Summary of the

"Swiss Federal Energy Research Master Plan for the Years 2004 - 2007"

Swiss Federal Office of Energy (SFOE)
Worblentalstrasse 32, CH - 3063 Ittigen
Postal address : **CH - 3003 Berne**
Tel. : 031 322 56 11 Fax : 031 323 25 00
Internet : office@bfe.admin.ch •www.swiss-energy.ch

— D R A F T 10 (18 March 2004) —

Introduction

The *Swiss Federal Energy Research Master Plan for the Years 2004-2007* guides decision-making bodies of the federal and cantonal governments and as well as the funding organizations of the research institutions. It also documents how public funding is applied to research activities to achieve politically defined goals.

Presented are the background, vision, short to midterm goals, strategies and applications of energy research. The *Master Plan* strives to preserve and strengthen the scientific and economic competitiveness of Switzerland.

Swiss energy research is committed to long-term sustainability. In this context, the main goal is a massive reduction of CO_2 emissions. This is also the goal of the *2000 Watt Society*. Addressed is the need to reduce pollution resulting from energy systems. Technical solutions alone are not sufficient to fulfil these goals. Success depends on personal decisions as well as individuals are influenced by socio-economic factors.

These premises form the foundation of Swiss Federal energy research. Priority is given to long-term perspectives, harmonised with European and global goals. Swiss Federal energy research must be of highest international quality, targeted at central long-term needs. In order for the research to be carried out efficiently, adequate funding and continuity are essential. Public support of energy research is necessary, given its long-term horizon. Emphasis is on applications-oriented research, flanked by pilot and demonstration projects. This work is closely linked to the political Programme *SwissEnergy*.

Four main areas of energy research

The *Swiss Federal Energy Research Master Plan* embodies four areas :

- **Rational Use of Energy (RUE) :** This is particularly relevant in the buildings and transportation sectors, the largest energy end-uses. Substantial savings potential exists also in better understanding combustion processes as well as in increasing the efficiency of storage and consumption of electricity. Also important are the optimal cogeneration of heat and power, as well as the use of environmental heat (heat pumps).
- **Renewable Energy Sources (RES) :** Much of the energy produced in Switzerland originates from renewable sources, thanks to plentiful water power and wood. Research is helping improve the price/performance ratio, public acceptance and user-friendliness of systems. Examples include solar thermal systems, use of environmental heat, photovoltaics and biomass (with priority given to wood). Technical development of geothermal energy, wind power and small hydro plants as well as longer-term research in the area of solar chemistry (including hydrogen) are also supported.
- **Nuclear Energy (NuE) :** This topic is divided into nuclear fission and fusion (a long-term option). Security and disposal of radioactive waste are the main research topics in the fission area. For fusion the focus is on experiments, making use of the facilities and competence within the framework of international projects. The goal is to deliver high-quality contributions to this collaboration.
- **Energy Policies & Economics (EPE) :** This research directly serves energy politics by clarifying how possible measures and scenarios might impact the overall economy. Economic, ecological and societal consequences of energy technology developments are being explored in order to better anticipate the social acceptance and possible outcomes. Bridging between research and applications is also promoted.

Co-ordinating and accompanying publicly funded energy research are responsibilities of the Swiss Federal Office of Energy (SFOE). The Federal Energy Research Commission (CORE) advises the SFOE on research and bringing research results into practice. Attention is given to: involving the Programme *SwissEnergy*, collaborating with privately funded research and networking with international research projects. These activities are tightly linked to related work funded by the Swiss Innovation Promotion Agency — in the past : the Commission for Technology and Innovation (CTI). This constellation has proven effective and should be preserved in the future.

Funding of energy research

The annual public funding for energy research has decreased by about 70 MCHF (million Swiss Francs, real value 2001) since 1992. In 2001 it amounted to 173 MCHF, including infrastructure expenses as well as contributions to pilot and demonstration projects (30 MCHF). The largest single funding source was the FIT Board (45%) followed by other federal institutions (40%) and Cantons and Communities (15%). In the period from 2004 to 2007 the Federal Department for Education and Science will no longer financing participation in new EU Framework Programmes, funding will come directly from Brussels. The Cantons are expected to increase their contribution to energy research in support of the Universities of Applied Sciences. By 2007 the annual total from all these sources should reach 213 MCHF, an increase of about 5%. This is the proposed with the level and rate of increase prescribed in the *Swiss Federal Energy Research Master Plan for the Years 2004-2007*. Figure 1 illustrates the distribution of funding among the four main areas of research.

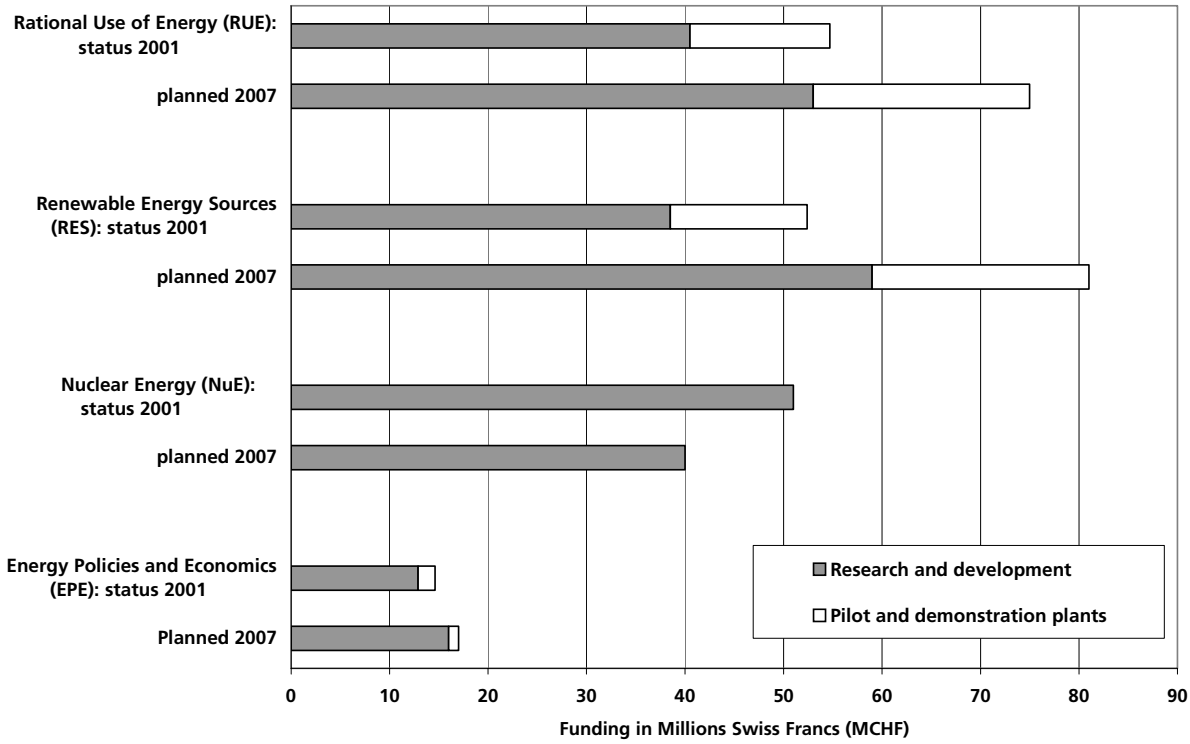

Figure 1 *: Annual expenditure for publicly funded energy research in 2001 and forecasted targets for 2007 (real base 2001). Public funding includes contributions from the federal, cantonal and local governments. For details see Table 1.*

Energy research is dispersed, being carried out at many research organizations. Transdisciplinary and interdisciplinary team work are required. Research funding comes from many sources, as evident in the headers of Table 1. The distribution among individual research areas can also be seen. Except for the case of private industry, these figures also include overhead and infrastructure costs. The fractions of the funding sources as well as the institutions carrying out the research have changed little over the last years. The notably high level of cantonal and federal support of private enterprises reflects their support of pilot and demonstration projects. Details can be found in the brochure, published as well in French as in German : "*Recherche, développement et démonstration dans le domaine de l'énergie en Suisse • Liste des projets 2000/2001 / Forschung, Entwicklung und Demonstration im Bereich der Energie in der Schweiz • Liste der Projekte 2000/2001*" [1].

[1] Available from ENET : in German, or in French ; and from the SFOE, theme "Research and Education" & "Research Projects" : http://www.swiss-energy.ch/internet/00280/index.html?lang=en

Table 1 *: Energy research funding in 2001 (MCHF) and distribution among research areas (including P+D projects) and research institution. (The full names of the federal institutions are given at the end).*

		FUNDING SOURCES						
		FIT-Board	SNSF	OPET (CTI)	SFOE	OFES [1] etc. [2]	Cantons, Communities	TOTAL (MCHF)
RESEARCH AREA	**Rational Use of Energy (RUE)**	**22.43**	**1.58**	**4.15**	**11.89**	**5.38**	**9.45**	**54.9**
	Buildings	1.49	—	0.04	3.04	0.63	2.07	**7.3**
	Transportation	2.76	—	0.18	4.07	1.08	1.13	**9.2**
	Electricity	6.57	1.32	1.88	1.47	1.85	3.01	**16.0**
	Heat & Power (incl. fuel cells)	4.37	—	0.88	1.31	0.31	2.22	**9.1**
	Combustion	5.81	0.15	1.17	1.74	1.19	1.02	**11.1**
	Processes	1.43	0.11	—	0.25	0.19	—	**2.0**
	Renewable Energy Sources (RES)	**12.43**	**0.92**	**2.35**	**17.13**	**4.57**	**14.83**	**52.2**
	Solar Thermal	1.64	—	—	3.20	0.49	1.75	**7.1**
	Photovoltaics	3.88	0.52	1.21	2.89	2.55	5.56	**16.6**
	Solar Chemistry	3.24	0.25	0.08	2.41	0.17	2.48	**8.6**
	Environmental Heat	0.57	—	—	3.22	0.06	1.80	**5.6**
	Biomass / Wood	0.64	0.01	0.31	3.20	0.52	1.79	**6.8**
	Geothermal / Wind / Water	2.45	0.14	0.76	1.92	0.91	1.44	**7.7**
	Nuclear Energy (NuE)	**34.08**	**1.59**	—	**2.31**	**12.47**	**0.60**	**51.0**
	Fission	20.06	0.30	—	2.18	3.85	0.48	**26.9**
	Fusion	14.02	1.28	—	0.13	8.61	0.13	**24.2**
	Energy Policies & Economics (EPE)	**8.33**	—	—	**4.78**	**0.70**	**0.83**	**14.6**
	Energy Politics / Sustainability / Technology Transfer	8.33	—	—	4.78	0.70	0.83	**14.6**
RESEARCH INSTITUTIONS	**Swiss Federal Institute of Technology in Zürich**	**11.70**	**0.85**	**1.13**	**1.47**	**1.14**	**—**	**16.3**
	Swiss Federal Institute of Technology in Lausanne	**24.42**	**1.50**	**2.64**	**0.91**	**8.59**	**—**	**38.1**
	Swiss Federal Laboratories for Materials Testing and Research	**2.06**	**—**	**0.20**	**0.69**	**0.35**	**—**	**3.3**
	Paul Scherrer Institute	**39.05**	**0.14**	**0.62**	**4.58**	**3.83**	**—**	**48.2**
	Other Federal Institutions	**0.04**	**—**	**—**	**2.91**	**0.19**	**—**	**3.1**
	Foreign entities	**—**	**—**	**—**	**0.50**	**1.01**	**—**	**1.5**
	Universities	**—**	**1.59**	**0.25**	**1.92**	**2.05**	**10.73**	**16.5**
	Engineering Colleges	**—**	**—**	**1.09**	**2.25**	**0.50**	**7.87**	**11.7**
	Other Cantonal Institutions	**—**	**—**	**—**	**0.98**	**0.09**	**1.03**	**2.1**
	Private Enterprises	**—**	**0.00**	**0.57**	**19.88**	**5.37**	**6.08**	**31.9**
	TOTAL (MCHF)	**77.3**	**4.1**	**6.5**	**36.1**	**23.1**	**25.7**	**172.8**

1) OFES primarily supports EU-projects. In the future, this research support will come directly from Brussels. The figures for foreign entities are net values for EURATOM and JET

2) Other Federal Agencies

Scenarios for decreasing or increasing overall energy research funding have been analyzed and the adjustment of funding of sub-areas of research anticipated (Table 2).

Table 2 *: Funding adjustments in response to a possible overall budget reduction or increase.*

Research Areas and Sub-areas R+D Research and Development P+D Pilot- and Demonstration projects	As announced				Adjustment [1] of funding in case of a :			
	2001, MCHF (Real base 2001)		2007, MCHF (Real base 2001)		budget-reduction		budget-increase	
	R+D	P+D	R+D	P+D	R+D	P+D	R+D	P+D
I RATIONAL USE OF ENERGY (RUE)	**40.5**	**14.2**	**53**	**22**				
Buildings	**5.6**	**1.7**	**13**	**6**	↘	↘	→	↗
Transportation	**3.2**	**6.0**	**4**	**5**	→	→	→	↗
Electrical storage and transport	**11.8**	**1.2**	**8**	**2**	→	→	→	→
(including batteries and super capacitors)	(6.1)	(1.2)	(6)	(1)	→	→	↗	↗
Electrical usage (appliances)	**2.7**	**0.4**	**4**	**1**	→	→	↗	↗
Heat & Power Systems	**5.9**	**3.2**	**13**	**4**	→	→	→	→
(including fuel cells)	(5.6)	(2.3)	(10)	(3)	→	→	↗	→
Combustion	**9.4**	**1.7**	**8**	**3**	↘	→	→	→
Processes (in industry, commerce, agriculture)	**2.0**	—	**3**	**1**	↘	↘	→	→
II RENEWABLE ENERGY SOURCES (RES)	**38.5**	**13.9**	**59**	**22**				
Solar energy	**26.6**	**5.7**	**38**	**7**				
Solar thermal (active, passive, storage)	4.2	2.8	6	4	↘	↘	→	→
Photovoltaics (solar cells & systems)	14.5	2.1	20	3	→	↘	↗	→
Solar chemistry (including hydrogen)	7.9	0.8	12	1	↘	→	→	→
Environmental heat (heat pumps)	**3.3**	**2.3**	**6**	**3**	↘	↘	→	→
Biomass (wood, garbage, sludge)	**3.0**	**3.7**	**10**	**3**	→	→	↗	→
Geothermal Heat	**2.2**	**0.9**	**2**	**5**	→	→	↗	↗
Wind	**0.5**	**0.9**	**1**	**1**	→	→	→	→
Water	**2.8**	**0.3**	**2**	**2**	→	↘	→	→
III NUCLEAR ENERGY (NuE)	**51**	—	**40**	—				
Fission		—	**18**	—	↘		→	
Security (including nuclear regulatory research [2])		—	13	—				
Radioactive waste		—	3	—				
Future-oriented research (new concepts)		—	2	—				
Fusion [3]	**24.2**	—	**22**	—	→		→	
Plasma physics, heating methods	22.8	—	18	—				
Fusion technologies	0.3	—	1	—				
Net contribution to international commitments	1.1	—	3	—				
IV ENERGY POLICIES & ECONOMICS (EPE)	**12.9**	**1.7**	**16**	**1**				
Energy policies (Scenarios, instruments, measures)	**2.7**	—	**3**	—	→		→	
Economy, society, environment	**8.7**	—	**11**	—	↘		↗	
Technology-transfer	**1.6**	**1.7**	**2**	**1**	→	→	→	→
TOTAL	**143.0**	**29.8**	**168**	**45**				
	172.8		**213**					

1) Planned values for 2007

2) Level of effort in 2001 for regulatory research : 7.5 MCHF ; Budget goal for 2007 : 6.5 MCHF.

3) Fusion research is considered basic research, though internationally it is considered as research.

National Allocation of Responsibilities and Coordination

The evolution of a new energy related product or process begins with basic research; is followed by application oriented research and development, pilot and demonstration; and ends with market entry and accompaniment. The institutions which assume responsibility along this path are indicated in Table 3. The presented fractions may vary in reality from the planned values presented here. Market introduction and accompaniment are no longer within the domain of publicly funded energy research and so not included in the *Master Plan* presented here. They are the central element of the Programme *SwissEnergy*. Out of their work comes technical, economic, ecological and societal questions which feed back into the research loop.

***Table 3* : Plan values for the fractions of public and private activities over the evolution of a product.**

		Energy Research Steps			Market Entry and Accompa-niment
		Targeted Basic Research	**Applied Research & Development (R+D)**	**Pilot and Demonstration projects (P+D)**	
Public Institutions	**FIT-Board & Universities**	70%	20%		
	Universities of Applied Sciences	15%	25%	10%	
Private Industry	**Engineering & Planning Firms**		5%	10%	5%
	Enterprises and Industry Associations	15%	50%	80%	95%

Following is a brief description of the federal, cantonal and private institutions which fund energy research in Switzerland, and their priorities.

Federal institutions :

- The **FIT-Board** (Board of the Swiss Federal Institutes of Technology, i.e. the controlling body of the **FIT-Domain**, composed of the two Swiss Federal Institutes of Technology in Zürich and in Lausanne and of the four Annexes Institutes) pays particular attention to achieving highest quality scientific work. An important topic is sustainability and the needed technical developments.

- The **OFES** (Swiss Federal Office for Education and Science) finances and co-ordinates the Swiss collaboration in projects within the EU-Framework Programme, though to the end of the 5th Framework. Thereafter, funding will come directly from Brussels.

- The **CTI** (Swiss Innovation Promotion Agency — in the past : Commission for Technology and Innovation) strives to strengthen the technical competitiveness of Switzerland. Short-term large market potential is important. Funding goes to engineering colleges but is limited to 50% of project costs, the rest must come from industry partners, who may keep research results confidential.

- The **SNSF** (Swiss National Science Foundation) supports basic research to Universities and others. Its goal is to support the development of the next generation of scientists. Interdisciplinary and Problem-oriented research programmes should have both a societal significance and advance scientific competence in a specific competence area.

- The **SFOE** (Swiss Federal Office of Energy) supports the whole spectrum of research from basic research through market entry of a product. Funding is often matched by other institutions. In this way, the SFOE is involved in some form in 70 % of all publicly supported energy research. The SFOE also indirectly influences an additional 20% of all energy research i.e. through its participation in advisory boards. By means of the biannual survey of all public funding of energy research, the SFOE maintains a clear overview of all activities, including the remaining 10 %. This oversight function is carried out by SFOE Programme managers.

Cantons : These support energy research at universities and engineering colleges.

Private funding agencies : Includes here are the Electricity Research Foundation (PSEL), Gas Research Foundation (FOGA) and Petroleum Research Foundation (FEV). These foundations support primarily research in their areas of special interests.

Conclusion

Energy research in Switzerland strives to reduce energy consumption as well as increase the energy supply from renewable sources. Thereby CO_2 emissions, pollution and dependency on foreign energy supplies can be decreased and a small step taken towards the ultimate goal of sustainability.

Funding comes from many sources and the research is carried out in many institutions. Accordingly, the overview of the energy research scene which the SFOE maintains is essential to assure that funding is used effectively and duplicity of efforts avoided.

By 2007 funding is expected to return back up to 1992 levels. Swiss researchers can newly seek financing directly from the EU. Indeed, Swiss energy research has always been closely tied to and highly respected within the international energy research community. This is demonstrated, for example, by the large number of projects of the IEA (International Energy Agency) initiated and lead by Swiss researchers. Energy research will continue to enjoy a high national priority and profile in the years 2004 – 2007.