ETH Domain Center for Environment and Sustainability – CCES
BUSINESS PLAN, November 22, 2005

Executive Summary

Vision

In 2000 the United Nations Millennium Development Goals stated that the principles of sustainable development should be integrated by 2015 into country policies and programs. To meet these goals, a new thinking and priority setting needs to be established, based on sound scientific and engineering knowledge. With the Center for Environment and Sustainability, the ETH-Domain aims at providing the scientific basis for this integration in Switzerland and more generally as a global player. CCES will focus research and applications on themes crucial for our future, ranging from climate and environment changes to food safety, sustainable landuse, natural resources and the management of natural risks.

Mission

To identify the relevant questions and the appropriate answers to foster the sustainable development of our future society while minimizing the impact on the environment.

Goals

The CCES overall strategic goals are to establish a coherent strategy for the E&S sector; enhance the ETH positioning; re-orient the research profile of the participating institutes; integrate the research activities of ETHZ, EPFL, WSL and EAWAG; foster major advancements in research; achieve a long-term institutional structuring effect; achieve a leading presence in the European research area; achieve a visible, durable societal impact with a focus on socio-economic implementation; establish a long-term, wide-ranging Education & Outreach program; increase the significance of the North-South dialog; implement integrated strategies for the environmental services and to access major research infrastructures in the ETH-Domain.

Strategies

The CCES implementation is based on

A. five Education and Research Units: SuLu - Sustainable Land Use, CLENCH - Climate and Environmental Change, FEH - Food, Environment and Health; NatuRe - Natural Resources; HazRi – Natural Hazards and Risks
B. common Research Platforms, including the test area ‘Swiss Experiment’, numerical modeling and analytical laboratories
C. the optimization of the scientific and environmental services offered by the ETH-Domain
D. a strong Education and Outreach (E&O) program, including Master curricula, graduate courses, North-South dialog, the CCES Graduate School, a visiting program and an outreach component
E. evaluation and strategic planning in key sectors through expert panels and think-tanks

Staff

Large sectors of the ETH Domain cooperate in CCES: S-ENETH (School Domain of Earth, Environment and Natural Resources) and D-BAUG (Environmental Engineering and Geomatics) at ETHZ, WSL, EAWAG and EPFL (ENAC faculty).

Finances

CCES is largely based on the re-orientation and focusing of the critical mass and excellence in science and engineering already existing at ETHZ, EPFL, EAWAG and WSL. In addition, the CCES Business Plan proposes activities for a combined yearly budget of 24 MFr, following a three-part scheme, with contributions from (i) the ETH-Board, (ii) dedicated resources by the participating institutions, and (iii) third party funding. The ETH-Board contribution requested for the 2006-2007 installation phase is of 14 MFr.

Steering Priorities

With the goal of establishing a long-term structuring program, CCES will operate with a 5+5 year schedule. An initial 2-yr installation phase (2006-2007) will be followed by a 3-yr operation phase (2008-2010). A full implementation plan has to be substantiated and developed during the initial installation phase.

The CCES Leading House is the ETH Zurich (S-ENETH). The ETHZ President is responsible for CCES toward the ETH-Board.
CCES is managed by the Director with the support of the CCES Manager, and governed by the Steering Board helped by the Advisory and Quality Assurance Board. ERUs are managed by ERU Leaders and Committees. The Director and the ERU Leaders form the CCES Management Committee.

CCES Business Plan

1. Motivation

The concept of sustainability has been known and applied long before the world summit in Rio de Janeiro (1992). In Swiss Forestry, for instance, sustainability was and is the basic management principle. However, the concept of *sustainable development* gained a new dimension at Rio and was placed on the top of the international agenda. In Switzerland[1] and within ETH Zurich[2] the Brundtland report "our common future" triggered a set of research initiatives. In 2000 the United Nations agreed on the Millennium Development Goals (MDG) explicitly stating among other objectives that the principles of sustainable development should be integrated by 2015 into country policies and programs.

Fifteen years of post-Rio sustainability research resulted in important findings, especially related to a process-based understanding of decisive environmental problems, but crucial knowledge gaps persist, related especially to environmental issues subjected to international political and scientific debate, with little hope for immediate solutions and consistent strategies (global warming, loss of biodiversity, and degradation of land resources and water supplies at an unprecedented pace) and to the general unwillingness and unpreparedness to think on time scales longer than a life span.

The Big Questions which motivate CCES are relevant, scientifically challenging and with far-reaching consequences for the future of our society and our planet:

- How can we sustain and/or improve ecosystem services in very different environments?
- How does global change induce local (regional) changes in natural and managed environments?
- How do the global element cycles tie in with the claim for a sustainable energy production?
- How can we produce food sustainably for the world's growing population, alleviate hunger and extreme poverty?
- How can we make better use of the underground and its resources?
- How can we mitigate natural hazards and ecosystem mal-functioning and disorders?
- What may prevent us from being entrained into an even more unsustainable behavior?
- How can we ensure that the "precautionary principle" enhances sustainability without curbing economic growth?

The CCES motivation is also driven by overall strategic goals relevant for the ETH Domain, which will be the benchmark to gauge the long-term impact of the center:

- Establish a coherent strategy for the E&S sector, towards enhancing the ETH positioning
- Re-orient the research profile of the participating institutes, eliminating duplications and fostering complementarity, with a focus on the integration of the research conducted at WSL and EAWAG with that at ETHZ and EPFL
- Foster major advancements in research
- Achieve a long-term institutional structuring effect without inducing dependence on the seed funding
- Achieve a leading presence in the European research area, with the leadership of major FP7 projects
- Achieve a visible, durable societal impact with a focus on socio-economic implementation
- Establish a long-term, wide-ranging E&O program
- Increase the critical mass and significance of the North-South dialog and activities
- Embed the existing competence centers and networks in a wider framework program
- Implement an integrated strategy for the environmental and hazard services conducted by ETH institutes
- Implement a Swiss-wide strategy for the optimal access to major research infrastructures and test areas

The ETH Domain has been very active in the field of environment and sustainability. CCES will integrate research across disciplines and between the institutions within and outside the ETH Domain, and will form a strategic and operational alliance of partners with complementary strengths with a common mission, an alliance that can progress at a faster pace, create synergies, and optimize the use of the resources of the partner institutions.

2. Market

CCES focuses on five complementary core themes, each covered by a Education and Research Unit (ERU), and the market analysis for each theme and ERU is given in the corresponding ERU Business Plan, in terms of state-of-the-art of science/research/technology, need for research and benefit for economical development in Switzerland.

[1] Swiss "SPP Environment" (1992 to 2002), the "NFP 54 Sustainable Development of the Built Environment" (2003 to 2013) and the NFP 48 (Landschaften und Lebensräume der Alpen)

[2] ETH-Zürich created the Alliance for Global Sustainability (AGS, 1993) and the Center for Sustainability (2003). The ETH Domain established Sustainability Strategy (2000 Watt Society, 1995) and its succession program Novatlantis (2003), the Swiss Center for International Agriculture (1993) and the Network for International Cooperation (2002)..

3. Categories of Activities and Thematic Focus

3.1 Identification of leading institutions within the ETH Domain

Large sectors of the ETH Domain cooperate in CCES: S-ENETH (School Domain of Earth, Environment and Natural Resources) and D-BAUG (Environmental Engineering and Geomatics) at ETHZ, WSL, EAWAG and EPFL (ENAC faculty). Specific groups and expertise are listed in the ERU Business Plans.

The CCES Leading House is the ETH Zurich (S-ENETH). The appointed CCES Director is Prof. D. Giardini of ETHZ.

3.2 Categories of activities

The CCES implementation is based on different categories of activities, integrating distributed and centralized approaches, with the declared goal of achieving a durable structuring effect which will add value to the whole domain of Environment and Sustainability, beyond the completion of CCES.

A. Education and Research Units (ERU)

The ERUs identify the thematic foci and overarching strategic priorities where CCES will concentrate its efforts. We identify for the first CCES implementation phase 5 ERUs:

- *Sustainable Land Use (SuLu)*
- *Climate and Environmental Change (CLENCH)*
- *Food, Environment and Health (FEH)*
- *Natural Resources (NatuRe)*
- *Natural Hazards and Risks (HazRi)*

Thematic research programs, experimental facilities and test areas will be established within the ERUs, with the goal of fostering world-class research bringing together the expertise already available in the CCES institutions. These activities will involve several institutes and professorships, in order to reach the required critical mass in the identified themes. The programs may be part of more than one ERU, for instance, the theme 'Global water resources and supply' relates to the ERUs NatuRe, FEH and SuLu.

CCES has a unique chance to influence sustainability through risk management and societal decision-making. The methodological framework for CCES will span all steps from (i) process understanding, (ii) vulnerability, (iii) prevention and mitigation, and (iv) mechanisms for optimizing the decision path to keep the threats within acceptable limits. These problem levels are encountered in all thematic contexts and a common approach will be pursued.

The ERU activities might evolve during the CCES implementation, depending on scientific and societal priorities. A common character of CCES will be the interactions and synergies among the ERUs. For each of the five identified ERUs, a separate first draft of the Business Plan is presented below, with more details on each theme. These thematic business plans will be further substantiated and developed during the initial installation phase (2006-2007) and will be reviewed by the Advisory and Quality Assurance Board. Projects will be selected according to their contribution to the overall goal of CCES and on the extent of resources allocated to the projects by the applying institutions.

B. Research Platforms

The widespread use of advanced technologies characterizes the whole CCES, ranging from advanced computing to analytical labs to visualization platforms. There is a need to coordinate, integrate and improve the methodological tools and specialized equipment operated by experts in several fields. The development of advanced research platforms will benefit the whole CCES domain. Initially CCES will concentrate on three platforms.

Swiss Experiment. Our capability to model natural and induced processes and to characterize their evolution is inherently connected to the acquisition of high-quality data. CCES will implement a Swiss test area to serve the combined monitoring needs of various ERUs. A Swiss valley will be selected as target for innovative data acquisition programs with the goal of increasing the resolution and quality of data, and allow to studying the interconnection between climate and environmental changes, precipitation and soil evolution, the predictability of natural processes and the development of rapid-onset hazards. The Swiss experiment is planned as a world-class research facility to monitor natural processes, and will be implemented by the ERU HazRi in cooperation with SuLu, CLENCH and NatuRe.

Numerical Modeling. The capacity of adequately modeling natural processes is the key for their understanding and mitigation. Elements of a new common strategy to enhance numerical modeling capacity at ETH Domain scale could include: (i) assess and optimize software and hardware resources in CCES, (ii) implement schemes to grid the main infrastructures for large scale modeling in the ETH Domain, (iii) build a dedicated software infrastructure, (iv) create a strong partnership with CSCS, (v) participate in the new Swiss Collaborative Computing Initiative (SCCI).

Laboratories and Infrastructures. CCES institutions operate a range of world-class analytical laboratories (e.g. isotope geochemistry; tree-ring lab; mass-spectrometry; microscopy) as well as field laboratories (e.g. avalanche, mud- and

debris flow launching, experimental catchments, forest hydrology experimental sites, long-term monitoring stations in selected habitats, agricultural research stations). We will develop a strategy to optimize, enhance and streamline the usage of these facilities, towards a common policy for Swiss-wide access to major research infrastructures.

C. Scientific Services

Important services activities are offered by the partner institutions of CCES, covering crucial sectors in the surveillance and alerting of natural hazards and environmental processes and habitats. These service activities are often regulated at federal (Bundesratsbeschlüsse) or cantonal level, and financed through a variety of internal and external funding sources. These include: earthquake surveillance and hazard assessment (Erdbebendienst, ETHZ), Avalanche warning (WSL), Species and habitat management (BUWAL/WSL), Forest inventory (BUWAL/WSL), Virgin forest reservations (Urwaldreservate, ETH Zurich), Water quality assessment (BUWAL/BWG/EAWAG). Additional modeling capabilities in the ETH Domain are concentrated in fields such as the modeling of surface and groundwater water processes, flood prediction, erosion control and nutrient export from cultivated land.

To maintain the services at the highest quality standards, a continuous link between science and development in monitoring and interpreting observations and modeled results is required. These activities are important for ETH because they make substantial external funding accessible, have a clear societal relevance and public recognition, receive consistent press coverage and contribute to build the ETH profile as an important component of the Swiss society. From a purely scientific point of view, they offer the unique possibility and important advantage of controlling the whole chain of specific environmental processes, from the monitoring and data collection, to modeling and to forecasting. CCES aims at increasing the market value and the societal impact of the service activities, and developing a strategy to optimize internal costs and expand external support.

D. Education and Outreach (E&O)

All CCES partners are involved in education at ETHZ, EPFL as well as in the course programs of WSL and EAWAG in various roles. They are engaged in knowledge and know-how transfer on all levels from basic training to advanced programs. The CCES activities will add an additional quality to these curricula, by giving the chance to provide specialized educations in themes of crucial importance for our future society. A first evaluation of the potential to establish a wide-ranging E&O program has identified the following elements:

- New master curricula will be introduced on the main CCES themes, i.e. “Natural Hazards and Risk Management”, “Forest- and Landscape Management”.
- Graduate courses, i.e. “Land-use Modeling” and “International Water Management” (working titles).
- Course blocks on the fundamentals of sustainability will be offered to non-CCES departments, both inside as well as outside of the ETH Domain.
- The North-South dialog will be expanded, with specific focus on developing countries as those where the sustainability pressure is higher. This will be realized with an effective integration with NIDECO (Network for Development and Cooperation) and ZIL (Center for International Agriculture).
- A Graduate School on Environment and Sustainability will be established to select the PhD projects and students for the research activities conducted in the CCES ERUs; a single selection commission will be established for the whole CCES, connected to the Research Commissions at ETHZ, EPFL and SNF.
- Visiting program: In addition to the budget already dedicated by the participating institutions according to their strategic plans, CCES will reserve resources to invite world scholars in sustainability science to join the competence center for longer visiting periods, contributing to both research and education.
- Internal seminars, think tanks, and international workshops will be organized to share and spread the CCES knowledge among participants and towards other institutions.
- Outreach: Know-how transfer and dissemination will include courses for permanent formation offered to professionals outside the university. The well functioning extension and public relation services of WSL, EAWAG, ETH Zurich, and EPF Lausanne will be instrumental for CCES.
- Exponents from politics and business, the prime actors for any transformation of societal processes, will be engaged and involved in the valorization and implementation of the produced knowledge.

E. Strategic Planning

CCES will organize and coordinate working groups, think-tanks and expert panels to evaluate the present status and propose future strategies in key CCES domains, involving also Universities and other sectors of society as appropriate. Expected output will be position papers and proposals for implementation plans. Identified initial targets include the coordination and access to research infrastructures, and the evaluation of the research profile for a future large-scale initiative replacing CENAT, the existing Competence Center on Natural Hazards of the ETH Domain.

3.3 Time frame for realization / Milestones

With the goal of establishing a long-term, structuring, effective program, CCES will operate with a 5+5 year schedule. The first 5-yr phase will initiate with a 2-yr implementation phase (2006-2007), designed to establish all the elements of the program. After the first program evaluation, a 3-yr operation phase (2008-2010) will consolidate the program and complete the first program phase. In addition to the evaluation provided by the Advisory and Quality Assurance Board, overall program evaluations are expected at the end of 2007, to evaluate the CCES implementation, and at the end of 2010, to approve the financing and program for the second 5-yr phase.

The milestones for the ERUs are listed in the individual Business Plans. The milestones for the overall CCES implementation for the 2006-2007 implementation phase – under the assumption of the allocation of the consolidated budget presented below – will cover the realization of all program elements listed above, including

- the planning and establishment of a comprehensive E&O program (including graduate school, visiting program, outreach, master curricula and individual courses),
- a strategy for the optimization of environmental services and for the access to major research infrastructures,
- the establishment of the Swiss experimental test area,
- the implementation of research platforms.

4. Partners

The Partners analysis is presented for each theme and ERU in the corresponding ERU Business Plan.

5. Networking

CCES will foster extensive networking. The individual ERU Networking analysis is presented in the corresponding ERU Business Plan. CCES will also pursue overall networking goals, including:

- a strong cooperation with the Swiss Universities. This goal will be targeted at the end of the CCES implementation phase, starting in 2008, through wide cooperation agreements where the support for the participation of Universities in major themes will be requested from BBW and SNF (NCCR-type framework).
- a strong North-South dialog.
- high-level strategic agreements with emerging countries, such as the Swiss-China cooperation agreement which is the focus of the delegation visit to China in November 2005, and a similar Swiss-India agreement.
- coordination with other large-scale initiatives and centers in Europe and US with similar focus and drive.

6. Contribution to teaching, services

The significant CCES contributions to teaching and services, with the corresponding milestones, are given in section 3.2.

7. Added value, Strengths, Opportunities

The added value of CCES arises because it brings together existing research groups in the two schools (ETHZ, EPFL) and in the Forschungsanstalten (WSL, EAWAG), focusing research and investments on core themes, and thus facilitates new thinking and research in a dimension and broadness that can make a real contribution towards achieving sustainability. The added value as perceived by the involved scientists is the possibility to embark on a project line of duration longer than the usual 3-year period and therefore being better suited for the special demands of cooperative, long-term work. Further added value elements are identified as strategic priorities in the Motivation chapter.

The scientific strengths of the potential partners have been recently assessed and documented in various international peer reviews: Evaluation D-AGRL (2004), D-BAUG (2004/5), D-UWIS (2004), D-ERDW (2002), D-FOWI (2004), Audit WSL (2003/2004), Evaluation EAWAG (2002), Task Force Report WSL „Contribution to CCES“ (2005).

The opportunity for the CCES consortium lies in the increased strategic relevance of the themes identified by CCES, reflecting the new needs of our society and warranting a broader perspective and a wider-ranging approach than in the past. Bringing together established and strong research environments that have been institutionally separated up to now is a further opportunity which is bound to bring out competences and results for tackling environmental problems in a dimension not possible before. Finally, the occasion to identify the missing components and to make progress at scientific interfaces is in itself a challenge and an opportunity not to be missed.

8. Required Resources

In establishing a resource plan for CCES, the following elements and criteria are considered.

Existing resources. The resources (Grundauftrag) allocated in the ETH Domain to the general field of environment and sustainability (S-ENETH, D-BAUG Environmental Engineering and Geomatics, EAWAG, WSL and ENAC Env. Eng.) reach almost 200 MFr/yr.

In-kind contributions. CCES is largely based on the critical mass and excellence in science and engineering already existing at ETHZ, EPFL, EAWAG and WSL. It is the re-orientation and focusing of research and planning which will provide the bulk of the resources for the CCES implementation. CCES will achieve a structuring effect by influencing the long-term planning of the involved institutions. For example, the strategic plan and professorial plan of S-ENETH for 2008-2011 is now aligned almost entirely with the priorities identified by CCES. This interaction will cover institutional activities (i.e. professorial plan) as well as overarching initiatives, such as the future mandate and functions of CENAT (the ETH-Domain Competence Center on Natural Hazards and Risk Management), which will be re-evaluated within the ERU HazRi. We project that over half of the professorships in the involved ETHZ and EPFL institutes will actively participate in CCES, as well as large sectors of the EAWAG and WSL research groups. It is estimated that the in-kind contribution to the CCES development deriving from the involvement of existing resources and personnel might reach in the order of 15-20% of the present budget.

CCES funding scheme. In addition to the institutional in-kind commitment, a program of the scope of CCES needs to raise support for new activities. Based on comparable large programs, the overall volume of new activities generated within CCES has to be of the order of 10-12% of the combined Grundauftrag of the participating institutions, in order to permit the realization of a critical mass of new activities and thus to warrant a meaningful re-orientation of the institutional profiles. The integrated CCES Business Plan foresees activities (central and ERUs) for a combined yearly budget of 24 MFr. These will be ensured (see also section 9. Financial Outlook) through a three-part scheme, with similar contributions (in the order of an average 8MFr/yr each) secured from

(i) the ETH-Board. It is expected that the ETH-Board contribution will be more important in the first 5-year phase of the CCES implementation, and will decrease afterwards.

(ii) resources dedicated by the participating institutions for new CCES initiatives, including scientific and technical personnel, infrastructures and operating funds for up to 3-4% of the present Grundauftrag for each participating institution. This is considered as a key structuring element for CCES and agreements within the participating institutions are taking place. The internal resources dedicated to CCES will be proportional to the engagement of the ETH-Board.

(iii) third party funding (EU FP7, SNF, SDC, industry, federal and cantonal offices). The required third-party funding is within the reach of the participating institutions, based on the support raised in past years, and will aim at covering both large-scale initiatives (i.e. EU) as well as smaller scale participations (SNF individual projects). The CCES themes are core priorities of the EU FP6 and FP7 programs as well as of the 10-yr Implementation Plan of GEOSS (the inter-governmental Global Earth Observation System of Systems). We aim at a strong, leading presence of the ETH Domain in the EU FP7.

Funding allocation. CCES will enforce a participatory scheme where individual projects requesting a contribution from the ETH-Board pool will be required to secure the corresponding support from the participating institutions as well as from external grants. This scheme will not be applied rigidly to each individual project, but as an envelope for the whole program. For example, it's expected that third-party funding will concentrate in specific areas, while the set-up of the graduate school will be financed mostly on internal and ETH-Board support.

Personnel resources. On the basis of the CCES elements described above, including in-kind institutional participation, overall activity plan and budget envelope, we project that over 200 FTE will be dedicated to CCES, including PhD students, technical personnel, postdocs, and researchers at various levels.

9. Financial outlook

On the basis of the resource plan outlined above and of the budgets prepared by the ERUs (see separate Business Plans) the expected CCES budget for new activities once the program will be fully established in 2008 is expected to reach 24'000 kFr/yr, partitioned as follows.

Activity	Annual cost [kFR/yr]
ERUs (including PhDs in the graduate school) (5 ERUs at 4'000 kFr/yr)	20'000
E&O (teaching, outreach, workshops, master program, visiting program)	800
Research Platforms (tools, hardware, software, technical staff)	1'200
Scientific Services (optimization, no yearly costs)	1'200
Management 4% (CCES Office, ERU Management, Advisory Board, staff, consumables)	800
Total	24'000

The installation period for CCES will last two years and we expect the program to be fully installed by end 2007, including the three main budget components. The evolution of the integrated budget and of the requested ETH-Board contribution for the first 5-yr phase is as follows:

Year	***2006***	***2007***	***2008***	***2009***	***2010***
Budget total	12'000	20'000	24'000	24'000	24'000
ETH-Board	6'000	8'000	9'000	9'000	9'000
Internal resources	3'000	7'000	8'000	8'000	7'000
Third-party funding	3'000	5'000	7'000	7'000	8'000

We request a contribution of 14'000 kFr from the ETH-Board for the 2006-2007 period, and a yearly contribution of 9'000 kFr/yr for the period 2008-2010.

The overall budget and contributions for the second CCES phase, 2011-2015, will be evaluated later.

10. Organization, Quality assurance, Governance

Structure

CCES will work with a lean central structure and an even leaner administration at the ERU level.

The CCES Leading House is the ETH Zurich. The Leading House, in the person of its President, is responsible for CCES towards the ETH-Board.

The Steering Board is the strategic forum responsible for the overall strategy and planning, the allocation of resources, the scientific and institutional profile of CCES. It will be composed by the President of the Leading House (ETHZ), a representative each of ETHZ and EPFL, the Directors of WSL and EAWAG, and up to three members from the business world and politics. The President of the Leading House (or his delegate) chairs the Steering Board.

The Advisory and Quality Assurance Board supports the Steering Board in evaluating and improving the strategic orientation of CCES and of the ERUs. It contributes to the definition of the quality criteria that form the basis for the evaluation of the ERUs. Members of this board include international experts in sustainability issues and environmental sciences as well as outstanding, independent scientists in charge of major programs (e.g. president of the ETHZ Forschungskommission, SNF President).

The CCES Director, with the support of the CCES Manager, is responsible for the implementation and budget of CCES, coordinates the structuring (i.e. research platforms, networking) and E&O activities, provides support for fund acquisition from specific international programs, is responsible for quality assurance, reporting and financial controlling and organizes all the necessary activities related to the achievement of the goals and objectives of CCES that are in the responsibility of the Program Management Committee. The CCES Director and Manager are appointed in the Leading House.

Each ERU is lead by an ERU Committee, a board of scientists appointed among the relevant institutes, directed by a ERU Leader. They are responsible for developing an outstanding, far-reaching and long-term program for their ERU for approval by the Management Committee and the Steering Board. They identify projects and their leaders, supervise the overall development of the ERU, assess in first place the quality and progress of the ERU and of its individual modules.

The CCES Management Committee is composed by the CCES Director and the ERU leaders. It is ultimately responsible for managing all the activities and monitoring progress, overall quality assessment, reporting and controlling.

Quality assurance

The SB defines the quality criteria on the basis of the recommendations of the AB. In agreement with international practice, the quality management will cover six aspects: organization, time, budget, quality, communication and risks. For each activity, a quality procedure will be defined stating expected milestones and deliverables, the activity specific risks and the remedial actions. In addition, CCES will identify mechanisms to measure benefits and success with respect to the expected targets. A broadly recognized four-part system of indicators (input, output, outcome and impact indicators) will be used in accordance with standard practice for EU projects of comparable dimension and complexity, in assessing the performance of CCES.

The Advisory and Quality Assurance Board supports the SB strategically to ensure a recurring positioning of the ERUs focus. The AB supports the ERU leaders to assure high level quality of the individual project modules, and, later in the process, they evaluate progress and success of the ERUs and their modules.

Governance

In the preparation phase, the five ERUs which will characterize the first CCES implementation phase have been defined in terms of thematic focus and planned research activities, as described in the individual business plans. The selection procedure has been carried out with a two-step approach.

1) in a first phase, a Strategic Planning committee formed by experts of the participating schools identified the priority areas on the basis of an evaluation of the present profiles of the institutes and of future expectations; the CCES Steering Board approved the selection and formed expert committees for each of these themes, structured as ERUs
2) each ERU Committee carried out a thorough evaluation of its field, polling the input from the wider scientific and professional community in a series of specific modules forming the core of the proposed Business Plan

This two-step approach is justified by the very wide field spanned by CCES and will be maintained also during its implementation. The role of an ERU Committees is in ensuring the highest possible scientific profile for the ERU, while the central office guarantees the whole managerial and administrative support to the scientists in charge of individual activities and projects. CCES focuses initially on five individual themes, implemented as ERUs, but it will be run as a single competence center with a single leading house.

The selection of individual projects within the identified modules of the ERUs will the carried out by the ERU Committees on the basis of open calls, and submitted to the evaluation of the Management Committee and of the Advisory and Quality Assurance Board. The selection of PhD candidates for the projects approved by each ERU will be handled by the CCES Graduate School, and students assigned to the individual projects and institutions, in order to guarantee uniformly high selection standards.

11. Legal Assessment

Agreements and contracts for the various types of co-operations among CCES-partners are negotiated, coordinated and set by ETH Zurich as the Leading House. The Steering Board will issue a Code of Scientific Behavior (publication rights and cooperation rules).

Funding provided by the ETH Domain will be allocated to the leading house to be used for CCES activities. Once allocated to the individual participants in the various ERU activities, the funds will be managed by the individual institutions of the principal investigators (WSL, EAWAG, ETHZ, EPFL).

12. Reporting

Reporting is an important element of quality management and will be conducted according to the rules of the funding institutions (ETH Domain, institutional funding, external funding) as well as part of the internal Quality Assessment procedures. Reporting will include:

- Results of research projects, as well as satisfaction of the external stakeholders such as industry or government partners.
- ETH Domain-wide focussing of research in areas of strength through common projects and reduction of redundancy; added value.
- Achievement of the milestones that were declared in the business plan.
- Use of ETH Board financial means.
- Minutes of progress meetings (oral reporting at CCES workshops; mandatory attendance), annual scientific and financial reporting, intranet activity logs to guarantee transparency in all controlling procedures.

The yearly reporting is due for the first time by the end of February 2007.

The first three years of operation of the Competence Centers will be evaluated at the beginning of the fourth year.by an international panel on behalf of the ETH Board.

BUSINESS PLAN - ERU SuLu: Sustainable Land Use

1. Motivation

Global, regional and local degradation of land resources as well as segregation of land-use, e.g. intensification on favorable land and marginalization in remote areas bears a world-wide conflict potential. The latter can be significantly reduced with new technologies, sound modeling approaches and knowledge-based decision support tools that reconcile economic growth and technological progress with ecosystem integrity. The current generation of land-use modeling and negotiating tools have been valuable means for exploring the implications of environmental, social and economic change, but they are limited because they focus on system states that are assumed to represent some kind of equilibrium under current and future conditions, respectively. These limitations are increasingly removed due to computational power, new simulation tools and remote sensing data at different spatial scales (see ERU Research platform Spatial information) as well as advances in the research on the human-landscape interface. The proposed ERU will exploit this momentum and proposes innovations in the following fields:

- Early detection and modelling of long- and short-term, spatially explicit landscape and ecosystem quality changes based on temporally, non-continuous data sources
- Modelling and forecasting land use change as a function of demographic, economic, technological and climatic driving forces; implementing the models into frameworks of adapted decision support tools that foster a transparent negotiation among various actors
- Developing technologies and land management schemes that enhance ecosystem functions, services and goods of 1) highly diverse non-degraded but vulnerable mountain ecosystems, 2) degraded environments of the lowlands, and 3) urban and periurban systems. This know-how will be propagated in a restoring and a preventive mode.
- Evaluating the influence of linear landscape elements (e.g. rivers) on the connectivity of ecosystems

2. Market

2.1 State-of-the-art of science/research/technology (nationally, internationally)

Cutting edge international research in the fields suggested by the ERU “Sustainable land-use” consists of models that (a) link ecosystem services with land-management schemes, (b) quantify the interdependencies (flows) between regions, and (c) link actor-based models with ecosystem processes at the site, local, regional and supra-regional scale (upscaling). The Swiss research community is playing already a vital role in this cutting edge research. It enjoys a high technological and intellectual standard and is influenced by both region-independent stimuli (e.g. remote sensing, sociology, population biology or statistics), and stimuli that have a strong bounding to the regional context.

2.2 Need for research (if relevant need for teaching and/or services)

Land use managers are increasingly dependent on ready-to-use modeling techniques. These models however need a sound theoretical and empirical background (e.g. an understanding of biodiversity-relevant processes and tools for measuring the degree of connectedness or isolation of populations, communities and habitats, implications of economically profitable exploitation of land resources, e.g. forests). Thus, the challenge of the ERU is to link cutting-edge biological, technical and remote sensing knowledge with quantitative models to derive sound decision support tools. Research is further needed to ensure adequate decision support in situations where possible outcomes are uncertain despite the use of adequate modeling and data acquisition techniques. Specifically, research needs to concentrate on:

- Providing ready-to-use cutting-edge land-use modeling techniques that rely on empirical site data, remote sensing and data-mining techniques, which allow for land-use modelling at different temporal and spatial scales (up-scaling)
- Innovative strategies for improving and maintaining ecosystem integrity and sustainable management of biodiversity hot spots (e.g. forests, creeks) and economically important landscape types (e.g. mountain regions for tourism)
- Decision support for sustainable management in mountain environments and periurban areas.

2.3 Benefit for economical development in Switzerland

There is a direct benefit in the sense that landscapes are the basic life-support system even in highly developed countries such as Switzerland. In addition, they provide the key resource for tourism, the basis for the well-being of people and for their cultural identification. State-of the art planning tools enable land managers to base their decision on transparent and scientifically based management approaches.

3. Thematic foci/research projects of the ERU

3.1 Identification of leadership institutions/institutes within the ETH Domain:

SuLu will harness the scientific expertise of 4 internationally recognized research institutions and approximately 20 SuLu-relevant potential partners on the professorship or research group level in the ETH domain, namely ETHZ (D-UWIS and D-AGRL in S-ENETH), WSL (research units Land use dynamics, Land resource assessment, Ecological genetics and evolution, Socio-economics), EPFL (ENAC, research units 'Génie civil' and 'Science et ingénierie de l'environnement'), EAWAG (department SANDEC).

The appointed ERU Committee includes scientists of all four institutions and is lead by Prof. H. Bugmann of ETHZ and Dr. F. Kienast of WSL.

3.2 Thematic foci

(1) Cutting-edge land-use modeling techniques

- *Ready-to-use modeling techniques* that rely on remote sensing and data-mining techniques and allow land-use change detection and monitoring at different temporal and spatial scales (up-scaling, in close collaboration with Geomatics ETHZ and the RMS Lab of the Univ. of Zürich).
- *Modeling land-use as a function of physical, economic and social driving forces*; generate a set of linked models (process based and static) that allow simulation of land development in various pilot regions (e.g. mountain regions, Alpine Valleys) as well as larger study areas as a function of various driving forces.
- *Early warning systems* to identify and prioritize undesirable environmental changes.
- *S*trong link with ERUs on "Food, Environment and Health", "Natural Resources", and "Natural Hazards".

(2) Innovative strategies for improving and maintaining ecosystem integrity and sustainable management of biodiversity-relevant habitats and economically important landscape types

- *Improving and maintaining ecosystem integrity and sustainable management of* landscape ecological networks (e.g. linear landscape elements such as rivers, hedgerows and roads) that play a decisive role for the flow of genes, matter and energy. Special emphasis will be given to restoring connectivity in rivers and their adjacent buffer strips, possible mitigation measures along large linear infrastructures (already existing on-going research effort between EPFL-EAWAG-WSL-SENETH).
- *Mitigation and adaptation strategies* that enable a proactive management of natural resources in mountain regions, instead of having to focus on restoration activities after negative impacts of environmental influences have occurred.
- Evaluation of keystone elements of ecosystems (species, resources) for restoring ecosystem functions and determination of community-level sensitivity and resistance (i.e. to invasive species, wildlife); principles for developing land use systems that contribute to the restoration of degraded sites

(3) Decision support for sustainable management in mountain environments and periurban areas:

- Decision tools for restoration of built-up areas that require new land management procedures and re-building incentives that re-create responsibility for the public space.
- Decision support in situations where possible outcomes are uncertain despite the use of adequate modeling and data acquisition techniques.

The three priority foci will be implemented through large-scale research projects. Three of these activities have now been identified, to start already in the 2006 (detailed descriptions available on request):

- ENHANCE: Enhancing ecosystem integrity at the landscape scale. Participants: WSL-S-ENETH (coordinator), EAWAG, EPFL
- SUSMOUNT: Sustainable Management of Mountain Landscapes. Participants: S-ENETH (coordinator), WSL, EPFL
- IMPA: Integrated Management of Periurban Areas (Leader and participants: EAWAG, S-ENETH, WSL

3.3 Time frame for realization / Milestones:

2006: JRA ENHANCE, IMPA, SUSMOUNT launched. First joint research activities operational.

2006+: Participation in the CCES international graduate school, with a line on "Landscape Ecology and Land Use Modeling" including international Summer Schools on these themes.

2007: Establishment of Professorships at WSL in the fields of Landscape Ecology, Conservation Biology and Land Resources with research platforms and seed money

2008: ERU fully operational

4. Partners: national, international

Owing to the broad multidisciplinary character of this ERU, the corresponding expertise can be found at various Universities and Research Institutions. The 4 ETH domain institutions have excellent collaboration with cantonal Universities such as Neuchatel, Lausanne and Basel. Collaboration is also intensive with the Universities of Applied Sciences of Rapperswil and Lullier. The activities within SuLu will create mutual benefits with different on-going or planned projects of the four institutions involved, e.g. NFP48, NFP54, SNF Plant Survival : TRUFE, MUSCAD, COMIN, SNF : CATGRASS, MASMOD, EU-project : ERAPharm, RECIPE, ALARM.

5. Networking (strategy for networking, in particular nationally and within ETH Domain)

The ERU SuLu will develop tools to analyse possible impacts of policies at different levels (regional to international) on the sustainability of regions and landscapes. It will strengthen the capacity of leading research units on sustainable development in the ETH domain. Members of the ERU are involved in a wide range of related Swiss and EU projects, e.g. IRENA MIRABEL and ALTERNET, MULTAGRI, SENSOR. They will use the excellent knowledge transfer units at WSL and EAWAG to reach the end-consumers of the decision support tools. SuLu will contribute to setting standards for various regulations, e.g. agri-environment regulations, the EU Commission's communication on statistical information for environmental indicators, various impact assessment guidelines, or the Water Framework Directive.

9. Required finances

Year / Activity	ERU funding (per year)	Matching funds of 4 partner institutions (per year)	Third party money (per year)
2006 JRA ENHANCE, IMPA, SUSMOUNT launched (50% PhD, 50% Postdoc level; first data acquisition)	700 kFr.	700 kFr.	700 kFr.
2007 JRA ENHANCE, IMPA, SUSMOUNT continued and established, seed money for joint professorships	1000 kFr.	1000 kFr.	1000 kFr.
2008 ERU fully operational	1400 kFr.	1400 kFr.	1400 kFr.
2008+ ERU completes his task with a full graduate and postgraduate school	1600 kFr. + teaching costs from central CCES resources	1600 kFr. + Grundauftrag for teaching resources	2000 kFr. + (industry, cantons)

BUSINESS PLAN - ERU CLENCH: Climate and Environmental Change

1. Motivation

We live on a planet shaped by human activity. Rapid human population growth and continuous exploitation of natural resources impact global ecosystems, lead to dramatic declines in biodiversity, affect the global hydrological cycle and climate, and render the society vulnerable to diseases and natural hazards such as extreme weather. Public health, livelihood, social justice and national security are linked by environmental change. The unique combination of experimental and modeling expertise within the ETH Domain will enable us to make significant contributions to master these intellectual, technological and political challenges. Finding innovative solutions to develop sustainable resource use under changing climatic and environmental conditions, to reverse the dramatic loss of biodiversity, and to reduce the atmospheric greenhouse gas (GHG) concentrations, which are effectively higher than at any other time within the past 500'000 years, will need a comprehensive *Earth System Science* program with a time horizon of "10+" years. CLENCH with its focal point on land-atmosphere interactions is an adequate answer to this challenge. Questions which we seek to answer include:

- How does climate and environmental change affect biodiversity and processes in the biosphere?
- How large are the feedbacks of the terrestrial biosphere on the production of GHG and aerosols, the Earth's energy budget, and hence on climate?
- How can a hierarchy of models – from the local subsoil to the global scale – be coupled and nested to improve the representation and the scaling of land-atmosphere interactions across spatial dimensions?
- What can we learn from past climate changes for future climates and their effect on the biosphere?
- How can we assess mitigation and adaptation options and technologies to fulfill Kyoto requirements and to slow-down climate change impacts on economies and societies?

2. Market

2.1 State-of-the-art of science/research/technology (nationally, internationally)

Climate change and the loss of biodiversity arguably are the most pressing global environmental problems humankind has to cope with to ensure human welfare. Among the drivers of climate change, GHGs and aerosols play a key role in terms of radiative forcing [IPCC, 2001]. Atmospheric GHG and aerosol loadings have increased at an unprecedented rate, with more than half of the current emissions being anthropogenic. Climate change is predicted to cause degradation of 80 % of Earth's wetlands leading to 50-60 % loss of biodiversity in affected habitats [Midgley et al., 2002].

The rate of current biodiversity loss is more than 1000-fold higher than the rate at which new species emerge by evolution [Pimm & Lawton, 1998]. The state and functioning of global ecosystems has changed fundamentally, shedding doubt if they can provide their services sufficiently to humankind in the future [MEA, 2005]. Mountainous environments with their high biodiversity seem especially vulnerable. Understanding the combined impacts of climate and biodiversity change on biogeochemistry and land-atmosphere interactions are thus identified internationally to be of utmost importance (IGBP programs). Despite their increasing complexity, current state-of-the-art climate models do not represent the terrestrial biosphere well (often treated simply as "green slime"). Improvements will therefore provide better understanding of the feedbacks of the land with its biosphere on the climate system. Nesting different types of models will allow scaling information across spatial and temporal scales.

In order to quantify anthropogenic effects and to calibrate climate models, natural climate variability needs to be fully understood. Valuable information can be found in natural archives such as tree rings, ice and sediment cores or geological archives. Past climate forcing and the response of the Earth system can be studied at various temporal and spatial scales. Adaptation and mitigation strategies to climate change are gaining relevance since stabilization at certain GHG concentration levels seems not possible with emission reductions alone. Carbon capture and storage is one option to slow down climate change, but technologies, feasibility and risks are still largely unknown or untested [IPCC, 2005].

2.2 Need for research (if relevant need for teaching and/or services)

Worldwide there are various research institutions and universities that have started centers dealing with the Earth System. The global problem – even when focusing only on the land-atmosphere interactions – is daunting, and the ETH Domain is in the privileged situation of being active in many fields of *Earth System Science* already. While classical climate research (e.g. within the NCCR Climate) mainly deals with physical aspects, significant progress is needed in chemical and biological aspects of land-atmosphere interactions as required for improved understanding of climate change, loss of biodiversity, and land use change-related problems. Within S-ENETH, one INIT-like project is already funded, but focuses on only one of the GHG, methane. CLENCH strives to bundle and focus the many activities within the ETH Domain in an unprecedented manner. It will achieve its scientific mission by state-of-the-art laboratory studies and field work integrating in a unique fashion climate, biogeochemistry and biodiversity research, with an emphasis on the Swiss Alps, a strong modeling initiative encompassing data sources worldwide and allowing to scale between regional and global levels, and by technological and socio-economic and societal components, dealing with the implementation and consequences of political measures. CLENCH´s program will later also encompass marine aspects. CLENCH will also foster our capability to provide a highly attractive educational graduate program and to better support service centers, e.g. MeteoSwiss, the Federal Office of Health, BUWAL, and cantonal offices.

2.3 Benefit for economical development in Switzerland

Direct benefit is foreseen in several areas: (1) assessment of new carbon capture and storage technologies for CO_2 sequestration, (2) general risk assessments on the impacts of climate and environmental change on Swiss forests, grasslands and croplands, (3) documentation of biodiversity required for directing management, subsidies and conservation efforts. (4) Furthermore, a large indirect benefit for the Swiss economy in the medium term can be gained by establishing measures for sustainable development in land use, utilization of genetic and natural resources.

3. Thematic foci/research projects of the ERU

3.1 Identification of leadership institutions/institutes within the ETH Domain:

ETHZ	D-UWIS, D-AGRL and D-ERDW in S-ENETH, and neighbored departments (e.g., D-MAVT)
EPFL	ENAC, including the LPAS (Air Pollution Laboratory) and LMCA (Laboratory of Atmos. Chemistry Modeling)
EAWAG	Research groups in freshwater biodiversity, long-term biological monitoring, application of isotopes to trace changes in the past
WSL	research units dealing with land use assessments, terrestrial biodiversity, dendro-archives, biogeochemistry and hydrology

Beyond these groups, there are units at PSI (Laboratory for Atmospheric Chemistry) and EMPA (Technosphere-Atmosphere Department) whose association to CLENCH would be of great interest.

The appointed ERU Committee includes scientists of all four institutions and is lead by Profs. T. Peter and N. Buchmann of ETHZ.

3.2 Thematic foci

All thematic foci will start as 3-4 year projects, but full benefit is expected only after "10+" years. New colleagues, e.g. with marine expertise, will be involved where appropriate.

(1) *Effects of climate and environmental change on biodiversity and processes in the biosphere.* CLENCH will link global change and biodiversity research with experimental and modeling studies (e.g., using remote sensing techniques) at species, population and community levels to improve our ability to predict adaptive responses of the biosphere. The identification of ecosystems sensitive to creeping or sudden changes (for example at treeline) will help to develop adaptation strategies for sustainable resource management in mountainous regions.

(2) *Feedbacks of the terrestrial biosphere on climate.* CLENCH will determine relevant processes leading to GHG and aerosol fluxes from land surfaces, including their isotopic signatures and spatiotemporal variability. (Sub)Soils, their weathering/erosion and microbial processes, vegetation changes due to climatic constraints, invasion, pests, livestock or management adaptations as well as ecosystem GHG and energy budgets affecting the local climate system will be studied using joint research sites (ETH research stations, Jungfraujoch, joint site with ERU "NatHaz") and airborne campaigns, applying state-of-the art instrumentation.

(3) *Improved representation of land-atmosphere interactions by a hierarchy of local to global models.* CLENCH will develop and apply a hierarchy of nested models of individual processes at different scales. A global atmospheric climate-chemistry model (CCM) will be coupled to Dynamical Global Vegetation Models (DGVMs) and Soil-Vegetation-Atmosphere-Transfer models (SVATs) to understand and simulate past, present and future interactions of GHG and aerosol fluxes, hydrology, land cover, land use change and their feedback loops with the atmosphere.

(4) *Lessons from past climate changes for future climates and their effect on the biosphere*. CLENCH will identify and assess the impacts of GHG releases from geological origin on biota. We will apply CCM-DGVMs within dedicated runs to paleo-conditions with substantially enhanced GHGs and aerosols/clouds and connect this to modern climate. Advanced isotopic tracers and dendro-archives will be used to reconstruct and investigate the most important processes responsible for past and present climate change.

(5) *Assessment of mitigation and adaptation options and technologies.* CLENCH will evaluate uncertainties in national GHG inventories by combining measurements and modeling, assess and model GHG and aerosol mitigation strategies in relation to land use. CLENCH will help evaluate technologies for capture and storage of CO_2 including feasibility, risk and safety issues.

3.3 Time frame for realization / Milestones:

2006 Open call for fellowship applications. Establishment of joint research sites and of light-weight aircraft. First joint Swiss bio-monitoring database. Models set for coupled/nested runs.

2007 Perform first high-intensity measurement campaign. First runs of coupled/nested models for Alpine region and paleo-climates. Model evaluation with experimental results. Feasibility assessment of European CO_2 capture and storage options.

2008 Comparison of upscaled land-surface fluxes with regional modeling results. First causal links between climate and biodiversity change as well as potential feedback mechanisms.

4. Partners: national, international

PSI (outstanding experience in aerosol and isotope research) and EMPA (high quality GHG measurements at Jungfraujoch) are welcomed partners (not funded within CLENCH). Numerous contacts to Swiss universities and institutions within existing programs and projects in the core competences of the involved partners, financed by SNF, ministries or foundations. Several groups in the EU and overseas have already well proven research contacts with the partners involved in CLENCH; these contacts will be further extended. MeteoSchweiz will be associated to CLENCH.

5. Networking (strategy for networking, in particular nationally and within ETH Domain)

CLENCH is an ambitious project involving many research groups from different disciplines at different Swiss research institutions within the ETH Domain. Main common platform will be an annual retreat (2-3 days) of all partners, including PhD students and invited guests. Partners of specific foci will meet more regularly. Particular emphasis will be placed on the exchange between experimental and modeling groups, in order to facilitate the data and information flow in both directions. A regular colloquium will be established with high rank national and international guests.

8. Required resources

Head count: About 30 PIs, each contributing on average 2 scientists (funded by base funding or 3rd party funding). Total number of people involved expected to be ~ 110 scientists when fully operational.

Running costs per year: 30 PIs involved (approx. 220 kFr/a, 20%, 1320 kFr/a), Institutional contributions to PI labs (approx. 30 kFr/a, 900 kFr/a) 10–15 fellowships for young scientists (900 kFr/a), 1 coordinator (senior postdoc level, 130 kFr/a), Project costs (e.g., consumables, flight hours, etc, 300 kFr/a), Third-party funds of each PI involved (approx. 2 grants ea., 3000 kFr/a), Travel and Communication (Retreat, Colloquium, 100 kFr/a) for a total of 6650 kFr/a. The budget will be about half in 2006, the first year of CLENCH, full in 2007 ad thereafter.

Large Infrastructure Investments in 2006: Laser system for isotope analysis in GHG (200 kFr), Instrumentation (gaseous species, aerosols, treerings, isotopes; 500 kFr) for a total of 700 kFr.

9. Required finances

Costs of the thematic foci will depend on the PIs and projects approved. Optimization of costs will be achieved by joint field sites and measurement campaigns (see above). CLENCH will be implemented following the three-part budget partitioning explained in the main CCES Business Plan. We aim at reaching the following budget

Resources of the involved institutions:	30 % or 2220 kFr/yr
Resources requested from the ETH Board for "Strategic Development":	29 % or 2130 kFr/yr
Third party funding:	41 % or 3000 kFr/yr

BUSINESS PLAN - ERU FEH: Food, Environment and Health

1. Motivation

The rapidly increasing size of the human population requires the development of innovative strategies for the sustainable exploitation of natural resources, but at the same time generates major challenges in supplying water and food and in combating diseases. FEH will provide solutions by research and teaching thus helping to develop answers to some of the most important problems of society to date.

The vision of FEH is to become an internationally recognized key player, through understanding of the agri-food chain, ecosystems processes and their management, for strategies to achieve simultaneously progress in the UN Millennium Development Goals (1), eradicate extreme poverty and hunger, and (7) ensure environment sustainability. It will give the basis to implement ways to improve public health by special foods and measures against diseases related to food and environmental changes. The mission is to develop and integrate new ways of environmentally-friendly food production and efficient water reuse in the South and innovative products and sustainable manufacturing technologies in the North while addressing consumer expectations for high quality and safe food, minimized environmental impact as well as improved public health. Through appropriate measures of education & outreach, dissemination of FEH's results will be guaranteed and the North-South dialogue will be facilitated.

Specific goals of FEH are to identify ways for environmentally-sound industrial production of healthy food and clean water, facilitate the production of enough unpolluted food and drinking water for the poor, develop a better understanding of the impact of environmental changes on infectious diseases, and educate key players in the North and in the South on how to apply FEH's results.

2. Market

2.1 State-of-the-art of science/research/technology (nationally, internationally)

The existing major challenge is the need to feed ca. 9 billion people in the near future. Global food production has to double by 2050 to meet this target. Production increases result in tremendous environmental stress endangering, among others, food safety and clean water. A number of diseases have been identified which have a direct relationship to food consumption or which are transmitted along with food production or other forms of infection. Diet plays a key role; 30-40% of all cases of cancer are causally related to nutritional factors. Fatal chronic non-infectious diseases with links to diet are cardiovascular diseases and cancer, others like dental disease and hypertension are costly. Also deficiency-caused diseases, remain widespread in Europe, and of course much more in developing countries. There is an increasing societal awareness that quality of life is improved through healthy eating and of the contribution that sustainable production protects the environment but solutions are not at hand. New ways of food production and processing open great chances to tackle these issues but could have undesirable environmental side-effects, especially water contamination.

2.2 Need for research (if relevant need for teaching and/or services)

Many universities, research institution or companies have independent research programs on food, agriculture, environmental or health sciences. However, systematic research to get a comprehensive view of challenges and to achieve efficient solutions for the problems related to industrial food production, access to food and water for the poor, prevention of food-related diseases and at the same time minimize environmental impact is lacking, and education in this area is very limited. These pressing problems can only be answered by an integrative research platform at the interface of these individual activities. This would open great opportunities to develop appropriate solutions to increase food and water security by establishing an active relationship with key organizations. Especially, there is a need for demand-driven multi-disciplinary research and education.

2.3 Benefit for economical development in Switzerland

The ERU attempts, by various ways, to increase public health and show sustainable ways to protect the environment aspects of high economic relevance. Also the food and pharmaceutical industry, addressed by this ERU, is a significant sector of the Swiss economy. Research and teaching in FEH is thus expected to generate considerable knowledge transfer with specific benefits for Swiss economy. Finally, FEH helps the Swiss society to fulfill its mission to care for economy and welfare in poor countries.

3. Thematic foci/research projects of the ERU

3.1 Identification of leadership institutions/institutes within the ETH Domain:

FEH will involve large sectors of the participating institutions, with research groups in

- Food, Environmental and Consumer Science (ETHZ), Environmental Microbiology, Biotechnology, Chemistry, Toxicology and Processing Technology (EAWAG, EPFL)
- Human Nutrition, Applied Entomology, Crop Production, Animal Nutrition, Agricultural Economics, Environmental Policy (ETHZ); Water Resources and Drinking Water, Environmental Toxicology (EAWAG); Environmental Microbiology and Biotechnology (EPFL) and Wildlife Ecology (WSL).
- Biomedicine, Environmental Biomedicine, Experimental Ecology, Theoretical Biology, Aquatic Ecology, Plant Pathology, Food Microbiology, Animal Husbandry (ETHZ), Water Resources and Drinking Water, Environmental Microbiology (EAWAG and EPFL)

The appointed ERU Committee includes scientists of all four institutions and is lead by Prof. M. Kreuzer of ETHZ.

3.2 Thematic foci

(1) *Development of healthy foods from novel environmentally sound industrial production technologies:* The objectives of this module are to provide a basis for innovative, healthy and safe foods with tailored functionality produced by clean and sustainable technologies including optimized energy and water management. The health-related functionality will focus on controlled delivery of micronutrients and antioxidants in order to fight micronutrient deficiencies, cardiovascular diseases and cancer. The sustainable manufacturing technologies will adapt the concept of 'Integrated Product Policy (IPP)' where the overall material flux management approach that minimizes the material flux and maximizes the recycling of valuable materials. This is particularly important for water and energy management. The coupled approach for healthy and safe food from sustainable, integrated product policy based production and the related close collaboration of food, consumer and environmental sciences within this module are globally unique. An industrial working group consisting of large enterprises and SMEs with impact on the Swiss economy in the domains of food, water and environment, will provide a forum for discussion, project evaluation and knowledge transfer. The module is expected to yield, gradually within the next decade, an increasing number of solutions for new industrially produced foods which are highly likely to be put with economic success onto the market but which are also simultaneously characterized by particular health value and environmentally sound way of production.

(2) *Global food and water security:* The objective of this module is to target the inter-relatedness of three urgent problems in the developing world: food security, environmental quality and health. The problems to be investigated are of utmost importance for the sustainable development of food production in developing and transitory countries. This module is designed to take a novel approach and to focus explicitly on the relationship and co-dependence of these issues. Subtopics are (i) specific interaction of food production and water use/reuse (together with the ERU NatuRe), (ii) countermeasures against under- and malnutrition of the poor (e.g. targeting underutilized food and feed resources, avoiding post-harvest losses) and related health problems with minimal environmental impact, (iii) sustainable land use in food production (measures against overgrazing and co-existence of wildlife and livestock; addressed together with ERU SuLu), and (iv) food policy measures including food forecasting. This module will be managed in synergy with the Center for International Agriculture (ZIL), and will enhance the profile and mandate of ZIL, into a leading center tackling global food and water security. Demand-driven approaches building on recom-

mendations of ZIL expert consultations and by participatory approaches in the target areas are followed in the ERU. Focus will be put on one or few research sites to facilitate synergism and use established partnerships (CGIAR). Collaboration within this module of FEH will eventually allow making a large difference to what is attempted so far by the scientific community. It is expected to be able to deliver a set of sound solutions within few years for different agro-ecological zones, taking into account political boundary conditions and traditions.

(3) Infectious Diseases and the Environment: Infectious diseases are a major threat to society, and increasingly also in the environment. FEH will advance the knowledge and understanding of the biology and control of infectious diseases (such as bird flue) in the context of societal and environmental changes including increased urbanization, global traffic, intensive farming and population size. A key aspect of FEH will thus be to study the interactions between human pathogens, food, and the environment, with the ultimate goal to identify ways to increase public health and protect environmental health. This will be done exemplarily on few, particularly threatening, diseases.

The *difference* to existing research approaches is made by specifically and mandatorily addressing the interface of two to three disciplines (food, environment, health). Explicitly showing these elements is a pre-requisite for funding of every single activity in FEH. In cases where related activities are planned in other ERUs, addressing these linkages will be specifically demanded.

Through the development of the three specific modules, representing concerted actions in research, the existing gaps in knowledge shall be reduced and education & outreach shall be facilitated. Approaches are chosen which are innovative and lacking so far in the scientific community. A major part of the activities relies on existing and approved mechanisms (particularly the North-South approaches). The ERU will have great impact scientifically and publicly by addressing public health, poverty, environmental threat and food technology issues. Modules 1 and 2 are fully complementary as 1 is oriented more on the industrial side and 2 on the agricultural side of food production with common aspects such as water reuse. Module 3 can be seen independent of 1 & 2.

The three modules were identified as tackling the most urgent problems of the field and were determined to have the highest probability of success. One of them builds on existing structures which can be efficiently promoted without the risk of duplication. All modules yield knowledge to be directly used in Education and Outreach activities of CCES. The ERU is fully in line with one of the Strategic Priority Areas of S-ENETH and covers major aspects of the 7th EU framework topic 'Food Quality and Safety'.

3.3 Time frame for realization / Milestones:

2006 start of three modules

2007 full implementation expected at end of the year

2008 program evaluation in each module taking into account achievements and progress made in contributing to the respective overall goals.

4. Partners: national, international

Nationally: SDC, Swiss Food Industry, D-BIOL (ETHZ), Universities of Zurich and Basel

Internationally: CGIAR institutes, Imperial College, national universities in developing countries/NARS

5. Networking (strategy for networking, in particular nationally and within ETH Domain)

Modules rely on existing networks such as Swiss Food Net and NIDECO which will be promoted by the ERU to get full Swiss recognition and could get the focal points where future Swiss-wide research activities cluster around. Module 3 is expected to develop highly synergistic, not duplicating interactions with the Center for Biology of Infectious Diseases, which is submitted as a Scientific Node of the 'Systems X' initiative.

8. Required resources

Approximately 30 research groups (ETHZ/EPFL: professorships) from four institutions of the ETH domain (ETHZ, EAWAG, EPFL, WSL) are involved in FEH.

9. Required finances

Costs of the projects/modules, cost optimization: MFr in 2006, 2007 and from 2008 onwards:

Modules 1: 0.8, 1.0 and 1.1; *2:* 1.3, 1.5 and 1.7; *3:* 0.8, 1.0 and 1.1; & 0.1/a for management

Total (MFr): 2006: 3; 2007: 3.6; from 2008 onwards: 4

Cost optimization: Not yet fully utilized synergies among existing research groups of S-ENETH, EAWAG, EPFL and WSL will massively increase cost-efficiency of funds and support acquiring of funds.

Resources of the involved institutions: *Separated into cash contribution and estimated in kind contribution (manpower, teaching and research funded from outside of the ERU etc.)*

Cash contribution: S-ENETH pool budget and similar pools at EAWAG, EPFL and WSL will make up 1 to 1.3 MFr/a

Estimated in kind contribution (salaries of staff etc.): Module 1: ca. 0.5 MFr/a; *Module 2:* ca. 0.6 MFr/a;

Module 3: ca. 0.7 MFr/a

Resources requested from the ETH Board for "Strategic Development":

Module 1: 250 kFr in 2006 (start in mid 2006); 300 kFr in 2007; 400 kFr from 2008 onwards

*Module 2: 5*00 kFr in 2006 and 600 kFr/a from 2007 onwards

Module 3: 250 kFr in 2006 (start in mid 2006); 300 kFr in 2007; 400 kFr from 2008 onwards

Third party funding:

Module 1: Expected contribution (e.g. from the food industry): 500 kFr/a

Module 2: Expected contribution from SDC through ZIL: 900 kFr /a (2006: start of next 4-year phase). Co-funding through projects submitted to the EU INCO-DEV program.

Module 3: Expected contribution (e.g. from the pharmaceutical industry): 300 kFr/a

BUSINESS PLAN - ERU NatuRe: Natural Resources

1. Motivation

One of the great challenges in coming decades is to master the global-scale pressure on natural resources: water, air, soil (including underground) and renewable energy. Increasing population and subsequent needs for food and water services as well as the decline of inexpensive oil are crucial elements of coming developments. Therefore, in this ERU we focus on the three essential topics of (i) water resources, (ii) wood production and (iii) energy resources. *NatuRe's* vision is to provide the scientific and technological basis for equitable and sustainable use of natural resources and renewable energy in a world whose population is expected to exceed 8 billion. The guiding principle is sustainable future development.

The proposed research in *NatuRe's* is motivated by the following global-scale developments and associated constraints:

- The *UN Millennium Development Goals* with targets for Sustainability
- Global trends such as rapid population growth, environmental degradation of natural resources and unacceptable global inequities
- Water resources limitations to economic and social development
- Climate and global change
- Strong dependency of adequate food production on the availability of water
- Decline of inexpensive oil and the need for its replacement by renewable energy

Such complex key challenges cannot be tackled exclusively by disciplinary research teams. CCES offers the unique opportunity to bundle a wide spectrum of outstanding competences on natural resources within the ETH-Domain to generate integrated multidisciplinary approaches. For such research, the ETH-Domain hosts a significant concentration of internationally leading institutions in science and engineering pertinent to natural resources, and is in the position to leverage a range of relevant current activities. Specifically we aim at using the intellectual and methodical resources available within the ETH-Domain; building common platforms and frameworks for integrated projects among the partners; cooperating with all four other ERU's in CCES and with the Center for Energy and Mobility; contributing to the North-South Dialog with projects and capacity building.

2. Market

2.1 State-of-the-art of science/research/technology (nationally, internationally)

Technology has been enormously successful over to past decades in tackling a wide number of specific environmental deficits. Despite these successes, myopically optimising only isolated aspects cannot any longer resolve large-scale global resource conflicts. To avoid generating secondary problems and for cost-effectiveness, natural resources issues have to be addressed in an integrated manner by considering entire portfolios of environmental policies and to balance "infrastructure" and "ecostructure".

2.2 Need for research (if relevant need for teaching and/or services)

The further development of the sustainable delivery of water/ecosystem-derived goods and services under the constraints of global change poses a great intellectual challenge. In *NatuRe,* consistent with legislation (such as the Euro-

pean Water Framework Directive), planning and integrated problem solving, the catchment scale will be the intrinsic management unit for water, forest and soil resources. Furthermore, with the decline of inexpensive oil, the innovative use of "renewable" energy sources – wood, solar, wind, geothermal and hydropower – calls for substantial product- and process-oriented research. Given the existing trends of global change, *NatuRe* should also focus on sustainable use of natural resources in transitional countries.

2.3 Benefit for economical development in Switzerland

There are direct benefits for the sectors of water resources engineering, treatment and clean-up technology and consulting. Switzerland, compared to other European countries, is not fully exploiting its potential in engineering services, compared to the level of available environmental sciences and engineering education. In addition, there will be indirect benefits for the Swiss economy and society in form of more stable north-south relations including an attenuation of the effects of excessive poverty and lack of natural resources.

3. Thematic foci/research projects of the ERU

3.1 Identification of leadership institutions/institutes within the ETH Domain:

All four leading CCES institutions will be involved in *NatuRe*. The appointed ERU Committee includes scientists of all four institutions and is lead by Dr. J. Wüest of EAWAG.

3.2 Thematic foci

(1) *Water quality management technology* – Water and soil quality targets promote technologies on various scales. Examples are: (i) chemical and biological sensors providing on-line water quality measures, process control options and ecological indicators; (ii) remote sensing for detection of large scale properties; (iii) improvements to physical, chemical or biological treatment processes, for example through development of membrane technology or advanced oxidation processes (iv) development and improvements in sustainability and efficacy of low-technology, low-energy semi-natural systems such as constructed wetlands for wastewater and sludge treatment as well as *in situ* treatments. A specific goal is to develop water management tools for low-income countries including quantitative and qualitative components of water demand where fresh water supply is limited. Geographic Information systems support the evaluation of this quantitative balance, while focussing on the prediction of natural geogenic contamination of groundwater.

(2) *Restoration techniques for aquatic systems* – Aquatic ecosystems provide a wide range of economically relevant goods and services, such as retaining floods, purifying water, recharging groundwater and maintaining biodiversity. Efficient conservation and restoration strategies are therefore required to meet the competing needs of water by nature, agriculture, industry and domestic water supply. Models to predict future water demands of individual ecosystem types are scarce but necessary to support conflict resolution among users. In addition to predictive models, adaptive strategies need to be developed for sustainable water allocation under different development scenarios. Best Management Practices shall be developed for management of forests accounting for their impact on water quantity and quality, and as source of biodiversity. As forest soils can alter and absorb chemical and biological pollutants only to a limited extent, negative influence of continuing nitrogen input by aerial pollution on drinking water quality has to be expected.

(3) *Wood production by intense plantation* – With the decline of inexpensive oil, innovative management of renewable energy sources such as wood is increasingly important as a long-term energy contributor. However, there is a need to identify Best Management Practices for the intensive use of forests for optimized wood and timber production. The goal is to find management options for maximizing energy output while minimizing the adverse impacts on ecosystem functioning. Intensified forest management and simultaneous protection of forest areas (wilderness) will be addressed in a broader context as a potential management option on a global-scale.

(4) *Exploitation of geothermal heat* – Heat mining is identified as one of the most promising new sources of energy for heat and power generation. We propose to coordinate leading-edge expertise to focus on the assessment of potential for sustainable use of geothermal energy in Switzerland. Interdisciplinary research is essential, as it must address crustal fluid flow, as the main motor for material and heat transport in the earth's interior, together with geological, geochemical and geophysical processes. Focus will be on the development of the integrated understanding required before significant technological investments are warranted.

(5) *Integrated use of Swiss underground* – Not only air, water and soil are subjected to environmental constraints and possible degradation. In many areas of Switzerland the deeper underground is targeted for future diverse destination, including protection of water supply, high-pressure reservoirs for gas and CO2, nuclear-waste disposal repositories, mining, tunneling and exploitation of geothermal energy. A comprehensive policy is required for the long-term use of the Swiss deep underground in an economically, environmentally and politically sustainable manner.

(6) *Energy resource outlook* – The ETH Domain recognizes the crucial importance of our future energy policy, with the establishment of the Competence Center on Energy and Mobility. CCES will contribute to the definition of new energy technologies and strategies, by providing a regional and global understanding of the primary resources at the base of sustainable energy production, including fossil fuels, water and geothermal energy. Goal of this activity is to develop a global outlook to identify short- and long-term trends in the availability of energy resources. Of particular relevance will be the inter-relation of energy resources and other environmental constraints, for example the role of decreasing precipitations in a changing climate in the sustainability of hydropower production. This activity will be conducted in close coordination with CCEM, as well as to other CCES ERUs.

(7) *Competence Center for Water and Agriculture in Sub-Saharan Africa* – In the near future major water- and food-related challenges are facing especially the developing world. Overexploitation of water and soil resources, inefficient use and severe quality degradation are significant deficits affecting large populations. The resolution of conflicting demands on natural resources – water, soil, ecosystems – necessitates complex decision-making. Concepts and technologies must be sought to eliminate this environmental burden and sufficient scientific as well as socio-economic information are needed to allow for informed decision-making. Asia and Africa's potential for hydropower and irrigation is only exploited to a small degree. During the 1990's, an estimated US$ 35–30 billion was spent annually on large dams in developing countries. The recent policy of the World Bank as well as the need of 40% food increase by 2025 indicate a reactivation of dam construction. The goal of this endeavour is to perform research on large-scale integrated water management problems and in parallel to build-up a top-university-level Competence Center of Water and Agriculture in the Sub-Saharan region, where the "gap" is largest worldwide.

3.3 Time frame for realization / Milestones:

2006 Identification of the location for the Build-up of the Competence Center

2008 *NatuRe* projects fully implemented.

4. Partners: national, international

Nationally: Associated partners: most Swiss universities, EPA's of the Cantons, NIDECO, Federal Offices such as Buwal+BWG (Naduf), seco and SDC.

Internationally: Several groups in every respective field of the ETH-Domain partners (> 50 so not listed).

5. Networking (strategy for networking, in particular nationally and within ETH Domain)

NatuRe requires many research groups from different disciplines to be involved. We envisage employing an experienced postdoctoral scientist for project coordination. There will be: semi-annual meetings of all partners, regular colloquium with high-ranking international guests and different international Summer Schools activities.

8. Required resources

An initial estimate of the required yearly resources identified running costs of 3150 kFr/yr and investments of 1350 kFr, resulting in a total annual cost of 4.5 MFr/yr. In the year 2006, support of approximately half of this amount is expected (depending on initiation). It is envisaged to acquire one third of the budget as in-kind contributions from the institutions and one third via third party funding though the institutions involved.

9. Required finances

Resources of the involved institutions:

1.5 MFr of the total annual cost (4.5 MFr/yr) will be contributed by the institutions involved in the following portions*: ETH (0.5), EPFL (0.25), WSL (0.35), EAWAG (0.5)*

Resources requested from the ETH Board for "Strategic Development":

1.5 MFr/yr of the total annual cost (4.5 MFr/yr).

Third party funding:

1.5 MFr/yr of the total annual cost (4.5 MFr/yr).

BUSINESS PLAN - ERU HazRi: Natural Hazards and Risks

1. Motivation

The social motivation for HazRi is that hazard events (e.g. extreme floods) have always occurred in mountainous Switzerland presenting major natural risks to both humans and the natural and built environment. Our description of these events could be substantially improved through the proposed research for the protection of life and resources. With in-

creasing human pressures and intensification of land use the need for accurate predictions of hazards and the assessment of risks is essential in any economic development planning. The scientific motivations are many and include foreseen improvements in: 1) Predicting extreme events; 2) Quantifying spatial and temporal variability and scaling in the environment; 3) Development of models to describe the complex non-linear interactions between hydrological/geological history and current weather;4) Mathematical description of environmental turbulence; 5) Accounting of small scale processes in large scale simulations; 6) Development of ecological and sustainable methods for protective measures; 7) Coordination and administration of Hazard information in Switzerland.

Recognizing the societal significance of Natural Hazards, in 1996 the ETH Rat established CENAT, the Competence Center on Natural Hazards and Risk Mitigation. CENAT is now coming to an end and HazRi will provide the forum to plan the stable continuation and to establish a high-profile scientific agenda for the future center.

2. Market

2.1 State-of-the-art of science/research/technology (nationally, internationally)

Nationally the disparate data sources (e.g. Meteo Suisse, WSL etc.) have not been assimilated coordinated and developed into user community based models for prediction and scenario studies (in addition to those discussed in detail here, earthquakes and other natural hazards). Internationally the **'Swiss Experiment'** has the potential to generate intense interest world wide since the field study proposed here will lead to critical advances in the science of mountain regions.

2.2 Need for research (if relevant need for teaching and/or services)

There is a large societal need to advance knowledge in mountain environments for hazards, risks, hydrology, climate, and land use consequences. There is a complete lack of intensive and high resolution experimental data to test theories and models. This lack of data presents the single most important stumbling block for advances in hazard prediction and forecasting in mountain environments. The development of community models will ultimately represent major new tools that can be used in decision making. An important added value of the models will be that much more accurate climate change scenarios especially for the cryosphere are possible and improved forecasts will become available to the user communities and government agencies. Because current climate change scenario predictions are based on incomplete knowledge of the surface mass- and energy balance especially over mountains and over snow and ice, predictions on permafrost development or snow/ice – climate feedback mechanisms will become much more reliable. The model developments will be carried by the CCES participating institutes but also with important support from other groups such as the Universities of Applied Sciences (e.g. Fribourg), and CSCS in Manno as well as international partners.

Expand capacity building and knowledge transfer programs including:

- Develop international summer schools and university field camps through HazRi.
- Facilitate capacity building at the level of the individual, in the area of hazard assessment (risk management and disaster preparedness).
- Create an international community of students with appropriate collaborative learning communities dealing with various aspects of natural hazards and risk.
- Create an environment for the transfer of knowledge between the participating institutes and the practitioners (i.e. public agencies, private companies, natural hazard experts).
- Develop a framework for delivery and management of project content and learning materials which utilizes a web portal that has a public and project collaborator area (with user login). Content belonging both to the public and collaborator areas would be managed with a standard content management system (e.g. tridion web content management edition; http://www.tridion.com). The public area is used for displaying information about the project and subprojects, and would also act as gateway to the learning resources. The learning resources are accessed through a learning management system (e.g. OLAT learning management system)

2.3 Benefit for economical development in Switzerland

This work is vital to planning further development of Swiss Mountain and Valley regions for tourism and other exploitation of our natural resources in a sustainable manner. Regional town and village governments, local authorities as well as federal government and insurance companies will benefit from improved description of risks and extreme events in mountain environments.

3. Thematic foci/research projects of the ERU

3.1 Identification of leadership institutions/institutes within the ETH Domain:

EPFL Civil and Environmental Engineering, Computer Science, Electrical Engineering and Communications

ETHZ Geological Sciences and Engineering, Environmental Sciences, Civil and Environmental Engineering; Socio-Economic sciences

WSL SLF, hydrology group

EAWAG Ecosystem, Surface water

The appointed ERU Committee includes scientists of all four institutions and is lead by Prof. M. Parlange of EPFL.

3.2 Thematic foci

(1) *Design, implementation, and operation of the 'Swiss Experiment':* Field studies for NHs have been inadequate due to lack of coordination, sparse data sets, limited to particular scales or type of observation – hence data gaps, often a sense of data ownership with little cooperation, primarily short term campaigns, or long term observations without reflecting NH research needs. Experimental observations at multiple scales, over different topography/ecosystems in alpine environments, and at intensive resolution are critical to be able to better understand the formation of NH events, develop improved theories and models, guide future science, predict ecological impacts, and ultimately improve forecasts, the issuing of warnings, and specification of hazard maps. The development of hazard scenarios and predictions are viewed as critical outcomes of HazRi. The experimental site has not been identified as of yet though a variety of possibilities have discussed and detailed planning will be undertaken in the first 6 months of year one. It was noted there are a number of very interesting possibilities in Switzerland that will allow many questions (including the role of forests in Hazards) to be addressed. Clearly a major short term task for the ERU members will be identification of a suitable region and the purchase of suitable instrumentation in addition to mobilizing existing facilities in the ETH domain. General characteristics, requirements, considerations and expectations for designing such a site (this list is not intended to be inclusive but indicative of critical issues): 1. Long term base line monitoring, 2. Ease for intensive observation periods, 3. Hazard Needs (Predisposition and Triggers), 4.Multiple scales, 5. Couple to existing facilities, 6. Accounting for the many skills and long term interests of the 4 ETH domain groups, 7 Accessibility and data retrieval.

(2) *Coordination and implementation of instrumentation technology:* It is agreed that there are very important and exciting possibilities for the use of new technologies developed in other fields, new data communication systems and application of recent advances in instrumentation that will propel forward discoveries in our understanding of Natural Hazards. The ETH domain comprises different disciplines and we will rely on the diversity of skills to make efficient use of new technologies and to further the development some of key technologies for Alpine terrain. One example of instrumentation technology that can be applied in this ERU is distributed fiber optic techniques for the measurement of temperature with a resolution on the order of 0.1 degrees C, spatial resolution of 1 m with temporal resolution of minutes along entire cables of lengths up to 40 km is now possible. This technology, which can also measure strain, could be of great utility in making observations of evaporation, infiltration, snow slip, land slides and spanning scales from 1 to 10,000 m. A research platform that could be used is an unpiloted helicopter with various remote sensing technologies. There are fantastic opportunities to expand the development of wireless instrumentation systems (to cooperate the Mobile Information Communication Systems, NCCR) in NH that should be pursued in the next three years and installed at the field sites.

(3) *Development of a Community Model for Alpine Processes.* The increased process understanding gained with the field experiments and the increased availability and resolution of new data will fuel a large community model development effort. The models will bridge the gap between current meteorological models, which are unable to represent the small scale processes needed for natural hazards prediction and statistical and expert analysis tools, which will finally predict the hazard associated with a particular processes. The model predictive capabilities will improve as more data are gathered in new field experiments, with the goal of developing operational products of most direct link to societal needs.

(4) *RiskCH.* Main limitations in the present natural risk assessment strategy in Switzerland are the lag, and often lack, in the application of recent scientific advancements, the partitioning of such activities among various research institutions and federal and cantonal offices, and the lack of a unified approach covering all natural hazards. We aim at constructing a unified risk assessment model for natural hazards in Switzerland, with architecture similar to that of the FEMA-developed HAZUS software widely used in the US. RiskCH will be based on a common, multi-scale GIS framework, with layers covering the relevant input parameters such as hazard, soil type and building vulnerability. It will incorporate both static and dynamic data, with direct feed of real-time data from monitoring systems such as the national earthquake and avalanches monitoring networks; it will incorporate the latest modeling scenarios, with the

aim of combining data acquisition and scenario modeling. It will also include real-time risk assessment and decision tools. RiskCH is not intended to replace existing services, such the avalanche risk assessment provided by SLF, but to embed the existing tools in a single framework. The model will be tested and improved with the acquisition of new data, and will in the end provide the basis for future monitoring and scenario assessment for Switzerland. For the development of this model, a strong cooperation with federal offices (BUWAL, BWG, MeteoSchweiz, VBS) and industry sectors (Swissnuclear, reinsurance) is expected.

3.3 Time frame for realization / Milestones:

HazRi is an ambitious program with a long-term time horizon of "10+" years. Meaningful results and added value beyond the EPF-Domain can begin to be expected after 2-3 years. Milestones 2006-2009:

2006/07 select site(s), design observatory, purchase instrumentation, recruit staff, develop local partnerships, mobilize existing teams and resources in the ETH domain,

2007/08 further instrument implementation; further develop partnerships with other universities and government agencies; initiate first intensive field campaign.

2008/09 Complete base line initial field installation; initiate further intensive field campaigns; users conferences, further coordination of ETH risk research and scientists, community model development.

2008-16 Longer term. Develop field camps and summer schools, develop community models and programs for capacity building, knowledge transfer and student exchange, expand scope of observatory – plan and undertake new intensive observations. Develop NCCR proposal, seek additional funding from the European Science Foundation, etc.

4. Partners: national, international

*Nationally:*Mountain Research Initiative, Universities (Lausanne, Bern, Zurich, …); Cantons, Water authority and env protection agency,; Consultants in hazards and risks; Federal offices, Buwal+BWG, seco and SDC; - HES Fribourg;- CSCS Manno.

Internationally: The US Consortium for the Advancement of Hydrologic Science; JHU Center for Environmental Fluid Mechanics; - NIED: Nagaoka institute for earth science and disaster prevention in Japan (SNOWPACK and Wind Tunnel);- ILTS: Institute for Low Temperature Science, Hokkaido University; Sapporo, Japan (SNOWPACK and Wind Tunnel); - MSU: Montana State University (Alpine Surface Model, Snow Microstructure); Leeds University (GAUDEX); KTI: Royal Technical University Stockholm, Sweden (Alpine3D); University of Innsbruck (Glacier mass balance simulation);- CRREL: Cold Regions Research and Engineering Lab.

5. Networking (strategy for networking, in particular nationally and within ETH Domain)

HazRi is an ambitious project, which will require many research groups from different disciplines to be fully engaged. We therefore envisage an intensive two week planning workshop for the Swiss Experiment field site selection and a program office in Lausanne. There will be regular monthly meetings in the first year (at a minimum) of the PIs and observatory staff. An annual 1 week workshop will be held. We will also interact closely with the Mountain Research Initiative to assist us in networking with colleagues on the social and economic aspects of this research.

8. Required resources

Head count: Approximately 15 PIs, each contributing minimum 2 or 3 scientists/technicians/engineers (funded by base funding or 3rd party funding). And some 20 staff members via ETH-Board support.

Staff / Finances: a) Engineers x 9; technicians x 9 (Electrical, Mechanical, Communications, etc.) & secretary x 1; b) Post doctoral Positions x 16 Additional post doctoral positions (minimum, an additional 8 posts) are to be provided through the EPF institutions, c) PhDs – it is expected some 30 PhD students will be involved with the Swiss experiment each year.

Instrumentation start up: expected to be order 1.5 MFr/yr for 3 years (matching funds will be obtained from the ETH programs, research teams.)

Baseline supplies, repairs, upgrades etc: order 600 kFr/yr in future years along with long term staff salary support.

Investments: Personnel/ Field Experimental Site/ instrumentation: 4 MFr/yr in 2006/7/8

9. Required finances

Similar to all ERUs, HazRi will apply a three-part funding scheme. The total required finances for the a) Instrumentation Facilities and b) Experimental site bring an overall cost of 4 MFr/yr in 2006/7/8, of which 1/3 is sought from the ETH Rat contribution, !/3 from external funding of PIs, 1/3 from the internal funding of institutes/PIs.