

The Swiss Competence Center for Energy Research: Supply of Electricity

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EnergyStrategy 2050



Switzerland 2050: 9 mil population, 60% GDP increase, electricity-based mobility \rightarrow same electricity consumption as today !



ES 2050



Global nuclear industry is very vulnerable and would not survive another Fukushima 10% hydropower increase is a challenge with today's water, and we don't know what water we will have in 2050



Federal support to energy R&D

Since 2013, Switzerland has increased support to energy R&D, enlarging the range of support offers. In addition to the traditional SNF and CTI projects in energy, we now have:

- ✓ 8 new Swiss Competence Centers for Energy Research (grids, efficiency, mobility, supply ...)
- New SNF professorships
- Increased (almost doubled) CTI budget for energy R&D with new rules (projects without industry participation)
- ✓ P&D SFOE
- ✓ SNF NFP70 Energiewende



The SCCER-SoE was initiated on November 1, 2013, to repond to three questions posed by the Bundesrat and Parliament for electricity supply

- 1) can we extract safely the deep geothermal heat and produce at competitive costs a substantial portion of the national electricity supply, covering up to 5-10% of the national baseload supply ?
- 2) is the geological capture of CO2 a viable measure to enable carbon-free generation of electricity from hydrocarbon resources ?
- 3) can we increase (i.e. by 10%) the present hydropower electricity production under changing demand, climate and operating conditions ?



Structure of the center

✓ Phase I: 1.11.2013-31.12.2016

- ✓ Domains: Geo-Energies, Hydropower
- ✓ 4 Work Packages, 14 Tasks, 13+10 Research Partners
- ✓ CTI budget: 12 mln Fr

Deep Geothermal Energy & CO2 Sequestration		HydroPower: usage & infrastructure	
WP1 Geo-energies T1.1 Resource exploration, assessment and characterization T1.2 Reservoir modeling and validation T1.3 P&D for reservoir creation T1.4 Geo-data infrastructure		WP2 Hydropower T2.1 Morphoclimatic controls of future HP production T2.2 Socio-economic drivers of future HP production T2.3 HP infrastructure adaptation T2.4 Environmental impacts of future HP operating conditions T2.5 Integrated simulation of HP systems operation	
	WP3 Innovativ T3.1 Geo-energy technologies	e technologies T3.2 Hydraulic machines	
	WP4 Integrative activities T4.1 Risk, safety and societal acceptance T4.2 Global observatory of electricity resources T4.3 SCCER-SoE modeling facility		
	Capacity building, Techn		



Key strengths

- Capacity building
- National embedding, coordination and integration
- Industry participation
- Ten year agenda with a 2050 outlook
- R&D roadmaps
- Big science: NFP, P&D, CTI cluster projects
- International embedding: IPGT, EERA, ERA-Net
- Focus on higher TRL
- In-kind and third-party matching funding
- New research infrastructures (DUG-Lab, turbine facility, ..)



Capacity building

Planned

- ✓ 3 new OP at ETHZ and EPFL; 1 new OP and 3 AP in the Universities
- ✓ 42 new and 29 contributed positions contributed at ETH
- ✓ 11 new and 7 contributed positions in the Universities
- \checkmark 6 new and 3 contributed positions in the UAS

Achieved

- ✓ All KTI/SCCER research positions established by 1.11.2014
- ✓ New professors
 - ETHZ, OP DGE and geological reservoirs, M. Saar, start 1.1.15
 - ETHZ, OP Geoenergy Process Technology, on-going search
 - EPFL, OP Geoenergy, on-going search
 - UniNe, OP Geothermics, S. Miller, start 1.5.14
 - UniNe, AP Geothermal exploration, B. Valley, start 1.9.14
 - UniGe, AP, on-going search



Integration across programs





SCCER-SoE includes the different R&D strength in the Swiss schools in the fields of GeoEnergy and HydroPower:

- Geological sciences at ETHZ and several Swiss Universities
- HydroPower R&D at ETHZ, WSL and EPFL
- GeoEnergy and HydroPower technology developments, at ETHZ, EPFL, and various UAS
- Integrated energy system, best evaluated at ETHZ, PSI and EPFL
- Key industry partners involved in GeoEnergy and HydroPower
- National offices and services (SwissTopo, CSCS, SED)

Leading House ETHZ

Academic and Cooperation Partners

1.	EPFL	1.	AXPO
2.	UNIBE	2.	GeoEnergie Suisse
3.	UNIL	3.	BKW
4.	UNIGE	4.	ALSTOM
5.	UNINE	5.	SwissTopo
6.	USI	6.	Alpiq
7.	PSI	7.	UNIBA
8.	WSL	8.	Sulzer Pumps
9.	EAWAG	9.	Sarmap
10.	HES-SO		
11.	HSLU		
12.	HSR		



Roadmap DGE 2014







Roadmap Hydropower 2014

Hydropower challenges In Switzerland Energy Strategy 2050		 > Climate change > Electricity demand and energy market > Winter and peak energy production > Environmental flow, hydro- and thermo-peaking > Severe operation conditions 			
Today's usage conditions		10yr work plan		Improved usage conditions	
New large hydropower plants until 2050 		Climate and glacier extension scenarios Water availability and natural hazard secenarios Snow and glacier melt forecast system Prediction of sediment load Analysis of future market conditions Effice nt sediment evacuation systems Stability of surge tanks		New large hydropower plants until 2050	
	Flexible winter	Fluid-structure interaction			
New small	and peak energy production	Air entrainment and floating debris		1430 GWh	
hydropower		Increase of storage capacity			
plants		Increase of installed capacity			
until 2050		Dam heightening and key organs		New email	
7		Multipurpose compensation basins		hew small bydropower	
		Structural safety after dam heightening		plants	
1290 GWh	$\langle \boldsymbol{\Sigma} \rangle \langle \boldsymbol{\Sigma} \rangle$	Small scale turbining and propeller turbines	Flexible winter	until 2050	
-		Reduce friction and water losses	and peak energ	y	
Extension and adaptation	Effect	Improved flushing devices	production		
of existing large	of	Potential of glacier lakes			
hydropower plants	GSchG	Impact of right by dro on acosystems	an for GWh in and	1600 GWh	
until 2050		New environmental flow criteria	3100 GWIT III 205		
870 GW/h	-1/00 GWh	Operation range of turbines and pump-turb.			
	-1400 GWII	Silt erosion in turbine components		Extension and adaptation	
		New turbines for water supply networks		of existing large	
		Fatigue in turbine blades	Effect	hydropower plants	
		Integrative activities	of	until 2050	
Task 2.1 Task Task 2.2 Task Task 2.3 Task	< 2.4 < 3.2 < 2.5	Integrated simulation of hydropower systems operation	GSchG	1520 GWh	
	2		-1400 GWI	1530 GWII	



Increasing TRL







SoE-HPGE: Supply of Electricity for 2050

- ✓ a cluster of seven projects supporting 20 PhD students for fundamental R&D in key SCCER-SoE domains:
 - P1-P2: fundamental research in Geo-Energies, focused on understanding deep processes for deep heat mining and CO2 circulation and on permeability and stimulation processes at high T-P conditions
 - P3-P4: development of HydroPower operations and infrastructures considering erosion and sediment handling in hydropower plants and the modifications in the peri-glacial environment
 - P5-P6: future hydropower operations, covering both demand and supply aspects under changing climate conditions
 - P7: comprehensive risk governance for both HydroPower and GeoEnergies, covering both supply and demand sides
- ✓ Budget 4.1M CHF
- ✓ Approved Sept. 2014

SCCER SOE

An integrated strategy for supply of electricity in Switzerland

