EPFL

Development Plan 2012-2016

August 31, 2011

Table of Content

0. Vision 3

1. Strategic Executive Summary 5

2. 2008-2010: Development and Achievements 13
   2.1 Moving beyond the educational reform according to the Bologna Declaration 13
   2.2 Promotion of outstanding research 14
   2.3 Improvement of international visibility 15
   2.4 Evolution of faculty and scientific staff 16
   2.5 Promotion of women 16
   2.6 Support of innovation 18
   2.7 Diversification of funding 19
   2.8 Creation of a lively campus 19

3. Positioning of EPFL 21
   3.1 EPFL strategy and specificity 21
   3.2 Strategic partnerships in the ETH Domain and in Switzerland 23
      3.2.1 Medical Strategy 23
      3.2.2 Collaborations with ETH Zurich 24
      3.2.3 Collaborations with the Research Institutes 24
      3.2.4 Collaborations with cantonal Universities 24
      3.2.5 Five strategic alliances (IDIAP, Swiss TPH, IRO, ISRV, CSEM) 25
      3.2.6 Collaborations with Universities of Applied Sciences 26
      3.2.7 Collaboration with high schools 26
   3.3 Strategic partnerships in Europe and worldwide 26
      3.3.1 Europe 27
      3.3.2 South and North America 27
      3.3.3 Russia 27
      3.3.4 Asia 28
      3.3.5 Africa 28
      3.3.6 International Alumni 28
      3.3.7 Accreditation and Quality Assurance 28
      3.3.8 Flow improvement of top students from the best universities 28

4. Major Missions 31
   4.1 Education 31
      4.1.1 Overall measures in education 31
      4.1.2 Bachelor 32
      4.1.3 Master 33
      4.1.4 PhD education 34
      4.1.5 Continuing education 35
      4.1.6 Quality of teaching and education 36
   4.2 Research 37
      4.2.1 Global strategy 37
      4.2.2 Institutional organization 38
   4.3 Technology transfer and innovation 38

5. Transversal Strategic Initiatives 41
   5.1 Advanced Manufacturing Technologies 41
      5.1.1 Green technologies for manufacturing 41
      5.1.2 Nano-Tera.ch 41
      5.1.3 Competence Center of Materials Science and Technology 42
   5.2 Energy Technologies for a Sustainable World 42
      5.2.1 Renewable energy conversion 43
      5.2.2 Smart energy management 43
   5.3 Engineering for Life Sciences 44

5.3.1 The Blue Brain Project ... 44
5.3.2 Nanoengineering for Health ... 45
5.3.3 From Translational Genomics to Personalized Medicine ... 46
5.4 Environmental Systems and Technologies ... 46
5.4.1 Risk management for built and natural alpine environment ... 46
5.4.2 Sustainable architecture and building technology ... 47
5.5 Methods and Platforms for the Advancement of Science ... 47
5.5.1 National electron microscopy network ... 47
5.5.2 Center for biomedical imaging (CIBM) ... 47
5.5.3 High-performance computing: the CADMOS initiative ... 48
5.5.4 Computational science and engineering ... 48
5.6 Other initiatives ... 49
5.6.1 Interdisciplinary Teaching Center (Teaching Bridge) ... 49
5.6.2 Cloud computing strategic initiative ... 49
5.6.3 Quantitative finance and risk management ... 50
5.6.4 Earth and Planetary Sciences ... 50

6. Strategies of Schools, Colleges and Centers ... 53
6.1 Architecture, Civil and Environmental Engineering (ENAC) ... 53
6.2 Computer and Communication Sciences (I&C) ... 54
6.3 Basic Sciences (SB) ... 56
6.4 Engineering (STI) ... 58
6.5 Life Sciences (SV) ... 59
6.6 College of Management of Technology (CdM) ... 61
6.7 College of Humanities (CDH) ... 62
6.8 EPFL Middle East ... 63
6.9 Centers ... 64
6.9.1 Energy Strategy and Energy Center ... 64
6.9.2 Transportation Center ... 66
6.9.3 Space Center ... 67
6.9.4 Center for Neuroprosthetics ... 67
6.9.5 MetaMedia Center ... 68
6.10 National Task: Fusion Energy Research ... 69

7. Resources ... 71
7.1 Human Resources ... 71
7.1.1 Development of skills and performance in an international environment ... 71
7.1.2 Promotion of young talent ... 71
7.1.3 Promotion of equal opportunities and respect for diversity ... 72
7.1.4 Wage flexibilization ... 73
7.1.5 Evolution of the working environment ... 73
7.1.6 Consolidation of the pension fund ... 73
7.1.7 Security, health and safety at work and social partnership ... 74
7.1.8 Development of an all-embracing ethics strategy ... 74
7.2 Finance Strategy ... 74
7.3 Building Strategy ... 75
7.3.1 Real estate management ... 75
7.3.2 Sustainable development ... 76
7.3.3 Objective: Campus ... 76
7.3.4 Culture campus ... 77
7.3.5 Conversion of the ME and BI buildings and Teaching Bridge ... 77
7.3.6 Conference Center ... 77
7.3.7 Microcity - Neuchâtel ... 77
7.4 Communications Strategy ... 78

0. Vision

One Step Beyond…

When it achieved Federal Institute status in 1969, the EPFL was entrusted with the mission to become – together with the Swiss Federal Institute of Technology Zurich – one of our country's technological flagships. Already at that time, the federal authorities' vision was that Switzerland, as a small country with a population of about 6 million, lacking in raw materials and whose economy relied heavily on exports, needed to boost its scientific and technological leadership so as to guarantee future prosperity and innovative strength.

Forty years on, the EPFL has gained worldwide acclaim as a leading institute of technology, focusing its development on innovative education for tomorrow's technology leaders, on phase-lead technological research to foster solutions to major world issues, and on innovative partnerships with the economy.

Forty years on, the federal authorities' initial vision remains highly topical. However, it now applies to a radically new context, as the Swiss Education & Research Minister in charge of the ETH Domain recently recalled in Zurich[1].

The task is now to project into the next decade to ensure that Switzerland remains a leading nation in education, research and innovation. For this we need to take into account that science and technology are becoming more and more central, more and more complex and increasingly global as the number of emerging countries grows in Asia, Latin America, the Middle East and soon in Africa. This entails increasing mobility and competition to attract the best brains, but it also means new opportunities for scientific and economic cooperation for the Swiss institutes of technology and businesses.

This new international framework confronts us with the same challenges as our exporting companies: we need to ensure a global presence throughout the world, to excel and innovate faster than the competition and to acquire adequate critical mass in key sectors. Failing to do so would be our downfall, with a consecutive loss of excellence, notoriety, jobs and growth for the Swiss scientific and economic environment.

In other words, if Switzerland is to retain its international reputation in the fields of education, research and innovation 10 or 20 years from now, the institutes of technology must go one step beyond on the path to growth so as to face worldwide competition and make the most of the new opportunities offered by globalization.

This is our ambition for 2020. Indeed, as the OECD Education Director recently said, "Change is unavoidable for Europe's academics. The world is indifferent to tradition and past reputations, unforgiving of frailty and ignorant of custom or practice. Success will go to those individuals and countries which are swift to adapt, slow to complain, and open to change"[2].

Prepare for 2020

With this in mind, EPFL intends to become, by 2020, one of the world's top 10 research universities, thus contributing to the emergence of a new European university system which is truly competitive at international level, using an original development model combining our international culture, our European roots and our regional and national embedment.

[1] Address by Federal Councillor Didier Burkhalter at the Swiss Federal Institute of Technology Zurich on 19 November 2010.
[2] Andreas Schleicher, Head of the OECD Education Directorate.

An **international culture** is required to relentlessly push the limits of fundamental knowledge on which innovation is based today. Science is global in essence. Scientific advances entail a meeting of the best minds on all continents, in Switzerland and abroad. Scientific progress also requires a systematic promotion of young talent through doctoral schools and the tenure-track system for young assistant professors, which has proved its worth in the USA, placing American universities on top of all world rankings for excellence. This is why partnerships, multicultural cooperation, a stronger worldwide presence and trust in young professors and PhD students are at the very heart of the EPFL development model.

At the same time, our **European roots** should help us to go beyond over-specialization, as the success of universities in the European sense is historically characterized by a determination to confront all forms of knowledge. As a result, the EPFL development model relies on this historical asset of our European continent – fostering interfaces and bridges across disciplines, between technology and other forms of knowledge, to ensure convergence between the various exact sciences as well as dialogue between the techno-science world, the humanities, culture and the arts. This philosophy fuels our education and research strategy – in particular through European research projects in which Switzerland fully participates thanks to the 1998 bilateral agreements – as well as the opening of our campus to art and society in general.

Finally, our **regional and national embedment**, which is rooted both in Western Switzerland and at nationwide level, given our federal status and the small size of our country, means that along with "big world science", the EPFL community pays more and more attention to everyday concerns. We need to be able to use the advanced basic science developed in our labs to design technological solutions to problems to be solved in Switzerland and for Switzerland, yielding economic opportunities for our companies and public institutions. Therefore, our development model promotes students solving technological issues of interest to SMEs and a strengthening of technology transfer and our presence in Switzerland via our regional hubs. This contribution to the economic growth and cohesion of Switzerland is an essential part of the mission of a federal and public institution such as EPFL, at a time when our country is looking more and more like a big city with 8 million people interconnected around major economic and urban centers, each of which has at least one institution of the ETH Domain[3].It is based on a strategic partnership with University of Lausanne, University of Geneva and with the partner institutions of Western Switzerland, in particular its University for Applied Sciences.

[3] ETH Zurich, the PSI, Eawag, Empa and WSL in the area combining the Greater Zurich Area and the Greater Basel Area; EPFL in the area comprising Western Switzerland, the Lake Geneva area and neighboring Cantons; the Manno / Lugano Supercomputing Centre in the Ticino area, which will be brought closer to French-speaking and German-speaking Switzerland with the new Mendrisio-Varese-Milan railway line (2013) and the Gotthard base tunnel (2016).

1. Strategic Executive Summary

In concrete terms, our ambition is expressed through the goals which we intend to achieve in the period 2012-2016 on the research, economic, institutional and infrastructure fronts. All initiatives set out in this development plan tend towards these goals. They represent our answer to the complexity of scientific and technological developments, to globalization and to the emergence of new research and technology actors throughout the world.

Research Development

In terms of research, EPFL intends to pursue its development, strengthen its critical mass and become a fully-fledged research university. The objective for 2019 – the 50th anniversary of our accession to federal status – is to bring together 10,000 students (of which 2,500 PhD students) and 500 professors to train the new generation of engineers, scientists and architects who will shape the Switzerland of tomorrow. This entails meeting five prerequisites in the period 2012-2016:

- to become a reference research university in the field of innovative teaching;
- to position the institution in specific and transversal research areas;
- to strengthen our links with medicine, management and design;
- to attract the best students and scientists from all over the world;
- to strengthen our international visibility and presence.

Become a reference research university in the field of innovative teaching

In terms of education, which is our primary mission, the EPFL's ambition is to become, by the end of 2016, a research university acknowledged for its cutting-edge teaching.

This process will be materialized through the new *Teaching Bridge* building, devoted to disciplinary and transdisciplinary training, which will offer students an innovative learning environment confronting them simultaneously with cutting-edge research and the problems experienced by our country's SMEs, in the form of totally rearranged practicals. Construction of this *Teaching Bridge* will complement the Rolex Learning Center built for the students in 2010. It will serve to apply new teaching concepts and to strengthen interaction with SMEs, in cooperation with the University of Applied Sciences Western Switzerland.

The task is also to continue the in-depth reforms initiated under the aegis of the Bologna Declaration. This entails making the educational programs even more flexible and further developing teaching and interactions between students and faculty by encouraging individual work and work in small groups.

Although the bachelors will remain a more general training phase to acquire the basic polytechnic skills at the root of EPFL education, masters will provide extensions into other educational fields (minors) as well as enhanced training in a specialist field. With this in mind, EPFL will pursue a targeted and specific development of joint masters with its top academic partners. In parallel, we shall seek to further our students' ethical, social and responsible commitment towards sustainable development.

Position the institution in specific and transversal research areas

As a university focused on research, EPFL aims to position itself in three transversal areas in the next few years, together with the specific development of the various disciplines at the heart of all EPFL activities.

First, we should actively contribute to the *convergence of info-nano-bio-cogno technologies,* by including into this integrative approach the ongoing research developments in the field of neuroscience, in which EPFL intends to take the lead at European and worldwide level with initiatives such as the Human Brain project or the development of the Center for Neuroprosthetics. EPFL's ambition in this area is to offer Switzerland a unique research infrastructure (a "CERN of the brain") and to mobilize these competencies so as to rise to technological challenges which require multidisciplinary cooperation.

Secondly, the transversal area of *simulation and computational science* should serve to extend and deepen knowledge in the various research disciplines as well as at an interface between these. In parallel, a solution for the data storage will have to be defined and implemented ("Data Center") to respond to the massive increase. A strengthening of collaborations with the Swiss National Supercomputing Centre (CSCS) in Manno-Lugano is also foreseen.

Finally, we shall focus on the development of green technologies in the wider sense, be it in the fields of energy, sustainable construction, urban planning, transport or sustainable systems for health, safety and the environment. The EPFL intends to make a significant contribution to Green Manufacturing with e.g. our "Microcity" hub in Neuchâtel (IMT, CSEM), our European project "Guardian Angels for a smarter life" and its self-powered chips, or the development of nanomaterials and technologies related to the use of sensitive natural resources.

Other areas will develop around the priorities of the Swiss political authorities in order to maximize the research and economic return of Switzerland's contributions to the international research project on fusion (ITER) and to the European Space Agency (ESA).

Strengthen our links with medicine, management and design

To take into account the development of society's needs and assert its position as a global, interdisciplinary university, it is essential for EPFL to accelerate integration and cooperation with three sectors: the medical world, with which a rapprochement was initiated ten years ago with the establishment of the School of Life Sciences and integration of the Swiss Institute for Experimental Cancer Research (ISREC) on the EPFL campus. Closer cooperation will develop in the years 2012-2016 with the Lausanne (CHUV) and Geneva (HUG) University Hospitals and with ETH Zurich in the framework of the ETH Board's medical strategy. In parallel, one of the key challenges for technological innovation is the management and project leading skills demonstrated by the future technology leaders trained at EPFL. Hence the importance of strengthening the activities of our College of Management and Finance by increasing cooperation with University of Lausanne (UNIL) and the International Institute for Management Development (IMD). Similarly, through the EPFL+ECAL Lab, the EPFL wishes to heighten cooperation with the University of Art and Design Lausanne (ECAL) in the field of design, bridging the gap between technology and the applied arts.

Attract the best students and scientists from all over the world

Following 10 years of efforts which have turned our institution into a fully European university through the Bologna process or European research programs, and opened it to other

continents, we must now make EPFL a global university by further diversifying the origin of our students and faculty, so as to take into account the evolution of world science and of new emerging countries in Asia, the Middle East, the Americas and Africa. The appointment of a Dean of International Academic Affairs reporting directly to the EPFL Vice President for Academic Affairs will strengthen endeavors in this field, both on the EPFL campus and abroad.

Strengthen our international visibility and presence

Finally, we should make the most of the positive dynamics created by the research achievements of EPFL faculty (in particular in obtaining European Research Grants, where we are among the front runners of European universities) so as to strengthen our worldwide presence.

This involves an expansion of our policy of strategic alliances. The development of wide-ranging bilateral or multilateral collaborations will enable us to boost our contribution to strengthening European research. Simultaneously, we intend to set up small hubs in several areas of the world so as to develop research which may not be as efficiently conducted in Switzerland (e.g. for climate reasons) or which is best conducted abroad so as to widen the scope of advanced technology applications for the benefit of our companies. We shall also anticipate the next wave of emerging countries, taking into account their scientific and technological specialization[4], with a view to promoting a new form of international cooperation based on the development of appropriate innovations and technologies. Nor shall we overlook the importance of the private sector in world education and shall, where appropriate, establish the necessary partnerships.

This is the thrust of the strategic initiatives which we are currently initiating and shall develop over the next four years, whether in Europe (Future Emerging Technologies Flagship "Human Brain" and "Guardian Angels" Projects), on the American continent (Natal in Brazil, Harvard Medical School in the USA), in the Middle East (EPFL Middle East), in Asia (exchange programs in India, China and Japan) or in future emerging countries of French-speaking culture (RESCIF network of 14 institutions on all continents, including 8 emerging universities in southern countries – Lebanon, Vietnam, Haiti, Morocco, Senegal, Cameroon, Burkina Faso).

Economic and institutional development

In addition to these research goals, EPFL intends to maximize its contribution to the Swiss economy and society during the period 2012-2016. This involves

- strengthening our industrial partnership with Swiss or foreign exporting businesses and investors willing to support EPFL;
- creating regional hubs in Switzerland to generate employment, in cooperation with interested municipal and cantonal authorities;
- asserting our role as ambassador of Switzerland abroad.

Strengthen industrial partnerships

EPFL first intends to strengthen its partnerships with industry and position itself as one of our country's major enterprises, anticipating the needs of the economy. Our task is to facilitate

[4] UNESCO Science Report 2010. The Current Status of Science around the World. UNESCO Publishing.

the “technologization” of our industry[5] by training the future engineers who will work for Swiss firms both in Switzerland and abroad.

This effort also explains the major internationalization of our campus. As a reminder, Switzerland is a small exporting country whose industrial basis has turned around since 1980. It has a working population of 4 million, plus an additional 2.4 million people working abroad for Swiss companies. This means that by welcoming foreign students, EPFL is training the young talents who will one day work for these firms and represent Switzerland throughout the world once they go back to their country of origin. The same applies to our engineers working for foreign companies who create jobs in Switzerland.

With this in mind, the EPFL Innovation Square and the 2,000 R&D jobs which it will soon house will considerably strengthen the EPFL’s role as a bridge for technology transfer between the realm of science and the world of industry. It will, on the one hand, enable the companies which base their research centers there (Nestlé, Constellium, Logitech, Credit Suisse, Nokia, Debiopharm, Cisco or Elca) to be close to the heart of science at EPFL, with its innovative atmosphere, laboratories, professors and students. On the other hand, it will offer the latter an opportunity to become familiar with the business world and to contribute to the Swiss economy of tomorrow. We anticipate that this proximity will foster new dynamics in creating start-ups, and especially in ensuring their growth capability.

Finally, based on the fact that the EPFL shares an entrepreneurial and international spirit with Swiss exporting firms, we also intend to involve interested companies in the international partnerships which will be developed in coming years to respond to the globalization of science and technology. We thus intend to position EPFL as a Swiss multinational for knowledge and technology, a brand and a major actor in the Swiss export economy.

Develop regional hubs

Together with its internationalization, over the past 10 years EPFL has been driving economic development for all regions in our country. This is the thrust of the projects currently developed or planned in partnership with the cantonal authorities, universities or universities of applied sciences concerned in Neuchâtel (Microcity), Basel (Studio Basel), Valais (IDIAP, IRO), and soon in Fribourg and Geneva, as well as of collaborative projects between EPFL, ETH Zurich and the PSI.

Riding on this positive trend, EPFL welcomes any requests by French-speaking cantons willing to invest, such as Neuchâtel with the Microcity project, without forgetting the City of Lausanne and Canton Vaud with the collaboration between EPFL and ECAL/University of art and design Lausanne (EPFL+ECAL Lab), as well as the planned implementation of a national-scale technology park to complement Innovation Square –the latter is soon fully booked, which demonstrates the concept’s validity. This is why EPFL, UNIL and the authorities of the City of Lausanne and Canton Vaud will compete to house one of the national technology parks foreseen by the future federal law on research and innovation.

EPFL is determined to play its role as a natural focus of activities for international firms interested in immediate vicinity with the Lausanne university campus, and for all those wishing to develop in other cantons, in particular around our regional hubs. Through this, EPFL will increase its contribution to generating tax revenue and jobs for the public institutions concerned.

[5] Crédit Suisse “The Structure of the Swiss Economy 1998–2020 ». July 2010.

The challenge is in particular to better exploit the very good fit between research and technology developments in ETH institutions and the specializations of the Swiss economic base[6]. This match is particularly evident in French-speaking Switzerland, where three activity sectors are predominant – higher education, the luxury industry and high-tech and telecom[7]. Even better, firms engaged in medium-high technology and knowledge-based industries, whose development largely relies on research activities (instrumentation, luxury watches, micro- and nanotechnology, biomed, IT, including the promotion of the arts and sports) account for 26% of the GDP of French-speaking Switzerland. Cantons Geneva, Neuchâtel and Jura have the strongest growth in these sectors, while Geneva, Vaud, Valais and Neuchâtel have the highest nominal values in these fields[8]. In addition, the growth of these strong R&D-based firms in the region is even stronger than the total growth of companies[9]. This is a sure sign that the research and advanced technology developed at EPFL are actually driving economic growth in Switzerland today and generating "intelligent specializations".

Assert our role as ambassador of Switzerland abroad

One often says that science and innovation are Switzerland's key assets in the new stage of the world's globalization, in line with our country's tradition of openness and active neutrality, as science and technology are universal, global and open to all by definition. The two federal institutes of technology are the spearheads of this trademark of Switzerland abroad.

However, despite the notoriety of our higher education in international rankings and scientific circles, Swiss innovation and creativity are not as well-known as we would hope outside specialist fields.

The small size of our country explains this phenomenon, which will increase due to globalization unless we do something to compensate the trend. Indeed, although Switzerland and its universities are acknowledged leaders in research and innovation when results are weighted to the size of individual countries, the larger nations – in particular those of the G-20 – are clearly ahead in terms of volume and international investments. It is therefore hardly surprising to observe the existing distortion between our innovative strength (as measured by the World Economic Forum or the European Innovation Scoreboard) and how this strength is perceived in some general international surveys (e.g. Country Brands Index or, more worrying, the UNESCO Report 2010 on the Current Status of Science around the World, whose analysis is focused on G-20 countries).

This is why the EPFL is ready, in its capacity as federal institute, to strengthen its partnership with Swiss diplomacy so as to promote Switzerland's strengths in science and technology outside purely research circles, including in cooperation with the "Presence Switzerland" organization, as well as with the "Swissnex" network of consular outposts specializing in science, education, art and innovation.

Infrastructure development

A top university's attractiveness is also measured by the quality of its infrastructure and urban design. In the long term, EPFL will probably welcome 10,000 students (including PhD

[6] Dominique Foray, Stéphane Lhuillery "La Suisse dans une économie globalisée de la connaissance", CEMI, EPFL College of Management, December 2005.

[7] "Les façettes d'une région affirmée", Forum des 100 – 2009 edition – study on FSO statistics conducted by Martin Schüler et al. (CEAT-EPFL).

[8] Respectively 42%, 26% and twice 11%. See "La force économique de la Suisse romande 2010" – Study conducted by the Romandie cantonal banks for the Forum des 100

[9] 4% increase in GDP against 3% in other sectors (ibidem).

students), 10,000 high added-value jobs in related companies, 3,000 student lodgings, a conference center, one or two hotels and various services, complemented by the adjacent UNIL campus with its sports center and Lausanne university institutions. Our goal is to gradually turn the EPFL center into a true Tech-Art City integrated into the Lausanne urban network and territories beyond via its regional and international hubs.

The period 2012-2016 should contribute to refine the design of this campus through urban planning measures with a three-fold objective:

- to bring science, technology and culture closer together (crossroads of knowledge);
- to strengthen integration into the global EPFL community (crossroads of continents);
- to turn EPFL into a laboratory for contemporary urban planning (crossroads of urban design).

Bring science, technology and culture closer together (crossroads of knowledge)

The training of a fully-fledged engineer must be open to all forms of knowledge and all elements of society. The Rolex Learning Center paved the way with its avant-garde architecture, interdisciplinary vocation and 24/7 access to EPFL students and visitors alike. With the previously mentioned *Teaching Bridge* and the pavilions foreseen on the Place Cosandey (welcome desk, Montreux Jazz Café, MetaMedia Center and experimental exhibition space), the EPFL campus will become a crossroads of knowledge open to new audiences of all ages and all walks of life.

Activities bridging various forms of knowledge will become more visible, in particular technological collaborations with neighboring sports and cultural institutions (International Olympic Committee, Montreux Jazz Festival, Swiss Cinémathèque film library, Federal Office of Culture), the programs developed by the Centre for Area and Cultural Studies ("Switzerland – a very short introduction", "Contemporary Studies in Asia and in the Middle East"), as well as the continuing education activities jointly offered with the University of Lausanne.

Strengthen the EPFL "corporate culture" (crossroads of continents)

The second objective of this urban planning effort is to ensure that the quality of campus architecture creates an atmosphere conducive to strengthening our sense of belonging. This also involves welcoming students who live on campus full-time, with the forthcoming extension of our housing capacity (515 additional lodgings in 2013) and the development of services, shops and a conference center which will make our campus one of the key nodes of the Lake Geneva and West Lausanne area.

This densification, including the new buildings around the Rolex Learning Center mentioned earlier, will offer more space at the heart of the campus, for the benefit of the student associations which liven up EPFL or to set up the Faculty Club as requested by our professors. First and foremost, this heart of EPFL will be a crossroads of continents where the 120 nationalities represented on our campus can meet and exchange.

Turn EPFL into a laboratory for contemporary urban planning (crossroads of urban design)

Finally, the evolution of our campus towards a new form of Knowledge City integrated in the surrounding urban environment and beyond, provides an opportunity to turn our institution into a laboratory for Swiss and international urban planning and to interlock this Global

Network University with the future networks of knowledge cities and universities, whose advent has been described by John Sexton, the President of New York University[10].

Seen from this angle, the development of our campus is an intellectual and practical challenge to all EPFL laboratories able to contribute to contemporary urban planning. Indeed, the task goes beyond building our central campus and hubs, to become an intellectual crossroads of urban design.

[10] John Sexton "Global Network University Reflection", New York University Web, December 21 2010.

2. 2008-2010: Development and Achievements

EPFL has undergone major quantitative and qualitative growth in recent years. The number of students (including PhD students) has increased from 6,345 at the beginning of 2008 to 7,762 at end 2010 and has doubled in 18 years (Fig. 1). The student population of approximately 7,500 projected for 2011 in the 2008-2011 strategic planning was already reached in autumn 2010. EPFL has become a true research institution, with more than 1,900 PhD students and with 48% of the students being graduates (master & PhD).

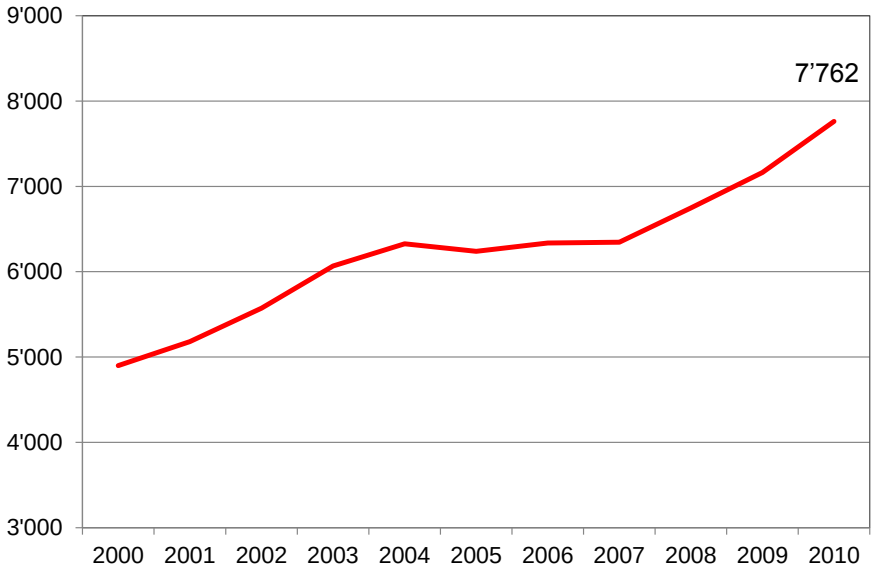

Figure 1. Number of students (bachelor, master, PhD and Postgraduate; CMS not included)

2.1 Moving beyond the educational reform according to the Bologna Declaration

EPFL offers 13 complete study programs at the bachelor's and master's level as well as 4 specialized master programs. EPFL has used the Bologna reform to diversify and add forward-looking fields like Financial Engineering, Nanoelectronics (joint degree with Politecnico di Torino and Grenoble Institute of Technology), Management of Technology and Entrepreneurship, Computational Science and Engineering or Nuclear Engineering (joint degree with ETH Zurich). The first graduates of the master in Life Sciences & Technology program received their degrees in 2008. Internships in industry are being introduced for all programs in engineering and relations with industry are being developed through the Sections' Advisory Committees. The number of contact hours has been reduced and flexibility of the curricula increased, for example with the development of new Minors within the master education. EPFL has become more and more international, with 34% of the bachelor students, 45% of the naster students and 73% of the PhD students coming from outside Switzerland (Fig. 2).

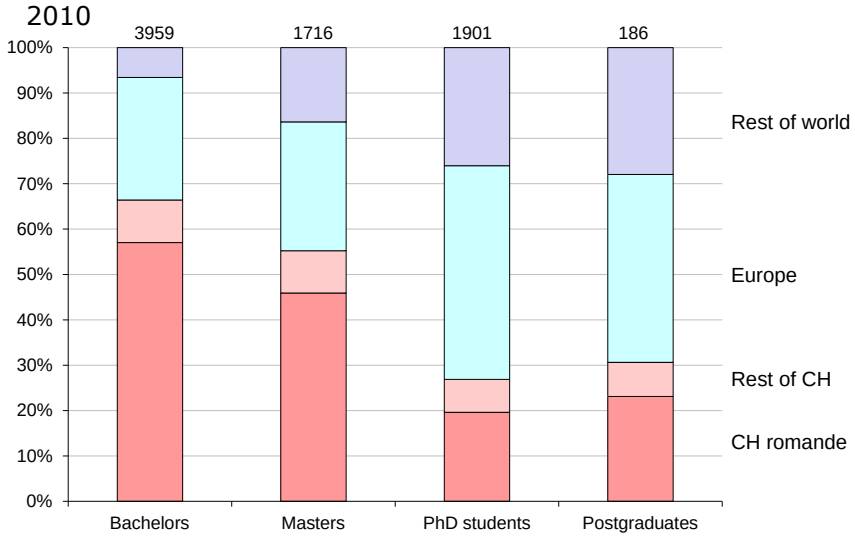

Figure 2. Origin of students in 2010

2.2 Promotion of outstanding research

EPFL has been extremely successful in terms of European Research Council grants. With 34 starting and advanced grants awarded between 2007 and 2010, EPFL is second of the list of European Universities.

In December 2010, two projects were submitted by EPFL to the FET flagship program of the European Union: The Human Brain Project (outreach of the simulation of brain functioning) and Guardian Angels for a smarter life (zero-power intelligent autonomous systems).

From the eight new National Centres of Competence in Research (NCCR) announced in Switzerland in 2010, three were awarded to EPFL as (co-)leading house (robotics, synaptic bases of mental diseases, chemical biology). EPFL is the leading house of Nano-Tera, a research initiative of national significance, and of CCMX, a national competence center in material science, showing the strong position of EPFL in Switzerland.

The promotion of transdisciplinary research is one of the strategic priorities of EPFL since several years. A number of interdisciplinary centers were created since 2008 such as the Center for Neuroprosthetics, the Transportation Center or the Center for Advanced Modeling Science (CADMOS) together with the Universities of Lausanne and Geneva. All these initiatives enable the exploration of emerging fields and help bridging established academic boundaries.

Numerous distinguished prizes have recently been awarded to EPFL scientists, e.g. the Balzan Prize 2009 and the Millennium Prize 2010 to Michaël Grätzel, who was described by Thomson ISI as one of the ten best chemists of the decade 1999–2009, the Marcel Benoist Prize 2009 to Gisou van der Goot, the Fresnel Prize and the Helmholtz Prize 2009 to Tobias Kippenberg, the Kuwait Prize for Basic Sciences in 2009 and the Humboldt Research Award 2010 to Majed Chergui, the Prince Sultan Bin Abdulaziz International Prize for Water 2010 to Andrea Rinaldo, the Robert Wenner Prize 2010 to Melody Swartz, the “Prix de l’association des ingénieurs mécaniciens” 2010 to John Thome and the “Prix international INSERM” 2010 to Denis Duboule.

The number of publications and citations are steadily increasing, showing an important increase in quantity and quality of research (Fig. 3 and 4). This is reflected by EPFL being No. 1 in Europe in two citation rankings (The Times Higher Education 2000-2010 for Engineering and CWTS Leiden 2004-2009).

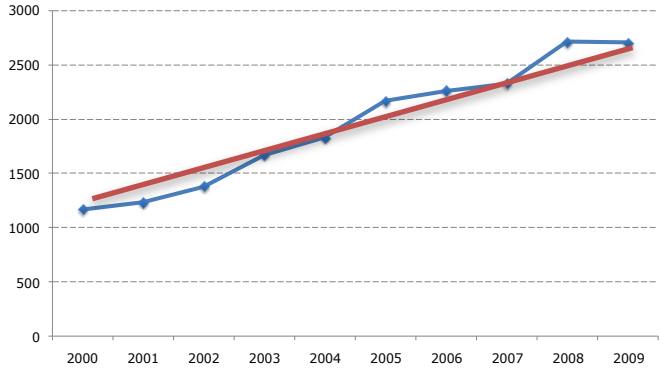

Figure 3. Number of ISI publications

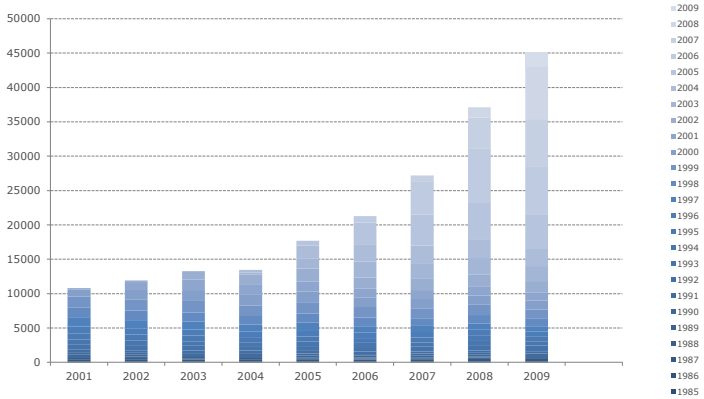

Figure 4. Number of citations

2.3 Improvement of international visibility

The increase in research quality and in particular the success of EPFL regarding the ERC grants greatly enhanced the international visibility of EPFL. This outstanding reputation and the tenure track system enabled EPFL to attract excellent faculty from all over the world, more than 50% of the professors coming from abroad.

EPFL has 189 Partner Universities from Europe, North and Latin America and Asia, with whom students can be exchanged. 19 new student exchange agreements were signed since 2008 and more than 3,000 students used the offers for academic mobility between 2008 and 2010 (1,806 incoming students and 1,291 outgoing students).

EPFL has launched an off-shoring project in Ras Al Khaimah in the United Arab Emirates, where a new academic campus is being defined ("EPFL Middle East"). The project includes the construction of a university campus, fully financed by the Emirate, and the development of its own master's and PhD courses. The first activities were launched in 2010 (continued education courses, 3 joint Lausanne-Middle East PhD thesis, announcement of a master starting in 2011).

EPFL has intensified its world-wide collaborations with the top Universities. As an example: Harvard Medical School and EPFL have established a joint research and education program thanks to a contribution from the Bertarelli Foundation. The Bertarelli Program in Translational Neuroscience and Neuroengineering is a collaborative exchange aimed at improving quality of life for people with neurological disabilities.

EPFL is an active member of international networks such as the Global University Leaders Forum (GULF), initiated by the World Economic Forum in 2006. A new network of 14 French-speaking technology universities, the Réseau d'excellence des sciences de l'ingénieur de la Francophonie (RESCIF), was launched under the auspices of EPFL at the 13th Conference of Heads of State of French-speaking Countries (Montreux, October 2010). The aim of the project is to promote collaborative scientific programs, especially in the areas of water, nutrition and energy management.

2.4 Evolution of faculty and scientific staff

The faculty hiring strategy of EPFL is centered on emphasizing tenure-track assistant professorships: 48% of the 72 new professors recruited since 2008 are tenure-track assistant professors, which corresponds to the 50% announced in the 2008-2011 strategic planning. By increasing the number of smaller lab, this strategy enhanced the flexibility of the schools. Furthermore, despite the important increase in the number of students it was possible to keep the staff-to-student ratio nearly constant (2008: 20.9 students/professor[11] and 8.2 students/teaching staff[12]; 2010: 21.9 students/professor and 8.7 students/teaching staff, teaching staff being professors, senior scientists and internal "chargés de cours").

A career plan is offered to the scientific staff, who have the opportunity to apply for the titles of research and teaching associate, senior scientist and adjunct professor. Between 2008 and 2010, 42 scientists were awarded the title of senior scientist and 25 of adjunct professor, recognizing their teaching and research skills (Fig. 5).

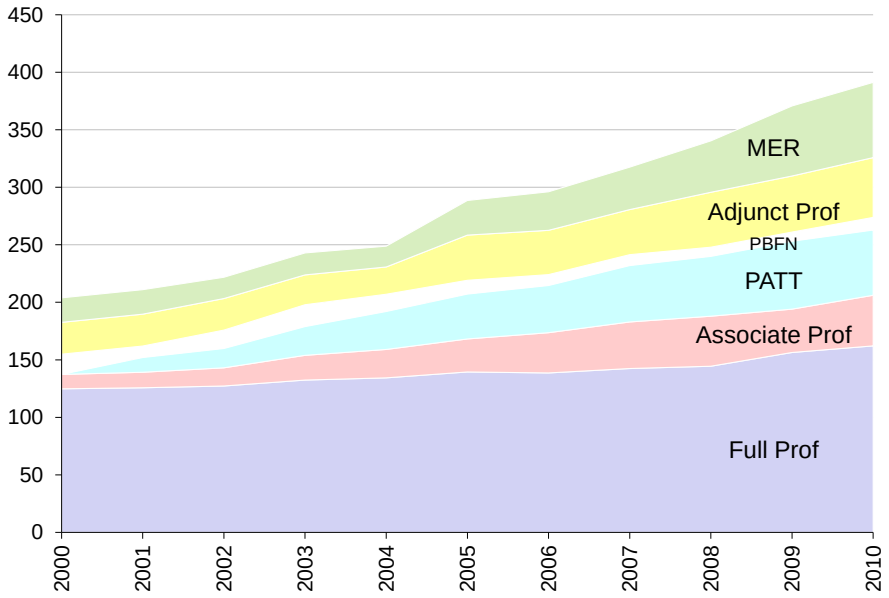

Figure 5. Evolution of Faculty (2000-2010)
(MER: senior scientist, PBFN: assistant professor Swiss National Science Foundation, PATT: tenure track assistant professor)

2.5 Promotion of women

EPFL's equal opportunities policy is based on measures and initiatives to promote equal opportunities at all levels and on specific initiatives to attract and retain women in scientific fields and in engineering.

In practice, this means initiating and carrying through:

- targeted measures to interest girls in scientific disciplines and engineering, and to encourage all categories of female scientific staff to pursue academic careers;

[11] Full, associate, assistant (tenure track & SNF) & internal adjunct professors
[12] Professors according to[10], senior scientists and internal "chargés de cours"

- measures to enable women to achieve a healthy balance between family life and their chosen career (work-life balance).

Between 2000 and 2010, the number of women on campus doubled, and the current percentage is around 29%. In 2010, women accounted for 27% of EPFL's student population (including PhD students) and 14% of the teaching staff[13]. The proportion of women taking bachelor's and master's courses increased from 18 to 27% (Fig. 6), which is higher than the 25% announced in the strategic planning 2008-2011. EPFL now recruits one woman for every two men; 68% of administrative staff and 22% of technical staff are women. A survey carried out in 2009 focusing on equality issues showed that, overall, equal pay for equal work is now the norm. Significant efforts have been made in recent years to increase the number of female professors, which has increased from 6 (3%) in 2000 to 37 (11%) in 2010. However, the ambitious number of 15% of women professors announced in the strategic planning 2008-2011 has not yet been reached, showing that further efforts are essential.

The number of women in executive posts almost tripled since 2005, increasing from 8.5 to 16%. Having women in 25% of executive posts by end 2011 – as stipulated in objective 1 of goal 5 of the performance mandate laid down for the ETH Domain – will be difficult to reach, but EPFL hopes to approach it thanks to the strategy and measures applied with success since several years.

The measures set in place comprise mentoring, participation in an ETH domain program "Fix the leaky pipeline", organization of networking events, courses, lectures, round tables and lunches, development of part-time working and flexible working hours, expansion of day care facilities, etc. Moreover, EPFL has set up a program aimed at kindling interest for careers in engineering in girls under 13 years of age by providing information, helping them gain confidence in their abilities and pointing to appropriate female role models, by organizing workshops and other events. EPFL, with the Haute Ecole Pédagogique of the Canton of Vaud, has also been running a bus "Les sciences, ça m'intéresse!" that travels the country promoting science among young people, especially girls, in French-speaking Switzerland.

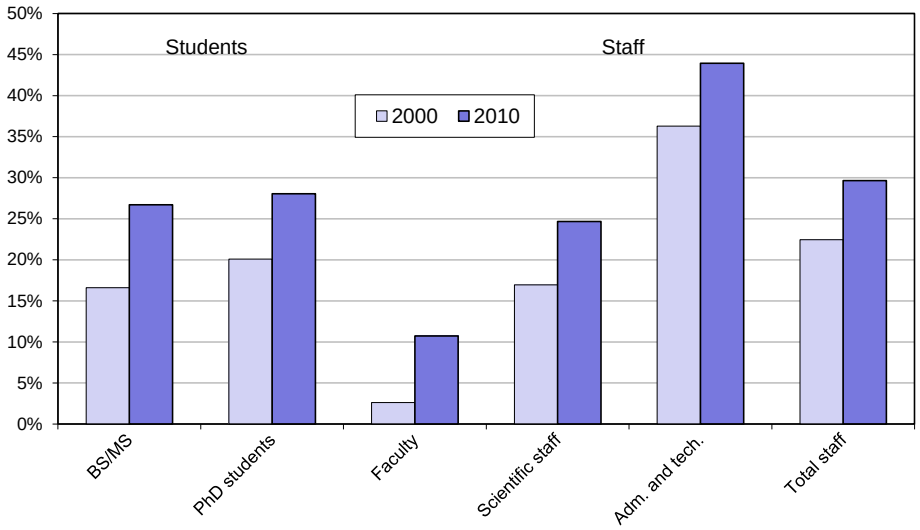

Figure 6. Proportion of women among students, faculty and staff (2000/2010)

[13] Full, associate, assistant (tenure track & SNF) & internal adjunct professors, senior scientists and internal "chargés de cours"

2.6 Support of innovation

Collaboration with the industrial, economic and scientific environments is a long-standing tradition at the EPFL. From the first computer mouse to methods for decoding DNA a thousand times faster, the EPFL is a unique place of innovation and competence. Created in 2004, the Vice-presidency for Innovation and Technology Transfer has launched several specific initiatives aimed at enhancing EPFL's impact on the economy, at promoting links between EPFL and the business world and at developing a dynamic regional centre of innovation.

The Science Park (PSE), founded in the 1990s, has evolved to become the Innovation Square currently housing 12 buildings that provide major companies and promising start-ups with the conditions they need to flourish. It is firstly devoted to house research groups and innovation cells from companies such as Logitech, Nokia, Nestlé, Cisco, Debiopharm, Constellium and Credit Suisse and that operate in fields as diverse as information technology, biotechnology and telecommunications. A second sector is devoted to young entrepreneurs. Today, it houses more than 80 start-up companies. A business incubator founded in 2008 is the latest service to become available. Known as the 'Garage', it provides future start-ups with the infrastructure and support they need to get off the ground.

Between 2008 and 2010, EPFL concluded 1137 research collaboration agreements with companies and public entities representing a financial contribution to participating laboratories in the amount of 264 mio CHF. 52 start-up companies were established three quarters of which have licenses for technology developed by EPFL (Fig. 7). 131 new patents were registered, 76 patents granted and 268 new inventions and software packages were announced. Further, 121 licenses and various transfer agreements were concluded. These numbers are in the same order of magnitude as institutions like the MIT and reflect the dynamism of EPFL.

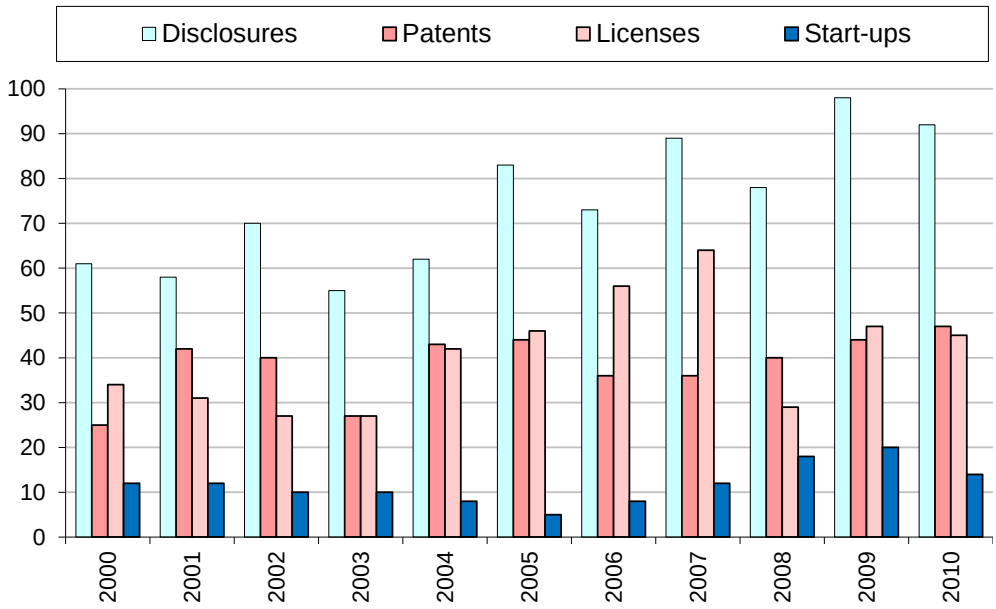

Figure 7. Disclosures, patents, licenses and start-ups (2000-2010)

2.7 Diversification of funding

Second- and third party resources almost doubled from 2000 to 2010, with competitively acquired funds registering a particularly strong increase (Fig. 8). In 2010, 30% of the global expenses of EPFL were provided by second- and third party funding. The origin of these resources was widely diversified over the last years and competitively raised funds from national and international organizations as well as resources from private sources (cooperation with industry, donations, sponsoring, etc.) play a more and more important role.

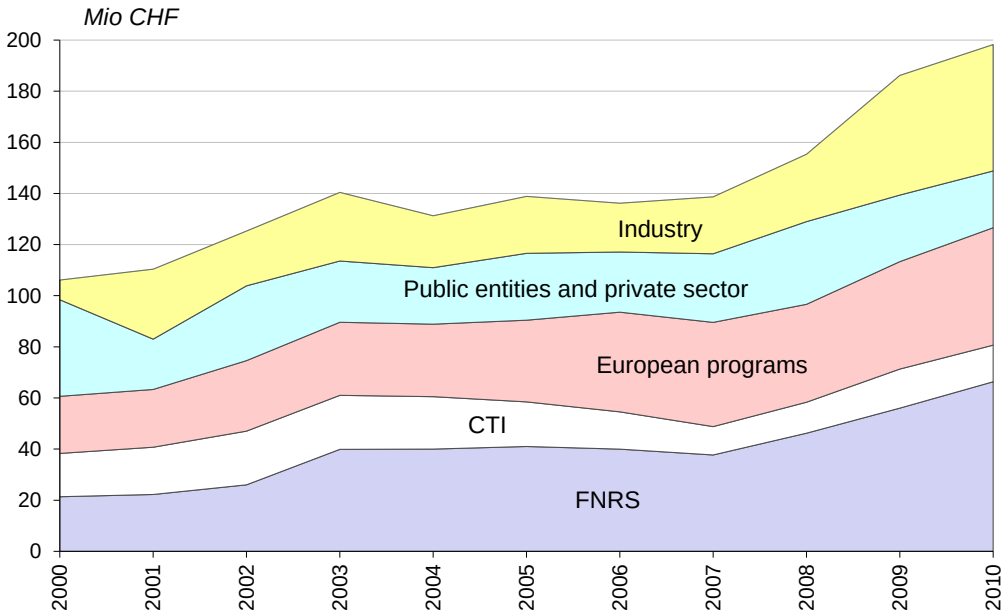

Figure 8. Diversification of funding (2000-2010)

2.8 Creation of a lively campus

The EPFL campus has undergone a continuous expansion. A new life sciences building was inaugurated in September 2009. A complex of student quarters as well as a hotel designed to accommodate visitors has opened in spring 2010. The Rolex Learning Center, an innovative project designed to house the new EPFL library with over 800 work places for students, has been inaugurated in May 2010. The architects, Kazuyo Sejima and Ryue Nishizawa, have been awarded the 2010 Pritzker Prize the award that is considered as the Nobel price of architecture. Between 2006 and 2012, more than 500 mio CHF coming from the private sector are being invested in form of Public Private Partnerships.

The flat roofs of the buildings are being covered with 20'000 m^2 of solar cells, such creating one of the biggest photovoltaic parks of Switzerland. EPFL is recognized for its commitment to sustainability: in 2009, the institution received the Sustainable Campus Award from the International Sustainable Campus Network (ISCN).

3. Positioning of EPFL

3.1 EPFL strategy and specificity

At the heart of the diversified and international Lake Geneva area, the EPFL has deep roots in European culture. Like Switzerland, with its multilingual and open-minded tradition, EPFL is proud of its multiculturalism and academic diversity, which contribute to its wealth, visibility and attractiveness. Relying on this fundamental strength in a rapidly-evolving world, EPFL has always had a proactive and pragmatic attitude, combining flexibility and innovative strength, and displayed a pioneering and entrepreneurial spirit.

The EPFL strategy aims to combine our regional embedment with our international culture and European roots in order to bring science, technology, culture and art closer together. In an evolving, unstable economic environment, this strategy is expressed through the following main lines, to enable EPFL to fulfill its three basic missions – education, research and technology transfer:

- Contribute to solving the great challenges of our society through commitment to our fundamental missions;
- Pursue the EPFL's qualitative and quantitative growth without compromising on quality or excellence;
- Strengthen EPFL's visibility and progress among the best universities, while preserving the institution's own identity and culture;
- Keep a flexible, pragmatic, dynamic and entrepreneurial approach so as to adjust developments as new opportunities arise.

The value of an institution is measured through the quality and competence of the people who keep it alive. It is therefore essential for EPFL to continue to attract the best students, scientists and staff at worldwide level, and to be able to offer them a first-rate research and academic environment.

The 2012-2016 Development Plan lays the foundations for a new phase in which EPFL intends to become one of the world's top 10 research universities by 2020. This phase will be designed around four guiding principles: ambition, globalization, fast implementation and partnerships.

Ambition and globalization

For our future development, we need to take into account the new international context so as to make the most of the new opportunities offered by globalization and to respond to worldwide competition.

Ambition is an absolute prerequisite given the complex nature and investments needed to make progress in research and technology in the coming years, in fields which are key to our planet's sustainable development such as energy, information technology, bio- and nanotechnology, space sciences or neuroscience. These investments require a pooling of the world's infrastructure and top scientists, leading to the creation of new international research consortia and permanent collaborations between scientists all over the world, including of course with our country's universities and universities of applied sciences.

European research, in which Switzerland is an active and respected participant, has shown the way forward over the past ten years. This has enabled the Ecole polytechnique fédérale de Lausanne to prove the excellence of its research in the ultra-competitive world of international science and to diversify its funding sources.

Given the rapid development of BRIC countries (Brazil, Russia, India, China) on the economic, research and technology levels, the next stage of research development will necessarily take place on a global scale. This is a recent situation. The take-off of certain countries like China, Brazil and India probably announces a wider rebalancing of world economies, with the forthcoming advent of second-generation emerging countries referred to as “Next Eleven” or “New Frontier” in financial circles. This latter category already includes over 30 countries in America, Asia and Africa.

This new wave of emerging countries will necessarily entail growing needs in education and research, which is why these countries are starting to invest massively in these fields and often attempt to attract interested universities and countries in the north which are able to invest in their territories. This is particularly true

- in South America (with Brazil’s research universities);
- in Asia (with the emergence, along with the Japanese or Korean universities, of large Chinese, Indian or Singaporean universities, complemented by e.g. the establishment of Yale University in Singapore);
- in the Middle East (with the construction in Saudi Arabia of the King Abdullah University of Technology – KAUST – involving (mainly U.S.) global university partners, or the arrival of MIT in Masdar, United Arab Emirates).

This evolution explains why ETH Zurich is currently establishing an outpost in Singapore, and why EPFL is developing activities in the Middle East and in Brazil. It also shows that this trend will grow, which is why globalizing our activities is the only answer if Switzerland is to remain in the world race for innovation, as all larger countries – in particular within the G-20, of which our country is currently excluded – are significantly ahead of us in terms of research and investment volumes.

Fast implementation and partnerships

This dual context (complexity of research and technological developments; globalization and emergence of new actors in science) obliges both ETH Zurich and EPFL to maintain a flexible and dynamic approach in this highly competitive environment. Our neighbors are not waiting for us to invest. Therefore, foresight and fast implementation are becoming essential, as the major risk for institutions such as ours is to miss out on a development or growth opportunity. However, this proactive approach will depend on maintaining certain prerequisites. Indeed, Switzerland’s size and international position mean that EPFL may only grow provided that

- our borders remain open (as the latest available statistics foresee a demographic decline in Switzerland);
- we are able to continue to attract the best professors, students and foreign companies;
- the Swiss policy-makers and people are willing to continue supporting Swiss universities financially in this globalization effort, while giving us the necessary leeway to efficiently cooperate with the private sector in Switzerland and abroad.

Regarding finance, it is vital for public funding to increase in the coming years, whether this is provided by the Swiss Confederation, European research programs or cantonal authorities, which derive economic benefits from the institutes of technology’s dynamism. However, this also implies that EPFL must continue to increase and diversify funding to ensure the institution’s development – through public funds as well as public-public and public-private partnerships. Therefore, the EPFL intends to pursue its increase of third-party funding and

cooperation with the private sector, with companies or donors interested in investing in tomorrow's science, technology and growth. In particular, the task for the forthcoming 2012-2016 development period is to attract more foreign companies willing to settle or strengthen their presence in Switzerland, and to further develop our fundraising activities.

This will require urban planning measures, supported by an integrated sustainable development policy, to accompany the EPFL's academic and infrastructure growth. In the frame of the International Sustainable Campus Network (ISCN), EPFL promoted the Sustainable Campus Charter among the main universities of the world, under the aegis of the Global University Leaders Forum (GULF) meeting of the World Economic Forum (WEF). By supporting and signing this charter, the EPFL demonstrates its determination to integrate sustainable development in its overall planning of building construction, renovation and use, to include environmental and social objectives, and to align these with research and training activities so as to become a living laboratory for sustainable development. In the planning period 2012-2016, priority issues will be power consumption management, the promotion of sustainable mobility and the social and cultural integration of the campus within the wider city.

3.2 Strategic partnerships in the ETH Domain and in Switzerland

3.2.1 Medical Strategy

The growing importance of life sciences, engineering and information technologies in medicine is a great opportunity and asks for a better cooperation between medical faculties, university hospitals and EPFL (and ETH Zurich).

Medical Schools and medical education today face many challenges. The ETH medical education strategy intends to provide a strong background in science and technology to (a small number of) MDs who will practice technology driven medical specialties (radiology, genetics, regenerative medicine etc.), and to foster physician scientists who can bridge the clinical and research worlds in cutting-edge translational research.

To reach this goal, a bridge will be established between EPFL and UniL (Medical School): students in this track obtain first a Bachelor in Life Sciences and Technology (EPFL) then enter their medical education at the Master level at UniL, upon completion of a series of defined courses. Students will be selected by UniL Medical Faculty on the basis of a dossier.

In the ETH medical research strategy, the ETH domain intents to propose to CRUS a national research program, joining engineering and science labs and clinical settings: health.ch, a leading initiative in translational research, in a nation-wide consortium with several sub-programs on translational medicine involving the ETH domain, the five medical faculties BE, LA, GE, ZH, BS and other research institutions / hospitals.

Health.ch will contribute to an improvement in patient-centered health and clinical practice with innovative natural and engineering science and its applications from "bench to bedside". Research shall be performed in a crosscutting, interdisciplinary approach (not organ- or technology- centered), organized under the "leading house" model, with at least one partner from an institution of the ETH domain in each project mandatory. Funding will be shared between the ETH Domain, SUK and University/Canton hospitals.

3.2.2 Collaborations with ETH Zurich

The collaboration between EPFL and ETH Zurich is very active and fruitful in terms of research (e.g., Competence centers, NCCRs, SystemsX and Nano-Tera, European Flagship project “Guardian Angels”). Furthermore, the two institutions have a common master degree in nuclear engineering, together with PSI. EPFL and ETH Zurich are now attempting to foster their collaboration via student exchanges and have submitted a proposal to the ETH Board for a student exchange program between the two universities, which would be financed by the ETH Board. Such an exchange for students on bachelor, master and PhD level would lower the barriers to student mobility between Lausanne and Zurich and would encourage and strengthen the interactions between the institutions. These exchanges are supported by the student associations of both campuses. The ETHDays, an event organized by the students implying a cross visit of students from ETH Zurich and EPFL on the respective campuses, will probably be reconducted the coming years.

3.2.3 Collaborations with the Research Institutes

As with ETH Zurich, the collaboration between EPFL and the research institutions is very dynamic in terms of research (e.g., Competence centers, SystemsX and Nano-Tera). This collaboration was fostered by the nomination since 2008 of nine researchers from the research institutes as professors at EPFL (4 full, 2 associate, 2 adjunct and 1 assistant professor). EPFL wishes to continue to intensify the collaboration by nominating more collaborators from the research institutes senior scientist or professor at EPFL and by integrating the research institutes into the student exchange program foreseen between ETH Zurich and EPFL (see above).

3.2.4 Collaborations with cantonal Universities

The many collaborations developed by EPFL with institutions in the ETH Domain, cantonal universities, university hospitals, universities of applied sciences and research institutions provide essential synergies in all fields of research and technology, but also in the humanities. These collaborations have a significant impact on education and research at EPFL, fostering a circulation of people and ideas and the sharing of knowledge, skills, research tools, infrastructure and services. Complemented by the pooling of financial resources between several institutions, these collaborations serve to create ambitious research centers, technology platforms and study programs.

Cooperation between EPFL and Swiss universities of applied sciences or research institutes supported by the Confederation (according to Art. 16 of the Research Law, cf. 3.2.5) has considerably increased in the past four-year period. In the wake of the *Science, Vie, Société (SVS)* program, many further collaborations have been initiated based on new opportunities, either with the initial partners (Universities of Lausanne and Geneva) or with institutions beyond the Lake Geneva area (Neuchâtel, Bern, Basel, Zurich, …). The period 2012-2016 will serve to consolidate these initiatives and to make the most of their full potential.

EPFL has a privileged relationship with its neighbor, the University of Lausanne. The numerous collaborations concern teaching (e.g. exchange of teaching hours), research (e.g. technological platforms) and campus development (e.g. sport center, mobility plan). Thanks to their complementarity, the development of University of Lausanne and EPFL are closely interconnected. Moreover, Lausanne and Zurich are the only Swiss university centers having the capacity to cover all academic fields, therefore playing an essential role in the Swiss scientific, technological and economic setting.

Major ongoing initiatives with Universities of applied sciences

The Center for Biomedical Imaging (CIBM), established in October 2004 through a simple partnership agreement between EPFL, UNIL, Geneva University (UNIGE) and the university hospitals in the Lake Geneva area, is pursuing its development (cf. 5.5.2). This Center offers a unique potential for synergy with the imaging initiative of the Basel-Zurich axis and the National Competence Center for Biomedical Imaging (NCCBI) bringing together EPFL and ETH Zurich.

Vital IT, the high performance computing (HPC) platform jointly run by the universities of the Lake Geneva area, is specifically dedicated to the life sciences. Under the aegis of the Swiss Institute of Bioinformatics, Vital IT also has prestigious partners from the computational industry, in particular HP and IBM. Given the growing interest in the services offered by Vital IT, in 2010 Bern and Fribourg universities expressed their wish to join the platform.

EPFL, UNIL and UNIGE joined forces in 2009 in the field of HPC and founded the CADMOS Center for Advanced Modeling Science. Based around an IBM Blue Gene P supercomputer, this platform targets research applications in fields as diverse as neuroscience, economy, finance, social science, biology, linguistics, climatology, physics, astrophysics or medical science (cf. 5.5.3).

After EPFL joined the western Switzerland partners in the Swiss Finance Institute (SFI-Léman) in 2006, EPFL and Lausanne University decided to intensify cooperation and to develop a competence center of national and international outreach in the field of finance. Bringing together the complementary skills of both institutions, this center aims to propose new approaches to better manage the complexity of financial instruments recently unveiled by the world financial crisis.

Prospects for 2012-2016

For the next period, the main lines of development and deployment will be as follows:

- Strengthening of the Lausanne campus (EPFL-UNIL-CHUV), with a focus on medicine and life sciences – Cancer Center, Biomedical Engineering Center, Neuroscience Center. Creation of platforms in the field of earth and environmental sciences with the Universities of Lausanne and Geneva. EPFL will also join in developing the major project of a Vaud School of Medicine, bringing together the CHUV hospital center and the UNIL Faculty of Biology and Medicine (FBM).
- Consolidation and development of the academic and research offer around Lake Geneva, mainly by setting up joint courses and platforms, fostering the mobility of students, professors and scientists, harmonizing practice between the various institutions, and analyzing terms of access – both for non partner university or industrial users - and financial terms for both internal and external users.

3.2.5 Five strategic alliances (IDIAP, Swiss TPH, IRO, ISRV, CSEM)

Pursuant to Art. 16 of the Research Law, EPFL is engaged in partnerships with the following five institutes:

- CSEM: Swiss Center for Electronics and Microtechnology in Neuchâtel
- IDIAP Research Institute in Martigny, specialized in the management of multimedia information and man-machine multimodal interactions
- IRO: Institut de Recherche en ophtalmologie in Sion
- Swiss TPH: Swiss Tropical and Public Health Institute in Basel

- SVRI: Swiss Vaccine Research Institute in Lausanne.

Such alliances give EPFL access to highly-specialized skills in targeted strategic fields such as signal processing for IDIAP, neuroscience for IRO, infectious diseases for Swiss TPH and immunology for SVRI. They also foster interchange in teaching and PhD education, in particular by enabling some IDIAP scientists to supervise EPFL PhD theses, or allowing EPFL to benefit from the advanced teaching of IRO. As for life sciences, these partnerships provide access to translational research for developments ranging from basic research to clinical applications. Interaction between the Global Health Institute (GHI) of our School of Life Sciences (FSV) and Swiss TPH is also enriching as it provides access to the findings of research on certain diseases such as malaria. With SVRI, the FSV benefits from high skills in immunology.

The EPFL Senior Management considers that these partnerships have definite added value. EPFL has already stated its wish to renew them for the forthcoming four-year period. However, it should be noted that this is subject to decisions and budget allocations made by the government.

3.2.6 Collaborations with Universities of Applied Sciences

EPFL has developed many fruitful collaborations with universities of applied sciences, in particular in the fields of research and technology transfer (e.g. Space Center, Alliance). These will be pursued, in particular in the case of the EPFL+ECAL Lab, and intensified, e.g. in the framework of the activities of the Energy Center and Transportation Center. Other strategic projects are under discussion in Fribourg, Neuchâtel and Valais involving a close collaboration with the concerned Universities of Applied Sciences.

3.2.7 Collaboration with high schools

EPFL has launched an initiative to consolidate the partnership between secondary education and EPFL. EPFL labs would welcome teachers from the upper secondary level, who would be granted a sabbatical by their Canton. On the one hand, these teachers would cooperate with their EPFL colleagues in giving a first or second-year course, enabling them to see how the knowledge which they impart to their pupils is used in EPFL education and letting EPFL teachers benefit from their experience. On the other hand, the teachers would participate either in a research project, or in developing teaching materials which they could subsequently use and share with their colleagues. This dual immersion within a laboratory provides an opportunity to get back in touch with the world of academia. This initiative was put forward to several French-speaking cantons and will be set up as from the spring 2012 semester with interested cantons.

3.3 Strategic partnerships in Europe and worldwide

EPFL has considerably developed and strengthened its internationalization over the past ten years. In terms of visibility, the institution has become much more attractive in recruiting students, scientists and professors worldwide. But internationalization is also expressed through the many agreements and partnerships developed with the best partners at international level.

EPFL will pursue and develop its contribution to international networks such as the Global University Leaders Forum (GULF) and Réseau d'excellence des sciences de l'ingénieur de la Francophonie (RESCIF) – the latter being currently developed under the aegis of EPFL. This is a unique cooperation program bringing together French-speaking research

universities in Europe, Canada, Africa, the Middle East and Vietnam to find concrete solutions to water, nutrition and energy problems through joint research programs. Three lines of cooperation have been set:

- student exchanges through joint courses,
- setting up joint research teams and labs in emerging countries,
- developing partnerships with industry.

3.3.1 Europe

In order to make the most of the EU's ERASMUS program, EPFL has developed statistics on the results of exchange students at EPFL and the number of credits obtained. These results help to adjust student flows by giving preference to those institutions that send good students.

Alliance Network

EPFL is involved in deploying a network made up of the Munich (TUM), Denmark (DTU) and Eindhoven (Tue) technical universities, whose objectives are to develop advanced research projects and joint courses and to pursue deployment of the concepts of doctoral school and tenure track assistant professors, so as to create a true academic labor market in Europe.

France

Given its deep roots in the French-speaking world and in order to strengthen ties with France, EPFL intends to consolidate its recent collaboration with ENS de Lyon and to rely on the system of competitive examinations to enter higher vocational schools, as well as to develop joint master programs and joint research projects. There are also plans to develop joint thesis supervision, joint masters or double diplomas with one or two French *Grandes Ecoles* such as Polytechnique Paris or Ecole Centrale de Paris.

Poland and new EU Member States

EPFL already benefits from Switzerland's cohesion fund for new EU members in obtaining research projects and grants for young scientists. This activity will strengthen in the next planning period.

3.3.2 South and North America

In addition to the collaboration initialed in 2010 with Harvard Medical School, collaborative projects will be set up in the U.S. together with MIT, the University of Texas at Austin, and in Canada with the University of British Columbia, especially in the form of PhD seminars.

Particular emphasis will be laid on developing relations with Latin America, particularly Brazil, (universities of Sao Paulo and Campinas, ELS-IINN, Natal), Chile and Colombia, with which EPFL has had close ties for over 20 years. This area of the world, where the EPFL has already long been represented through its Cooperation unit, offers opportunities for cooperation and exchanges of students and scientists.

3.3.3 Russia

The Russian government has created the status of National Research Universities in order to enhance the quality of research and education in selected Russian universities as well as to strengthen their collaborations with universities abroad. A total of 29 universities have been awarded this status and will receive each additional funding of up to 59 mio CHF for a ten year period. EPFL intends to pursue collaborations with five of them: the Bauman Moscow

State Technical University (BMSTU), Moscow Institute of Physics and Technology (MIPT), Saint-Petersburg State University of Information Technologies, Mechanics and Optics (ITMO), Tomsk Polytechnic University (TPU) and Perm State University.

3.3.4 Asia

India

The strategy for the coming years involves both strengthening existing partnerships and creating new opportunities to advance bilateral interests in institution building. New initiatives will be oriented towards developing relationships with the emerging educational and research institutions, such as the new Indian Institutes of Technology, Indian Institutes of Science and Research, and Indian Institutes of Information Technology. EPFL guidance as leading house in Switzerland will ensure a true and creative partnership with Indian governmental agencies, as mandated in the current bilateral research program (2008-11).

China, Japan, South Korea, Singapore, Taiwan, Vietnam

The relations with China and Singapore have been developed to an excellent level; relations will be consolidated with key Japanese (e.g. University of Tokyo) and Korean institutions (e.g., KAIST). EPFL will promote its image and will explore the potential for collaboration with new excellent partners in Taiwan (National Taiwan University) and Vietnam universities (Hanoi University of Science and HCMC University of Technology).

Australia

A visit in 2010 laid the foundations for the signing of academic cooperation agreements with three key institutions in this country - University of Sydney, University of New South Wales and University of Melbourne. These agreements will be signed in 2011 to support the mobility of scientists and master and PhD students.

3.3.5 Africa

EPFL, through Cooperation@epfl and ENAC School, has been cooperating with SDC in Burkina Faso to support 2IE Engineering School in Water and Sanitation. Knowing that the African students have more difficulties to integrate EPFL Doctoral Schools, an effort of scientific collaboration will be made with the development of specific scientific relations with South Africa's universities and through networks like RESCIF and GULF.

3.3.6 International Alumni

In close cooperation with the Alumni association A3, EPFL will promote interactions, communications, programs and services for EPFL's international alumni chapters with a specific focus on international Ph.D. alumni.

3.3.7 Accreditation and Quality Assurance

The successful EUR-ACE accreditation (European Accreditation of Engineering Programme) of EPFL engineering programs entails a reform of EPFL teaching (expected competencies). This is a key prerequisite to obtain the next joint accreditation in 2015. Meanwhile, accreditation of the new masters in financial engineering and computational science & engineering is foreseen on written application in 2013.

3.3.8 Flow improvement of top students from the best universities

Close ties have been formed with top universities in France, Iran, Romania, Greece, Turkey, China and India. These actions, together with targeted promotional activities, have served to

increase the number and quality of master and PhD applicants. In the period 2012-2016 EPFL intends to intensify its efforts to consolidate and extend the network of privileged partner universities. EPFL will seek to make its mark with key institutions in Italy, Spain, Bulgaria and Serbia.

4. Major Missions

4.1 Education

Education is the primary mission of EPFL. Training young engineers, scientists and architects means educating the researchers, leaders and entrepreneurs needed by society to rise to major challenges. This mission must take into account the national context and the European framework established by the Bologna reform.

This reform is now fully implemented and bachelor and master's degrees have been issued by EPFL for several years. This new structure aims to promote better student mobility both geographically (changing universities) and thematically (changing educational fields). This reform has also made it possible to introduce more flexibility in the curricula.

From the onset of the reform, EPFL was determined to combine a strong single-discipline character with transdisciplinary opportunities for all its study programs. It has relentlessly defended engineering titles and their close relationship with master's degrees, which are the key qualifications granted by our institution. In 2007, all engineering titles were accredited by the Quality Assurance body of the Swiss Universities (OAQ) and by the Commission des Titres d'Ingénieur (CTI) in France, enabling EPFL to obtain the EUR-ACE label in 2010 for our engineering degrees.

The number of students has been constantly rising at EPFL in recent years. At national level, this growth is moderate despite efforts to promote science and our institution's outreach to society. At international level, the EPFL's excellent reputation is extremely attractive to young foreigners and serves to attract excellent students.

For the period 2012-2016, EPFL will consolidate the quality of the degrees it issues and make sure that they respond to society's needs. In particular, the accreditation process made it possible to take stock of the situation and to develop concrete measures to maintain excellence in our educational offer. These measures will be implemented and followed up in close collaboration with the faculty for several years.

4.1.1 Overall measures in education

Reflections on education have led to the adoption of measures to strengthen core polytechnic disciplines, to get closer to the labor market and to make an in-depth review of the consistency of our curricula and their structuring around learning objectives.

The central feature of EPFL education is the *wide general science base* acquired in initial training years. In our bachelors, the first year is a preparatory year to develop the necessary reasoning skills and scientific mindset to pursue higher studies. This first year also serves to select students so as to avoid painful failure in the middle or at the end of the curriculum.

At EPFL the general science base is mainly made up of basic science, mathematics, physics and chemistry. Harmonization of the contents of this polytechnic base appears desirable. The same applies to exams. This delicate issue requires in-depth reflection, which EPFL is currently conducting by taking into account the attractivity and the perception of EPFL education programs by high school-leavers. The possibility of introducing two generic bachelors – one in engineering and the other in basic science – will be considered. The 2012-2016 will put this outcome of this reflection into concrete form.

EPFL students currently have a great educational infrastructure enabling them to rapidly be integrated into the research realized in the numerous EPFL labs. In coming years, a focus will be put on strengthening ties with the labor market. It is important that the students are

exposed to this environment during their EPFL studies. Various measures are being implemented to this end. Each section has an advisory committee made up employers' representatives working with the heads of the programs in order to better define the main lines of education. EPFL has decided to introduce compulsory business internships for all master courses leading to an engineering degree. This introduction is currently ongoing and the process will be regulated and stabilized in coming years. This will be supported by the activities of the Career Center and by the development of the Science Park and Innovation Square. The College of Management is strengthening its offer with more courses in fields beyond pure engineering.

The mechanical engineering section is currently conducting an in-depth review of its curriculum. With the help of its advisory committee and experts in this field, the section is drawing up the ideal profile for a graduate mechanical engineer. The study plan will be remodeled accordingly, with clearer and more explicit learning objectives. This lengthy process should lead to better consistency of the whole curriculum, grouping courses, and to a better match between the education provided and labor market expectations. This pilot project in mechanical engineering should serve as a basis for extending the process to all EPFL sections. This development will call for a strengthening of section directors' positions and additional teaching support. The teacher support unit (CRAFT) will develop its activities to this end.

The new web-based multimedia environments offer additional prospects for online courses and various recordings like e.g. video recordings, PowerPoint and direct recording on a touch pad with automated segmentation into hyperlinks. This intelligent online publishing of courses enables students to initiate an in-depth review of course contents. EPFL intends to invest into this field so as to offer students better possibilities of deepening their knowledge through self-learning. Following a few test phases, the pilot project has begun with the experimental online publishing, in autumn 2010, of a few showcase introductory courses for optional master subjects and some basic 1st-year teaching content.

The *Teaching Bridge*, a building dedicated to subject-specific and transdisciplinary training enabling students to apply new teaching concepts, will be developed and built in the forthcoming 2013-2016 planning period (cf. 5.6.1).

4.1.2 Bachelor

Efforts are being made to promote science among young people and targeted events such as "open house" days or events to welcome high-school students aim to attract youngsters to the technical and scientific education provided by EPFL. These efforts will be pursued. To ensure that they bear fruit, particular attention will be devoted to 1st-year supervision and a strengthening of contacts with high schools. As admission to bachelor courses is mainly for holders of a Swiss baccalaureate *maturité*, relations between EPFL and high schools are vital. A contact unit is in place to coordinate activities. EPFL invites high school maths and physics teachers for training days, and a stronger partnership is being developed to welcome high school teachers part-time within our labs over a semester (cf. 3.2.7). For the latter, this will represent a continuing education opportunity, while enabling EPFL in turn to promote science within high schools.

Moving from high school to university is difficult for many youngsters. Too many students experience problems in their 1st year. Measures are in place to help new students to fit in and, on the academic side, the free distribution of the "savoir-faire en mathématiques" booklet and the "Bilan Math" test which prospective students may take even before they enroll, and also officially at the start of term, enable them to become familiar with the level of

maths required in 1st-year EPFL courses. However, the course/test structure in large classrooms may be a problem for some applicants, and exams all taking place at the end of term may be a trap for those who fail to quickly get down to work. This is why a 1st-year tutoring project has been set up and is currently being tested. The idea is to have students work in small groups with a tutor (student in a higher year) coached by the professor. The initial response to this project followed by CRAFT is very positive and the intention is to extend this tutoring to all 1st-year courses in major subjects. While maintaining the level of requirements, EPFL will therefore help students to pass their 1st year and choose the right path thereafter.

Implementation of the Bologna system facilitates recruitment of high-potential students abroad. As the EPFL bachelor curriculum is given in French, it is natural to use our excellent reputation to strengthen the presence of students from French preparatory classes. Fast-track access to 2nd or 3rd year bachelor courses is being introduced for such students. Additionally, cooperation has been initiated with the Ecole normale supérieure de Lyon, enabling EPFL to put a foot in the door of the French competitive examination system and to be better known in France. The recruitment of French students with strong scientific skills will develop in coming years.

Therefore, EPFL will make a special effort in the period 2012-2016 to strengthen bachelor studies. The Schools and sections will play a vital role in this process and provide incentives for the teaching staff to make a strong commitment to bachelor education.

4.1.3 Master

In order to maintain the excellent reputation of its engineering degrees and to ensure that these are clearly visible in the labor market, EPFL's policy is to pursue mainly single-subject masters to avoid a dilution of its offer. Most of our masters follow a bachelor on the same subject. To make education more flexible, EPFL prefers offering minors (openings to another field) and specializations (in the same field) which are included in the 120 credits for the master. This policy will be continued in the years to come. In this sense, the possibility of following a minor in another discipline has recently been opened to all students. A follow-up of trends and students' preferences shall be introduced.

To complement the current offer of master's degrees, the EPFL foresees:

- the development of joint masters or double diplomas with world-renowned universities;
- the development of a restricted number of specialized masters which do not follow on a bachelor in the same field.

EPFL has indeed initiated masters in financial engineering, nuclear engineering and management, technology and entrepreneurship.

The population of master students has diversified and this trend will increase. Firstly, as EPFL bachelors are not considered as a full engineering education, most of our students pursue their training with a master on our campus. Secondly, the introduction of the bachelor/master system has opened a new door. Some students come from Swiss universities or universities of applied sciences. Many international students apply for an EPFL master, which requires an offer of courses in English. For the new 2010 academic year, almost 2000 application files were reviewed by the Sections and the master Admissions Committee. Each year one observes a strong increase in the number of applications, which stresses yet again how attractive EPFL is at worldwide level. The arrival of these "international" students, carefully selected based on academic excellence, brings

new blood to master classes while introducing interesting multicultural elements. This also serves to train more highly-skilled engineers for our economy. Moreover, many of these foreign students pursue their studies with a PhD in our laboratories, thereby contributing to our country's technological development with their innovative ideas and scientific knowledge.

Privileged ties have been formed in recent years with the top universities in certain countries, in particular within and close to the European Union. In the period 2012-2016 the network of privileged partner universities will have to be extended and strengthened, and EPFL will continue to focus more on raising the quality of admitted candidates than on increasing their numbers.

So as to remain internationally competitive and to attract the best candidates, EPFL will have to pursue the development of a system of scholarships based on excellence. The current system serves to fund about twenty international students carefully selected among all top candidates. However, given the number of very high-level applicants, the number of students granted financial aid should be significantly increased. Solutions are already being tested such as the development of a program of teaching and research assistant students or the joint public-private funding of excellence scholarships. They will gradually be deployed on a wider scale.

International master students often come from radically different educational systems and cultures. Their integration into the EPFL academic structure and Swiss university culture is a core concern. An individual mentoring system is being considered, so that each master student receives personal advice by an EPFL lecturer throughout the master curriculum. Such mentoring also aims at guiding top candidates towards our PhD programs, thus keeping the best scientists.

4.1.4 PhD education

Doctoral education holds a key place in research policy and in building a European Research Area. This also represents the third educational cycle in the Bologna process and has given rise to heated debate in recent years. This discussion reflects the change which has taken place in the way research is now being conducted – as a team and at a crossroads of disciplines – and the gradual movement of academic PhD holders towards private economy.

In this context, PhD students are generally acknowledged as professionals being trained by research in research. During their training, they represent a major part of universities' research capacity. PhD holders should then serve to drive innovation and change, in particular by helping to create new businesses and transforming traditional SMEs. The latter point is particularly important in Switzerland.

Whereas EPFL globally shares the vision of doctoral studies emerging from the debate at European level, EPFL intends to pursue its original reflection and implement its own PhD education, which best meets the needs of our country and institution. In particular, the normative three-year duration of PhD education, as advocated in discussions about the third cycle of academic training, is considered too short to reach the set objectives, and PhD education at EPFL is built around a normal duration of four years.

During these four years, PhD students in physics or natural or technical science must acquire knowledge in four main general fields:

- scientific methodology to express and solve problems,
- the ability to generate knowledge,

- transferrable skills in communication and management to be able to take on scientific or technical management responsibilities,
- a taste for innovation and entrepreneurship.

The mission of the EPFL Doctoral School is to guarantee the framework conditions to ensure that these skills are transmitted and assimilated by PhD students and that they are in line with the needs of the employment market, be it in academia or in the public or private sectors. Its activities, in cooperation with other EPFL education and teaching support units, spans the three processes in PhD education, i.e.:

- recruitment of PhD applicants,
- training them in the framework of units and research projects,
- follow up their career after they obtain their PhD, assess their training's adequacy in light of employers' expectations and promote EPFL PhDs among the latter.

Since 2008, the EiDE Excellence in Doctoral Education project launched by the EPFL Doctoral School has been implementing the necessary measures to guarantee the quality objectives set for all three processes. This has led to the introduction of numerous actions regarding, among others, recruitment procedures, supervision and doctoral courses. The notion of acquired skills is particularly central to this reflection.

In the period 2012-2016, the newly introduced measures to ensure excellence in doctoral education should be strengthened and refined. Externally, EPFL shall increase inter-institutional exchange and heighten the visibility of PhDs at international level and in the private sector. More specifically, efforts will be made to

- increase resources to enable programs to fulfill their mission of transversal research stimulation;
- implement recommendations on supervision from the thesis supervisor's perspective, but also from the student's standpoint;
- improve the welcoming structure for exchange PhD students, simplify administrative procedures and ensure their rapid integration into doctoral programs;
- activate and use the network of PhD alumni for the assessment and promotion of EPFL PhDs;
- develop an original form of PhD in partnership with the companies in the EPFL Innovation Square.

4.1.5 Continuing education

The recent creation of a joint EPFL-UNIL foundation for continuing education is a landmark for the expansion of this strategic domain in Western Switzerland. The new foundation aims to enhance the stature and visibility of continuing education both regionally and internationally, launch new programs, stimulate joint initiatives by both institutions and provide new high-level infrastructure -- notably, the new site in the Innovation Square.

This general framework will facilitate a substantial expansion of the activities in this field along two main avenues: (1) programs leading to a degree; (2) short-term programs primarily oriented towards industry, public entities and professional organizations. Overall, the second sub-domain is expected to grow faster than the first one because of the increasing demand and the evolving character of continuing education needs -- in particular as far as the preparation for the new job markets are concerned. In this context, the revenues for the foundation are expected to increase, making it possible to invest more resources for less-profitable programs of high cultural and/or social value.

The domains specifically targeted by the EPFL within this general scenario concern both its traditional areas of strength and new initiatives. One should specifically note:

- the different programs in specific engineering technologies and scientific topics;
- the programs in technology management and industrial management in general;
- the initiatives concerning the continuing education of high-school teachers for the entire region;
- the new programs in industrial safety, including technical as well as legal aspects;
- programs for the introduction of foreign managers in Switzerland to the Swiss culture, political system, science and technology;
- innovative programs in domains such as diplomacy;
- the expansion of programs at the interface of different disciplines.

The new foundation specifically promotes the links between the EPFL and the UNIL. In addition, it is planned to strengthen the ties in this strategic domain with the ETH Zurich, the ETH-domain in general, the University of Geneva and the IMD.

4.1.6 Quality of teaching and education

Several clues seem to indicate that there is considerable potential for improving the quality of teaching and education:

- The general extension of course evaluation and the introduction of a teaching portfolio as a prerequisite for academic promotion have not yielded the expected impact in promoting teaching quality. The trend is often to make do with “adequate” teaching.
- Advances in pedagogy, such as e.g. the definition of learning outcomes or more active teaching for the students, are difficult to implement for lack of resources in the sections and lack of commitment on the part of the teaching staff.
- The CRAFT assessment and advisory services are still much appreciated by interested students and lecturers, but their number remains under 150 per annum. The majority of these assessment advisories relates to high-quality teaching provided by lecturers who do their utmost to comply with requirements.
- The wide range of teacher training workshops offered by the *Réseau romand de conseil, formation et évaluation de l’enseignement universitaire*, which brings together CRAFT and its sister units in the 4 universities in Western Switzerland, only attracts a low proportion of EPFL lecturers, even for workshops taking place on campus.

The above observations seem to indicate that institutional pressure and the resources devoted to promoting quality teaching are adequate to ensure continuity, but insufficient to cover needs if EPFL is to remain proactive in the field of quality.

Therefore, the following measures will be taken in the period 2012-2016:

- devising a renewed policy in terms of teaching quality requirements and giving teaching services added value,
- substantial increase of sections’ weight and resources,
- increase in the CRAFT’s teaching support staff in partnership with the sections.

In the long-term, all study plans, course books and teaching materials should be revised along the following main lines:

- clarity, consistency, coordination and validation of learning outcomes,

- characterization, alignment and targeted improvements of existing teaching methods,
- definition, clarification and negotiation of learning agreements between the sections, lecturers and students through a new, fuller and more detailed course book.

4.2 Research

Research at EPFL is based mostly on a bottom-up approach where the best possible talents are hired, in particular through the organization of our tenure track assistant professorship system, and to give them the appropriate means for obtaining the appropriate external funding. With this in mind, the organization of the research commission was modified and an efficient Grant Office was set up.

4.2.1 Global strategy

In an evolutionary and flexible context, the global EPFL research strategy is not defined in a rigid manner, but rather through different stimuli, including of course competitive hiring in the key domains. However, several broad domains were defined in which the relative efforts will be increased. These are: Green technologies and sustainability, Info-nano-bio-cogno convergence and Simulation based research (cf. chapter 5 on transversal strategic initiatives):

Info-nano-bio-cogno convergence

The encounter of the fields of information science, micro and nanotechnologies with the field of life and neuroscience is giving rise to and will bring along a very wide range of possibilities. EPFL is ideally positioned to be able to take a leading role in such a multidimensional field with the established competences in the Schools of computer sciences, engineering and life sciences. Such competences are fully backed up by the very basic research performed in the corresponding fields in the School of Basic Sciences. EPFL has already developed a hiring strategy at the border of the different fields. Such a strategy has already given very interesting results and will be reinforced in the future.

Simulation based research

EPFL has already established a very strong strategy around high performance computing. The tools and the machines have allowed bringing understanding to a wide variety of fields, as diverse as mechanics or plasma physics. With the ever increasing complexity of the system to study, as well as the cost of many of the experiments, EPFL plans to organize the necessary computational means allowing to replace part of the experiments by appropriate computation tools. Large projects in this direction have already been launched, with the appropriate collaborations both at the national and at the international level. The continuation of this effort will be a major strength of EPFL in the future.

Green technologies and sustainability

Within a world where resources are bound to limit our possibilities, research is looking for solutions enabling to limit the use of natural resources and to provide better ways of producing goods. Although such a field relies on technological development, EPFL is convinced that changes of paradigm are needed and that only basic research will be able to provide disruptive and innovating solutions. In this sense, several chairs will be opened, either on direct federal funding or by making use of donations.

4.2.2 Institutional organization

The efficient organization and planning of a large number of external grants necessitates the proper administrative services. EPFL is organizing user friendly, optimized offices allowing the preparation, negotiation, management and reporting of the different external grants. This is organized around four main structures, the Grants Office, the Research Commission, the Equipment office and the Office for interinstitutional programs.

These offices and the commission are headed by persons who are knowledgeable in science and technology, and are used to deal with large programs.

Grants Office

EPFL has recently organized a Grants Office with the purpose to help in the preaward processing of the different types of grants, and particularly with the FP7 and ERC grants. The office has developed a very detailed web-site, where most questions are answered. The Grants Office has also improved the EPFL know-how on the proper procedures and, in particular, has been able to set an EPFL policy to avoid time sheets. The success of the Grants Office and its recognition by the EPFL research staff requires expanding the help towards post-award processing, in particular with the management of the accounts and reporting. The Grants Office is the primary contact for the auditors.

Research Commission

The EPFL Research Commission is also a local SNF commission. It used to provide scientific reviewing for all SNF projects. It was decided that such a procedure was not meaningful as SNF anyway requests advice from external referees. Therefore, the Research Commission focuses on checking that the appropriate conditions exist at EPFL (in terms of personnel, building, basic equipment). The Commission is also in charge of discussing long-term planning with the EPFL Senior Management, and takes care of ethical issues.

Platforms and ateliers

One of the major specificities of EPFL is the existence of high level equipment, usually organized in ateliers or platforms open to all researchers. The purchase and the maintenance of heavy equipment is a major task and contributes largely to the success of the school. An office in the Direction of Research is dedicated to such matters, establishing a multiannual planning of the budget and assuring the coordination with the R'Equip program of the SNSF. A reflection will be conducted about the coordination inside and between schools regarding the management, the financial investment and the human resources, in order to optimize their use and their renewal. This reflection will be carried out in parallel with ongoing considerations about the rooms and infrastructure for practicals.

Interinstitutional programs

Such programs, with for example the NCCRs, the programs within Nano-Tera, or within CCMX, as well as the future Flagship programs necessitate specific administrative support, quite different from what is needed for standard research grants. A team able to help managing such large scale projects was therefore organized, which provides the necessary unity of doctrine.

4.3 Technology transfer and innovation

If teaching and research are and will remain the two main missions of universities, innovation and tech transfer which has been recognized as a third mission still needs a strong support.

Innovation requires adequate rules, resources, people, incentives and evaluation. All players in the economy (large corporations, SMEs and start-ups but also public entities) should be targeted and internal players (from professors to students) should have an interest in the field. Innovation certainly needs more recognition of its role.

Relations with corporations

Large corporations and SMEs do not have the same needs. SMEs lack R&D facilities and usually look for specialized expertise. Strong industry liaison offices such as Alliance are efficient structures to help in establishing relations. Large corporations have an interest in broader and longer term research areas. Taking into account this heterogeneity, EPFL adapts its offering from simple research contracts to more integrated partnerships, including a presence at its new Innovation Square. The early decision of companies such as Cisco, Constellium, Logitech, Debiopharm, Nokia, Credit Suisse and Nestle is an indication that the strategy chosen by EPFL has been acknowledged. The proximity of research labs, start-ups and students should become a real asset and the Innovation Square should guarantee that such relations will develop over the long term.

Technology Transfer

EPFL's technology transfer office was formally created more than 10 years ago. It has acquired a unique expertise not only in the management of intellectual property (patenting, licensing) but also in the structuring of the research collaborations, in particular with industry. It is the best example of a situation where adequate rules, appropriate flexibility and responsiveness have enabled an efficient innovation practice. At the same time, it is also the critical place where all parties interact in negotiations (scientific, legal and business) and therefore where visibility and recognition of the actions should be emphasized. Patenting is budget intensive and corporate partners are very sensitive to the tech. transfer policies; which is therefore a critical tool of the VPIV.

In order to increase the likeliness of transfer of the most promising inventions of EPFL scientists, VPIV will further support specific studies within and outside EPFL (proof of concepts through demonstrators, prototyping, etc) through a program which was launched in 2010. This initiative will complement the Innogrants which are focused on start-up creation. In the growing dynamics of the EPFL, the intention is to strengthen and further develop the professionalism in technology transfer having the public benefit as main driving force. New ways of collaborating with companies will also be experimented in order to be more efficient to translate basic discoveries into useful products or services while maintaining core values of our academic institution.

Stimulation of creation and development of start-ups

Entrepreneurship has been further encouraged at EPFL in the recent years through the Innogrants and the "venture ideas" conferences in addition to tools provided by PSE and the Foundation for Technological Innovation (FIT). However, the weaknesses of the system or of its outputs are well known: entrepreneurship is only weakly in the culture of our students and staff; a decent number of companies are created but they do not grow. The Innogrants have shown their values (40 projects funded out of 250 proposals and 20 companies created) and have helped in maintaining a good number of start-up creations. This tool needs to be consolidated. The growth issue is being dealt with in part through the development of the network of experienced and international people. An effort has been made and will need further development with the Alumni association A3. A need for more Business Angels exists, it is not clear if it can be satisfied. In parallel, a new strategy will be developed around

further funding through the FIT and local venture capitalists, with the caveat that seed and early funding may not be in the mission of EPFL.

Finally, over the long term, the culture of a region is changed by exposing its people to more entrepreneurial regions such as Israel or Silicon Valley. The “venture ideas” conferences are opportunities for the EPFL community to listen to the stories of entrepreneurs but ideally anyone interested in high-tech entrepreneurship should be given an opportunity to discover such regions. The “venture leaders” program at the Swiss level gives an opportunity to a small group of Swiss entrepreneurs to learn about the US entrepreneurial ecosystem.

National Innogrants Program

Funding is definitely an issue. Finding money is a concern from research to company creation to company development. The Innogrants are neither an investment, nor the funding of research. They are based on the sponsoring of innovation and their positioning is unique. A program at the national level may be necessary to guarantee their existence, possibly in partnership with ETH Zurich (and their new Pioneer Grants) and with the support of public institutions (SNF, CTI, Cantons) as well as private sponsors (as was the case with Lombard Odier and KPMG in the past).

Transdisciplinary activities

Innovation will more and more come from the bridging of disciplines which traditionally did not communicate often. Computer Science and Biology, Materials and Medical Technologies, Environment and Mathematics are just examples. The VPIV is coordinating such new trans-disciplinary centers as exemplified with the Transport, Energy or MetaMedia Centers as well as unique initiatives such as Solar Impulse. Such centers also need the support as innovation vectors of experienced managers who can give a business flavor to these research activities, to accelerate tech transfer via use case, etc.

As a summary, there is a real danger that too much visibility diminishes interest in the innovation activity. The right level of recognition and motivation of TT activities is required. It also means the adequate level of resources. Resources first mean people with the right profiles. Experienced people with an interest in the intermediary role between industry and laboratories are critical. Secondly, resources mean adequate budget to support corporations, SMEs and start-up creation as well as trans-disciplinary centers and specific labs and professors interested in innovation.

5. Transversal Strategic Initiatives

The ETH Board has defined five ***key focus areas*** for the coming years: Advanced manufacturing technologies, Energy technologies for a sustainable world, Engineering of life sciences, Environmental systems and technologies and Methods and platforms for the advancement of science. Within the portfolio of activities, emphasis is given to items that correspond to societal needs and that are considered to hold particular promise within the context of international competition. In each of the key focus areas, EPFL has defined major strategic initiatives integrated into the research strategy 2012-2016 outlined in chapter 3.2.

5.1 Advanced Manufacturing Technologies

5.1.1 Green technologies for manufacturing

Green technologies encompass a broad spectrum of topics including sustainable manufacturing, power efficient devices, environment sensitive processes, energy scavenging, recycling. This topic represents not only specific technologies and products but also a general methodology and approach to manufacturing of products of all types to address the challenges of the limited resources and the environmental protection of the earth. This strategic initiative will give the research impetus needed to provide the Swiss industry with the proper knowledge and leading edge tools to successfully compete in the emerging arena of green technologies. EPFL is preparing to play a leading role in this exciting new research dimension by making green engineering the focus of the Neuchâtel site of the Microtechnology Institute of the STI School, with the key topics being energy scavenging and low power consumption electronics. This development is done in close cooperation with industry. In addition, the new EPFL Middle East campus in Ras Al Khaimah will primarily focus on research into energy and the environment (cf. 6.8).

5.1.2 Nano-Tera.ch

The Nano-Tera.ch initiative is supporting research in engineering of complex (tera scale) systems for health, security and the environment (HSE) using nanotechnologies. The program has several objectives, such as pursuing excellence in collaborative scientific research in engineering disciplines, creating and expanding educational programs, constructing demonstrators of the technologies being studied and transferring the results to the Swiss industry. The program started in the Federal budget cycle 2008-2011. Looking forward, Nano-Tera.ch must continue its mission at full speed in the period 2012-2016. It is essential that the scientific momentum is mapped – during the next funding cycle – into a direct impact on the Swiss economy and society.

The Nano-Tera.ch program is articulated in three phases. The first 4-year phase has been – and currently is - successful in researching and developing enabling technologies and experimental systems. The first phase has given light to 19 major interdisciplinary projects, involving EPFL, ETH Zurich, CSEM, EMPA, PSI as well as cantonal and applied universities, with more than 300 researchers. The second phase, in 2012-2016, will focus on integrating new technologies into systems, demonstrating the possibility of new products and markets. During this phase Nano-Tera.ch will seek a growing participation of the private sector to support the research. A third phase is envisioned in 2017-2020, which will be mainly dedicated to the consolidation of the results and deliverables of those projects that are showing a strong societal and industrial impact.

Specific objectives for the 2012-2016 budget cycle include, but are not limited to:

- Continue and expand interdisciplinary projects, with researchers from different universities/research centers and from different research fields, with the goal to apply advances in nanotechnology to the design of complex information systems.
- Continue training doctoral students with a broad background as well as a deep knowledge in technology areas.
- Continue the promotion of education in systems engineering using nanotechnologies at all levels, by partnership and curricula development.
- Form partnerships between the Nano-Tera.ch consortium and the private sector, to favor the creation of high added-value systems exploiting the technology as well as favor technology transfer.
- Place Switzerland in a leading position in Research and Development of electronic systems that address health, environment, security and energy issues.
- Continue to address properly all engineering aspects in order to be able to play the role of a key partner for the local and national industries.

The Nano-Tera.ch program can act as a catalyst for the Swiss research and development community and help achieving a bridge between technology development and products and as a result providing a significant return on investment to the Swiss society and economy.

5.1.3 Competence Center of Materials Science and Technology

Since its inception in 2006, the Competence Center for Materials Science and Technology (CCMX) has succeeded in using scientific and technical knowledge from ETH domain researchers to promote interaction with industry and to leverage their interest and financial support; more than 20 companies have contributed to public-private research partnerships. CCMX focuses on pre-competitive research, which bridges the gap between basic research and corporate R&D, providing the expertise, competences, and people to address challenges in the next decade.

Beyond 2011, CCMX aims to consolidate these efforts, reinforcing links between academic research and industry in the field of Material Science and Engineering. Industry funding will be channeled into substantial grants to young academics so that they may tackle areas identified as priorities by Swiss industry. In parallel, CCMX will contribute seed funding to hire new professors, educating future engineers and fostering cutting edge research, thus enabling the ETH domain to meet the needs of the Swiss economy. Building on current successes, CCMX will additionally continue organizing innovative and relevant educational and outreach events.

5.2 Energy Technologies for a Sustainable World

The issue of energy production and consumption will play a significant role throughout the world in the decades to come. The Federal Council has decided to make energy research a top priority and to establish a related Swiss Action Plan. As a key player in energy research, EPFL is well positioned to play an active role in the Action Plan and to further develop research, education and technological solutions in this field on the national and international level. This research, coordinated by the Energy Center at EPFL (cf. 6.9.1), will be conducted in collaboration with the other institutions of the ETH Domain as well as with cantonal universities, universities of applied sciences and industrial partners, and will rely on the competences of all EPFL schools. Regarding education, an effort will be made to offer interdisciplinary courses to raise the students' awareness to this key concern.

Two important fields in which EPFL will be particularly active and which are included in the Strategic Plan 2012-2016 of the ETH Board are described below. Other significant fields not included in the Strategic Plan, as well as the EPFL's own energy strategy, are detailed in chapter 6.9.1.

5.2.1 Renewable energy conversion

Renewable energy will have to play a significant role in the world energy mix within the next decades. The area includes direct and concentrated solar thermal, thermo or photochemical conversion to fuel (e.g. H_2), photovoltaics as well as hydroelectric, geothermal and wind energy. Bringing the different solutions to wide scale deployment require strong technology platforms and a multi-disciplinary approach (physics, chemistry, materials science, thermodynamics, engineering,…). Switzerland is well positioned to contribute to the field. The ETH domain hosts several world class labs and many companies that are commercializing first generation technologies. EPFLs contribution, in collaboration with the institutions of the ETH domain and with industry, will be mainly in advanced photovoltaic research as well as hydroelectric and wind energy.

During the period 2012-2016, EPFL will develop photovoltaic research in the following fields (among others): devices based on thin film silicon and c-Si, the emerging approach of dye sensitized devices, direct H2 production, concentrated solar thermal and thermal applications.

EPFL is making a commitment to strengthen the area of wind engineering by building a world class research and industrial wind tunnel at the EPFL Middle East campus where unique and highly specialized experiments can be undertaken (cf. 6.8).

Similarly efforts in hydroelectric and geothermal energy are cross cutting the campus especially as related to hydraulics, fluid mechanics and turbo machinery. In the area of hydroelectricity an emphasis will be put on turbomachinery at STI and environmental hydraulics/fluid mechanics and hydraulic constructions at ENAC.

In parallel, major research and development efforts will have to be made on energy storage and distribution technology. Finally, research must be pursued into nuclear fusion, which has enormous potential for humankind, but requires major investment in both time and resources.

5.2.2 Smart energy management

Smart energy management concerns:

- Energy consumption: reduce usage thanks to smart metering and dashboards (load shedding); rise awareness of users of their consumption to reduce waste; put pressure on manufacturers to produce energy efficient devices; move non time critical usages to off peak periods (load shifting).
- Energy production by micro-producers (home production): reduce the overall production needs by utilities; adapt production of users to the needs of the grid and further offset the peak production problem. This assumes that some forms of distributed buffering are possible (solid hydrogen, home batteries, hybrid vehicles used as home batteries).
- Monitoring and management of the distribution grid to reduce failures due to hardware faults and optimize replacements policies.
- New distributed storage architectures: managing an inhomogeneous storage infrastructure.

Potential significance is:

- Reduce the need for additional energy production plants by reducing peak power usage and incorporating home produced energy into the grid;
- Increase the proportion of green energy (CO_2 neutral, non nuclear);
- Increase reliability of the grid.

This area requires an extremely high level of reliability and predictability, both at the component level and system-wide. This implies a unique collaboration between entities that did not have such links in the past; such entities are today scattered mainly in computer science, communication systems, electrical engineering, control and complex systems theory. At EPFL, a future smart energy infrastructure will be developed that will look like the ''internet of energy'', with a web of sources, services and users, and with high requirements on security. This will be done in collaboration with other institutions from the ETH domain and with industrial partners.

5.3 Engineering for Life Sciences

5.3.1 The Blue Brain Project

The Blue Brain Project (BBP) was launched in July 2005 in cooperation between the Brain Mind Institute at EPFL and IBM. Its aim is to model the neocortical column, the basic functional unit of the mammalian cerebral cortex. The project – seen as a prototype for future efforts in large-scale simulation science - builds on 15 years of experimental data from Henry Markram's laboratory and on IBM's BlueGene/L supercomputer, one of the first machines with the power to achieve the project's goals.

The year 2008 marked the successful proof-of-concept for the BBP that a novel modeling facility can be set up to automatically create cellular models of neural circuitry in a completely data-driven fashion. Since 2009 BBP has been used for extensive "in silico" experimentation: on the one hand, experimental protocols published by other research groups from the single cell level to thalamocortical network dynamics have been explored in the model. On the other hand, the facility is used to complement experimental insights into the construction principles of the cortical column that would not be achievable by other means. In particular the question how the statistical properties of neuron morphology determine the wiring diagram of neural circuits.

Beyond the extensive exploitation of the cellular level facility and model, extensions towards subcellular as well as macroscopic detail have been brought on the way. These explorations at different scales are strongly facilitated by an upgrade to a new IBM BlueGene/P supercomputer (16384 processors, 16Terabytes of RAM) acquired by the cantons of Vaud and Geneva hosted in the multi-institution center CADMOS (Center for advanced modeling and simulation).

BBP consists today in an international multidisciplinary team of over 35 experimentalists, modelers and computer scientists with important international collaborations with Spain, Israel, Germany, the USA and several other countries inside and outside Europe. Especially, the newly founded Cajal Blue Brain initiative of twelve Spanish principal investigators from Consejo Superior de Investigaciones Cientificas (CSIC) and the Technical University of Madrid (UPM) supports BBP's efforts through an aligned agenda in electron microscopy, data extraction and visualization.

The ETH Board has added the BBP to its strategic planning and named it a national priority; accordingly, a ramping up was decided of 5 mio CHF / year for 2011 and 2012. In 2013-2016, the ramping up of the BBP will continue (through additional means planned in the message FRI 2013-2016), internal means will be increased, and interdisciplinary collaboration between the BBP and I&C will be favored. After a successful international evaluation in March 2011, the BBP is inscribed into the national roadmap of infrastructures of the Swiss confederation. This will permit to count on the support of the Swiss National Supercomputing Centre (CSCS) for future upgrades of BBP-dedicated supercomputers.

The strategic goal of the Blue Brain Project is to build a large-scale ICT facility, representing a new paradigm for supercomputer-based simulation science. The planned facility should have the capability to model and simulate the brain of different species, including humans, across all levels of biological organization, and at any age. The aim is to provide a new platform for the neuroscience and medical communities, helping them to:

- Understand the structural and functional design principles of the brain;
- Understand and heal the pathologies of the brain;

In addition, under the lead of H. Markram / EPFL, a large European consortium grouping leading centers in high performance computing, neuroinformatics, neuroscience, clinical neuroscience, robotics, neuromorphics, theoretical and computational neuroscience has deposited a proposal – The Human Brain Project - for a new European funding scheme, the FET Flagships. The final results of the call will be known at the end of 2012 and could propel the Human Brain Project, an extension of the Blue Brain Project, at a funding level of a 100 mio € /yr.

5.3.2 Nanoengineering for Health

In a planned strategic collaboration by the School of Life Sciences, the School of Engineering, and the School of Basic Sciences, EPFL will launch a transversal strategic initiative in Nanoengineering for Health. The domain of nanotechnology encompasses advances spanning engineering, chemistry, physics and the life sciences, and understanding the nanotechnological aspects of biological systems and exploiting those in nanoscale interventions presents a number of high-impact opportunities in basic and translational research. Other nations have recognized this, for example as reflected in the US NIH Roadmap's Nanomedicine Initiative and the creation of a number of NIH-sponsored Cancer Centers focused on nanomedicine, most notably at MIT. The EPFL and the ETH Domain have invested heavily in basic nanosciences, and continued investment at the interface with the life sciences can be expected to be particularly fruitful. Several unique opportunities exist at the nano-dimension that present new openings for basic understanding and translational impact in human health. EPFL will focus on the following during the 2012-2016 period:

- Photonic materials and biophotonics: powerful methods for in vitro and in vivo imaging for understanding basic biological processes at the subcellular level.
- Delivery - biotransport and penetrating barriers: development of nanomaterials that penetrate barriers and that deliver drugs or vaccines.
- Single molecule analysis and manipulation to understand the structural bases of a number of life and pathogenesis processes.
- Parallelization of manipulation and detection.

5.3.3 From Translational Genomics to Personalized Medicine

Life sciences are in the midst of a revolution brought about by quantum progress in the ability to analyze the genomes of organisms and derived cells through high-speed and low-cost DNA sequencing methods, and by the parallel development of technologies allowing the large-scale detection and quantification of other molecules from cells and tissues. This opens the door to establishing predictive connections between an individual's genotype (i.e. her or his genetic make-up) and phenotype (i.e. the sum of traits that can be observed or measured). Moreover, these high throughput techniques allow integrating the influences of the environment (e.g. diet, exercise, exposure to chemicals, sunlight, viruses or bacteria) and of the microorganisms that colonize the human body (which hosts ten times more microbes than it contains human cells) into these analyses. This effort will allow the adoption of new therapeutic paradigms where treatment, for instance of cancer, is based on the identification and monitoring of molecular footprints rather than on tissue of origin. In the long run, clinicians will be able to evaluate an individual's health risk and disease susceptibility and to predict her or his response to specific treatments, that is, to practice truly personalized medicine. Such a global approach requires the efforts of biomedical researchers and doctors, but also of engineers, mathematicians, physicists and computational scientists, in order to analyze, integrate, and make accessible the colossal sum of information that will be yielded by genomic studies. The success of this interdisciplinary endeavor further requires that a new generation of scientists, endowed with truly quantitative and integrative skills, be specifically trained.

The EPFL School of Life Sciences has been working towards this goal for some eight years, be it through the recruitment of top-level faculty from very diverse scientific horizons, the training of young engineers in life sciences and technology with skills deeply anchored in quantitative fields, the development of fully interdisciplinary research programs, or the establishment of thematic collaborations with both the clinical and the private sectors. Noteworthy, the Lake Geneva area ranks amongst the very best in the world in both fundamental and clinical genetics, and the Swiss health system, which offers to all full access to care at the most performing level, has traditionally provided a very supportive background for the conduct of prospective clinical studies (e.g. Swiss HIV cohort, Swiss HCV cohort, CoLaus study). Capitalizing on these strengths, a Center devoted to research and education in Translational Genomics will be launched. Nucleated within the EPFL School of Life Sciences, it will bring together biologists, medical doctors, mathematicians, physicists and computer scientists within a network extending locally from the EPFL at large to the University of Lausanne, its affiliated hospital the CHUV, to the Swiss Institute of Bioinformatics and the accompanying Vital-IT program, and to Swiss (e.g. Nestlé, Novartis, Merck Serono, Roche) and international (e.g. Glaxo Smith Kline) industrial partners. Immediate fields of application, based on ongoing projects in the Lausanne area and particularly promising collaborations between EPFL and industrial partners (e.g. Nestlé), will be infectious and nervous system diseases, nutrition and metabolism.

5.4 Environmental Systems and Technologies

5.4.1 Risk management for built and natural alpine environment

There is an urgent need to assess the impacts of the dynamics of the built and natural environments, and in general of human activity, in alpine regions and to identify technological solutions of preventive measures to safeguard this immeasurably important natural resource.

For Alpine regions to be developed in a sustainable manner, it is imperative that science and technology serve a leading role and contribute, via long-term planning and proactive interactions with policymakers, to the integration of cultural, economic and environmental values. Towards this goal, the improved observation, modeling and prediction of the interactions and feedbacks between human developments and alpine ecosystems, the feedbacks taking place through the hydrologic cycle, the response of ecological communities, the possible loss of biodiversity and the related natural hazards are being pursued and developed by EPFL.

5.4.2 Sustainable architecture and building technology

Sustainable architecture addresses among others the conservation of energy, the interface of the built and natural environment and the development of new technologies that can be used to save and provide energy. The challenges of sustainable development also concern the issue of architectural form. How can one introduce a process of formal and technological innovation in a perspective of sustainability? The idea is to use the principles of concurrent engineering that insist that the earliest design work gives a balanced and simultaneous consideration to architectural, structural, and environmental issues, followed closely by those of constructability and cost. Attention centers on the architectural geometry and the consequences not only in terms of architectural form, but also structural stability, use of material, penetration of light and air, heating and cooling requirements, wind resistance and acoustics. The design, maintenance and transformation of structures remain central to ENAC directions.

5.5 Methods and Platforms for the Advancement of Science

5.5.1 National electron microscopy network

Electron microscopy plays a key role in many areas of research of national interest. Electron microscopy is a vital technique in the nanosciences, underpinning highly interdisciplinary research spanning basic sciences, materials and engineering sciences, and life sciences and medicine. The latest instruments are extremely expensive, making their purchase by a single institute problematic. A national network for electron microscopy would allow new expensive instruments to be purchased and make best use of their capabilities by supporting projects across the entire ETH domain.

It is intended that the electron microscopy network will operate in a related way similar to that of the Swiss Light Source, the main difference being that the instruments are not based at one location but distributed throughout the EPFL, ETH Zurich, PSI, EMPA and C-CINA at the University of Basel. The network would allow the exchange of instrument time between institutions, enhance collaboration and exchange of know-how and experts between fields and institutions, facilitate the organization of training courses for students and scientific staff, strengthen existing expertise, rationalize the costs and use of the instruments and strengthen the acquisition of very specialized high end instruments for Switzerland instead of duplicating techniques at all ETH sites.

5.5.2 Center for biomedical imaging (CIBM)

Biomedical imaging plays a key role in bridging FSB and the life sciences. The School of Basic Sciences (FSB) is the academic home for the recently created Center for Biomedical Imaging (CIBM), jointly supported and operated by UNIL, UNIGE, the CHUV and HUG

university hospitals together with the EPFL. With its five magnetic imaging field systems (including very high field instruments), the CIBM is already a leader in Europe in its field. EPFL will contribute to the nationwide effort in imaging, particularly magnetic resonance imaging (MRI) and positron emission tomography (PET). To contribute to Swiss leadership in the field, the EPFL initiative will include advanced image processing, one of its traditional areas of excellence. Innovative approaches such as phase contrast radiology and X-ray fluorescence imaging and especially dissolution dynamic nuclear polarization (DNP) will be developed and expanded in close collaboration in particular with the PSI. Overall, the Geneva-Lausanne region has the ambition to become one of the world poles in imaging science and technology.

5.5.3 High-performance computing: the CADMOS initiative

The Swiss national program in High Performance Computing and Networking (HPCN) is based on two strategic pillars: the centralized facilities at the CSCS in Ticino and a few complementary regional high-level nodes. CADMOS (Center for Advanced Modeling Science) is the concrete realization of this second strategic element for Western Switzerland. Jointly funded by Cantons Geneva and Vaud and by the Swiss Confederation (through the EPFL), CADMOS is a partnership involving the EPFL, the UNIGE and the UNIL, whose most visible result was the joint acquisition of an IBM Blue Gene/P system. This facility is already serving a large number of users from the three institutions, including applications in non-traditional areas such as bridging many national languages.

CADMOS will provide the framework for the 2012-16 HPCN activities not only at the EPFL but in the entire region, along the same complementary lines. The lifetime of the present facilities will cover in part that period. However, new facilities must be considered to follow the evolution of the national HPCN plan and the general trends of the field.

This will pose important technical challenges, specifically as far as the building needs and their infrastructure are concerned. Innovative solutions will be required to optimize the local and national investments. In particular, a coordinated strategy is envisioned with the acquisition of new hardware that can be housed by the CSCS thanks to the large capacity of its new building. Although fully integrated in the national network, this type of solution will make it possible to continue the "two pillar" HPCN strategy by enabling regional nodes -- in spite of the increasing demands for electrical power and infrastructure in general of the new high-performance machines.

This strategy is expected to evolve from a focus on computing power to a more flexible approach also based on the development of new algorithms and on strongly enhanced local and non-local storage capacity. In this regard, CADMOS is playing and will continuing to play an essential role: a substantial part of its resources are invested for the creation of new professorships, with particular emphasis on the mathematical aspects of the HPCN evolution.

5.5.4 Computational science and engineering

Contemporary engineering and science problems incorporate increasingly sophisticated physical models and constitute a formidable task for simulation-based engineering science. The robust and efficient numerical solution of problems combining different physics at different scales will be the challenge for the next decades. This implies a need to strengthen the links between HPC specialists, algorithms, and applications. Numerous examples include Materials, from molecular structure to physical properties and material optimization; Structural engineering under extreme solicitations; Predictive models for climate change

impacts, water resources and pollution; City systems/for urban planning and transportation; Data uncertainty, parameter estimation, signal and data processing; Computational quantum chemistry for environmental sustainability; and turbulence simulation for wind energy and engineering.

5.6 Other initiatives

5.6.1 Interdisciplinary Teaching Center (Teaching Bridge)

EPFL students help supply the high-technology workforce that is essential for a healthy Swiss economy, and thus they need to be trained with the newest and most modern scientific techniques, which are often interdisciplinary in nature. To prepare our students to solve real-world problems, they need to be trained to be true experts in a particular field but at the same time able to cross traditional boundaries and draw from a number of different disciplines. It is thus proposed to implement a new teaching concept in a new, state-of-the-art teaching building.

The new teaching building will be occupied by modern disciplinary undergraduate teaching laboratories with state-of-the art instruments for chemistry and life sciences as well as significant computer hardware and software for data acquisition and analysis by advanced computational methods.

In addition, this new building will house conceptually new interdisciplinary teaching laboratories, which will enable novel approaches to science teaching for advanced undergraduate and graduate students at EPFL. These laboratories will be designed and equipped to allow students to combine fundamental manipulations of chemistry, physics and life sciences with goal-oriented interdisciplinary tools in analytical, molecular, cellular and computational sciences. Students from different disciplines would partner together to attack real-world, open-ended problems in a discovery-based approach.

Close collaboration between those responsible for the design of the new building and those developing the new teaching concepts will be essential, since the design will be an integral part of achieving the interdisciplinary aims. Within the EPFL, the teaching project will be managed by a project leader and a scientific board comprised of professors from across the different Schools and Sections who are fully committed to the concept of interdisciplinary project-based learning.

5.6.2 Cloud computing strategic initiative

Future computing infrastructure will consist of mobile devices on one hand and large data centers on the other hand. PCs and enterprise servers will lose their predominance. This vision of the future is sometimes referred to as “cloud computing”. In order to realize this vision, much research is needed in the energy-efficient construction and management of data centers, structuring of applications to work in a cloud environment, development of new applications, and security and privacy issues resulting from the presence of sensitive data in shared data centers.

Three fundamental scientific advances are necessary to make the cloud vision a reality. The first is the need to make computing more energy-efficient. Energy is becoming the bottleneck in all of computing, and this is in particular the case in the context of datacenters, which will form the backbone of the cloud and of future IT infrastructure. The second is the need for quasi-unlimited scalability. To satisfy the rapidly varying demands of a large number of

businesses, the cloud will have to scale up to unprecedented amounts of computing, storage and networking. The third issue is multi-tenancy– i.e., the presence of several administrative domains within a single cloud. In such an environment, privacy and security become prime concerns, both at a legal level (e.g., what policies to support?) and at a technological level (e.g., how to implement such policies efficiently?). In more detail, energy, programming, data storage, management, security and privacy are the areas in which EPFL wishes to excel. This led to the recent establishment of the EcoCloud center, which brings together about fifteen EPFL labs and aims to become a catalyst for sustainable development of ICT in both environmental and economic terms (cf. 6.2).

5.6.3 Quantitative finance and risk management

The Swiss Finance Institute of the College of Management has recently hired a number of researchers in the fields of quantitative finance and risk management. Most of these specialists work on complementary areas such as specialized topics of risk management, or asset valuation in incomplete or fragmented markets (e.g. liquidity problems and slow moving capital). These fields are particularly important for the financial industry and for regulators as the recent financial crisis has shown that economic actors did not have a deep enough understanding of the potential problems that could arise, for example, in the case of a liquidity crisis. A number of researchers within the institute also work on capital requirements, credit risk, and optimal financing structures. These topics are also very important in light of the remodeling of the Swiss financial system (e.g. in the changes to be made in the financing structures of large financial institutions like UBS or Credit Suisse), a key actor of the private and public national economy (and of the Lake Geneva area). The EPFL Institute will also strongly collaborate on these topics with research in the Finance group of UNIL (complementary development of competences), with the Institutes of Mathematics at EPFL and with the Department of Mathematics and the Risk Center at ETH Zurich, with which common work is expected in Ph.D. programs. The finance faculty from EPFL and UNIL will be instrumental in identifying and formulating the various key issues related to the initiative and they will develop analytical tools jointly with the aforementioned people in the Department of Mathematics at EPFL and ETH Zurich.

5.6.4 Earth and Planetary Sciences

There is a great and underutilized potential in Lausanne in the general field of Earth and Planetary Sciences, meaning in the generation and application of knowledge related to the origin, nature and evolution of our planet and of our more immediate natural environment. As Earth and Planetary Sciences are largely complementary across UNIL and EPFL, the strategy is to build an ambitious and concerted joint project between the two institutions.

Earth Sciences cannot address current-day problems without strong awareness of the evolution of the environment, nor without strong experimental facilities for the investigation of the inner structure of matter. In order to progress in this direction a joint research platform will be built with UNIL dedicated to advanced characterization techniques of common interest, structured with an eye to promote interdisciplinary research with a strong focus on “micro-nano” microstructural characterization techniques, specifically around Secondary Ion Mass Spectrometry (SIMS).

Examples of research themes that could be promoted through this enhanced collaboration include: Geochemistry of natural systems: isotopic tracing with stable isotopes, mineral microbe interactions; the physics, chemistry and microstructure-property relations of geomaterials and bio-geomaterials; Physics, chemistry and microstructural evolution under extreme conditions characteristic of the deep Earth; Research on aerosols and aquasols;

Research in subsurface environments and geohydrology; Medical mineralogy and geochemistry; The physics and engineering of natural disasters.

6. Strategies of Schools, Colleges and Centers

6.1 Architecture, Civil and Environmental Engineering (ENAC)

The core mission of the School of architecture, civil and environmental engineering is to respond to sustainable development challenges in the built and natural environment through education of students, research and outreach. Such challenges are highly influenced by the interfaces between society and the environment: (1) increased population growth, the expansion of cities and considerable land use pressures and degradation; (2) increased demands for energy, water, transportation and communication; (3) improvement and maintenance of the built environment, particularly in urban areas; (4) expanded ecosystem services and biodiversity preservation; (5) natural and man-made risk management.

The overall goal of the ENAC School is to undertake teaching, research and technology transfer in order to provide education that meets the needs of society, to provide new knowledge and contributions to tackle these challenges, and to focus professional and academic careers towards new job creation. For this purpose ENAC has taken a long-term academic response to this multidisciplinary challenge ("Projeter ensemble") through a coordinated cross-disciplinary approach to understand and solve complex built and natural environmental problems. This initiative has been a guiding principle of ENAC and its evolution, which over the past six years has included substantial new faculty hires, growth in undergraduate and graduate student numbers, expansion of its research portfolio and external funding.

ENAC has implemented broad advances in its teaching curricula especially concerning interdisciplinary project-based teaching that involve joint teams of Architecture, Civil and Environmental Engineering students. ENAC has aligned research and teaching activities in these fields, as well as in urban planning, and leads increased technology transfer efforts and further strengthening of links to industry and other institutions in Switzerland, Europe and overseas. ENAC has also made a special effort to enhance its doctoral programs (e.g. Civil and Environmental Engineering), specifically by increasing the spectrum of semester long courses and offering core graduate level classes in, for example, quantitative methods that are required for all students.

Continuing education continues to play an important role within ENAC. The models include daylong update courses for professionals as well as three-day courses that include graduate students from other institutions and professionals. ENAC is leading some of the continuing education courses being offered through EPFL Middle East and continues to host regular workshops and research conferences. Finally, ENAC organizes extended continuing education courses ("Master of advanced studies") on building expertise and on tunnelling.

ENAC continues to expand its research efforts in the engineering sciences, architecture and urban planning. Important areas of growth include Risk management for built and natural environments, Computational Science and Engineering, Sustainable Architecture and Building Technology as well as Transportation and Urban Systems. The latter concerns the mobility of people, goods and information which is a key element of modern societies and one that is crucial for their economic and social development. Planning, managing and operating transportation and urban systems, in order to fulfill the everlasting increase of mobility needs while controlling the direct and indirect costs, is a difficult and important challenge. Addressing this challenge requires the creation of new paradigms and, therefore, the continued development of advanced interdisciplinary research.

The inter- and trans-disciplinary endeavor is not only within ENAC, but embodies stronger ties with other EPFL schools. For example ENAC took the lead in the recent creation of the Transportation Center (cf. 6.9.2), which involves 36 laboratories across the campus, and plays an important role in cross-disciplinary graduate programs. ENAC also hosts the Landolt Chair for a Sustainable Future which hosts visiting professorships across the campus and a successful distinguished seminar series. Other examples of active research collaboration include with SB (extreme value statistics, statistical physics, scientific computation), STI (engineering computing, materials and structures, energy life-cycle assessment), I&C (design, virtual architecture, computer-aided engineering, wireless sensor networks for environmental applications), SV (architecture, microbiology and biotechnology, assessment of perceptions of space, biomechanics), as well as collaboration with the College of Humanities (joint seminars) and the College of Management of Technology (project management). ENAC is also closely involved in the development of the EPFL Middle East campus, which is centered on issues related to sustainable development like wind energy and engineering, water resources, transportation, sustainable architecture and energy.

The ENAC School is working actively to strengthen academic ties with the research institutes of the ETH Domain; in particular, joint faculty appointments with EAWAG and PSI have been established, and plans are underway with EMPA and WSL/SLF. Over the past four years ENAC has been closely involved with the ETH Domain's centers in environment and energy, developing a variety of joint research projects in various domains. ENAC is preparing a master in urban planning and engineering and is exploring a possible doctoral program in this field, both with ENS Lyon based on sharing various complementary strengths.

6.2 Computer and Communication Sciences (I&C)

Regarding education, much effort has been invested in the recruitment of students at the BS level. The explosion of the Internet bubble in 2000-1 led to a worldwide enrollment decline that was also felt at EPFL. Since 2008 the trend has started to reverse itself, and student enrollment is again on the rise. Indeed, the need of Swiss information technology industry in engineers is higher than the number of graduates from Swiss universities. To satisfy this high demand, IC will continue its efforts to promote the teaching programs and to increase female enrollment, which is currently around 15%.

The I&C School is very active in attracting foreign students to its MS and PhD programs. The School has also been a forerunner in terms of its doctoral program, which currently provides fellowships for half of its first-year students, has a considerable amount of mandatory coursework, and a thriving graduate student association.

An important curriculum revision has been carried out at the BS level, unifying the first year for all I&C students. In addition, the curriculum at the MS and PhD levels has gradually been broadened to reflect the arrival of newly hired faculty.

The main educational goals for the next four years are then: 1) to revise the curricula at all levels to optimize the preparation of the students to the new developments in the field, 2) to augment the number of PhD fellowships so that they are available to all first-year students, 3) to diversify the geographic origins of our incoming MS and PhD students, 4) to increase female enrollment.

Regarding the evolution of faculty, the school lost some competences in the fields of algorithms and verification due to departures. For computer science these two fields, as well as bioinformatics, are priority in terms of recruitment. In communication systems, the

traditional competences in rather theoretical fields like cryptography and theory of networks and information need to be complemented by rather practical fields like network systems, social networks and security. I&C will pursue its strategy in recruiting ad hoc by extended searches putting the priority on the quality and the capacity for innovation of the candidates, thus avoiding an excessively inflexible top-down planning of the profiles of the future faculty. As for the students, the strategic priority will be to attract and keep women faculty.

Research on Cloud computing (cf. 5.6.2) will play a central role. To do so, the school needs access to a prototype datacenter large enough to enable industrial-strength cloud system development and 3 evaluation, and system-level access (i.e., not user-level access readily available to academia from industrial partners or service providers) to a cloud infrastructure. Such an infrastructure will enable research in a variety of fields, such as energy management, security, data safety and privacy, system manageability, and performance modeling, sensing and instrumentation. On the mobile end, cloud computing will enable the next-generation of mobile computing research pioneered by the MICS NCCR, primarily taking advantage of the wealth of sensors available in our day-to-day environment.

EPFL is positioning itself as the European academic player in this evolution with two initiatives. The first initiative is the establishment of the EcoCloud research center in 2011 to pioneer robust, cost-effective and environmentally-friendly cloud technologies and to become a hub for cloud technology transfer and expertise in Europe. The second initiative is the acquisition of the Datacenter Exploratory in 2011, a testbed for cloud system innovation and evaluation (in collaboration with ETH Zurich and Lugano).

The ambition of IC is to become leader in some strategic fields such as “Datadriven science”, “Network science” and “Visual computing”.

“Data-driven science”: In addition to traditional ways of doing science, namely experimental, theoretical and computational sciences, a fourth way has been gaining momentum, namely data-driven science. In this new approach, very large amounts of data are analyzed automatically to discover correlations, find causalities, and in general to extract information otherwise hidden in the wealth of data. This approach has been pioneered around the internet, using machine learning and large-scale distributed systems. The methods are however general, and will revolutionize other areas of science, from classic sciences where large amounts of data including scientific papers can be sifted for new knowledge, to new areas like digital humanities. I&C sees this as a growth area for computer and information sciences, in line with its vision and objectives.

“Network science”: Networks are at the heart of information and communication systems, and more broadly of large engineered and evolved systems such as neural and social networks, the power grid, or gene regulatory networks. The emerging field of network science lies at the intersection of several established fields in discrete mathematics, statistics, data mining, and communication and computer sciences. Its central ambition is to model the shared properties and behaviors of network structures in several domains of application, including information and social networks, biology, and economics. It combines large-scale data analytics and modeling (understanding how an epidemic disease spreads through a society) with engineering (building a more robust and efficient Internet). This new science of networks promises to become one of the most fertile interfaces between our community and the fields of biology, economics, and social and environmental sciences.

“Visual computing”: We are daily exposed to masses of information that we could not process, understand, or act upon without the help of computers. This is even more critical in many key scientific fields, such as life and environmental sciences, which involve collecting

huge quantities of data that must then be carefully analyzed and catalogued to be of any use. Current computer science technologies have proved very good at handling structured information as epitomized by Google's phenomenal success. They have also been shown to be effective with information in natural form such as speech, but only in very limited contexts such as stock trading or airline reservations.

This is the challenge I&C wants to address within the broad fields of Signal Processing, Computer Vision, Computer Graphics, Visualization, and Human-Machine Interfaces. We intend to give computers of tomorrow the ability to perceive, compute, visualize, and understand the data, as well as act upon this understanding. In other words, computers should eventually be able to see, hear, touch, display, and animate data in ways that mirror human abilities and ease human-machine interaction.

Regarding technology transfer, a good fraction of the companies attracted to the EPFL Innovation Square are in the IT field (Cisco, Credit Suisse IT, ELCA, Logitech, Nokia), witnessing the intense industry interest for the work done in the school. In terms of startups, NexThink and Scala are the most successful offspring. A number of more recent spinoffs are also promising.

A major shortcoming is that many spinoffs, while producing viable small companies, do not achieve critical mass to grow to a worldwide scale. There is a need to stimulate their ambition and to create the contact networks so that engineering and commercial teams can be put together quickly, and funding can be found to sustain ambitious growth. I&C will collaborate with existing efforts of the VPIV in this direction.

Collaboration with industry is somewhat hampered by the inability to hire development personnel. Many industry projects are not suitable for PhD students because of their short-term nature. A new policy has been recently developed EPFL-wide in order to hire MS students on research projects, but this program needs to be further advertised and developed. In addition, I&C needs to be able to hire programmers to provide long-term stability to development efforts, while avoiding the pitfalls of large numbers of permanent research staff position. A new human resources framework is needed to accomplish this goal.

6.3 Basic Sciences (SB)

The mission of the School of Basic Sciences is fourfold:

- to educate and train the next generation of scientists and engineers in the basic sciences;
- to create new knowledge through discoveries that form the basis of next generation technologies;
- to find scientific solutions to real world problems;
- to foster innovation for economic growth.

The FSB's educational mission is critical to the success of the EPFL, as all its disciplines require a strong background in the basic sciences. The FSB intends to modernize its undergraduate teaching laboratories in the basic sciences as well as push forward a major new initiative in interdisciplinary teaching. Actually, these undergraduate teaching laboratories have not kept pace with the new developments in technology and have difficulty meeting the increasingly stringent safety requirements. One pillar of this initiative will be the construction of a new building housing state-of-the-art disciplinary and interdisciplinary

teaching laboratories (*Teaching Bridge*, cf. 5.6.1). This building will be designed and equipped to allow students to combine fundamental manipulations in basic sciences as well as in engineering, with goal-oriented interdisciplinary tools in analytical, molecular, cellular and computational sciences. Students from different disciplines will partner together to attack real-world, open-ended problems in a discovery-based approach.

A second major initiative, driven by both education and research, lies in the domain of computational mathematics. As simulation-based research plays an increasingly important role in most areas of science and engineering, it is essential that its advance remains strongly rooted in mathematics. Towards this end, the FSB recently created a new Mathematics Institute of Computational Science and Engineering (MATHICSE) along with an associated Master degree in this field. Building on EPFL's existing strength, the goal of creating a world-leading CSE institute is well underway, with additional professorial positions to be added with the help of initial funding from the CADMOS project. The synergy generated by the interaction with the "Centre Européen de Calcul Atomique et Moléculaire" (CECAM), with its headquarters on the EPFL campus, as well as with the existing groups in computational chemistry and numerical physics makes EPFL fertile ground for developing an internationally renowned effort in simulation-based research.

The masters degree in Nuclear Science and Engineering, which was created by the EPFL, ETH Zurich and the PSI in response to an urgent national need for trained scientists in this domain, has gotten off to a solid start, with approximately a dozen students per year. To reinforce this new program and ensure its long-term success, the number of professors contributing to it needs to be increased. In addition to replacing the current professor in nuclear reactor physics, the FSB will reinforce this program by seeking the support of the Swiss nuclear industry to establish a sponsored chair in the field of materials for nuclear fission, in collaboration with the PSI.

With the awarding of the NCCR in Chemical Biology jointly to the EPFL and UniGE, EPFL chemistry has demonstrated both its current strength and future potential to develop the tools necessary to advance our understanding of the chemical basis of disease. The FSB plans to further reinforce its efforts in chemical biology by the addition of a tenure track assistant professorship in this field.

A second strategic objective in Chemical Sciences and Engineering will be to rebuild a program in chemical engineering. Concurrent with the severe shortage of trained chemical engineers for the Swiss chemical industry, the EPFL has been unable to replace recently retired professors in this field with new candidates. The FSB thus plans a major effort, together with the support of the Swiss chemical industry, to build a strong teaching and research program in chemical engineering.

EPFL physics will continue to play a major role at CERN, both on the experimental and theoretical side. As the Large Hadron Collider (LHC) ramps up to full energy, the contributions of EPFL theorists will be essential for the discovery of new physics beyond the Standard Model. The FSB plans to renew its collaboration with the CERN theory department by supporting two EPFL-CERN theory fellows. On the experimental side, the EPFL Laboratory of High Energy Physics will be fully engaged in collecting and analyzing data from their LHCb experiment as well as planning the next generation of experiments beyond the LHC.

Continuing support for astrophysics is also planned through the search for a new chair at the Laboratory for Astrophysics, in collaboration with the University of Geneva. The FSB will also

reinforce its activities in the area of ultrafast physics and chemistry, where a number of EPFL groups already participate in the recently funded NCCR led by the ETH Zurich.

Driven by the increasing demand for alternative energy solutions, this domain will remain a key component of FSB research, in collaboration with other EPFL schools as well as other institutions and research institutes. In addition to nuclear physics, the FSB will reinforce its efforts related to renewable energy and energy storage. The FSB will continue its already significant activity in hydrogen research, including water-splitting catalysis, pursued in collaboration with EMPA. The FSB will also make a major effort in the next period to reinforce its research infrastructure in NMR, mass spectrometry, x-ray diffraction and microscopy. These are multi-user platforms that support not only FSB research, but also across all schools of the EPFL, with particular importance at the interfaces with life sciences and materials sciences.

6.4 Engineering (STI)

The School of engineering will continue to attract highly qualified faculty, and consequently top students and additional external funds and recognition, in turn enhancing further the academic reputation of EPFL in an upwards spiral. Over the last few years, faculty appointments were made via broad searches focused on hiring the best available candidate. Increasingly the STI School will need to take into account the needs of the various institutes and sections as well as its responsibility to maintain strong relationships with industry. By 2020, STI is working towards a goal of 100 labs (up from 72 today) with a total budget of 100 mio CHF (up from 77 mio CHF today).

With this hiring backdrop, STI has started an initiative to increase the representation of women among the faculty. In 2010 (the first year of the initiative's implementation), 5 of 9 new hires were female. Continuing at this pace will see over 25% female representation amongst STI faculty by 2020, compared to 11% today.

A major new initiative is related to the new "Microcity" building in Neuchâtel, which will help accommodate this growth with room for at least 12 labs. As a result of this increased capacity, new hires in micro-engineering over the next several years will be housed in Neuchâtel and the center of gravity of micro-engineering will naturally shift towards Neuchâtel. New hires are foreseen in robotics for micro-manufacturing, nanofabrication with application to the watch industry, green engineering and materials for small machines. The chairs in Neuchâtel will take advantage of and strengthen the area's traditionally strong ties with the local industrial fabric. The focus in Lausanne will continue on the nanotechnology activities with the establishment of the new CMI+ facility and biomedical applications increasingly attracting the attention of the micro-engineering labs in Lausanne.

The upcoming renovation of the Mechanical Engineering building is a key component of the rejuvenation of the Mechanical Engineering Institute. Appointments in the existing disciplines (solid mechanics, fluid mechanics, turbines, control, and mechanical design) will be necessary to replace retiring professors, but at the same time the STI School wants to open new doors, for example in the field of energy: renewable energy, energy storage, and efficient engines. Other areas of possible interest are mechanics at the small scale, mechanics of soft matter, and biomechanics.

Electrical engineering is also a target for rejuvenation. Electrical power is a key area with new challenges and potential for growth. The support of industry in this area is a key element and it is expected that two chairs will be installed in the coming 5 years in electrical power,

both with strong involvement with local power producers and distributors. Communication and computers at the hardware level also provide opportunities for growth in EE.

Materials Science is an EPFL pole of excellence. Building on the existing strengths and reaching an even higher level of excellence in Materials Science and Engineering remains a priority for STI. Developments will include the new chair in materials for small machines related to the watch industry, as well as a new major initiative on “functional materials”.

The new robotics and neuroprosthetics facilities, to be housed in the renovated Mechanical Engineering building, are major steps towards establishing close relationships between the technologists in STI and the School of Life Sciences (FSV). As bioengineering is very important for Switzerland due to the huge biomedical industry, this field will continue to grow rapidly. Since EPFL does not operate a hospital, the challenge remains to expand the current collaborations with the hospitals in Lausanne and Geneva (CHUV & HUG), but also with Harvard Medical School in the framework of the recently signed partnership. Lately, 3 joint appointments have been made between STI faculty and the regional hospitals.

The EPFL Bioengineering Institute is jointly managed with the school of Life Sciences. Both schools share a joint masters program, and this collaboration could serve as a model for further collaboration and relationship with other schools such as I&C and SB. For example the strong presence of photonics in STI and throughout EPFL has led to the proposal of a masters in Photonics and a Photonics Graduate School.

The STI School has spearheaded the creation of a structure for independent scientists, to which senior scientists can apply to be assigned. Here non tenure-track researchers are encouraged to build small research teams exclusively through third-party funding. These teams participate in faculty life – research, teaching and industrial relations – like any other lab, and are particularly valuable in ensuring continuity in teaching curriculum. At the moment this entity consists of 8 teams and has external funds of 5 mio CHF per year.

A critical focus area for the next 5 years is undergraduate teaching laboratories, which in the past were managed by large, well-endowed labs. In the new system where labs no longer have significant permanent staff, the responsibility for maintaining and managing the teaching laboratories shifts to the School. Our plan calls for the STI teaching laboratories to be managed by the collaboration of the sections in STI, managed administratively by the dean’s office by an adjunct for teaching matters, with individual professors taking responsibility for individual teaching labs. Renovation of teaching labs will have to be analyzed considering the future creation of the EPFL *Teaching Bridge* (cf. 5.6.1).

6.5 Life Sciences (SV)

Since its creation in 2002, the School of Life Sciences has seen a steep development, housing today 45 research laboratories organized in 4 institutes. More than 1200 collaborators and students study in SV's programs, or work in the laboratories and in the administrative, technical or scientific support services. These include close to 200 PhD students and more than 400 BA/MA students.

The mission of the School of Life Sciences has been from the start to take advantage of the unique configuration at EPFL that allows putting in direct vicinity biomedical scientists with the tremendous engineering expertise crucial for the modern quantitative life sciences. This overall goal is reflected in a highly multidisciplinary teaching program as well as in intensive collaborative efforts in the main research areas of SV, namely neuroscience, fundamental

cancer research, infection biology, and bioengineering. Based on this strong foundation, SV will further intensify its efforts towards new innovative programs at the interface of biology, medicine and engineering.

As far as education is concerned, the BA/MA teaching program was launched in the fall of 2003, and the first 3 graduating classes have since left our school. The curriculum relies on a strong basis in mathematics, physics, chemistry and computer sciences, on which builds engineering disciplines, like informatics, electrical systems or signal processing, and selected fields of biological sciences. Together with recommendations from the faculty audit (2008), broad discussions within the SV School led to several modifications in the curriculum for the academic year 2010/11 (for example: increased time for practical laboratory classes at the bachelor level, and internships in industry and higher students' freedom of choice for course compositions combined with individual mentoring of students in 3rd year bachelor and at the master level). The new configuration of SV master programs facilitates the entry of excellent national and international candidates from outside EPFL in a true spirit of the Bologna reform. Continued critical evaluation and experiences with this new plan during the coming 5 years will be very important to optimize further the education that SV is offering.

Expertise and manpower for the analysis of the vast amount of data produced every day from modern systems biology approaches has become a true bottleneck to fully exploit this tremendous information now available to the scientific community. Therefore, SV has launched a minor in Biocomputing together with the School of Computer and Communication Sciences I&C, which will be open to master students from both schools. Moreover, SV plans to take advantage of the know-how present at existing core facilities in these fields, and to offer training opportunities to graduates in the area of data analysis services. These efforts will be coordinated with corresponding laboratories and platforms elsewhere in Switzerland.

The research laboratories at SV are the principal players of three doctoral programs from the EPFL Doctoral School (Neuroscience, Bioengineering & Biotechnology, Infection & Cancer). Given some overlapping fields and common targets for recruiting the most brilliant undergraduate students, efforts are being undertaken in order to better coordinate their rules and practices, in particular the student hiring policies.

Major research initiatives at SV during the comings years will consist in integrating programs that involve scientists and clinicians from a wide range of disciplines and expertise.

The initiatives *The Human Brain Project*, *The Center for Neuroprosthetics* and *"From Translational Genomics to Personalized Medicine"* are described extensively in chapter 5.3.

Approved in 2009 and launched in 2010 under EPFL's leadership, the NCCR on "Synaptic Bases of Mental Diseases" will be a major initiative to drive further neuroscience research at EPFL and at other Swiss institutions. The main objective of this NCCR is to develop an ambitious translational program linking neuroscience to psychiatry with the aim to uncover the pathogenetic neurobiological mechanisms underlying mental and cognitive disorders. Eventually, these efforts should contribute to the development of novel preventive and therapeutic approaches, and to the training of a new generation of clinicians with a strong neuroscientific background. It will also foster the emergence of a neuroscience-based psychiatry.

The "More Medicines for Tuberculosis" (MM4TB) consortium evolved from the highly successful FP6 project, "New Medicines for TB" (NM4TB) that delivered a candidate drug for clinical development two years ahead of schedule. Building on these firm foundations and exploiting its proprietary pharmacophores, MM4TB will continue to develop new drugs for TB treatment. An integrated approach will be implemented by a multidisciplinary team that

combines some of Europe's leading academic TB researchers with two major pharmaceutical companies and four SMEs, all strongly committed to the discovery of anti-infective agents. The model established for TB drug discovery could be extended to other therapeutic areas and neglected diseases such as malaria and helminth infections.

A common initiative by the EPFL, the University of Lausanne (UNIL), the University Hospital CHUV, and the ISREC Foundation has been launched to create a new Lausanne Cancer Center (LCC). It will be dedicated to translational projects from basic research, mechanisms of the disease, to clinical oncology, and eventually to innovating more effective therapies for the overall care to cancer patients. Crucial to this goal is fostering catalytic interactions between basic scientists and physician scientists (medical and surgical oncologists) engaged in applied cancer research. Lausanne has amongst its institutions notable capabilities in basic and clinical cancer research and in the treatment of patients with cancer. The partners' prime mission of this integrated and interactive center is to organize these dispersed expertise into a cohesive entity primed to expedite the translation of results from laboratory research into clinical applications.

The center will be organized along projects of distinctive forms of cancer, bringing together into one project basic scientists and clinicians with disparate expertise and commitment to understanding the particular form of cancer in order to find new mechanism-based targeted therapies. The center will strongly benefit from the initiative on translational genetics *"From Translational Genomics to Personalized Medicine"* (cf. 5.3.3), which will create an important foundation for a new approach to understand mechanisms of disease progression in cancer, and to advance towards therapies targeted to the individual patient.

6.6 College of Management of Technology (CdM)

The ultimate goal of the College of Management of Technology is to become the top-ranked program in Europe in “Management Science” as measured by research visibility, international rankings, student selectivity, and faculty recruiting. CdM’s focal areas deal with the areas of finance, management and economics that have close links to engineering, science, and technology. The strategy of the CdM is to build on current strengths both within CdM and at the level of EPFL. Such a College is a strong asset to EPFL infusing the campus with more entrepreneurial orientation; cross-disciplinary research partnerships; technology transfer practice and research; and attraction of endowed chairs into all parts of EPFL.

Over the last four years, CdM has witnessed tremendous growth. Two new institutes have been created, the Management of Technology and Entrepreneurship Institute (MTEI) and the Swiss Finance Institute at EPFL (SFI), leading to a substantial increase in CdM's visibility and to major synergies among professors and teaching programs. Two highly-competitive Bologna masters have been launched, the master in Management, Technology and Entrepreneurship and the master in Financial Engineering. The former has received more than 150 applications in the year of its launch, demonstrating the need for such a program. The latter has seen its applications increase by more than 200% over the last two years. In addition to these programs, CdM offers a highly successful PhD program in Management of Technology with a very strong placement record in both industry and academia, and one of the world’s premier PhD programs in finance, with the best academic placement of all European programs over the last three years.

Over the next few years, CdM will need to foster the development of the new master in Management, Technology and Entrepreneurship. The program has a particular flavor that is

unique within Europe and can only be found as such at peer institutions as Stanford and MIT. The near-term objectives are to increase the class size while maintaining the current selectivity admission ratio and to strengthen the Supply Chain Management & Systems Modeling orientation by recruiting professors in these fields.

The CdM will also need to demonstrate its central role within EPFL by helping students understand the whirlwind of economic forces swirling around them through the development of *new bachelor courses in finance and economics*. Three areas need to be covered: introductory economics, fundamentals of finance, and risk analysis. These courses will help students better understand the economic environment in which firms evolve, to know what stocks and bonds are, what risks and returns these assets offer, and how best to manage those risks, and finally to learn from the stockpiles of data that the modern computer age has given everyone.

Regarding research output and international visibility, the two institutes of CdM will continue to strive for excellence by publishing in leading scientific journals, writing high impact books, and organizing high profile workshops and conferences such as the SwissQuote Conference in Finance, the CCC Doctoral Colloquium in the Management & Economics of Innovation, the EPFL-Princeton workshop in finance, and the Monte Verità conference on Knowledge Management.

6.7 College of Humanities (CDH)

The primary mission of the College of Humanities is to develop and manage the courses in human and social science (SHS) provided to all EPFL bachelor and master students.

Structurally speaking, in 2010 the CDH grew by creating the Centre for Area and Cultural Studies (CACS), specializing in analyzing the cultural context for the production and appropriation of knowledge in South Asia, Eastern Asia and the Middle East. As from 2011, a new center specializing in Social Theory was attached to the CDH, devoted to interdisciplinary research between engineering and social science around the role of science in general and information technology in particular as they impact social stability and social change.

Since its inception in 2004, the CDH has responded to the need for EPFL teaching programs to go beyond purely polytechnic skills to include an education in human and social science. The SHS program currently offers a choice of about 120 courses across a wide range of themes, in particular in the fields of production of knowledge, societal organization, cultural and artistic production and the social and human aspects of technical, scientific and entrepreneurial professions. These courses are provided by approximately 80 lecturers, most of whom are based at Lausanne University (in the framework of an exchange of teaching services), at EPFL, at ECAL/University of art and design Lausanne and at the Geneva University of Art and Design (HEAD).

Further to the CdH audit in 2009, several aspects of the SHS program were revised: semester-long bachelor courses, introduction of thematic and interdisciplinary courses in 1st year bachelor, widening of the offer in social science and science studies and in area and cultural studies, and introduction of a Minor in Contemporary Asian Studies.

The period 2012-2016 will be devoted to consolidating the revised program and to developing new courses (Middle East; basics of entrepreneurship; basics of IP; research ethics at doctoral level). Together with other partners the CACS will develop a continuing

education program in Contemporary Asian Studies and pursue its activities to provide foreign members of the EPFL community with skills to embrace the Swiss context.

From the start, the CDH also took as its mission to boost research. It aims to promote a culture of innovative and strongly interdisciplinary research, characterized by integrative approaches on themes and subject across several research disciplines.

In addition to the research pursued by the CACS and the center for Social Theory, three priority research avenues are being considered:

- Relations between science and society – in particular the Ethical, Legal and Social Implications (ELSI) of contemporary research and technology innovations with a strong potential to alter human and social life and the environment;
- The new modes of production and use of scientific knowledge and technological innovation, in particular the contextual analysis of the production and appropriation of knowledge;
- Mutual integration of theories and models of human and social science and natural science, life sciences and engineering in fields with a strong innovation potential, in particular in brain-mind relations and information science.

These research activities will be developed in the framework of in-house and interinstitutional collaborations. A system for project calls, project selection and funding will be set up. The period 2012-16 will be a pilot phase to initiate 3-5 specific research projects.

6.8 EPFL Middle East

In December of 2008, EPFL and the Government of Ras Al Khaimah (RAK, United Arab Emirates) have entered a pioneering partnership for the creation of an EPFL offshore campus in RAK, the first of its kind for any Swiss public institution of higher education. The new campus, a branch of EPFL, focuses on graduate and postgraduate research and education. The project, developed under the name “EPFL Middle East”, implies the creation of 5 new research laboratories in RAK, and their close collaboration with a corresponding number of laboratories on the Lausanne campus, and with host laboratories on the RAK Campus. EPFL Middle East’s effort concentrates on major challenges for the 21st century, in selected topics underpinning sustainable development, notably:

- Wind engineering, as the fastest and one of the most promising sources of renewable energy,
- Sustainable urban and architectural design, applied particularly to the region’s severe climate,
- Energy, applying and developing technologies for MENA and near Asia countries.
- Water resources management, with a particular emphasis on arid and hot environments.
- Transport, and the new paradigms of multimodality in and between very large urban systems

Graduate research projects involving both EPFL and its Middle East Campus are already underway in most of the scientific areas highlighted above. They take the form of PhD research projects conducted in Lausanne, as well as master or semester projects, on topics relevant to the wider MENA and Near Asia region. In addition to the existing teaching

curricula (i.e., master in energy management and sustainability and several continuing education programs) new programs will be developed.

The recruitment of professors will coincide with the development of the campus at RAK. By 2016, EPFL Middle East should reach the maturity stage described by the following targets:

- 5 laboratories in RAK, each headed by a Faculty,
- well established MSc programs, covering all the topics of interest,
- PhD students in RAK, collaborating closely with laboratories on the EPFL Campus,
- an active cell of the doctoral school of EPFL in RAK, interfacing with the doctoral school,
- self-funded and self-supported continuing education programs (executive education),
- internships and partnerships with companies from the Gulf region and from India, for master and PhD students,
- active innovation programs,
- well established industrial relations between each laboratory and its corresponding industry.

EPFL Middle East is to be located on a campus, custom-made to host the academic activities. By the end of 2016, the Government of RAK, with the academic concourse and program inputs provided by EPFL, will have built, commissioned and started operating the campus buildings. These will include learning and education spaces, flexible work spaces, specialized facilities, of which a wind tunnel facility, and common spaces and forums. Accommodation and sport facilities may also be added to the new campus, depending on its location and further developments around.

The physical campus should be the outer expression of the declared vocation of EPFL Middle East, and its conception, construction and operation should be based as closely as possible on principles of sustainability.

EPFL Middle East should become a gateway for EPFL and the ETH Domain in the Middle East, in one of the most dynamical regions in the world. The local and regional economy and scientific research will benefit from the graduates of EPFL Middle East, who will start creating the type of regional network necessary for the innovation process to start, for internships patterns to become gradually established.

Beyond the academic aspects of accessing new research markets for EPFL as well as new pools of recruitments looking East, EPFL Middle East will also constitute a showcase for Swiss technologies, and will inevitably offer enhanced opportunities of collaborations and impact for the Swiss industry and standards.

6.9 Centers

6.9.1 Energy Strategy and Energy Center

Energy is a critical issue for our society and will remain so for a long time:

- the economic prosperity of our country (indeed, of all countries) will continue to depend on adequate energy supply;
- the energy intensity of human activities will have to decrease in the 21st century, which calls for continuous technological innovation;

- the decarbonization of our economy needed to mitigate global warming forces us to rapidly rethink our mix of energy sources;
- the disappearance within the coming generation of easily accessible and cheap fossil fuels obliges us to develop alternative energy sources;
- the current political debate on phasing out nuclear power for safety reasons compounds the need for new energy sources.

As mentioned in section 5.2, energy research, in which the ETH Domain is the main actor in Switzerland, can contribute to the technological answers needed to meet these challenges, which will require major investment. The EPFL's vision in the field of energy may be summarized as follows:

a) Strategy

- EPFL will rely on existing know-how and take care that this is perpetuated, or even strengthened through existing or new professorships;
- EPFL will open new professorships in essential fields;
- Regardless of political decisions, Switzerland must maintain its research and education capabilities in areas no longer considered as priorities in Switzerland, although they remain so in other countries (nuclear fission and dismantling) as well as on energies for the future (nuclear fusion in the framework of CRPP and Euratom framework programs; cf. 6.10). Therefore, EPFL intends to keep up its expertise in such fields.

b) Research priorities

- Conversion to renewable energy as well as storage systems and technologies for its wide deployment (cf. 5.2.1), focusing on solar energy (photovoltaic, biomass, solar thermal, solar fuels);
- Smart energy management (cf. 5.2.2);
- Energy efficiency, with particular focus on industrial, building and urban applications;
- Carbon cycle, including the use of CO_2 as the basis for synthetic fuel production;
- Sound systemic integration of energy technologies into multi-energy systems and networks implementing the best available technologies while taking into account geographic, socioeconomic and local policy constraints;
- Energy needs of societies in emerging regions of the world and resulting technology requirements;
- Energy policy, including regulatory aspects.

c) Role of the EPFL Energy Center

The Energy Center will coordinate energy research at EPFL and assume the following tasks:

- Promote, develop and implement major R&D projects involving several units on campus and/or several institutions beyond EPFL;
- One-stop energy resource for all units beyond EPFL, in particular the private sector and public authorities;

- Inter-institutional ties and agreements in the field of energy, in particular with other institutions in the ETH Domain, Swiss universities and universities of applied sciences and research institutes at European level;
- Information about energy challenges, in particular in relation to Swiss policy-makers and the general public.

The Energy Center will continue to represent EPFL, or even Switzerland, within national and international bodies active in the energy arena, such as e.g. the Federal Energy Research Commission (CORE), Competence Center for Energy and Mobility (CCEM), Electrosuisse, Centre de Recherches Energétiques et Municipales de Martigny (CREM), The Ark Energy foundation in the Valais Canton, as well as within the International Energy Agency (IEA) and the STS Forum.

6.9.2 Transportation Center

Established in April 2009, the TraCE Transportation Center brings together 36 labs with over 500 scientists from all EPFL Schools. Its added value in promoting research and technology transfer in this field is widely acknowledged among its numerous academic and industrial partners in Switzerland and abroad. The Center's existence has made it possible in particular to strengthen international cooperation, especially to respond to European project calls.

Regarding education, the transport component in the civil engineering program is currently being revised to better promote the existing offer in this transdisciplinary field. Beyond the Transport minor, the Center will systematically put forward subjects for semester and master projects as well as internships, both within the Transportation Center itself and among external partners.

At doctoral level, the new EDCE program now includes a course on intelligent transport systems and another on modeling and simulation.

TraCE also intends to broaden the continuing education offer with highly-specialized short courses on key transport issues to respond to the needs of industry, such as the integrated public transport training module developed for the Federal Railways (CFF). An intensive course on transport systems was also developed and integrated into the continuing education offer available at the EPFL Middle East offshore campus.

The Center has served to highlight new promising areas of research for the future, such as e.g. multimodal sustainable transportation, zero emission mobility, integrated land-use and transportation policies, active modes, life-cycle analysis of transportation systems, cooperative mobility or physical logistics. Most of these advanced research topics are already being dealt with outside EPFL in the form of concrete research projects with external partners.

On campus, TraCE nurtures cooperation with the companies joining the new Innovation Square and establishing R&D outposts (Postlab, Nokia Research Center, Constellium, etc.) at EPFL, as well as with start-ups housed at the PSE. The Center also develops partnerships with leading firms in the sector as well as academic or institutional actors (universities, universities of applied sciences, design offices, public institutions). One of the strategies implies strengthening relations with other transport research institutes in Europe, in the U.S. and throughout the world, in particular within emerging economies like India and China. To this end, the opening of the transport center at EPFL Middle East will considerable bolster EPFL's leading position in advanced integrated multimodal transport systems to respond to these countries' rapid economic and territorial growth.

6.9.3 Space Center

Setup in 2003, the Space Center EPFL has become an undisputed center of competence in Switzerland thanks particularly to the successful launch of SwissCube in 2009, the first Swiss satellite ever launched. Owing to an excellent cooperation with several large Swiss space industries and with the support of the Swiss confederation, the Space Center EPFL has been able to establish focused areas of excellence for space R&D recognized nationally and internationally. On the education side, the Minor in space technologies is attracting more and more students and plays an important role at the Space Center EPFL in order to promote the education of new concepts with a strong innovative project-led teaching.

One of the key visions for the Space Center EPFL is to turn into a R&D center at national level, including not only EPFL but also other large Swiss universities to better coordinate Swiss space activities under the umbrella of the Swiss Space Office in Berne. Cooperation with industries, both large European groups and local SME's, will be strengthened to better answer to their needs, particularly in the field of new technology developments for space applications.

In addition, the Space Center EPFL strategy for the coming years is to become a leading center for small observatories in space, pulling miniaturized technologies, and pushing the frontiers of science. Several exciting projects are being presently considered including an exo-planet observation spacecraft, a space debris removal mission, and a constellation of very small satellites for Earth observation monitoring. The success of these projects will require an excellent cooperation between the academic, the industrial and the institutional members of the Space Center EPFL which has made so far its success.

Finally, it is foreseen to strengthen the research activities by increasing the number of PhD students active in the space sector and to augment the number of staff of the Space Center EPFL including a new chair of aerospace at EPFL and hiring experienced engineers in order to respond to the ever-increasing industrial and educational loads.

6.9.4 Center for Neuroprosthetics

Understanding of the circuitry and the signaling within the brain has advanced phenomenally within the past decade, based on developments in technology for recording the electrical signals associated with tens to a few hundreds of neurons in the brain as well as analysis of the complex data that derives from these neuronal networks and its association with motor and sensory function. These advances have given rise to the nascent field of neuroprosthetics, focused on the use of technology to develop deeper understanding of the brain, spinal cord and peripheral nervous system and on the development of technology for augmentation of neural function lost to disease or trauma.

Aligned with recent breakthroughs in understanding neural circuitry and signaling and translating that understanding toward restoration of function, the EPFL has launched the Center for Neuroprosthetics, largely sponsored by Foundations Bertarelli, Defitech and Sandoz as well as the International foundation for paraplegic research (IRP). EPFL seeks to exploit its core strengths in basic neuroscience, bioengineering and engineering disciplines such as signal processing, micro- and nanofabrication and materials to develop novel neurotechnologies for establishing a deeper basis of fundamental understanding underlying the concepts of neuroprosthetics, aiming to leverage a more mechanistic approach into more advanced interventional translational systems.

From a practical perspective, the Center will seek to hire approximately five new professors in domains that relate to the fields listed below. It is sought to hire professors with cross-

cutting expertise, touching a number of clinical/translational disciplines, rather than one person per relevant clinical domain. These cross-cutting areas include the following:

- Noninvasive sensing for brain-machine interfaces
- High-density electrode array-based neural recording in the brain
- Combined stimulation and recording, for development of mechanistic insight into deep brain stimulation
- Biologics and their delivery for stabilization of the electrode-brain interface and induction of neural tissue regeneration including in the spinal cord
- Machine learning for decoding neural recordings and development of prosthetic control algorithms

These cross-cutting disciplines will impact both basic and translational neuroscience toward clinical applications, the latter including the following:

- Advanced prosthetics for restoration of audition
- Advanced prosthetics or biologics for restoration of vision
- Body-surface or near-surface recording for re-establishment of gross-scale motor control
- Cortical recording and robotic control for re-establishment of fine-scale motor control
- Repair of the spinal cord, or re-establishment of partial function in paraplegia

6.9.5 MetaMedia Center

The media landscape is in constant evolution. This ecosystem is very complex and volatile as it relies upon user acceptance and “fashion” effects. Innovation cycles are very fast and corporations are searching for new products for shorter time frames, typically in a 3-5 years range. At EPFL, this means understanding media trends will allow anticipating needs and encourage research to “invest” in value adding topics. This also means being more proactive to find relevant research to industrial future needs. This translates into building end-to-end stories and demonstrators, a key to prove relevance of technologies and “use cases” to convince companies to further support research and perform technology transfer.

In that perspective, EPFL decided in 2011 to create a new center around media to bring together researchers and corporations around common innovation projects. Creating a “MetaMedia Center” (MMC) as a research platform to address specific needs of innovation in media will provide a creative space and an experimental showroom for open collaborative innovation and experiments. The media behavioral trends are supported by technology developments, which in turn induce new media usage. Standards, relationships, connectivity, interfaces/devices, content, user experience and services are interlinked. Responding to these trends and technology challenges is a unique opportunity to interact between researchers and industry leaders.

The mission of the MMC is to prepare, stimulate and perform technology transfer. The MMC, which is sponsored by Audemars Piguet and several private donors, is currently leading two main efforts, integrating numerous research elements:

- The media interaction story inside a building dedicated to media innovation, to be erected on campus (Place Cosandey, 2013),
- Montreux Jazz Festival digitalization and valorization which will foster innovation in creating relationships between users and media content.

Several laboratories in acoustics (LEMA), signal processing (LTS2, LTS4), micro-electronics (LSM), audiovisual communication (LCAV) and design (EPFL+ECAL Lab) are already involved. Together with the Institute of Architecture the partners will cooperate on several areas like 3D cameras, user interactions, enhancement of audio and video experience or music recommendation.

6.10 National Task: Fusion Energy Research

In 2011, a strategy for fusion energy research was adopted by CEPF, ultimately aimed at developing a fusion reactor, along two interlinked axes:

- at the government level, the continuation of the participation of Switzerland to the Euratom framework program, and
- at the implementation level, a strong participation of Swiss researchers and laboratories to all the activities in the frame of Euratom, to obtain the maximum scientific impact of our participation.

In the "Contract of Association" between the Swiss Government and Euratom, the Plasma Physics Research Center (CRPP) at EPFL is the single research unit responsible for all Swiss activities. Those are performed nearly exclusively by CRPP at its two premises (EPFL and PSI).

In line with the three EPFL strategic missions, research, teaching and technology transfer, and with its research vision in the field of energy, the CRPP will contribute to the three main challenges of the international integrated program:

- accomplishment of the necessary research to secure an efficient operation of the International Thermonuclear Experimental Reactor (ITER) and the design of the first Electricity Producing Reactor (DEMO) (research mission) ;
- training of the younger generation of scientists and engineers for the exploitation of ITER and the design of DEMO (teaching mission);
- construction of ITER, a fusion reactor with many components which are beyond the state of the art and which still require R&D before construction by industry (technology transfer mission).

To meet these challenges, the CRPP will continue to develop its main strengths in the fields of physics of hot magnetized plasma (theory and experiments), heating and diagnostics technology, as well as material physics and technology (material in a nuclear environment and superconductivity). Synergies with other ETH Domain institutions will be explored. The program will also fully benefit from the opportunities offered by the European fusion program such as the availability of 100-1000 Teraflops computers dedicated to fusion research, and specific actions initiated by Euratom in the frame of the European Fusion Development Agreement (EFDA) and Fusion for Energy (F4E), or by the Swiss Confederation (the "Broader Approach").

The main infrastructure used for the experimental studies of fusion grade plasmas is the “Tokamak à Configuration Variable” (TCV). In order to maximize our impact on the international scene, an up-grade of the heating and control capabilities of TCV will be implemented. Once completed, these enhancements will allow experiments in dense plasmas with both hot electrons and ions, while retaining the unique feature of plasma

shaping of TCV. These features will pave the way for major investigations for ITER and DEMO.

7. Resources

7.1 Human Resources

In the framework of its performance mandate and target agreement, EPFL constantly seeks to develop and improve the skills and performance of its staff in education, research and services, to keep up with a rapidly evolving, competitive and multicultural academic environment.

Whereas the Federal Personnel Law and various ETH Board ordinances set overall working conditions, the employment market and professional developments require top-notch employers to constantly adjust their services. Major international interchange and customer focus call for a level of service increasingly close to that prevailing in multinationals in the private sector.

7.1.1 Development of skills and performance in an international environment

Staff hire and development must enable EPFL to have the highest internationally available skills throughout its activities. Among other measures to reach this goal, EPFL intends to develop an online recruitment process.

The principle of mobility for scientists should ensure not only that academic careers are enriched, but also a continuously renewed source of knowledge, creativity and entrepreneurial spirit. EPFL thus plans an expansion of monitoring tools for HR management, satisfaction surveys and reporting so as to further reinforce follow-up of scientific or administrative careers.

7.1.2 Promotion of young talent

The concept of a tenure-track system was introduced in 2002 and has steadily developed and improved since. In early 2011, EPFL counted 60 tenure-track assistant professors (PATT), i.e. approximately 20% of all faculty members. PATT positions and the conditions offered are very appealing and enable EPFL to attract outstanding young scientists from all over the world. Recently, a review including a poll conducted by the PATT themselves and some recommendations pointed out that they are satisfied with the overall process, but that there is room for improvement. The period 2012-2016 will provide an opportunity to improve the system while preserving the clarity, transparency and fairness of the tenure process by introducing in particular a formal mid-term review, an informal annual discussion with the faculty Dean, the possibility for a mentoring and a harmonization of the procedure and the practices between the schools.

In parallel, the policy to promote the “corps intermédiaire” by awarding Adjunct Professor, Senior Scientist and Research and Teaching Associate titles will be pursued. Sound management of technological platforms and “ateliers” requires research and technical continuity, and consequently stabilizing part of the high-level research and technical staff. An effort will be made to offer all staff members career prospects in line with their competence.

PhD and postgraduate assistants are at the heart of education and research at EPFL. Top candidates are recruited at worldwide level, which implies developing a recruitment policy to foster integration as well as diversity. The working conditions must be among the best in the world. A standardized, flexible wage system will ensure both equal treatment and actual performance incentives.

In addition to specific training in their academic area, vocational training aimed at non-tenured lecturers serves to boost both their management and behavioral skills, which is highly useful when looking for a new job. An individual census of all training performed will be conducted.

It should be noted that one should also anticipate and prepare for renewal of the administrative and technical staff in order to adequately support EPFL activities and development in the medium and long term.

7.1.3 Promotion of equal opportunities and respect for diversity

EPFL is one of the world's most cosmopolitan research universities. It promotes all forms of diversity and makes every effort to ensure integration at both the regional and national level. For the period 2012-2016, EPFL has committed to increase financial means allocated to equal opportunities measures to 0.4% of the Confederation's financial contribution[14].

Over the past 10 years, EPFL has attached major importance to its equal opportunities policy, as evidenced by recent statistics: the share of female students has risen from 18% to 27% from 2000 to 2010. This policy is based on the implementation of equal opportunities measures at all levels, as well as on the development of specific actions to attract and retain women in science and engineering fields. In practice, this means initiating and carrying through:

- targeted measures to interest girls in scientific disciplines and engineering, to encourage all categories of female scientific staff to pursue academic careers and to increase the number of women at all levels;
- measures to enable women to better reconcile family life and their chosen career.

In order to reach the ambitious targets set by the ETH Board for the ETH Domain in the period 2012-2016[1], EPFL intends to pursue and strengthen its related policy, in particular by:

- implementing measures to inform girls at all school levels and encourage them to opt for scientific and technical education. According to the August 2010 report by the Federal Council regarding the extent and causes of the shortage in qualified personnel in science, technology, engineering, and mathematics (STEM) education, one should arouse interest in STEM fields at the preschool age, in kindergarten and in primary and secondary school and pursue the related measures already taken by higher education establishments. In this framework, the EPFL program "Les sciences, ça m'intéresse!" targeting girls from 7 to 13 should serve to increase the number of girls opting for science subjects in secondary school, thus producing mid- and long-term results at university level. Additionally, further measures need to be developed for girls from 13 to 16;
- pursuing mentoring programs for female students and scientists at all levels and implementing new measures in this field;
- developing specific measures to increase the number of women professors and women in leadership positions and decision-making bodies (e.g. by systematically preferring women among equal quality applicants);

[14]ETH Board objectives for 2012-2016 according to the strategy adopted on 6/7 December 2010:
- To increase financial resources allocated to measures fostering equal opportunities to 0.4% of the financial contribution
- To target the following shares of women by 2016: 35% of students, 30% of non-tenured lecturers, 28% of assistant professors and 13% of full/associate professors.

- implementing measures to better reconcile family and professional life. Projects will be initiated in order to increase preschool childcare facilities and identify daycare solutions for school-age children.

In order to ensure equal opportunities for people from all social horizons, EPFL will pursue the following measures:

- A social welfare system complementing cantonal support.
- Information and awareness-raising campaigns for science – the Equal Opportunities Office will conduct these in primary and transition schools, in particular with the bus "Les sciences, ça m'intéresse!". These campaigns will also be extended to secondary schools as much as possible. Science events (camps, courses, etc.) will be provided free of charge so that girls and boys from all strata of society may benefit.
- EPFL actions to promote bachelor studies in high schools for pupils of all social strata.

So that finances do not hamper success, EPFL intends to strengthen financial aid to 1st year Swiss and resident students. Additionally, a communication campaign targeted at high school students will be launched to inform them of the EPFL financial support policy.

7.1.4 Wage flexibilization

The adjustment of the New Remuneration System (NRS) implemented by EPFL serves to put a premium on experience and reward individual or group performance. Thanks to a dual incentive system, performance and skills are rewarded by one-off bonuses and/or extraordinary salary increases, resulting in a selective allocation of available means. The implementation processes for this new system will be further improved for better effectiveness without, however, leading to inflationary effects. These adaptations and processes will be developed in a clear and transparent manner throughout EPFL.

7.1.5 Evolution of the working environment

Changes in work requirements and patterns and the promotion of female careers are pushing EPFL to promote both internal mobility and all forms of work for the scientific and administrative staff – both women and men. Flexitime and the introduction of technologies conducive to distance work make it possible to have increasingly rare and highly-specialized skills available anytime, anywhere. These various possibilities will be further developed, taking care, however, that a more flexible and dynamic working environment does not encroach on privacy and promotes family life, association and sports activities and the development of hobbies.

In order to be able to respond to these professional and organisational changes, the administrative and technical staff must be given the opportunity to complement or refresh its skills. In this widening context, continuing staff education becomes a must. The offer will be analysed and further developed if applicable.

7.1.6 Consolidation of the pension fund

The financial crisis has highlighted how sensitive pension funds are to major stock market developments. The current system, largely based on capitalization, must be protected against market fluctuations and guarantee optimum security for deferred annuities, in particular for the 2nd pillar.

More flexible retirement possibilities will be offered with tiered pension plans, and disability and death compensation will be further improved.

7.1.7 Security, health and safety at work and social partnership

The expansion of the EPFL campus and extreme diversity of research activities imply strengthening the safety of people and equipment. Student life, science and cultural events, the presence of start-ups on campus and of large companies in Innovation Square require advanced security measures and greater attention to health and safety and work. In particular, a medical unit ensures that persons exposed are followed up and provides workstation analyses, first aid and, where applicable, large-scale sanitary campaigns.

Psychosocial hazards are among priority concerns and the security measures to guarantee the best possible quality of life on the EPFL campus are developed in close cooperation with the social partners and all associations representing the members of the EPFL community.

The EPFL HR or social report regularly evidences the development of EPFL Human Resources and the host of measures taken to improve working conditions as a whole.

7.1.8 Development of an all-embracing ethics strategy

A top quality university is bound to implement high standards of ethics. EPFL is constantly striving to take into account this requirement at several levels. EPFL has published and is permanently improving documents to set out principles in the clearest possible manner. The procedures to be followed are also carefully reviewed to ensure that everyone knows how to behave in an ethically responsible fashion.

7.2 Finance Strategy

The EPFL strategic objectives for the 2012-2016 planning period have been defined under the assumption of a federal budgetary increase of 6% per year over the 2012-2016 timeframe, in conformance with the anticipated growth rate for the ETH domain. This growth rate is considered as the absolute minimum to cope with the expected growth rate of students at all levels and to maintain the quality of EPFL teaching and research environment.

In this context, it might be worthwhile stressing that EPFL has experienced almost 20 years of near budget stagnation in real terms, despite a doubling in the number of students and staff. Nevertheless, a focused spending and global cost containment policy has allowed the school to carry its assigned tasks successfully. However, a point is now reached where growth can simply no longer be absorbed without a real budget increase, failing which the institution’s tasks will be jeopardized. The requested budget increase is therefore absolutely necessary for it to pursue its strategy of qualitative and quantitative growth, thus to further improve its overall competitiveness and attractiveness.

At the same time, and to supplement the federal budget, EPFL will continue trying to diversify its sources and methods of funding both for research and for infrastructure development. The ratio between third party and budget funding is expected to further increase during the planning period, and reach approx. 50% in 2016.

With third party funding for research, not only traditional research funds are meant, but also sponsorship to finance chairs, scientific equipments and platforms. Regarding infrastructure, EPFL has played a pioneering role developing and using public-private partnerships to expand and complement its campus with essential, albeit non-core business, buildings such as student accommodations, innovation center, scientific park, congress center, hotel, which all further contribute to the attractiveness and competitiveness of the School.

EPFL has established an internal controlling system following the guidelines of the Swiss Federal Audit Office. It covers all processes with a potential financial impact such as purchasing, payroll, etc. It is our intent to further use and develop this system as an important management instrument, together with the risk management schemes in place.

With the added flexibility given to the institutions in terms of treasury and cash management, EPFL has implemented an advisory board with members external to the school in order to define the investment strategy and supervise the asset management.

The long-term economic growth and competitiveness of the country will depend in part on the commitment that is made to teaching and research. Contrary to what happened in the previous planning periods, where the real growth rate came out much lower than the promised one because of measures to reduce indebtedness, EPFL pledges for a more predictable budgeting process that takes into account the specific time constants found in education and research. Furthermore, it is important that competitive funding agencies (SNF, CTI) pay sufficient overhead to cover the real costs of the supported projects to avoid castigating the base budget of the institutions. For the European programs, the variations of the exchange rate constitute an additional problem.

Switzerland cannot afford to lag behind other established and emerging countries in the world that invest massively in this area. Once again, vigorous political will and decisions followed by concrete actions are expected for this planning period and are indispensable for the future of our country and its teaching and research institutions.

7.3 Building Strategy

7.3.1 Real estate management

The campus buildings are a vital resource benefiting the EPFL scientific community. Their strategic importance and related financial means have long led the institution to optimize real estate management processes. For example, analytical indicators to measure each building's efficiency have been implemented and a strategic plan has been devised to anticipate budgetary needs and foreseeable measures to preserve the campus' use value. Indeed, comparison with other similar organizations in the private and public sectors has shown that the EPFL building stock is managed in a particularly competitive way in relation to market practice.

EPFL will continue to optimize its real estate management through continuous challenging, benchmarking against best practice in other institutions and resorting to increasingly effective planning and management tools, both for the buildings themselves and for building use and services. Priorities will relate to preserving asset value, risk management and user accountability, as well as consideration of the space requirements to ensure that education takes place in optimum conditions adjusted to growing student numbers.

The 2012-2016 strategic plan for buildings is a continuation of recent construction south of the campus, in particular the newly-built *Rolex Learning Center,* a flagship building grouping 10 libraries previously spread across the whole campus – a place to study, meet and exchange at the heart of EPFL. The *Starling Hotel at EPFL* (154 rooms), the housing complex for students and academic visitors *Les Estudiantines* (330 beds) and the *Innovation Square* dedicated to major corporation R&D centers complement this concept. The *Objectif Campus* project, whose first stage was completed in 2010, is the connecting thread for urban planning and between the recent and future constructions to the north and south of campus.

7.3.2 Sustainable development

With the "Sustainable CAMPUS durable" initiative launched in late 2007, the EPFL has devoted additional resources to develop an integrated sustainable campus, thus strengthening the efforts of many years in this field. This project has made it possible to promote the sustainable development aspects related to campus, to network individual and group initiatives and to foster a pioneering approach for infrastructure. Management of the building stock is conducted along the four main lines: construction and energy, mobility and accessibility, and environment/landscape/quality of life. Thanks to these efforts, in 2009 EPFL was awarded the first International Sustainable Campus Award by ISCN – the International Sustainable Campus Network.

The energy master plan reports on current energy use and future resources. Reductions in energy consumption, in particular through the ENERGHO Suisse Energie project and Rumba (resource and environmental management system throughout the federal administration), as well as consumption monitoring and annual reports make up the institution's energy scoreboard.

All projects to be implemented in the 2012-2016 period will fit into the sustainable campus vision. Project planning will be closely related to the reflections elicited by the energy & fluids master plan so as to anticipate the expansion of technological infrastructure and ensure that the necessary resources are available, as these are bound to grow despite the planned energy-saving measures. In order to manage the growth of the campus population and its accessibility, one of the priorities will be to implement a mobility plan in collaboration with University of Lausanne.

7.3.3 Objective: Campus

Today the EPFL campus is toned up by the many events organised by dozens of student associations. In parallel, the campus evolves as various new building projects come to fruition.

The *Objectif Campus* project is a logical response to the development of a campus whose activities are increasingly 24/7, 365 days a year. The aim is to devise a clear and consistent campus strategy for the students and the personnel, but also for its many visitors, by rethinking connecting routes and a joint approach to landscaping, signposting and lighting. Another important aspect will be the significant development of living and interaction areas, accessibility and flows and pursuing an EcoMobility policy.

The first stage of implementation in 2009/10 mainly related to the southern end of campus with landscaping around the Rolex Learning Center and the creation of a new main square, named Place Cosandey as a tribute to EPFL's first president.

The focal point of the second stage of this ambitious project will revolve around the creation of a consistent range of animation, meeting and exhibition areas in line with the institution's mission. 2013 will see the construction of several pavilions to host the following activities:

- The crux of this development will be the MetaMedia Center. In the framework of cooperation with Montreux Sounds, EPFL will receive a full copy of the digital archives of the Montreux Jazz Festival with a mission to set off their value on campus. The MetaMedia Center will provide a meeting place for students, staff members and visitors to experience new archive technologies and relive festival highlights. This technological and cultural showcase will be combined with a café – a friendly eating place at the heart of campus primarily dedicated to our students.

- A welcoming area to present EPFL, the institution's history and major ongoing projects. This will be complemented with a meeting room for presentations to foreign delegations or policy-makers, press conferences, etc.
- A modular, flexible area for privileged interaction between technologies developed at EPFL and culture – an exhibition area combining the real and virtual worlds, for everyone to discover, live or experience research and technology developments.
- These pavilions will be built based on the latest sustainable development concepts (energy, materials, life cycle, operation).

The Objectif campus project will also strengthen north-south linkages along the Avenue Piccard and through the SG square in the direction of the future Conference Center.

7.3.4 Culture campus

By establishing a Cultural Affairs unit reporting to the President's Office in 2009, the EPFL Senior Management showed its determination to give students the cultural dimension needed to complement their science education and to initiate a continuous, fruitful dialogue between science and the arts.

Culture abounds on campus, but in the Rolex Learning Center – and particularly its Forum – it has found a new and privileged place where science and culture can cross-feed each other. Designed to host conferences and debates on science, but also on art and culture, the Rolex Learning Center hosts events that are diversified according to opportunity and through permanent dialogue with EPFL scientists and students.

It should be noted that the pavilions to be built on Place Cosandey will complement the offer of artistic and cultural fora at the heart of the campus, in addition to the numerous activities organised in particular by student associations.

7.3.5 Conversion of the ME and BI buildings and Teaching Bridge

The conversion of the mechanical engineering halls and of the former library is closely linked to the above concepts. Their ground level will have a front facing the *Rolex Learning Center* while their north sides will remain connected to levels 1 and 2 as per the initial EPFL design in the first stage.

The forthcoming conversion of the former library will have to anticipate flows and architectural design dictated by a second stage to be implemented in 2015. Indeed, the EPFL plans to build a *Teaching Bridge* - a teaching and education showcase to accommodate cutting-edge technology labs for disciplinary and transdisciplinary practical work.

7.3.6 Conference Center

The Conference Center, whose construction started beginning 2011 on the north side of campus, will open in 2013 and include a modular, 3000-seat conference hall, over 500 student lodgings, shops, services and car parks. This infrastructure will offer students and staff a true living campus with all the services expected of a leading research university.

7.3.7 Microcity - Neuchâtel

Although this is outside the EPFL budget, the new microtechnology building should be mentioned. It will be commissioned in 2013 and ultimately host up to twelve professorships. This project is being implemented in close cooperation between EPFL and the State of Neuchâtel, which will own the building and guarantee its funding.

7.4 Communications Strategy

The communications strategy implemented since 2008 aims to pursue the work initiated in 2000 by opening new territories to promote EPFL and shifting the semantic positioning of the EPFL brand. This strategy is summarized in 6 major points:

i) Refocus the EPFL image on science by gradually shifting public interest from major symbolic landmarks (Alinghi, Solar Impulse…) to the School's academic and technology transfer activities.

ii) Develop internal communications by improving horizontal and transversal information flows.

iii) Develop international recognition in targeted markets (Europe, USA, China, India, Middle East, Brazil).

iv) Develop relations with the Swiss media by presenting EPFL as a nationwide institute of technology rather than a school in western Switzerland.

v) Develop and shift our visual image with more graphic (computer graphics, content-related photos…) and human-centered (scientists, students…) visual environments

vi) Reorganize communications by coordinating the science promotion policy and overall demand responsive communications (1,200 events per year, 1,500 press clippings per year, 8,000 website hits per day, 800 requests for interviews per year) with the growing technological requirements for communication. Create a community of professional communicators within EPFL to trace dormant activities within the labs.