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SCCER – SoE «GeoEnergy»
View from the Swiss Federal Office of Energy

Gunter Siddiqi, Swiss Federal Office of Energy*

SCCER-SoE Annual Conference 2015

Neuchâtel, 11 September 2015

Division Energy Economics / Section Energy Research &
Division Renewable Energy and Energy Efficiency / Section Renewable Energy

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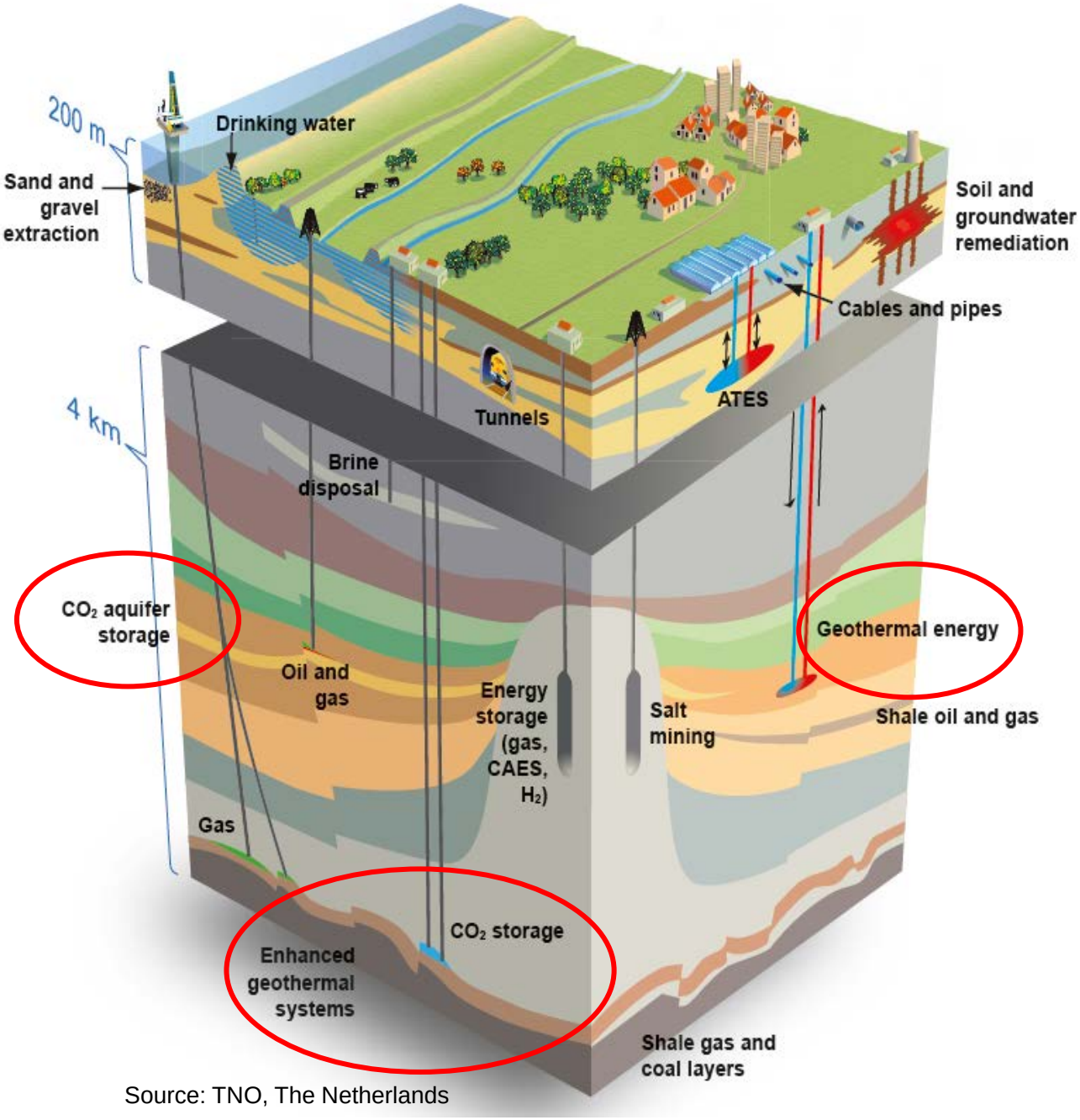
Energy and related resources in the subsurface



Source: TNO, The Netherlands

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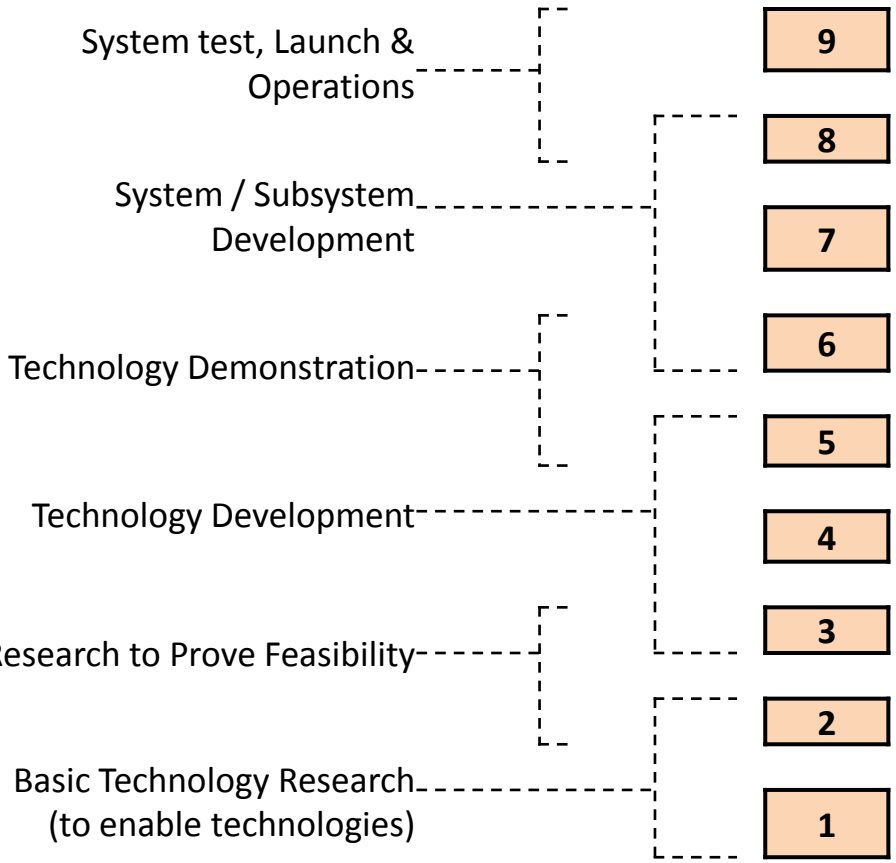
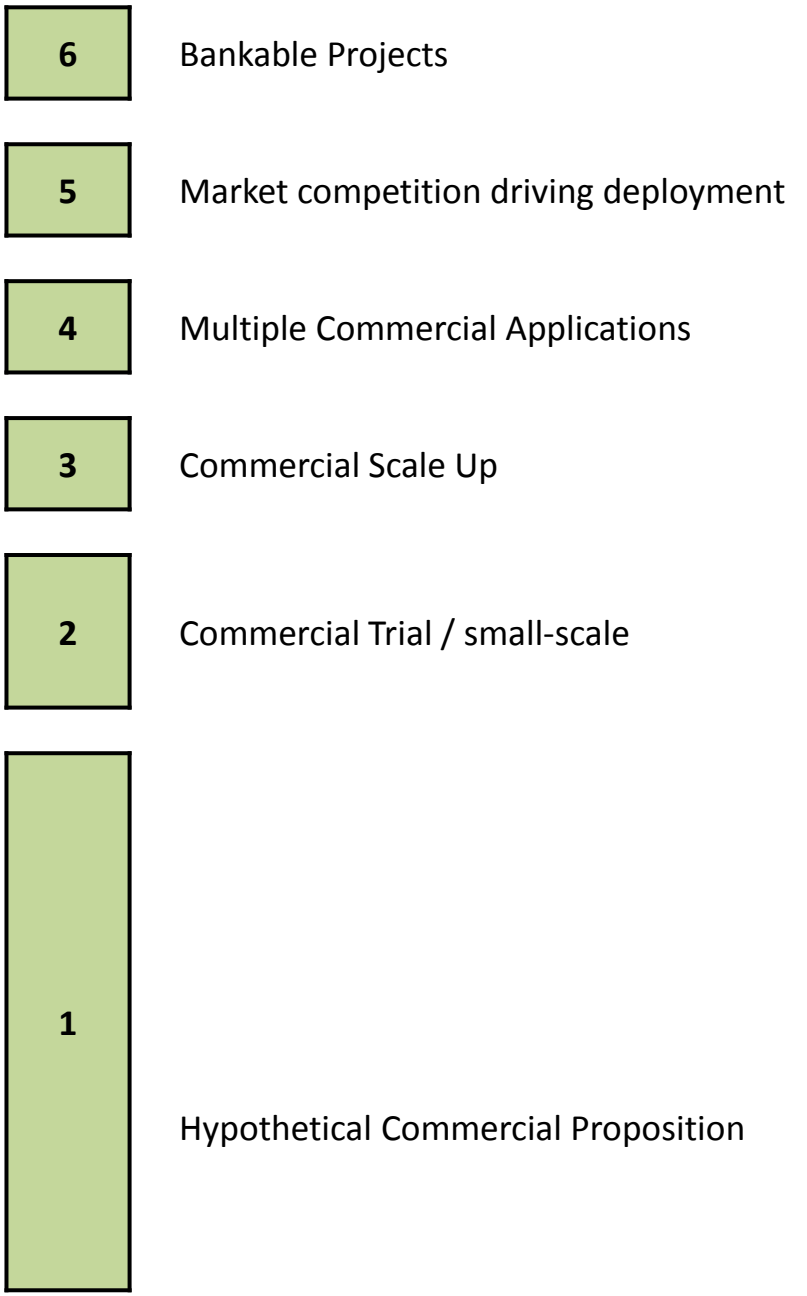
TRL - Technology Readiness Levels

CRI - Commercial Readiness Indices





Source: Australian Government, Australian Renewable Energy Agency (2014) LOOKING FORWARD: BARRIERS, RISKS AND REWARDS OF THE AUSTRALIAN GEOTHERMAL SECTOR TO 2020 AND 2030

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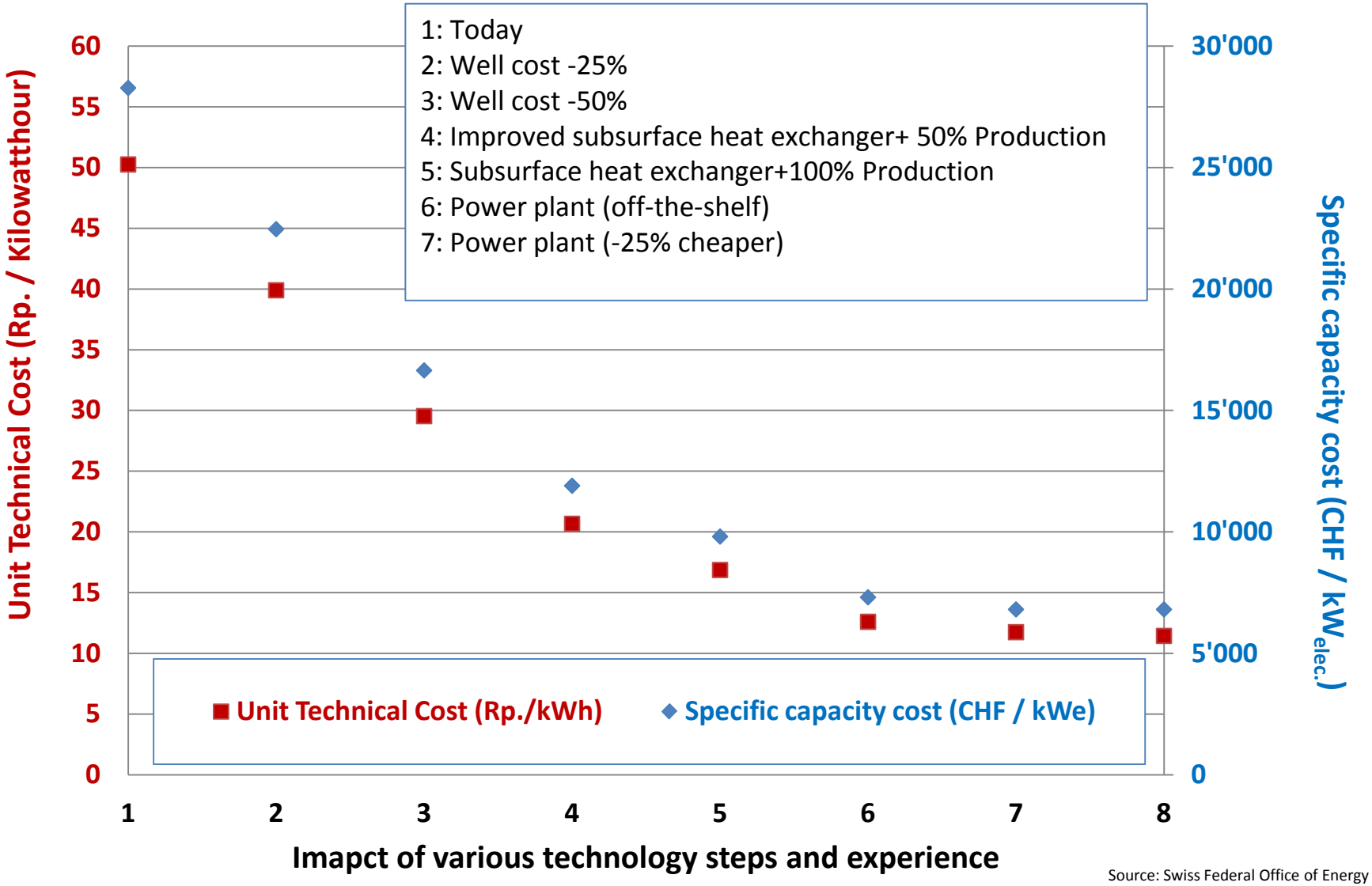
Impact of R&D on key economic metrics



Source: Swiss Federal Office of Energy

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Some of it is learning how «to do» things efficiently: learning curves in the Bavarian Molasse Basin

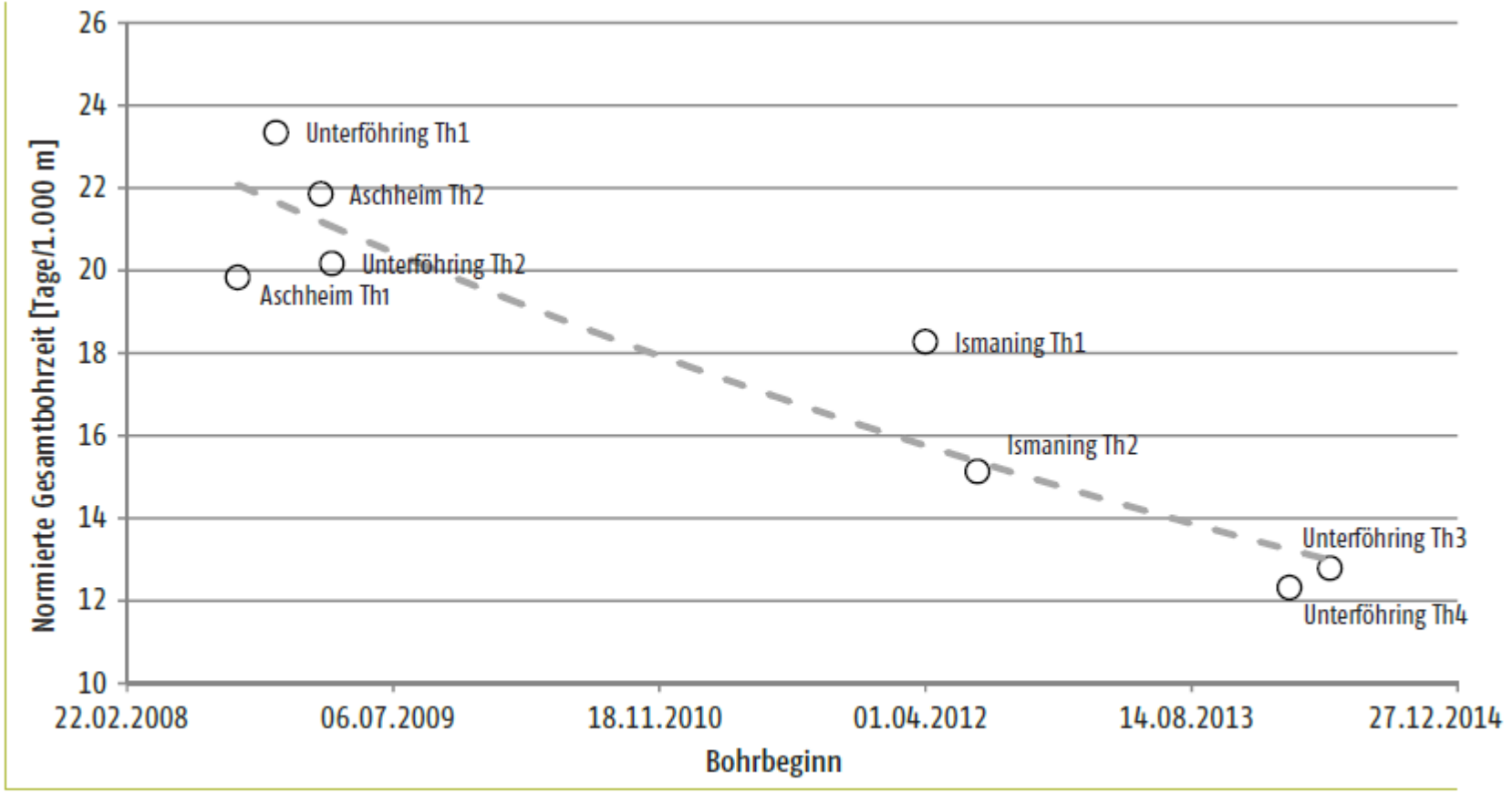

Abb. 4 – Lernkurve der Bohrungen am Standort Unterföhring und Umgebung

Source: "Performance Drilling" am Beispiel des kommunalen Geothermieprojekts Unterföhring; BBR Sonderheft Geothermie, 2015, Autoren: David Lentsch, Dr. Franz Böhm, Dr. Klaus Dorsch, Dr. Achim Schubert

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Some of it is true R&D geared towards Reservoir Development: In-situ stimulation and circulation test at the Grimsel

Motivation:

To enable the large-scale exploitation of deep geothermal energy for electricity generation in Switzerland, solutions must be found for two coupled problems:

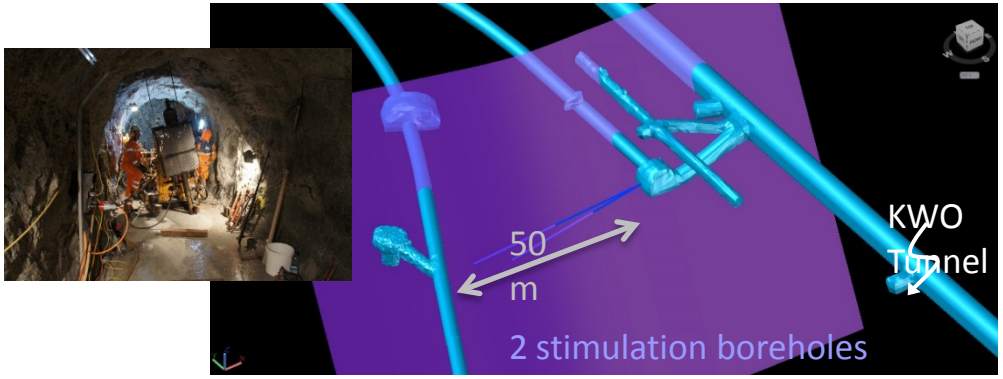
(1) How do we create an efficient heat exchanger in the hot underground that can produce energy for decades while

(2) at the same time keeping the nuisance and risk posed by induced earthquakes to acceptable levels?

→ A fundamental understanding of key THM-coupled processes and its is link to micro-seismicity is essential

→ Calls for an initiative operating across many disciplines

→ *TRL 1 – 2*



Location of experiment at Grimsel Test Site GTS

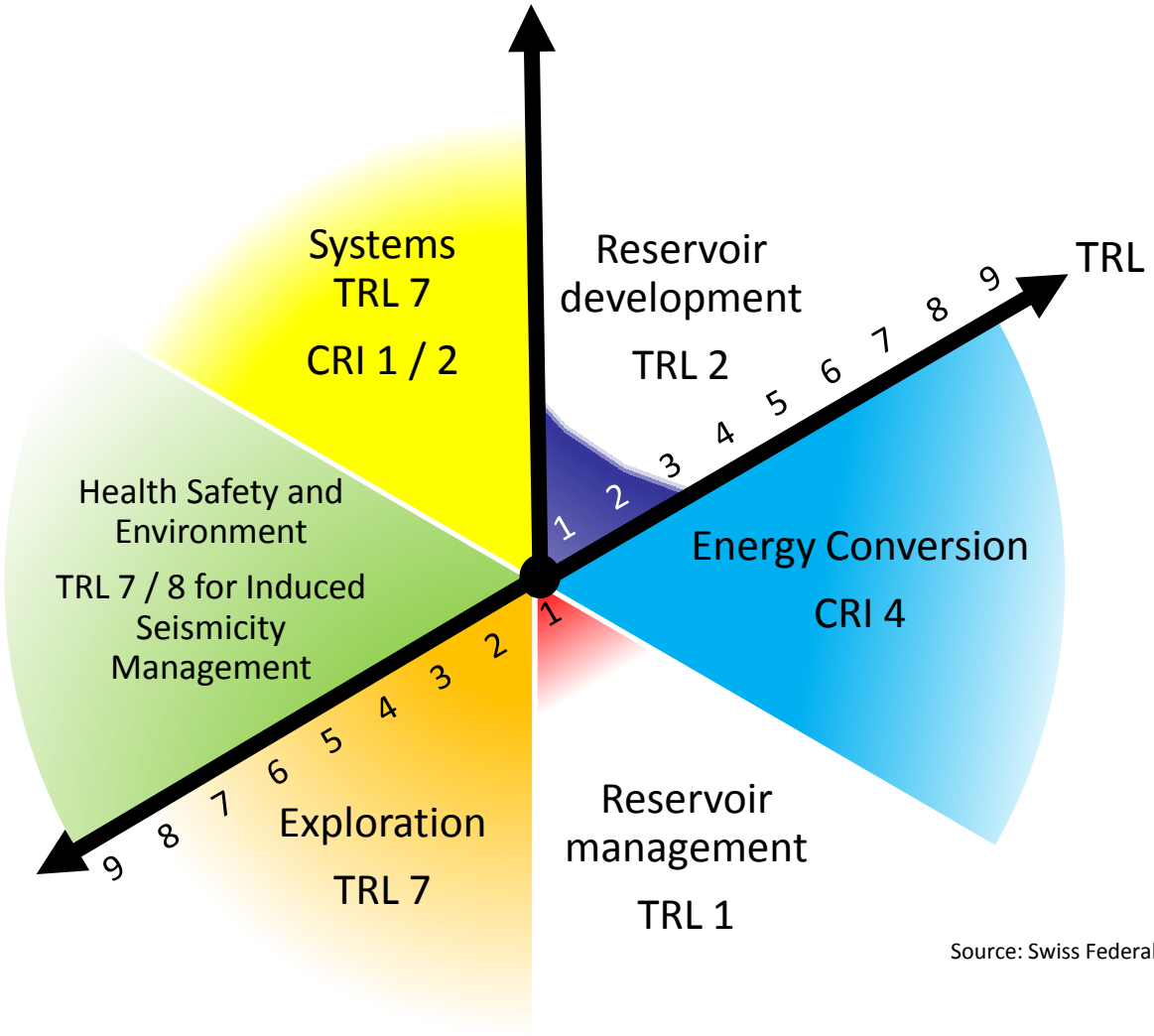
Lead Organisation: SCCER-SoE (ETH Zurich)

Experiment Objectives

- Hydro-shearing of faults
- Monitoring microseismicity
- Pressure propagation during shearing
- Permeability creation
- Thermal transport properties
- Stimulation in 2016, circulation in 2017

Slide courtesy of Florian Amann, DUG Lab Manager

Energy R&D on Engineered Geothermal Systems



Source: Swiss Federal Office of Energy

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Enabling innovation (2015)

Support for R&D and P+D Projects:

- Swiss Federal Office of Energy (R&D, P+D) ↘
- CTI ↑
- Swiss National Science Foundation ↑
- ETH Domain ↑
- swisstopo →
- Federal Office for the Environment →
- Cantons (v.a. GE, AG) ↑
- Europ. Commission**, USA*, Island*, Australia* und New Zealand*
- IEA Implementing Agreements (Geothermal, CCS, Gas and Oil Technologies)

Human capacities:

- Within the framework of the SCCER-SoE: various professorships (EPFL, ETHZ, Uni NE, Uni GE, Uni BE) and Senior Scientist positions; areas of mutual interest with SCCER-HaE, -CREST, -FURIES

Research infrastructures:

- Deep Underground Laboratories (Grimsel Test Site, Mont Terri)
- ECCSEL (European CCS Laboratory Infrastructure)
- Geo-Energy Testbed Initiative within EPOS (European Plate Observing System)
- More to be expected via H2020


Source: ETH Zürich

*Partners International Partnership for Geothermal Technology; **ERANET ACT (funded as of 7 Sep 2015 & GEOTHERMICA (in prep. to be submitted May 2016)

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National energy research master plan of the CORE (Swiss Federal Energy Research Commission) 2017-2020:

Geo-Energies feature strongly - priorities to 2020

– **Physical and chemical properties** of deep rocks and fluid-rock interaction, with topics ranging from cap-rock integrity to fault re-activation to permeability creation

– **High-resolution exploration techniques** to evaluate resources, to increase the probability of success in finding reserves, and to detect the location and extent of deep faults.

– **Integrated modelling** techniques, combining numerical, theoretical and experimental advances.

– New approaches to **enhance rock permeability**, with optimal distribution of micro-cracks and porosity to maximize heat exchange, swept area and water circulation to create a sustainable heat exchanger at depth

– **Reliable and cost efficient geothermal reservoir development**, including innovative drilling technologies, energy conversion techniques, improved heat exchange and efficiency, corrosion, cooling, and life-cycle sustainability.

– **Technologies for risk assessment**, monitoring, abatement and mitigation of induced seismicity.

– **Testing and validation of technologies** and protocols in deep underground conditions, with the establishment of a national deep underground research infrastructure for geothermal research.

– **National pilot and demonstration projects** for geothermal energy extraction (heat and power), CO_2 and natural gas storage.

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Switzerland's international aspirations related to coordinated research and development

European Union:

- Participation in an ERA-NET*, a co-fund action of member & other states to pool resources, and together with support from the European Commission, launch coordinated calls for R&D and P+D projects
  (aspiration: €30-45 million for a relatively low number of key projects)
- Participation in ERA-NET ACT (accelerating low carbon technologies, i.e. CCS) Cofund Action (Switzerland: a major original equipment manufacturer and hotbed of innovation)
- Continued high participation rate of Switzerland in Horizon2020 calls

International Energy Agency IEA – Geothermal Implementing Agreement

- Participation in IEA technology cooperation agreement with focus on direct use of geothermal energy and emerging technologies (drilling, stimulation, reservoir management and induced seismicity)

International Partnership for Geothermal Technology (USA, Iceland, Switzerland, Australia and New Zealand)

- Focus on induced seismicity, stimulation and reservoir modeling

* to be submitted to European Commission in April 2016; first call in 2017 for work in 2018-2021

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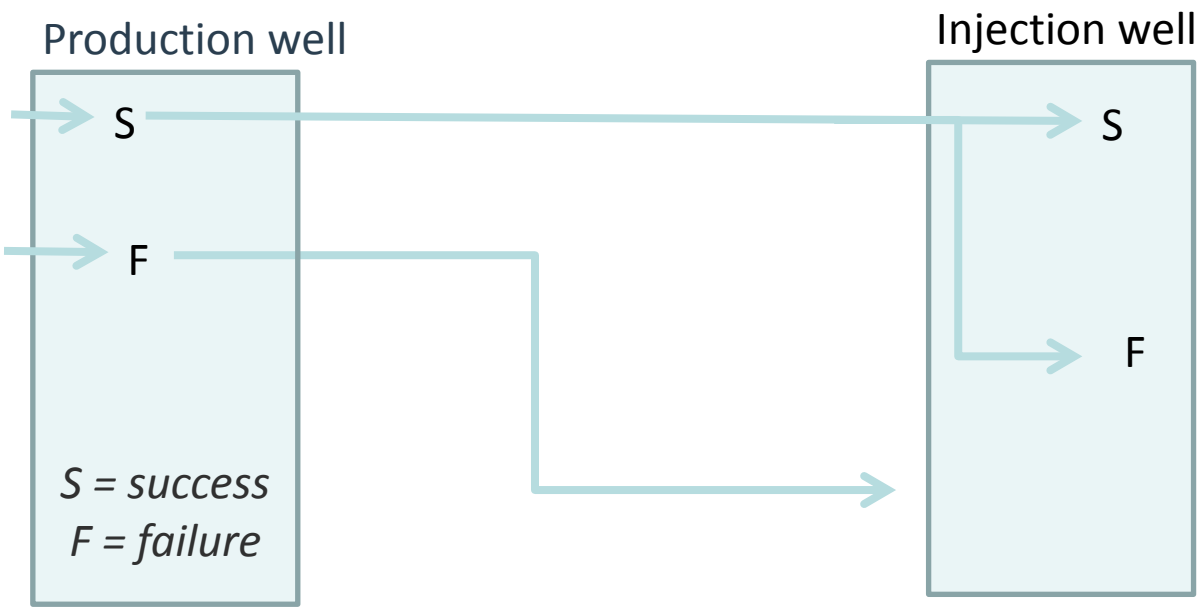
Improving the commercial readiness index by addressing exploration risk in hydrothermal projects



P_{temp} = 0.9
$P_{formation}$ = 0.8
$P_{productivity}$ = 0.5

ΠP =S=POS=
0.9*0.8*0.5=36%
F=1-S=64%

P_{temp} = 1
$P_{formation}$ = 0.9
$P_{injectivity}$ = 0.9

ΠP =S=POS=
1*0.9*0.9=81%
F=1-S=19%

~70% Failure
~30% Success

Source: SFOE

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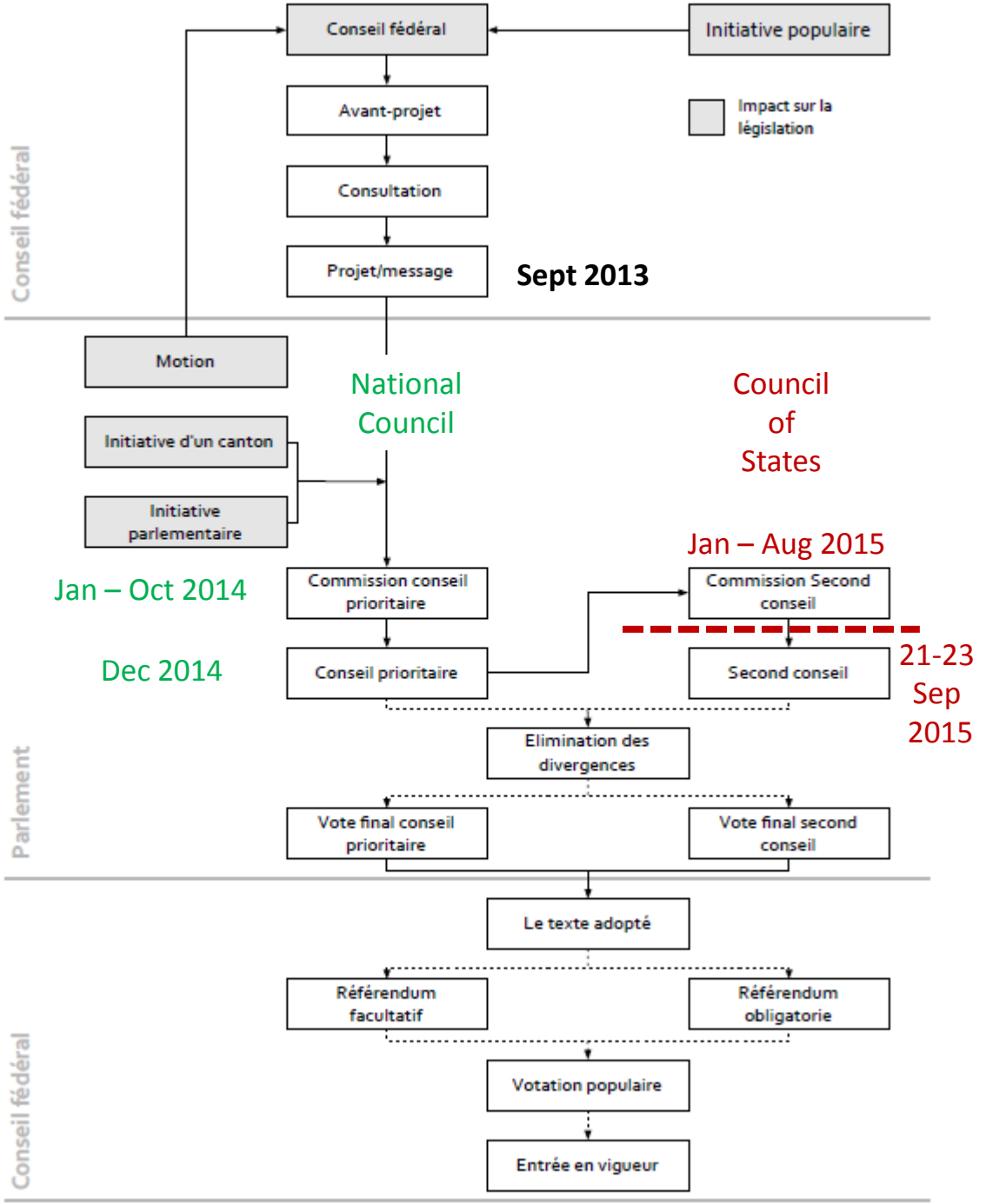
Energy Strategy 2050 – 1st of measures

- e.g. the revision of the Energy Act, currently in parliament



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Geothermal energy in the currently debated revision of the Energy Act….

Conseil fédéral	*Conseil national*	*Commission du Conseil des Etats*
Art. 35 Garanties pour la géothermie	*Art. 35*	*Art. 35* Contributions à la prospection et garanties pour la géothermie
		[1a] Des contributions peuvent être fournies pour couvrir les coûts relatifs à la prospection de ressources géothermiques destinées à la production électrique. Le montant de ces contributions ne peut excéder 60 % des coûts d'investissement imputables.
[1] Des garanties sont fournies pour couvrir les investissements consentis dans le cadre des préparatifs et de la réalisation d'installations géothermiques destinées à la production électrique. Le montant de ces garanties ne peut excéder 60 % des coûts d'investissement imputables.	[1] Des garanties peuvent être fournies …	[1] … … dans le cadre de la prospection de ressources et de la réalisation d'installations géothermiques …
		[1bis] Un projet de prospection de ressources géothermiques peut recevoir soit une contribution, soit une garantie, mais pas les deux à la fois.
[2] Le Conseil fédéral arrête les modalités, en particulier les coûts d'investissement imputables couverts par les garanties, ainsi que la procédure.		[2] … …, en particulier les coûts d'investissement imputables, ainsi que la procédure.

Art. 38 of the draft legislation specifies that at most 0.1 Rp. per kWh transported via the high voltage grid may be taken from the grid surcharge (paid by us, the consumers)
to fund the geothermal guarantee scheme and investment grants for exploration

Source: http://www.parlament.ch/sites/doc/CuriaFolgeseite/2013/20130074/S1-2%20F.pdf

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… and in the draft CO_2-Act which is concurrently debated

Art. 34 Réduction des émissions de CO2 des bâtiments

Droit en vigueur	*Conseil fédéral*	*Conseil national*	*Commission du Conseil des Etats*
bâtiments chauffés; b. à promouvoir les énergies renouvelables, la récupération des rejets de chaleur et l'amélioration des installations techniques jusqu'à concurrence d'un tiers de la part annuelle affectée à ces activités du produit de la taxe.			
		1bis La Confédération soutient directement les projets d'utilisation de la chaleur géothermique de moyenne profondeur. Elle y consacre une petite partie des moyens prévus à l'alinea 1. Le Conseil fédéral fixe les critères et les modalités du soutien ainsi qu'un plafond annuel aux contributions financières.	1bis Afin de réduire à long terme les émissions de CO2 des bâtiments, la Confédération soutient les projets d'utilisation directe de la géothermie pour la production de chaleur. Elle y consacre une petite partie des moyens prévus à l'al. 1, mais au maximum 30 millions de francs. Le Conseil fédéral fixe ...

i.e. the Confederation may support direct use geothermal energy projects that supply heat to buildings

Legislative commission of the Council of States: max. CHF 30 million per year

ghgt-13

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Call for abstracts opened 1st September 2015
Deadline for submission 10th February 2016
Registration opens 6th April 2016
Draft technical programme 1st June 2016
Early bird registration closes 13th July 2016

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Swiss Confederation

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LAUSANNE, SWITZERLAND, NOVEMBER 14-18, 2

Persistently working on all fronts (R&D, implementation, support measures....)