<td>EPFL</td>
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<td>962</td>
<td>925</td>
<td>1,041</td>
<td>1,171</td>
<td>1,284</td>
<td>1,284</td>
<td>113</td>
</tr>
<tr>
<td><strong>Exact and Natural Sciences</strong></td>
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<td>3,273</td>
<td>3,295</td>
<td>3,373</td>
<td>3,671</td>
<td>3,942</td>
<td>4,155</td>
<td>4,476</td>
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<td>304</td>
</tr>
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<td>1,935</td>
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<td>2,083</td>
<td>2,271</td>
<td>2,470</td>
<td>2,606</td>
<td>2,790</td>
<td>2,903</td>
<td>113</td>
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<tr>
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<td>1,287</td>
<td>1,290</td>
<td>1,400</td>
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<td>1,549</td>
<td>1,686</td>
<td>1,877</td>
<td>191</td>
</tr>
<tr>
<td><strong>Life Sciences</strong></td>
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<td>2,315</td>
<td>2,508</td>
<td>2,678</td>
<td>2,858</td>
<td>3,034</td>
<td>3,176</td>
<td>3,314</td>
<td>3,708</td>
<td>394</td>
</tr>
<tr>
<td>ETH Zurich</td>
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<td>1,832</td>
<td>1,951</td>
<td>2,040</td>
<td>2,128</td>
<td>2,255</td>
<td>2,472</td>
<td>2,551</td>
<td>2,823</td>
<td>2,727</td>
<td>107</td>
</tr>
<tr>
<td>EPFL</td>
<td>148</td>
<td>280</td>
<td>364</td>
<td>468</td>
<td>550</td>
<td>603</td>
<td>643</td>
<td>704</td>
<td>763</td>
<td>885</td>
<td>12</td>
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<tr>
<td><strong>System-Oriented Sciences</strong></td>
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<td>1,961</td>
<td>1,919</td>
<td>1,927</td>
<td>2,030</td>
<td>2,104</td>
<td>2,205</td>
<td>2,261</td>
<td>2,201</td>
<td>-60</td>
</tr>
<tr>
<td>ETH Zurich</td>
<td>2,002</td>
<td>1,929</td>
<td>1,961</td>
<td>1,919</td>
<td>1,927</td>
<td>2,030</td>
<td>2,104</td>
<td>2,205</td>
<td>2,261</td>
<td>2,201</td>
<td>-60</td>
</tr>
<tr>
<td><strong>Management, Technology and Economics</strong></td>
<td>519</td>
<td>540</td>
<td>488</td>
<td>529</td>
<td>626</td>
<td>778</td>
<td>819</td>
<td>859</td>
<td>833</td>
<td>870</td>
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</tr>
<tr>
<td>ETH Zurich</td>
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<td>394</td>
<td>339</td>
<td>350</td>
<td>433</td>
<td>534</td>
<td>562</td>
<td>592</td>
<td>584</td>
<td>583</td>
<td>-1</td>
</tr>
<tr>
<td>EPFL</td>
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<td>166</td>
<td>149</td>
<td>179</td>
<td>193</td>
<td>244</td>
<td>257</td>
<td>267</td>
<td>249</td>
<td>287</td>
<td>38</td>
</tr>
<tr>
<td><strong>Humanities, Social and Political Sciences</strong></td>
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<td>100</td>
<td>130</td>
<td>154</td>
<td>169</td>
<td>199</td>
<td>202</td>
<td>255</td>
<td>276</td>
<td>268</td>
<td>-8</td>
</tr>
<tr>
<td>ETH Zurich</td>
<td>70</td>
<td>100</td>
<td>130</td>
<td>154</td>
<td>169</td>
<td>199</td>
<td>202</td>
<td>255</td>
<td>276</td>
<td>268</td>
<td>-8</td>
</tr>
</tbody>
</table>

Number (headcount) of students including doctoral students at ETH Zurich and EPFL combined in nine subject areas. For description of counting method, see boxed text, p. 105.

### Fig. 11: Proportion of women among the students at ETH Zurich and EPFL

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>% in bachelor's programme</td>
<td>27.3</td>
<td>27.6</td>
<td>28.2</td>
<td>28.8</td>
<td>28.9</td>
<td>28.9</td>
<td>29.4</td>
<td>29.2</td>
</tr>
<tr>
<td>% in master's programme</td>
<td>21.9</td>
<td>25.0</td>
<td>26.8</td>
<td>28.0</td>
<td>29.0</td>
<td>29.0</td>
<td>29.2</td>
<td>28.7</td>
</tr>
<tr>
<td>% in doctoral programme</td>
<td>25.6</td>
<td>27.1</td>
<td>27.3</td>
<td>28.6</td>
<td>29.3</td>
<td>30.4</td>
<td>29.4</td>
<td>29.8</td>
</tr>
<tr>
<td>% in MAS/MBA*</td>
<td>29.0</td>
<td>30.3</td>
<td>31.3</td>
<td>34.2</td>
<td>34.8</td>
<td>37.0</td>
<td>37.1</td>
<td>36.7</td>
</tr>
</tbody>
</table>

*Continuing education programmes MAS/MBA: Master of Advanced Studies/Master of Business Administration*

Development of the proportion of women at the various study levels since 2005. For description of counting method, see boxed text, p. 105.
previous years. As this increase could not keep up with rising student numbers, it had a negative effect on the supervision ratio, which rose from an average 35.8 students per professor to 36.4 students per professor. However, the supervision ratio does not represent the entirety of supervision provided but primarily serves as an indicator to aid comparison with the published ratios of foreign universities. A large portion of supervision is provided by senior scientists and other scientific personnel employed by the two Federal Institutes of Technology and the four research institutes. If the relevant personnel categories are incorporated into the calculation, the “extended” supervision ratio amounts to fewer than 25 students per teacher on average, but has also worsened from year to year since 2007 (see fig. 16).

Once again in 2012, the significant involvement in teaching on the part of the research institutes of the ETH Domain is reflected in impressive figures (see fig. 17). Scientists from these institutes provided a total of 14,735 hours of teaching at the two Federal Institutes of Technology, at universities and at universities of applied sciences. Teaching performance therefore seems to be levelling out at around 15,000 hours. The research institutes also (co-)financed 96 joint professorships with both Federal Institutes of Technology and with other Swiss and foreign universities. It is not least thanks to this involvement in teaching that the research institutes are able to attract a considerable number of students for application-oriented papers. This was reflected by the 807 doctoral theses and 542 bachelor’s and master’s theses that were supervised by researchers from the research institutes in 2012.

Knowledge and technology transfer
In total, ETH Zurich, EPFL and the research institutes applied for 750 patents, concluded over 950 licence agreements and founded more than 200 spin-offs in the 2008–2012 performance period. The average annual performance between 2008 and 2011 of around 140 patents and 180 licence agreements was significantly exceeded in 2012: The institutions of the ETH Domain applied for a total of 195 patents and concluded 230 licence agreements in the reporting year. They also founded 38 spin-offs, around the same number as in the preceding two years (see fig. 18).

The licenses indicator includes licence agreements for more extensive software packages. The figure reported may display larger fluctuations due to periodic releases of new licences. The sharp increase in licence agreements in the reporting year is partly due to this factor.

Compared with the 2004–2007 performance period, the average annual number of new patents (exclusively priority applications) stayed almost unchanged in the period from 2008 to 2012 and the number of licence agreements rose by 28 %. The number of spin-offs founded each year seems to be levelling out at around 40. Compared with the 2004–2007 period, the number of newly founded companies increased by an annual average of 58 % in the 2008–2012 period.

The KTT activities of the ETH Domain displayed a positive trend in the 2008–2012 performance period, to which both Federal Institutes of Technology and the research institutes all contributed to varying extents – a fact which reflects the different tasks and complementary orientation of the institutions of the ETH Domain.

**Reporting methods: How counting was performed**

All student numbers and indicators derived from them are based on headcounts; in cases of simultaneous enrolment in several courses or levels of study, the prioritised course (the prioritised level) is counted. The student numbers include guest students and exchange students, but not physical education teachers (ETH Zurich until 2008). The education of career military officers at ETH Zurich has been implemented as a bachelor’s course since 2003. Students in the introductory mathematics course (CMS students) at EPFL are not included. Master’s students taking the joint master’s course in nuclear engineering, which is offered by the two Federal Institutes of Technology collectively, are counted at both Federal Institutes of Technology.

In the academic achievement report (including monitoring table, see p. 102) all professors at both Federal Institutes of Technology who are involved directly or indirectly in the teaching and supervision of students are counted (in full-time equivalents), including members of Executive Boards at professor level, as well as dual professorships, whereas professors who have an employment contract with ETH Zurich and/or EPFL are included in the personnel reporting (see p. 116 f.). Dual professorships financed by a partner tertiary institution are therefore only included in the academic achievement report. In order to calculate the supervision ratio, the full professors, associate professors and all assistant professors, including endowed professorships, are counted. The senior scientists, Maîtres d’enseignement et de recherche and permanently employed scientific personnel included in the “extended” supervision ratio belong to senior management (functional levels 10–13).
### Fig. 12: Proportion of foreigners among the students at ETH Zurich and EPFL

<table>
<thead>
<tr>
<th>Year</th>
<th>ETH Zurich</th>
<th>EPFL</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>2,047</td>
<td>1,354</td>
<td>3,401</td>
</tr>
<tr>
<td>2004</td>
<td>3,794</td>
<td>2,175</td>
<td>5,969</td>
</tr>
<tr>
<td>2005</td>
<td>5,350</td>
<td>3,168</td>
<td>8,518</td>
</tr>
<tr>
<td>2006</td>
<td>5,982</td>
<td>3,104</td>
<td>9,086</td>
</tr>
<tr>
<td>2007</td>
<td>6,332</td>
<td>3,084</td>
<td>9,416</td>
</tr>
<tr>
<td>2008</td>
<td>6,896</td>
<td>3,242</td>
<td>10,138</td>
</tr>
<tr>
<td>2009</td>
<td>7,344</td>
<td>3,626</td>
<td>10,970</td>
</tr>
<tr>
<td>2010</td>
<td>7,757</td>
<td>3,959</td>
<td>11,716</td>
</tr>
<tr>
<td>2011</td>
<td>8,236</td>
<td>4,364</td>
<td>12,600</td>
</tr>
<tr>
<td>2012</td>
<td>8,668</td>
<td>4,891</td>
<td>13,559</td>
</tr>
</tbody>
</table>

*Fig. 12 shows the proportion of foreigners among the students at ETH Zurich and EPFL from 2003 to 2012. The data includes foreign-educated foreign nationals.*

### Fig. 13: Students according to study level

<table>
<thead>
<tr>
<th>Study Level</th>
<th>2003</th>
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<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>△2011/2012 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor's programme</td>
<td>3,401</td>
<td>5,969</td>
<td>8,518</td>
<td>9,086</td>
<td>9,416</td>
<td>10,138</td>
<td>10,970</td>
<td>11,716</td>
<td>12,600</td>
<td>13,359</td>
<td>759 6.0</td>
</tr>
<tr>
<td>ETH Zurich</td>
<td>2,047</td>
<td>3,794</td>
<td>5,350</td>
<td>5,982</td>
<td>6,332</td>
<td>6,896</td>
<td>7,344</td>
<td>7,757</td>
<td>8,236</td>
<td>8,668</td>
<td>232 2.8</td>
</tr>
<tr>
<td>EPFL</td>
<td>1,354</td>
<td>2,175</td>
<td>3,168</td>
<td>3,104</td>
<td>3,084</td>
<td>3,242</td>
<td>3,626</td>
<td>3,959</td>
<td>4,364</td>
<td>4,891</td>
<td>527 12.1</td>
</tr>
<tr>
<td>Master's programme</td>
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<td>3,909</td>
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<td>5,326</td>
<td>5,997</td>
<td>6,568</td>
<td>6,981</td>
<td>4,13</td>
<td>6.3</td>
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<tr>
<td>ETH Zurich</td>
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<td>4,607</td>
<td>4,755</td>
<td>148</td>
<td>3.2</td>
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</tr>
<tr>
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<td>1,633</td>
<td>1,607</td>
<td>1,621</td>
<td>1,577</td>
<td>1,716</td>
<td>1,961</td>
<td>2,226</td>
<td>265</td>
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<td>751</td>
<td>395</td>
<td>191</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
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<td>7,033</td>
<td>5,252</td>
<td>3,453</td>
<td>2,324</td>
<td>1,316</td>
<td>751</td>
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<td>2,489</td>
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<tr>
<td>Doctoral programme</td>
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<td>3,987</td>
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<td>4,372</td>
<td>4,823</td>
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<td>5,408</td>
<td>5,660</td>
<td>5,836</td>
<td>176 3.1</td>
</tr>
<tr>
<td>ETH Zurich</td>
<td>2,528</td>
<td>2,613</td>
<td>2,674</td>
<td>2,792</td>
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<td>3,199</td>
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<td>1,374</td>
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<td>1,785</td>
<td>1,901</td>
<td>1,975</td>
<td>2,041</td>
<td>66 3.3</td>
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<tr>
<td>MAS/MBA*</td>
<td>588</td>
<td>644</td>
<td>503</td>
<td>528</td>
<td>565</td>
<td>695</td>
<td>676</td>
<td>792</td>
<td>801</td>
<td>911</td>
<td>110 13.7</td>
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<td>336</td>
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<td>502</td>
<td>606</td>
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<tr>
<td>EPFL</td>
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<td>159</td>
<td>192</td>
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<td>259</td>
<td>174</td>
<td>186</td>
<td>142</td>
<td>148</td>
<td>6 4.2</td>
</tr>
</tbody>
</table>

*Continuing education programmes MAS/MBA: Master of Advanced Studies / Master of Business Administration.*

Number (headcount) of students according to study level. For description of counting method, see boxed text, p. 105.
Fig. 14: Degrees awarded according to study level

<table>
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<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>△2011/2012</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>Bachelor's</td>
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<td>1,452</td>
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<td>1,835</td>
<td>1,900</td>
<td>1,988</td>
<td>2,216</td>
<td>228</td>
<td>11.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETH Zurich</td>
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<td>381</td>
<td>838</td>
<td>1,086</td>
<td>1,203</td>
<td>1,283</td>
<td>1,304</td>
<td>1,447</td>
<td>143</td>
<td>11.0</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>658</td>
<td>614</td>
<td>570</td>
<td>632</td>
<td>617</td>
<td>678</td>
<td>769</td>
<td>85</td>
<td></td>
<td>12.4</td>
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<td></td>
</tr>
<tr>
<td>Master's/diploma</td>
<td>1,647</td>
<td>1,723</td>
<td>1,783</td>
<td>1,807</td>
<td>1,949</td>
<td>1,978</td>
<td>1,988</td>
<td>1,898</td>
<td>2,159</td>
<td>2,320</td>
<td>161</td>
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<td>1,203</td>
<td>1,309</td>
<td>1,317</td>
<td>1,370</td>
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<td>604</td>
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<td>628</td>
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<td>Doctorates</td>
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<td>774</td>
<td>861</td>
<td>852</td>
<td>962</td>
<td>986</td>
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<td>1,095</td>
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<td>569</td>
<td>572</td>
<td>651</td>
<td>650</td>
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<td>199</td>
<td>248</td>
<td>268</td>
<td>292</td>
<td>280</td>
<td>311</td>
<td>336</td>
<td>331</td>
<td>348</td>
<td>17</td>
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<td></td>
</tr>
<tr>
<td>MAS/MBA</td>
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<td>435</td>
<td>461</td>
<td>332</td>
<td>471</td>
<td>336</td>
<td>400</td>
<td>283</td>
<td>301</td>
<td>256</td>
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<td>-15.0</td>
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<tr>
<td>ETH Zurich</td>
<td>177</td>
<td>237</td>
<td>233</td>
<td>226</td>
<td>213</td>
<td>213</td>
<td>239</td>
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<td>160</td>
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<td>228</td>
<td>106</td>
<td>258</td>
<td>123</td>
<td>161</td>
<td>98</td>
<td>72</td>
<td>26</td>
<td>-26</td>
<td>-26.5</td>
</tr>
</tbody>
</table>

New admissions to bachelor’s courses at the two Federal Institutes of Technology since 2005 according to subject area: there is no bachelor’s course in management, technology and economics; in humanities, social and political sciences, there is only one bachelor’s course (for career military officers) and student numbers are low, so no statistically relevant statement can be made regarding the trend of new admissions. For description of counting method, see boxed text, p. 105.

Fig. 15: New admissions to bachelor’s courses at ETH Zurich and EPFL

<table>
<thead>
<tr>
<th></th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>△2011/2012</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
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<td>578</td>
<td>534</td>
<td>629</td>
<td>689</td>
<td>671</td>
<td>646</td>
<td>599</td>
<td>-47</td>
<td>-7.3</td>
</tr>
<tr>
<td>Civil and Geomatic Engineering</td>
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<td>377</td>
<td>379</td>
<td>459</td>
<td>513</td>
<td>556</td>
<td>638</td>
<td>620</td>
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<td>-2.8</td>
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<td>847</td>
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<td>1,200</td>
<td>1,183</td>
<td>1,240</td>
<td>1,354</td>
<td>114</td>
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</tr>
<tr>
<td>Information and Comm. Technology</td>
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<td>307</td>
<td>278</td>
<td>325</td>
<td>396</td>
<td>425</td>
<td>448</td>
<td>465</td>
<td>17</td>
<td>3.8</td>
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<tr>
<td>Exact and Natural Sciences</td>
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<td>623</td>
<td>647</td>
<td>787</td>
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<td>832</td>
<td>954</td>
<td>986</td>
<td>32</td>
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<td>486</td>
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<td>529</td>
<td>578</td>
<td>700</td>
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<td>321</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Humanities, Social and Political Sciences</td>
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<td>13</td>
<td>17</td>
<td>23</td>
<td>18</td>
<td>13</td>
<td>13</td>
<td>32</td>
<td>12</td>
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<tr>
<td>Total</td>
<td>3,375</td>
<td>3,482</td>
<td>3,400</td>
<td>4,052</td>
<td>4,425</td>
<td>4,527</td>
<td>4,838</td>
<td>5,072</td>
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New admissions to bachelor’s courses at ETH Zurich and EPFL.

Fig. 16: Supervision ratios at ETH Zurich and EPFL

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<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Supervision ratio</th>
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</thead>
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<td>32.7</td>
<td>32.9</td>
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<td>34.7</td>
<td>35.1</td>
<td>35.8</td>
<td>36.4</td>
<td>32.6</td>
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<tr>
<td>in bachelor’s/master’s programme</td>
<td>24.7</td>
<td>24.3</td>
<td>24.6</td>
<td>24.5</td>
<td>24.0</td>
<td>25.1</td>
<td>25.7</td>
<td>26.1</td>
<td>26.8</td>
<td>27.3</td>
<td>24.7</td>
</tr>
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<td>in doctoral programme</td>
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<td>7.2</td>
<td>7.2</td>
<td>7.2</td>
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<td>8.0</td>
<td>7.9</td>
<td>7.9</td>
<td>7.8</td>
<td>6.8</td>
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<td>20.4</td>
<td>21.9</td>
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<td>23.0</td>
<td>23.8</td>
<td>24.5</td>
<td>19.5</td>
</tr>
<tr>
<td>in bachelor’s/master’s programme</td>
<td>14.8</td>
<td>15.3</td>
<td>15.2</td>
<td>15.2</td>
<td>15.3</td>
<td>16.1</td>
<td>16.6</td>
<td>17.1</td>
<td>17.8</td>
<td>18.4</td>
<td>14.8</td>
</tr>
<tr>
<td>in doctoral programme</td>
<td>4.1</td>
<td>4.5</td>
<td>4.4</td>
<td>4.5</td>
<td>4.6</td>
<td>5.0</td>
<td>5.1</td>
<td>5.2</td>
<td>5.2</td>
<td>5.3</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Supervision ratios at the two Federal Institutes of Technology. The ratio is based on the total number of students overall (i.e. including doctoral and Master of Advanced Studies / Master of Business Administration students) or the total number of students studying in a bachelor’s/master’s course or for a doctorate. For information on the categories of professor and other persons involved in teaching who are included in calculation of the supervision ratio (“extended supervision ratio”), see boxed text, p. 105.
Academic achievement report

Fig. 17: Teaching provided by research institutes

Teaching activities of the research institutes of the ETH Domain. Left axis: number of supervised bachelor’s, master’s, diploma and doctoral theses; right axis: number of teaching hours given per year.

Fig. 18: Knowledge and technology transfer in the ETH Domain

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
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<tr>
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<td>142</td>
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<td>155</td>
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<td>40</td>
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<td>33</td>
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<td>44</td>
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<td>75</td>
</tr>
<tr>
<td>Research institutes</td>
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<td>38</td>
<td>33</td>
<td>39</td>
<td>27</td>
<td>21</td>
<td>33</td>
<td>18</td>
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<td>112</td>
<td>101</td>
<td>92</td>
<td>94</td>
<td>99</td>
<td>164</td>
</tr>
</tbody>
</table>

Knowledge and technology transfer activities of the institutions of the ETH Domain using the indicators of patents (priority applications only) and licences (including technology transfer agreements) as well as newly founded companies (spin-offs).

Rankings of tertiary institutions confirm quality of both Federal Institutes of Technology

Both Federal Institutes of Technology occupy top positions in Europe in the international rankings of tertiary institutions and were able to further improve these placings again in 2012. ETH Zurich has consolidated its position as by far the best continental European university and, compared with the previous year, EPFL has once again made significant advances in most rankings and categories. According to the QS Ranking, eight universities from the UK plus ETH Zurich in fifth place, and EPFL in ninth place, make up the 10 best European universities. The THE Ranking puts ETH Zurich in fourth position and EPFL in eighth position, where they are likewise surrounded by universities from the UK. Universities from other European countries only follow on afterwards.

Of the 20 best universities contained in the 2012 rankings, three quarters are in North America (USA and Canada) and the rest are in Europe. Around one third of the 100 best universities are from North America and Europe respectively, around one fifth are from Asia and just under one tenth are from Oceania.
Rankings observed worldwide

In most worldwide rankings – Times Higher Education World University Rankings (THE), QS Top Universities (QS), Academic Ranking of World Universities (ARWU, Shanghai Ranking) – publicly available (but in some cases also specially gathered) statistical data on teaching and supervision, research, publishing activity, third-party funding and international networking are incorporated into the calculation of indicators. These indicators are ultimately used to determine a ranking order for universities worldwide, for certain regions, or for individual disciplines. In addition, there are also rankings (e.g. the Leiden Ranking) which rely solely on the universities’ research activities based on the number of publications and the frequency with which these publications are cited, and do not take other aspects such as teaching into consideration.

Of the top 400 universities, 45 % are in Europe and 25 % in North America. The Asian share of universities comes to just under 20 % and around 10 % are accounted for by Oceania, Latin America and Africa. Both Asian and European universities have improved their rankings in recent years. Rankings have deteriorated above all among North American universities.

Rankings of tertiary institutions provide an easy means of gaining a rapid impression of the performance of an academic institution when compared internationally. However, the increasing worldwide attention they are receiving should not be allowed to obscure the fact that, for methodical reasons, their informative value is limited: the indicators drawn upon differ from each other and they can change over the years. Different rankings can therefore produce different results, although the key trends are nevertheless comparable.
Sharp increase in second-party resources and third-party funding

ETH Zurich, the Paul Scherrer Institut and Empa were very successful in securing additional second-party resources and third-party funding. EPFL has the highest share of total revenue made up of second-party resources and third-party funding. In terms of second-party funding there was a particularly large rise in revenue from the competitive research funding provided by the Commission for Technology and Innovation (CTI) resulting from the package of measures to offset the strength of the Swiss franc.

Revenue
Total revenues in 2012 came to 3,073.4m CHF. They are comprised of direct contributions from the Federal Government (internal resources), second-party resources and third-party funding as well as service and other revenues.

Internal resources comprise the federal financial contribution and the investment credit for buildings and in 2012 amounted to a total of 2,175.4m CHF which represents a 1.4% decline on the previous year. In order to calculate the entire Federally funded share of the ETH Domain’s financing, the so-called second-party resources (see next paragraph) must be added.

Second-party resources are competitively acquired resources from national organisations for the funding of research (Swiss National Science Foundation, Commission for Technology and Innovation), resources for research projects from Federal offices (government-funded research) and resources from the European Research Framework Programmes (funding from the EU is listed under second-party resources because Switzerland co-finances EU research funding). These funds also come indirectly from the Federal Government or its organisations. Second-party resources amounted to 477.3m CHF in 2012 and constituted 15.5% of total revenues. In terms of second-party resources, the sharp increase in revenues from the CTI (+ 32.6m CHF; + 153.2%) is particularly worthy of mention and is largely due to the fact that, as part of the measures to counter the strength of the Swiss franc, the CTI was able to deploy 100m CHF and finance more projects. The researchers of the ETH Domain succeeded in obtaining competitive funding from the CTI within the scope of this package of measures.

Both Federal Institutes of Technology and the four research institutes also obtain financing via so-called third-party funding if this is compatible with their tasks. Third-party funding includes financing from private sources (cooperation with industry, donations and bequests) as well as funds arising from cooperation with cantons and municipalities. Third-party funding amounted to 292.7m CHF in 2012 and made up 9.5% of total revenues. They rose by 37.7%.

Please note
The financial key figures chapter comprises a longitudinal and cross-comparison of the figures and changes for the ETH Domain (both Federal Institutes of Technology, the four research institutes and the ETH Board). For more detailed commentary on the 2012 annual financial statement of the ETH Domain, please consult the enclosed special accounts of the Federal Government.

Special mention must be made of the inflow of 50.0m CHF in funds (from a total of around 100m CHF) to ETH Zurich from the legacy of Branco Weiss for the “Society in Science – The Branco Weiss Fellowship” talent promotion programme.

Service and other revenues include, for instance, income from user fees (tuition fees, licences/patents), from the provision of services, from sales, any reimbursements and revenue from real estate. Altogether, the resulting revenues amounted to 129.4m CHF after consolidation (4.2% of total revenues). The decrease of 66.0m CHF is attributable to the discontinuation of the capitalisation of internally produced assets by PSI, among other things.

The financial result comprises financial income less financial expenditure and amounted to 12.9m CHF in the reporting year. The financial result is strongly dependent on the current economic conditions and the situation on the stock market. Financial income mainly comprises income from the investment of third-party funding (including capital gains) and income from interest on second-party resources. Financial expenditure comprises interest paid and fees as well as any book and capital losses.
Expenditure
Personnel and materials expenditure as well as investments in real estate, movables and intangible assets are financed with the available funds. Operating expenses increased by a moderate 1.8% to 3,038.2m CHF.

At 62.8%, personnel expenditure accounts for the largest share of total expenditure in the ETH Domain. Compared with the previous year, it increased by 65.1m CHF (3.5%) in 2012. The different growth rates of the two Federal Institutes of Technology and the four research institutes reflect institution-specific developments. The percentage growth rates vary between minus 1.5% and plus 5.4%.

The number of employees (excluding trainees) increased by 434 FTEs in 2012 compared with the previous year. This growth comprises the increase in positions financed by the financial contribution (157) on the one hand and the increase in positions financed by second-party resources and third-party funding (277) on the other.

Personnel expenditure includes wages and salaries, employer contributions to social insurance schemes (AHV, ALV, IV, EO, MuV; employee benefits insurance; accident and health insurance) and other personnel expenditure. Among other things, the latter includes contributions to childcare, training and continuing education, job advertisements, recruitment agency fees, interest rate reductions and compensation for the expenses of employees abroad. The ETH Board decided to compensate for the year-end inflation of 0.4% as of 1 January 2012. As in previous years, an additional 1.2% of the total payroll was provided for the adjustment of salaries according to experience and performance within the new salary system, although this was partly balanced out by fluctuation gains.

The ETH Domain had to pay an additional employer contribution to the pension fund (Publica) of 3.0m CHF (2011: 6.5m CHF) because, according to the Federal Act on the Personnel of the Swiss Confederation, the employer contributions for pensions, risk insurance and bridging pensions must add up to at least 11% but no more than 13.5% of the pensionable payroll. As early retirements remained at a low level in 2012, hardly any new bridging pensions had to be financed and the employer contributions amounted to less than the minimum value of 11%.

<table>
<thead>
<tr>
<th>In m CHF (figures rounded)</th>
<th>2004</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>∆2011/2012</th>
<th>%</th>
</tr>
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<td>1,853.6</td>
<td>1,949.4</td>
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<td>1,984.5</td>
<td>2,025.9</td>
<td>2,040.7</td>
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<td>173.8</td>
<td>170.9</td>
<td>146.4</td>
<td>145.4</td>
<td>181.3</td>
<td>134.7</td>
<td>-46.6</td>
<td>-25.7</td>
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<td>54.0</td>
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<td>54.0</td>
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<td>51.9</td>
<td>50.1</td>
<td>53.5</td>
<td>54.0</td>
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<td>92.1</td>
<td>96.9</td>
<td>99.4</td>
<td>97.9</td>
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<td>89.4</td>
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<td>96.0</td>
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<td>29.8</td>
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<tr>
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<td>52.3</td>
<td>51.5</td>
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<td>53.3</td>
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<td>50.8</td>
<td>43.0</td>
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<td>50.6</td>
<td>50.4</td>
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<td>13.9</td>
<td>1.5</td>
<td>8.5</td>
<td>3.1</td>
<td>2.7</td>
<td>2.3</td>
<td>-0.4</td>
<td>-16.3</td>
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<td>44.3</td>
<td>58.4</td>
<td>50.6</td>
<td>66.2</td>
<td>15.6</td>
<td>30.7</td>
</tr>
<tr>
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<td>15.5</td>
<td>23.9</td>
<td>44.3</td>
<td>58.4</td>
<td>50.6</td>
<td>66.2</td>
<td>15.6</td>
<td>30.7</td>
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*Credit transfer

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<td>162.2</td>
<td>133.7</td>
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<td>Transfer of remaining credit from previous year</td>
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<td>20.0</td>
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<td>Remaining credit</td>
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<td>-20.0</td>
<td>-0.9</td>
<td>-</td>
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## Financial Key Figures

**Fig. 21: Project-oriented second-party resources, third-party funding, service revenues and financial results**

<table>
<thead>
<tr>
<th>ETH Domain consolidated</th>
<th>2004</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Δ2011/2012 absolute</th>
<th>%</th>
</tr>
</thead>
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<td>ETH Domain consolidation</td>
<td>-0.2</td>
<td>-6.7</td>
<td>-7.9</td>
<td>-6.7</td>
<td>-9.4</td>
<td>-14.7</td>
<td>-14.3</td>
<td>0.4</td>
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<tr>
<td>Changes in second-party resources and third-party funding</td>
<td>-34.0</td>
<td>-21.4</td>
<td>-149.3</td>
<td>-95.0</td>
<td>-108.6</td>
<td>-52.3</td>
<td>-99.4</td>
<td>-47.1</td>
<td>90.1</td>
</tr>
<tr>
<td>ETH Domain</td>
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<td>558.7</td>
<td>706.4</td>
<td>710.2</td>
<td>763.6</td>
<td>863.2</td>
<td>912.3</td>
<td>49.1</td>
<td>5.7</td>
</tr>
<tr>
<td>Second-party resources</td>
<td>241.6</td>
<td>279.0</td>
<td>323.8</td>
<td>372.5</td>
<td>408.5</td>
<td>445.2</td>
<td>477.3</td>
<td>32.1</td>
<td>7.2</td>
</tr>
<tr>
<td>Third-party funding</td>
<td>104.3</td>
<td>146.9</td>
<td>230.5</td>
<td>188.3</td>
<td>210.3</td>
<td>212.6</td>
<td>292.7</td>
<td>80.1</td>
<td>37.7</td>
</tr>
<tr>
<td>Service revenues</td>
<td>97.4</td>
<td>116.3</td>
<td>144.4</td>
<td>136.4</td>
<td>137.5</td>
<td>195.4</td>
<td>129.4</td>
<td>-66.0</td>
<td>-33.8</td>
</tr>
<tr>
<td>Financial result</td>
<td>10.8</td>
<td>16.5</td>
<td>7.8</td>
<td>13.1</td>
<td>7.3</td>
<td>10.0</td>
<td>12.9</td>
<td>3.0</td>
<td>29.7</td>
</tr>
</tbody>
</table>

| ETH Zurich | 198.6 | 268.6 | 311.0 | 319.6 | 356.4 | 362.0 | 428.1 | 66.1 | 18.3 |
| Second-party resources | 100.4 | 131.9 | 131.1 | 167.7 | 190.2 | 195.0 | 211.2 | 16.2 | 8.3 |
| Third-party funding | 46.7 | 70.3 | 112.2 | 80.4 | 93.9 | 83.7 | 141.2 | 57.5 | 68.7 |
| Service revenues | 46.0 | 57.7 | 67.0 | 64.0 | 66.6 | 76.7 | 68.6 | -8.0 | -10.5 |
| Financial result | 5.4 | 8.7 | 0.8 | 7.6 | 5.8 | 6.6 | 7.1 | 4.0 | 6.3 |

| EPFL | 140.6 | 162.9 | 241.7 | 221.7 | 245.5 | 263.5 | 270.0 | 65.2 | 2.5 |
| Second-party resources | 91.1 | 88.3 | 131.6 | 127.3 | 136.7 | 159.7 | 162.3 | 2.5 | 1.6 |
| Third-party funding | 17.8 | 40.2 | 63.6 | 56.3 | 72.7 | 72.0 | 75.5 | 3.5 | 4.8 |
| Service revenues | 28.6 | 30.6 | 42.2 | 34.3 | 34.6 | 29.2 | 29.8 | 0.6 | 2.0 |
| Financial result | 3.1 | 3.8 | 4.3 | 3.9 | 4.1 | 2.6 | 2.5 | -0.1 | -3.5 |

| PSI | 49.6 | 55.6 | 74.9 | 80.9 | 73.1 | 137.0 | 109.6 | -27.4 | -20.0 |
| Second-party resources | 14.7 | 22.2 | 18.0 | 23.7 | 28.4 | 33.2 | 38.7 | 5.5 | 16.7 |
| Third-party funding | 26.7 | 19.9 | 36.2 | 35.6 | 23.9 | 36.1 | 55.6 | 19.4 | 53.8 |
| Service revenues | 6.5 | 11.9 | 19.1 | 20.7 | 20.2 | 67.3 | 12.1 | -55.2 | -82.1 |
| Financial result | 1.7 | 1.6 | 1.6 | 0.8 | 0.6 | 0.4 | 3.3 | 2.8 | n/a |

| WSL | 18.6 | 16.8 | 20.9 | 22.7 | 23.1 | 25.1 | 24.5 | -0.7 | -2.7 |
| Second-party resources | 14.0 | 10.7 | 13.9 | 16.7 | 16.8 | 18.1 | 17.6 | -0.5 | -3.0 |
| Third-party funding | 3.2 | 4.1 | 5.2 | 4.5 | 5.1 | 4.7 | 4.6 | -0.1 | -3.2 |
| Service revenues | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 2.3 | 2.3 | -0.0 | -0.8 |
| Financial result | 0.1 | 0.4 | 0.3 | 0.0 | -0.4 | 0.0 | 0.0 | 0.0 | n/a |

| Empa | 36.7 | 40.9 | 43.3 | 51.4 | 49.4 | 56.7 | 62.0 | 5.3 | 9.3 |
| Second-party resources | 14.6 | 17.8 | 20.4 | 27.3 | 26.0 | 26.8 | 35.5 | 8.7 | 32.6 |
| Third-party funding | 7.4 | 8.9 | 8.6 | 8.7 | 10.7 | 11.8 | 10.6 | -1.2 | -10.3 |
| Service revenues | 14.2 | 13.3 | 13.9 | 14.8 | 12.9 | 18.1 | 15.8 | -2.3 | -12.5 |
| Financial result | 0.5 | 0.9 | 0.3 | 0.5 | -0.2 | -0.0 | 0.0 | 0.0 | n/a |

| Eawag | 10.0 | 13.2 | 14.6 | 13.9 | 16.1 | 18.7 | 18.1 | -0.6 | -3.3 |
| Second-party resources | 6.8 | 8.1 | 8.8 | 9.9 | 10.5 | 12.4 | 12.0 | -0.3 | -2.7 |
| Third-party funding | 2.5 | 3.5 | 4.8 | 2.8 | 3.9 | 4.2 | 5.3 | 1.0 | 24.7 |
| Service revenues | 0.6 | 1.0 | 0.6 | 0.9 | 1.6 | 1.8 | 0.7 | -1.1 | -58.9 |
| Financial result | 0.0 | -0.6 | 0.3 | 0.3 | 0.2 | 0.3 | 0.0 | -0.3 | -85.3 |

| ETH Board | 0.0 | 0.7 | 0.2 | 0.0 | 0.1 | 0.0 | 0.0 | -0.0 | -7.1 |
| Service revenues | 0.0 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.4 |
| Financial result | -0.4 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | -0.0 | -27.0 |
In view of the change in the underlying legislation as of 1 July 2012, the additional contribution only had to be paid for the first half of 2012.

Accommodation costs mainly constitute the imputed expense for the use and rent of federally owned premises. This is calculated on the basis of the imputed depreciation and the capital costs. Accommodation costs have been calculated since the introduction of the New Accounting Model on 1 January 2007; in the past five years they have been between 269.9m and 301.0m CHF.

Materials expenditure mainly concerns the operation and maintenance of infrastructure, costs for water and energy and for telecommunications and IT. It rose by 885.6m CHF to 901.5m CHF and accounts for 29.7% of total expenses. Depreciation amounted to 157.3m CHF.
### Abb. 23: Personnel expenditure

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<td>62.0</td>
<td>62.0</td>
<td>63.0</td>
<td>63.0</td>
</tr>
<tr>
<td>Percentage of total expenditure**</td>
<td>%</td>
<td>63.5</td>
<td>61.2</td>
<td>62.6</td>
<td>62.0</td>
<td>62.0</td>
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<td>-3.4</td>
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<td>%</td>
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<td>-0.0</td>
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<td>%</td>
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<td>65.4</td>
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<tr>
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<td>-3.2</td>
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<td>%</td>
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<td>29.5</td>
<td>21.2</td>
<td>39.6</td>
<td>29.5</td>
</tr>
</tbody>
</table>

** Total expenditure: personnel, materials, provision of goods and services, external rental expenditure, accommodation expenditure, amortisation and depreciation, changes in performance commitments, transfer expenditure.
*** ETH Board: since 2009, including one-off contributions to Publica (pension fund of the ETH Domain).

### Fig. 24: Materials expenditure**

<table>
<thead>
<tr>
<th></th>
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<td>In m CHF (figures rounded)</td>
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<td>28.6</td>
<td>27.1</td>
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<td>%</td>
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<td>70.2</td>
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<td>ETH Zurich</td>
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<td>380.0</td>
<td>418.6</td>
<td>417.5</td>
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<td>%</td>
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<td>59.1</td>
<td>59.1</td>
<td>59.1</td>
<td>59.1</td>
<td>59.1</td>
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<td>85.1</td>
<td>104.6</td>
<td>129.5</td>
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<td>19.1</td>
<td>19.4</td>
<td>20.9</td>
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<td>%</td>
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<td>25.3</td>
<td>26.2</td>
</tr>
<tr>
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<td>33.9</td>
<td>34.3</td>
<td>36.4</td>
<td>44.8</td>
<td>41.4</td>
<td>-3.5</td>
</tr>
<tr>
<td>Percentage of total expenditure</td>
<td>%</td>
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<td>23.6</td>
<td>22.4</td>
<td>23.6</td>
<td>27.2</td>
<td>24.9</td>
</tr>
<tr>
<td>Empa</td>
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<td>20.2</td>
<td>23.8</td>
<td>15.1</td>
<td>17.5</td>
<td>16.0</td>
<td>-1.5</td>
</tr>
<tr>
<td>Percentage of total expenditure</td>
<td>%</td>
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<td>31.9</td>
<td>35.2</td>
<td>24.5</td>
<td>26.3</td>
<td>24.5</td>
</tr>
<tr>
<td>Eawag</td>
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<td>29.7</td>
<td>51.1</td>
<td>21.9</td>
<td>26.9</td>
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<tr>
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<td>%</td>
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<td>70.0</td>
<td>78.4</td>
<td>59.9</td>
<td>69.9</td>
</tr>
</tbody>
</table>

** Materials expenditure: materials, provision of goods and services, external rental expenditure (excluding accommodation expenditure), amortisation and depreciation, changes in internal performance commitments, transfer expenditure.
*** Total expenditure: personnel, materials, provision of goods and services, external rental expenditure, accommodation expenditure, amortisation and depreciation, changes in performance commitments, transfer expenditure.
## Fig. 25: Investments

<table>
<thead>
<tr>
<th>In m CHF (figures rounded)</th>
<th>2007*</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012 absolute</th>
<th>2011/2012 %</th>
</tr>
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<tbody>
<tr>
<td><strong>ETH Domain consolidated</strong></td>
<td>378.5</td>
<td>434.3</td>
<td>356.5</td>
<td>332.8</td>
<td>494.0</td>
<td>360.3</td>
<td>-137.7</td>
</tr>
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<td>ETH Domain consolidation</td>
<td>-</td>
<td>-0.3</td>
<td>-</td>
<td>-</td>
<td>-0.1</td>
<td>-</td>
<td>-0.1</td>
</tr>
<tr>
<td>Investment in real estate**</td>
<td>210.1</td>
<td>231.0</td>
<td>151.6</td>
<td>148.4</td>
<td>183.7</td>
<td>141.7</td>
<td>-42.0</td>
</tr>
<tr>
<td>Movables / intangible assets***</td>
<td>168.4</td>
<td>203.6</td>
<td>204.9</td>
<td>184.4</td>
<td>310.4</td>
<td>218.6</td>
<td>-91.8</td>
</tr>
<tr>
<td><strong>ETH Zurich</strong></td>
<td>179.1</td>
<td>183.3</td>
<td>168.6</td>
<td>190.7</td>
<td>272.4</td>
<td>216.8</td>
<td>-55.6</td>
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<tr>
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<td>110.2</td>
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<td>100.0</td>
<td>104.6</td>
<td>85.2</td>
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<tr>
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<td>73.1</td>
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<td>131.6</td>
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<td>155.1</td>
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<td>85.2</td>
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<td>23.9</td>
<td>42.8</td>
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<td>-9.2</td>
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<tr>
<td>Movables / intangible assets</td>
<td>34.3</td>
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<td><strong>PSI</strong></td>
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<td>73.2</td>
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<td>115.3</td>
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<td>30.1</td>
<td>15.9</td>
<td>-14.3</td>
</tr>
<tr>
<td>Movables / intangible assets</td>
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<td>56.7</td>
<td>85.1</td>
<td>30.9</td>
<td>-54.3</td>
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<tr>
<td><strong>WSL</strong></td>
<td>1.7</td>
<td>1.7</td>
<td>3.7</td>
<td>3.6</td>
<td>2.4</td>
<td>2.1</td>
<td>-0.3</td>
</tr>
<tr>
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<td>2.1</td>
<td>2.3</td>
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<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
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<td>1.6</td>
<td>1.3</td>
<td>1.9</td>
<td>1.1</td>
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<td>14.5</td>
<td>13.9</td>
<td>12.3</td>
<td>-1.7</td>
</tr>
<tr>
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<td>10.0</td>
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<td>3.8</td>
<td>0.9</td>
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<tr>
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<td>7.0</td>
<td>11.0</td>
<td>8.4</td>
<td>-2.5</td>
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<td><strong>Eawag</strong></td>
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<td>6.0</td>
<td>4.9</td>
<td>4.7</td>
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<tr>
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<td>2.7</td>
<td>2.3</td>
<td>-0.4</td>
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<tr>
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<td>2.4</td>
<td>2.3</td>
<td>2.9</td>
<td>2.2</td>
<td>2.4</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>ETH Board</strong></td>
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<td>0.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Movables / intangible assets</td>
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<td>-</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

** Building investment in federally owned real estate and in real estate owned by the two Federal Institutes of Technology or any of the four research institutes (including co-financing).
*** Net investment in movable goods, IT, user-specific operating equipment, intangible goods.
Consistency in personnel

The year 2012 was shaped by minor changes to the number of employees. For the first time more foreign employees than staff with Swiss origins are working at the ETH Domain. It is now the case that two thirds of all professors and two thirds of all scientific personnel come from abroad.

On 31 December 2012, the number of employees at the ETH Domain amounted to 19,398 employment contracts or 16,072.1 FTEs (previous year: 19,034 employment contracts with 15,609.2 FTEs), see fig. 26. At 364 new employment contracts, the increase (1.91 %) was weaker than in the two preceding years (2011: 442; 2010: 525). Annual growth has levelled out again at a long-term mean of around 2 to 3 % in the past few years. Of these additional employment contracts, 286 (78.6 %; 2011: 69.7 %) concerned scientists, 176 of whom were additional doctoral students. The proportion of senior scientists, Maîtres d’enseignement et de recherche and senior scientific personnel with important permanent roles in teaching and research amounts to 4.2 % of total staff numbers. The trend towards an increasing proportion of scientific personnel compared to technical and administrative personnel is continuing. With 11,975 employment contracts or 61.7 % (2011: 61.4 %), scientific personnel, including doctoral students, are clearly the largest function group within the ETH Domain (see fig. 26).

Of the financial resources for the positions newly created in 2012, at 36.2 % (2011: 30.4 %) more than one third come from the federal financial contribution (internal resources); almost two thirds (63.8 %; 2011: 69.6 %) are financed by second-party resources and third-party funding (see fig. 32).

Professors

In 2012, a total of 621 full (F) and associate (A) professors (2011: 595), 96 assistant professors with tenure track (2011: 94) and 48 assistant professors without tenure track (2011: 60) worked at ETH Zurich and EPFL (see box below).

Compared with 2011, the number of professors (all categories) increased by 16 persons (2.1 %) to 765 (2011: 30 or 4.2 %; see fig. 27).

In the three categories, women accounted for 11.9 %. Among F and A professors the proportion was 8.2 % (2011: 7.7 %), among assistant professors with tenure track it was 29.2 % (2011: 30.9 %) and among assistant professors without tenure track it came to 25 % (2011: 20.0 %) at the end of 2012.

Of the 463 professorships (449.3 FTEs) at ETH Zurich, 24.9 FTEs were financed with second-party resources and 16 FTEs with third-party funding in 2012. Of the 302 professorships (289.7 FTEs) at EPFL, 5.6 FTEs were financed with second-party resources and 16 FTEs with third-party funding in 2012. Of the 302 professorships (289.7 FTEs) at EPFL, 5.6 FTEs were financed with second-party resources and 5.0 with third-party funding.

While in 2011 it was still the case that 66.1 % of all professors came from abroad, in 2012 this was slightly lower at 65.8 %. The share of professors from the European Union (EU) has fallen to 51.8 % while the share from other countries has risen to 14 % (see fig. 28). Almost half of the new appointments in all professorial categories are EU citizens while 37.5 % are from Switzerland (see fig. 29). Of all new appointments, 83.3 % were male professors and, at 16.7 %, the share of female professors remained virtually unchanged on the previous year (16.9 %).

At ETH Zurich, nine full professors retired in 2012. At EPFL, six full professors retired in 2012 and one more left EPFL for personal reasons.

Proportion of women

The development of the proportion of women at the individual institutions and across the ETH Domain varies (see fig. 31), with a slight decline recorded across the ETH Domain as a whole for the first time in years. This is attributable in particular to the two Federal Institutions of Technology. The proportion of

Professorial categories

The various professorial categories differ with regard to status and employment conditions.

Full and associate professors, assistant professors with and without tenure track teach and do research at both Federal Institutes of Technology. Tenure track means that assistant professors can become permanently employed as full or associate professors if they meet a given performance target. Full and associate professors are appointed permanently, while assistant professors sign employment contracts for a maximum of four years. These can be renewed once for up to another four years.
women is traditionally lowest at PSI and Empa, i.e. at institutions with a high share of technically oriented functions and engineering sciences. In 2012, the number of women employed in the ETH Domain increased by 76 (2011: 233) to reach a total of 6,374 at the end of the year (+1.2%; 2011: +3.8%). The proportion of women among the entire personnel was 32.9% at the end of 2012 (2011: 33.1%). A slight increase in the proportion of women can be seen among professors and administrative personnel.

Among full professors, associate professors and executives, the proportion of women is still low and clearly fails to reach the target level of 25% as specified in the federal performance mandate (objective 5, sub-objective 1). The considerably more pronounced narrowing of the personnel pyramid with regard to the higher executive positions for women compared to men has various reasons upon which the employer can only exert a limited influence in both the short and longer term. Existing and new activities for promoting equal opportunities and gender equality are having some success but must continue to be pursued vigorously in the years to come (see pp. 25 and 72 f.). It has become clear in recent years that the politically specified target values for universities specialising in natural sciences and technology at top-level research institutions can only be achieved in the long term. Alongside increased efforts to promote the compatibility of family life and a scientific career, girls' interest in MINT disciplines must be stimulated and encouraged at school age in a manner which suits their level. Similarly, executive development opportunities need to be proposed that are attractive for women.

Internationalisation: Origins of personnel
The origins of employees also reflect the long-standing trend towards increasing internationalisation in the ETH Domain. In 2012, the number of women employed in the ETH Domain increased by 76 (2011: 233) to reach a total of 6,374 at the end of the year (+1.2%; 2011: +3.8%). The proportion of women among the entire personnel was 32.9% at the end of 2012 (2011: 33.1%). A slight increase in the proportion of women can be seen among professors and administrative personnel.

Among full professors, associate professors and executives, the proportion of women is still low and clearly fails to reach the target level of 25% as specified in the federal performance mandate (objective 5, sub-objective 1). The considerably more pronounced narrowing of the personnel pyramid with regard to the higher executive positions for women compared to men has various reasons upon which the employer can only exert a limited influence in both the short and longer term. Existing and new activities for promoting equal opportunities and gender equality are having some success but must continue to be pursued vigorously in the years to come (see pp. 25 and 72 f.). It has become clear in recent years that the politically specified target values for universities specialising in natural sciences and technology at top-level research institutions can only be achieved in the long term. Alongside increased efforts to promote the compatibility of family life and a scientific career, girls' interest in MINT disciplines must be stimulated and encouraged at school age in a manner which suits their level. Similarly, executive development opportunities need to be proposed that are attractive for women.

Internationalisation: Origins of personnel
The origins of employees also reflect the long-standing trend towards increasing internationalisation in the ETH Domain. While in 2007 42% of all employees were from abroad, in 2009 around 46% and in 2011 49% in 2012 the 50% threshold was exceeded for the first time with 50.4% or 9,785 individuals from abroad. Of these, 36% or 6,990 individuals are citizens of an EU country and 14.4% or 2,295 individuals come from countries outside the EU. The composition of foreign nationalities shows that last year the proportion of EU citizens increased only about half as much as the proportion of employees from other countries. A total of 5,836 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. 26: Headcount and employment level by function group

<table>
<thead>
<tr>
<th>2012</th>
<th>ETH Domain</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>Women</td>
<td>Total</td>
</tr>
<tr>
<td>Professors (F/A)</td>
<td>570</td>
<td>549.9</td>
</tr>
<tr>
<td>Assistant professors without tenure track</td>
<td>36</td>
<td>33.6</td>
</tr>
<tr>
<td>Assistant professors with tenure track</td>
<td>68</td>
<td>67.7</td>
</tr>
<tr>
<td>of whom senior scientific personnel</td>
<td>8,612</td>
<td>7,129.7</td>
</tr>
<tr>
<td>Technical personnel</td>
<td>2,756</td>
<td>2,596.9</td>
</tr>
<tr>
<td>Administrative personnel</td>
<td>692</td>
<td>599.5</td>
</tr>
<tr>
<td>Trainees</td>
<td>290</td>
<td>290.0</td>
</tr>
<tr>
<td>Total</td>
<td>13,024</td>
<td>11,267.3</td>
</tr>
</tbody>
</table>

Headcount and employment level of men, women and the entire ETH Domain by function group. As of 2010, the senior scientists and Maîtres d’enseignement et de recherche, as well as the other senior personnel are counted separately, but nevertheless still included under scientific personnel. A total of 5,836 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. 27: Change in the number of professors

<table>
<thead>
<tr>
<th>2011</th>
<th>2012</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>Women</td>
<td>Total</td>
</tr>
<tr>
<td>Professors (F/A)</td>
<td>549</td>
<td>46</td>
</tr>
<tr>
<td>Assistant professors without tenure track</td>
<td>48</td>
<td>12</td>
</tr>
<tr>
<td>Assistant professors with tenure track</td>
<td>65</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>662</td>
<td>87</td>
</tr>
</tbody>
</table>

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

#### Fig. 28: Origin of professors

<table>
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<tr>
<th>2012</th>
<th>Switzerland</th>
<th>EU</th>
<th>Other</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Total</td>
</tr>
<tr>
<td>Professors (F/A)</td>
<td>217</td>
<td>15</td>
<td>232</td>
</tr>
<tr>
<td>Assistant professors without tenure track</td>
<td>13</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Assistant professors with tenure track</td>
<td>10</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total professors</strong></td>
<td><strong>240</strong></td>
<td><strong>22</strong></td>
<td><strong>262</strong></td>
</tr>
</tbody>
</table>

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

#### Fig. 29: Origin of new professors hired

<table>
<thead>
<tr>
<th>2012</th>
<th>Switzerland</th>
<th>EU</th>
<th>Other</th>
<th>ETH Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Total</td>
<td>Men</td>
</tr>
<tr>
<td>Professors (F/A)</td>
<td>10</td>
<td>3</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>Assistant professors without tenure track</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Assistant professors with tenure track</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total professors</strong></td>
<td><strong>15</strong></td>
<td><strong>3</strong></td>
<td><strong>18</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

Number of new professors in 2012 broken down by origin: Switzerland, the EU and other countries.

#### Fig. 30: Employees’ native languages in 2012

- German 54.4 % (56.6 %)
- French 18.0 % (17.8 %)
- Italian 5.3 % (4.9 %)
- English 9.5 % (9.8 %)
- Other 12.8 % (10.9 %)

Native languages of employees in the ETH Domain in 2012. Previous-year figures are shown in brackets.
are foreigners, closely followed by scientific personnel at 65.7%.

Concerning the presence of linguistic communities, the proportion of those with German as their native language decreased further to 54.4% in 2012 (2011: 56.6%), while the proportion with French as their native language remained virtually unchanged at 18% (see fig. 30). The segment of employees who describe themselves as native English speakers declined slightly to 9.5%, while a minor increase is to be observed among Italian speakers (5.3%).

**Trainees**

The ETH Domain created more training positions again in 2012 in the spirit of the Federal Act on the Personnel of the Swiss Confederation. The number of training positions for young people has now increased from 344 in 2003 to 430 at the end of 2012. Of these 430 trainees, 140 or 32.6% are female (2011: 32.9%).

The ETH Domain offers training positions in more than a dozen different professions. Polymechanics, chemistry laboratory assistants, merchandisers, physics laboratory assistants and computer scientists are particularly popular vocations. The focus of the training positions offered lies in the field of natural sciences/technical professions.

**Appeal as an employer**

The institutions of the ETH Domain are increasingly confronted with the topic of dual careers: Partners of newly employed executives in the ETH Domain also move to Switzerland and have to integrate not only into society but also into the job market. For this reason, the institutions extended their consultation services further in 2012: When employing top-level
Fig. 33: Source of funds by function group

<table>
<thead>
<tr>
<th>Source of funds</th>
<th>Function group</th>
<th>Professors (all)</th>
<th>Scientific personnel</th>
<th>Technical personnel</th>
<th>Administrative personnel</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal resources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal financial contribution</td>
<td>2012</td>
<td>687.5</td>
<td>5,292.6</td>
<td>2,686.5</td>
<td>1,859.3</td>
<td>10,525.9</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>669.7</td>
<td>5,203.8</td>
<td>2,679.9</td>
<td>1,815.5</td>
<td>10,368.9</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012</td>
<td>17.8</td>
<td>88.8</td>
<td>6.6</td>
<td>43.8</td>
<td>157.0</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012 in %</td>
<td>2.66</td>
<td>1.71</td>
<td>0.25</td>
<td>2.41</td>
<td>1.51</td>
</tr>
<tr>
<td><strong>Second–party resources</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research funding (SNSF, CTI, NCCR, SUC), government-funded research and EU research programmes</td>
<td>2012</td>
<td>30.5</td>
<td>3,369.4</td>
<td>242.4</td>
<td>52.9</td>
<td>3,695.2</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>41.3</td>
<td>3,201.2</td>
<td>205.1</td>
<td>49.9</td>
<td>3,497.5</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012</td>
<td>~10.8</td>
<td>168.2</td>
<td>37.3</td>
<td>3.0</td>
<td>197.7</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012 in %</td>
<td>~26.15</td>
<td>5.25</td>
<td>18.19</td>
<td>6.01</td>
<td>56.65</td>
</tr>
<tr>
<td><strong>Third–party funding</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry-oriented research, donations/bequests</td>
<td>2012</td>
<td>21.0</td>
<td>1,003.1</td>
<td>270.3</td>
<td>126.6</td>
<td>1,421.0</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>11.0</td>
<td>929.6</td>
<td>278.9</td>
<td>122.3</td>
<td>1,341.8</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012</td>
<td>10.0</td>
<td>73.5</td>
<td>~8.6</td>
<td>4.3</td>
<td>79.2</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012 in %</td>
<td>27.9</td>
<td>1.8</td>
<td>~3.8</td>
<td>15.2</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>739.0</td>
<td>9,665.1</td>
<td>3,199.2</td>
<td>2,038.8</td>
<td>15,642.1</td>
</tr>
<tr>
<td></td>
<td>2011</td>
<td>722.0</td>
<td>9,334.6</td>
<td>3,163.9</td>
<td>1,987.7</td>
<td>15,208.2</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012</td>
<td>17.0</td>
<td>330.5</td>
<td>35.3</td>
<td>51.1</td>
<td>433.9</td>
</tr>
<tr>
<td></td>
<td>∆2011/2012 in %</td>
<td>2.35</td>
<td>3.54</td>
<td>1.12</td>
<td>2.57</td>
<td>2.85</td>
</tr>
</tbody>
</table>

Financing of positions according to source of funds (in FTE) in 2012 and in comparison to 2011. ∆ (delta) shows the absolute change from the previous year (2011).

In order to make the working conditions in the ETH Domain

talent from abroad, both Federal Institutes of Technology and the four research institutes support the new arrivals’ partners in their professional reorientation and in issues concerning their children’s school attendance, and generally help the families to integrate within Switzerland.

In general, it is important to offer the scientists competitive and attractive working conditions and to facilitate interesting career steps. Staff surveys show that development opportunities must be promoted more intensively at all stages of academic careers. The supervision of doctoral students must also be intensified. This includes helping them to shape their scientific careers after completion of their theses. The career centres at ETH Zurich and EPFL play a vital role here.

Equal opportunities strategy
In 2012, the ETH Domain and its institutions undertook numerous further measures to encourage staff and in particular to enhance the support of the next generation in the academic sector (see p. 72 f.). One focal point here was and remains the promotion of gender equality, with the goal of sustainably increasing the proportion of women at all levels and especially in executive positions. For this purpose, in 2010 the ETH Board approved core elements of a strategy to promote equal opportunities and drew up packages of measures for implementing these in the years to come.

Outlook: 2013 objectives
The implementation of personnel strategies and overall personnel management generally only display an impact over the long term, something which also applies to the ETH Domain. The trends and developments described above will therefore also continue in the years to come. As illustrated by the employee survey carried out by ETH Zurich in 2012, the institutions of the ETH Domain will have to place an even stronger emphasis on overall career support and, in particular, on the promotion of young talent in teaching and research as well as in technical and administrative areas. In view of the competition with both the private sector and other research institutes for highly qualified scientists, the institutions of the ETH Domain need to step up their efforts in drawing their doctoral and postdoctoral students’ attention to development opportunities and in facilitating career steps. These measures include, for instance, the creation of additional permanent upper middle-ranking positions (senior scientists), both as important pillars supporting the continuity of teaching and research and as knowledge bearers for large technical facilities.

Increasing the proportion of women in executive position and particularly in scientific function will remain a focal point in the years to come. Further efforts are required in terms of both the compatibility of work and family life and the topic of dual careers. The experience of the past few years has shown that success here in the field of top academic positions can only be achieved very slowly. Consistent promotion of diversity, cultural diversity and the diverse nature of the individual employees should contribute towards supporting an inspiring and creative atmosphere, thus generating added value for the institutions of the ETH Domain.

In future, personnel advancement and development will not only be fostered for scientific positions but across all professional categories and hierarchies. Further expansion of the development of executives and management is planned and to some extent has already been implemented. This also includes the introduction of sabbaticals in non-scientific functions.
more attractive and to deploy employees effectively, more efforts are being made with regard to health management and occupational safety. Moreover, the ETH Board initiates regular audits within the institutions to ensure and, if necessary, enhance health protection and occupational safety for the employees at their place of work.

The trend towards the internationalisation of the ETH Domain will increase further. Both Federal Institutes of Technology and the four research institutes actively seek exchange and cooperation with the world’s best, regardless of nationalities and cultural backgrounds. The ETH Domain also strives to integrate foreign employees well and to enhance their understanding of Swiss peculiarities by means of targeted measures. This includes the aforementioned dual career efforts as well as all supporting measures and facilities which make it easier to combine family life with studies or scientific work. For the ETH Domain, the word “family” encompasses various forms of cohabitation.

Main features of the personnel strategy

The personnel strategy of the ETH Domain is intended to create good conditions for the appointment of qualified employees. Furthermore, a high level of diversity and protection against discrimination should be achieved.

The personnel policy of the ETH Domain is based on the Federal Act on the Personnel of the Swiss Confederation (Art. 4 FedPerA). It follows the objectives and requirements specified there and in the ETH Domain’s performance mandate (objective 5, see p. 72 f.).

The ETH Board is a responsible employer for the entire ETH Domain, with modern employment and working conditions, and intends to remain so in the future. It is committed to a management style which involves forms of cooperation appropriate to the respective field and level and fosters an open information policy.

Both Federal Institutes of Technology and the four research institutes of the ETH Domain place high demands on their employees and support their development. They are committed to consistent promotion of and adherence to equal opportunities. They do not tolerate any discrimination of their affiliates due to gender or to social, ethnic or religious background. Knowledge about diversity and a conscious handling of this issue are important prerequisites for meeting the complex challenges with adequate ways of thinking and acting.

To fulfill its mandate, the ETH Domain relies on employing excellently qualified personnel at all levels and in all areas. Only if the institutions can continue to network internationally, recruit their professors for teaching and research on the international stage and remain attractive for doctoral and non-doctoral students from abroad will the ETH Domain be able to hold its own in the global competition between tertiary institutions. In addition, working conditions must be offered which are competitive and attractive in the context of the international and national competition for recruitment of the best personnel.
Expansion of real estate infrastructure in line with strategy

The prevailing growth in the number of students is bringing the ETH Domain to its limits in terms of space, area, infrastructure and financing. Planning and activities not only have to address timely procurement, but also the costs entailed by the maintenance of real estate.

The ETH Domain invested around 217m CHF in total in 2012 in its real estate portfolio to cover priority user needs and maintain its value and functionality. The infrastructure requirements for its core business of teaching, research, and knowledge and technology transfer are important success factors. They make a major contribution to its global competitiveness and in so doing constitute a strategic resource. However, the ETH Board has made clear its commitment not to allow the investment and expenditure required for this to impair its financial resources for conducting its core business. The institutions of the ETH Domain address this challenge by prudently developing the real estate portfolio and exploiting alternative financing models.

Strategy: Development of the portfolio in 2012

The real estate strategies of the institutions of the ETH Domain set out in the 2011 Activity Report proved to be correct for 2012 too in view of the continued growth in the number of students.

ETH Zurich focused on the physical merging of departments with a view to the longer-term planning of professorships and the implementation of its ambitious energy concept. A massive increase in student accommodation of 900 beds at the Hönggerberg site was included in the master plan. Alternative financing models (public-private partnership (PPP) models) are to be applied for construction and operation.

The master plan of EPFL for the Ecublens campus included expansion in terms of space and the restoration and adaptation of older buildings to the strategic objectives of teaching and research. The development of the campus into a public meeting place for society, academia and business was carried out with supplementary facilities that are also financed and realised with PPP models.

The new strategic large-scale research facility comprising the X-ray free-electron laser SwissFEL is the main focus of the real estate strategy at PSI. At WSL, Empa and Eawag the real estate portfolio was developed further with enhancements, resource conservation and the maintenance of value and functionality.

Ongoing and realised projects in 2012

In line with the strategy, the institutions constructed new buildings and invested in existing ones in order to meet the growing space requirements for teaching and research. This includes a good number of smaller and larger maintenance and conversion projects.

ETH Zurich continued the Oberer Leonhard project in 2012 (total cost including operational and research facilities: 113m CHF). At the Hönggerberg site, the HPL laboratories (total cost: 114m CHF*) were occupied in the autumn (see illustration on p. 127). In Lugano, the new Swiss National Supercomputing Centre (CSCS) entered service at the start of 2012 (83m CHF*). ETH Zurich thereby created the infrastructure for the Swiss National Strategic Plan for High-Performance Computing and Networking approved by the Federal Council (HPCN strategy, see also p. 11 f.). Significant progress was made on the two new buildings planned as PPP models for student accommodation on the Hönggerberg; an investor competition was held for this in 2012.

At EPFL in Lausanne the conversion and extension of the existing Halles Mécanique building (69m CHF*) was continued. As with the refurbishment of the former library (16m CHF*), spatial improvements were carried out and the building’s energy balance sheet was improved. As a result of the architectural competition for the Objectif Campus project (24m CHF*), three pavilions housing the entrance area, an art and science area and the Montreux Jazz café are being constructed on Cosandey Square. The Conference Centre PPP project with shops and around 500 student apartments is under construction.

The four research institutes PSI, WSL, Empa and Eawag did not make any investments in new buildings in 2012. Maintenance work to improve energy consumption, fire protection and earthquake resistance was carried out. PSI continued its planning work for the new SwissFEL large-scale research facility. At Eawag, refurbishment of the lakeside laboratory at the Kastanienbaum site was completed. Planning for the NEST project (a modular research and laboratory building) was continued. The innovative NEST research facility that is co-sponsored by Empa alongside Eawag, ETH Zurich and EPFL is being built in close cooperation with the construction industry.

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* Total costs including operating equipment and research institutes.
Real estate management in figures

The historic cost of the real estate portfolio of the ETH Domain on 31 December 2012 amounted to 7.1bn CHF. The book value is around 4.4bn CHF, which equals around one third of the entire portfolio of the Federal Government. The Swiss real estate portfolio comprises 410 buildings and around 120 installations on 175 plots of land. In line with the strategies of the institutions and the rising number of students, the main usable area reported for the real estate of the ETH Domain at the end of 2012 of 890,700 m² represents a slight decline on 2011 (891,900 m²) of 0.1%. New buildings such as the CSCS in Lugano (6,220 m²) and the new HPL life sciences platform on the Hönggerberg (9,600 m²) are offset by space that is temporarily not usable due to conversions. Compared with 2011 (4.5bn CHF), the book value of the portfolio fell by 2% (see fig. 34). This is due to the lower increase in value from investment activities, ordinary depreciation and extraordinary value adjustments due to sales, conversions and refurbishments (improvement costs).

Further portfolio adjustments were carried out in 2012. Due to an improvement and forest merger in Wettswil (Canton of Zurich), the number of individual plots of land in this area was reduced by 20. Following completion of the new building in Lugano, the previous CSCS site in Manno, Ticino (2,000 m²) was sold. The approval of the Parliament of the Canton of Zug is still pending for the transfer of ownership of the Chamau research station to the Canton of Zug. Under certain conditions, the institutions of the ETH Domain can reinvest the sales proceeds of properties they use themselves. This enables user requirements to be better met while at the same time upholding the value of the portfolio as a whole.
Investments and source of funds in 2012
The 2012 investment credit for the entire ETH Domain amounted to 134.7m CHF, which was down on the previous year’s 181.3m CHF following a credit transfer from the 2011 investment credit of 0.9m CHF and a credit reallocation to the financial contribution of 18m CHF (11.8%). 44% of the investments from this loan applied to new and replacement constructions and 56% to safeguarding the maintenance of value and functionality (see fig. 35). On top of this, third-party funding of around 7.1m CHF was deployed for construction activities, and investments from the financing contribution amounting to 75.1m CHF were made in user-specific operational facilities owned by the institutions. Furthermore, investors in PPP projects provided infrastructure financing of some 56m CHF which will additionally enhance the attractiveness of the two universities and indirectly support teaching and research. The entire construction volume triggered by the ETH Domain in 2012 accordingly came to 273m CHF (see fig. 35). For the imputed rent of the real estate of the Federal Government, the ETH Domain received accommodation funding of 301m CHF in 2012.

2013 construction programme, credit commitments and credit line
The ETH Domain uses the annual construction programmes to apply for credit commitments for new projects planned in the years to come. The financing of the projects is carried out through annual investment credits within the budget appropriation of the Federal Government. In November 2012 the President of the ETH Board presented the 2013 construction programme to the Finance Committees of the National Council and the Council of States. This was approved by the Federal Parliament on 13 December 2012 by federal decree as part of the 2012 budget. The largest project in the 2013 construction programme is PSI’s SwissFEL large-scale research facility with a supplementary credit commitment of 80.1m CHF for the execution of work already started. The overall costs, including operational and research facilities, amount to 275.5m CHF, of which 30m CHF are being borne by the Canton of Aargau.

Further approved costs exceeding 10m CHF are the construction of the new HIB building for ETH Zurich’s Institute of Technology and Architecture for 30.5m CHF, the energy-efficient renovation of the heat supply and the improvement in the supply of electricity to the EPFL campus in Lausanne for 19.4m CHF and a student hall of residence as part of ETH Zurich’s Science City on the Hönggerberg for 16.5m CHF.

Credit lines make it possible to carry out construction projects up to 10m CHF and to plan projects over 10m CHF in terms of applying for the requisite credit commitments. The credit line of 141.1m CHF requested for 2013 is 62.6m CHF higher than that of the previous year.

Proof of maintenance of value and functionality
The average age of all properties of the ETH Domain is around 50 years, with part of the portfolio significant both in terms of volume and value already having been through several cycles of renovation. Each year the key value of properties significant in terms of volume and value is stated as the figure for maintenance of value and functionality as calculated by a standard method recognised in the industry (see fig. 35). With this report, the ETH Domain meets the information requirements of the Federal Government and

Real estate management in the ETH Domain

The ETH Board is responsible for the real estate portfolio of the ETH Domain and coordinates strategic real estate management with the institutions. The real estate of the ETH Domain is the property of the Swiss Confederation. The ETH Board assumes the ownership role in trust (as one of the Federal Government’s three building and real estate authorities), coordinates management of the properties and ensures the maintenance of their value and functionality. Fulfilment of the strategic mandate is jointly assumed by the ETH Board, the Executive Boards of both Federal Institutes of Technology and the Directorates of the four research institutes. The institutions of the ETH Domain base their investment plans on the academic plan, the real estate and site strategies, the energy master plan, and the maintenance plan. Investment planning is coordinated with academic planning via strategic controlling in the form of spatial master plans.

The investment credit for buildings is specifically earmarked from the payment instalments of the Federal Government to the ETH Domain. In the state accounts it appears under the Federal Office for Buildings and Logistics (FOBL).

The ETH Board is responsible for ensuring the maintenance of value and functionality, which is derived from needs-oriented planning geared – also in the interests of the owner – to cost-benefit considerations. The corresponding controlling is based on investment and maintenance planning, implementation by the institutions and periodic assessment of the condition and value of the buildings.

The owner receives knowledge of this through the reports of the ETH Board. The ETH Domain is committed to the sustainable development of its real estate portfolio and accordingly complies with the mandate assigned by the Federal Constitution to the Federal Council, as well as its sustainability strategy. The sustainable building objectives shared by the ETH Domain – to cost-benefit considerations. The corresponding controlling is based on investment and maintenance planning, implementation by the institutions and periodic assessment of the condition and value of the buildings.

The owner receives knowledge of this through the reports of the ETH Board. The ETH Domain is committed to the sustainable development of its real estate portfolio and accordingly complies with the mandate assigned by the Federal Constitution to the Federal Council, as well as its sustainability strategy. The sustainable building objectives shared by the ETH Domain – to cost-benefit considerations. The corresponding controlling is based on investment and maintenance planning, implementation by the institutions and periodic assessment of the condition and value of the buildings.

The owner receives knowledge of this through the reports of the ETH Board. The ETH Domain is committed to the sustainable development of its real estate portfolio and accordingly complies with the mandate assigned by the Federal Constitution to the Federal Council, as well as its sustainability strategy. The sustainable building objectives shared by the ETH Domain serve to preserve the environment and climate. Economically speaking they are geared towards the real estate life cycle. Targeted cooperation within the ETH Domain contributes towards ensuring sustained management of the real estate and continuously reducing the consumption of resources in a long-term and exemplary manner.
the Swiss Confederation as the owner of the real estate with regard to the maintenance of value and functionality. The evaluation of the entire ETH real estate portfolio shows that despite the partially high age of the buildings and their many years of intensive use, their current value calculated in relation to their new value is consistently high. No decrease in the current value can be observed, and the buildings with the lowest values are successively covered by the institutions’ renovation strategies. This serves as proof that the ETH Domain fulfills its responsibility of managing the buildings placed at its disposal by the Federal Government in a sustainable manner with adequate maintenance of value and functionality.

Major renovation projects in 2012 included ETH Zurich’s HPP Physics Tower and, at EPFL, the old library building and the engineering building, which is being stripped down to its carcass and greatly extended. Prior to the start of construction of the SwissFEL large-scale research facility, the construction activity of PSI was largely focused on renovation projects, in particular the staff restaurant.

Renovation projects worth more than 650m CHF are currently contained in the 2013–2016 investment plan and in 2012 triggered an investment volume of some 75m CHF. In addition, ongoing maintenance work to the tune of around 30m CHF was funded from the financing contribution.

**Sustainability in terms of energy**

In 2012, the ETH Domain was strongly influenced by the Federal Government’s Energy Strategy 2050. In 2013 the institutions will collaborate on the Energy Strategy 2050 and adopt the implementation measures agreed by consensus as part of their sustainability strategies. Sustainability objectives have long been an integral part of the procurement and management of real estate at all institutions. The ETH Domain constructs state-of-the-art buildings and focuses on energy-efficient construction methods. While taking account of cost effectiveness in their projects, the institutions always aim to test the limits of feasibility or even to enter new territory, in order to send out a positive signal externally.

ETH Zurich approved a new energy concept at the end of 2012 to be officially deployed on 1 January 2013. This concept sets out reduction targets for the university’s own final energy consumption, for the use of non-renewable energy sources and for its CO2 emissions. These reductions include the aspired targets for 2020 and 2035. As well as energy efficiency requirements for new buildings and conversions, ETH Zurich in particular targets a systematic and above all continuous operational enhancement. These requirements are supplemented by ETH-internal guidelines and standards.

PSI is currently working on a project for heat recovery from components of the SwissFEL. In order to deploy the heat efficiently, a radio frequency power amplifier is being developed that discharges the heat loss to the coolant at 80°C rather than the previously customary 40°C. Initial pilot tests have been very positive. It will be the first time in the world that the waste heat of an installation of this kind has been used. PSI is therefore embarking on a planned increase in the use of residual heat from the large-scale research facilities.

At WSL the new plant protection laboratory building with level 1–3 (of 4) laboratories is being planned and will be con-
In 2012 the treated floor area grew due to the academic growth strategy by around 1.5%. Total energy consumption was around 6.1% above that of the previous year. The fact that more heating was needed in the colder winter months partially contributed to this. For economic and technical reasons, the separate measurement of building and process-related energy (for instance due to the heat loss of research facilities) in the ETH Domain is not feasible. The energy costs of the ETH Domain rose by around 3.7% compared with 2011.

The 410 buildings of the ETH Domain also include a large number of showcase buildings dating from 1858 to the present time. To ensure an efficient infrastructure, real estate management is required. The real estate portfolio used by the institutions of the ETH Domain comprises well-known historic buildings in central locations, contemporary office and laboratory buildings, large and energy-intensive research facilities as well as forests and entire Alpine farms. The portfolio is broad-ranging in terms of age: From the 1858 Semper building in the centre of Zurich to spectacular modern buildings such as the EPFL Rolex Learning Center opened in 2010. A considerable percentage of the buildings of the ETH Domain is of historic significance. Some properties are listed historic monuments. The renovation outlay – above all for the historic buildings – is in some cases considerable compared with the benefits and gives rise to challenging construction projects. The ETH Domain and its institutions assume this responsibility to maintain the cultural heritage. However, the framework conditions associated with this often entail restrictions in terms of usage and spatial development. An 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 fulfill the required quality standards. It is the job of the ETH Domain’s real estate management to ensure the functionality of the real estate portfolio in the short, medium and long term and to preserve its cultural value. Needs-oriented planning and the timely realisation of new construction projects, conversions and renovations are at the heart of its remit.

### Key energy figures of the ETH Domain

In 2012 the treated floor area grew due to the academic growth strategy by around 1.5%. Total energy consumption was around 6.1% above that of the previous year. The fact that more heating was needed in the colder winter months partially contributed to this. For economic and technical reasons, the separate measurement of building and process-related energy (for instance due to the heat loss of research facilities) in the ETH Domain is not feasible. The energy costs of the ETH Domain rose by around 3.7% compared with 2011. The institutional energy performance indicator (in MJ/m² p.a.) for 2012 was 17,118,787 MJ/m² p.a. (17,148,787 MJ/m² p.a.; 6.1%)

---

**Energy reference area**

<table>
<thead>
<tr>
<th>ETH Zurich</th>
<th>EPFL</th>
<th>PSI</th>
<th>WSL</th>
<th>Empa</th>
<th>Eawag</th>
</tr>
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<tbody>
<tr>
<td>(in m²)*</td>
<td>644,085</td>
<td>427,622</td>
<td>135,664</td>
<td>27,578</td>
<td>122,267</td>
</tr>
<tr>
<td><strong>Total for ETH Domain</strong> (previous year; change)</td>
<td>1,384,800 (1,364,800; 1.5%)</td>
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</tr>
</tbody>
</table>

**Energy consumption** (in MJ p.a.)

<table>
<thead>
<tr>
<th>ETH Zurich</th>
<th>EPFL</th>
<th>PSI</th>
<th>WSL</th>
<th>Empa</th>
<th>Eawag</th>
</tr>
</thead>
<tbody>
<tr>
<td>573,561,000</td>
<td>305,000,000</td>
<td>512,106,289</td>
<td>16,121,144</td>
<td>57,393,583</td>
<td>17,148,787</td>
</tr>
<tr>
<td><strong>Total for ETH Domain</strong> (previous year; change)</td>
<td>1,481,330,803 (1,395,923,800; 6.1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Energy costs** (in CHF p.a.)

<table>
<thead>
<tr>
<th>ETH Zurich</th>
<th>EPFL</th>
<th>PSI</th>
<th>WSL</th>
<th>Empa</th>
<th>Eawag</th>
</tr>
</thead>
<tbody>
<tr>
<td>17,213,000</td>
<td>11,500,000</td>
<td>13,694,703</td>
<td>501,198</td>
<td>1,667,335</td>
<td>607,711</td>
</tr>
<tr>
<td><strong>Total for ETH Domain</strong> (previous year; change)</td>
<td>45,183,947 (43,567,800; 3.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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* Source: Key indicators in real estate management SIA D0165 (2000) based on SIA 180/14.

** Source: RUMBA (Resource and Environmental Management of the Federal Administration).

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. The key indicator “energy consumption” shows the total consumption of heat and electricity in 2012 for buildings as well as for teaching and research activities. The energy performance indicator (in MJ/m² p.a.), which can be calculated from the energy reference area and the energy consumption, serves to compare buildings which are put to the same use. In view of the different energy intensity of the various research activities conducted, and due to types of usage which cannot be compared with each other, a domain-wide energy performance indicator is not appropriate. The key indicator “energy costs” shows all expenditure incurred in 2012 (cash out) for the generation and distribution of energy (heat, electricity, cooling etc.).
The new teaching and research building for life sciences: the HPL of ETH Zurich at Hönggerberg.

In 2012, the institutions launched a working group to standardise the capture of key figures for energy and environmental reporting and align them even better to the needs of the Resource and Environmental Management of the Federal Administration (RUMBA).

**Governance**

Work on the complete revision of the existing Real Estate Ordinance was successfully completed. It resulted in a new real estate directive implemented by the ETH Board with effect from 1 January 2013. This resolution was preceded by the participation and a hearing of the institutions of the ETH Domain as well as an interdepartmental consultation within the Federal Administration. The new real estate directive created the basis for future cooperation on real estate management within the ETH Domain. As part of the project for calculating the long-term real estate management follow-on costs, the ETH Board and the institutions drew up a policy and implementation plan in specialist committees that received the final approval of the ETH Board. The standard definition and harmonisation of the so-called spatial and financial master plans (SFMP) as a long-term planning and control instrument is envisaged.
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- the departmental heads and employees on the ETH Board as well as the departmental heads in the institutions of the ETH Domain.

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