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«Regulierungskriterien und Vollzugshilfen für oberflächennahe Geothermie-anwendungen im alpinen Raum der Schweiz»

Ein Beitrag zum GRETA-Projekt

energieschweiz
Unser Engagement: unsere Zukunft.

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Inhalt

1 Einleitung

1.1 GRETA-Projekt

Das Projekt GRETA (Near-surface Geothermal Resources in the Territory of the Alpine Space) hat sich zur Aufgabe gemacht, die nachhaltige Nutzung erneuerbarer oberflächennaher Geothermie im Alpenraum zu verbessern, um damit zur Minderung der CO_2-Emissionen beizutragen.

Das auf drei Jahre (15.12.2015 - 15.12.2018) angelegte GRETA-Projekt vereint 12 Partner aus Deutschland, Frankreich, Italien, Österreich, der Schweiz und Slowenien.

Das GRETA Projekt umfasst drei Ziele:

- den **Austausch des Wissensstandes zur Genehmigungs- und Umsetzungspraxis** für die Nutzung der oberflächennahen Geothermie zwischen den Ländern des Alpenraumes (*siehe vorliegender Beitrag zur Schweiz*)
- die **Erhebung des flächendeckenden Potentials** zur Nutzung der oberflächennahen Geothermie im Alpenraum
- die **Erweiterung des Know-hows** von technischen Planern und Kommunen zum Einsatz der oberflächennahen Geothermie

Um diese Ziele zu erreichen, werden geothermische Potentialkarten erstellt. Diese dienen als Entscheidungsgrundlage für die Integration der oberflächennahen Geothermie in wirtschafts- und umweltpolitische Maßnahmen und können für die räumliche Planung geothermischer Anlagen durch öffentliche und private Interessenten genutzt werden. Weiter werden Leitlinien entwickelt, um die Harmonisierung von operationellen Kriterien und Genehmigungsverfahren für die Nutzung der oberflächennahen Geothermie im Alpenraum zu fördern. Darüber hinaus werden Strategien entworfen, um die oberflächennahe Geothermie stärker in politische Maßnahmen einzubinden.

Detaillierte Informationen zum GRETA Projekt sind zu finden unter: http://www.alpine-space.eu/projects/greta/en/home

1.2 WP 2 Regulations and best practice knowledge exchange

Der vorliegende Bericht ist die Grundlage für die Weiterverwendung im Arbeitspaket (engl. workpackage WP) WP2 „Regulations and best practice knowledge exchange“ des GRETA-Projektes.

Dieses Arbeitspaket zielt darauf ab, die länderspezifischen Regulierungselemente gegenüberzustellen und die besten Vollzugshilfen für oberflächennahe Geothermiesysteme im Alenraum zu überprüfen. Hierbei werden in den Teilnehmerländern jeweils die nationalen und regionalen Regulierungselemente analysiert und vorhandene Vollzugshilfen bewertet. Die Erhebung der Informationen erfolgt durch einen standardisierten Fragebogen mit insgesamt 55 Fragen. Aufgrund der Internationalität erfolgt dies in englischer Sprache. Details zum Arbeitspaket

WP 2 sowie die Fragebogen-Vorlagen und Ergebnisse sind zu finden unter: http://www.alpine-space.eu/projects/greta/en/project-results/work-in-progress/wp2-regulations

2 Regulierungskriterien und Vollzugshilfen für oberflächennahe Geothermieanwendungen im alpinen Raum der Schweiz

2.1 Templates

2.1.1 Attributes and stock of values in the tables of regulation elements

Attribute	Stock of values
Legal regulation	Not allowed / Allowed / Obligatory / Not required / Recommended / Not regulated
Legal instrument	Act / Decree / Rule / Standard / Voluntary standard / Technical guidance / Ordinance / Decision / Approval / Guidelines
Regulation level	EU / National / Regional / Provincial / Local

2.1.2 Tables

2.1.2.1 Levels of regulations in the Country

Introduction

National legislation:

The deployment of **N**ear **S**urface **G**eothermal **E**nergy (NSGE) in Switzerland is mainly regulated by the water protection legislation on the national level. The individual cantons have to adopt the federal water protection law and decree (introductory act, *Einführungsgesetz*), but are allowed to add specific requirements or regulations.

To provide a guideline for the federal and cantonal public authorities and to harmonize the execution of the water protection law and decree, the Federal Office for the Environment FOEN (*Bundesamt für Umwelt BAFU*) published two guidelines (Vollzugshilfen[1]/Wegleitungen[2]). The first publication contains guidelines for the approval procedure / utilisation of NSGE (BAFU, 2009: *Wärmenutzung aus Boden und Untergrund – Vollzugshilfe für Behörden und Fachleute im Bereich Erdwärmenutzung*). The second one concentrates on the protection of groundwater (Wegleitung

[1] http://www.bafu.admin.ch/publikationen/publikation/01042/index.html?lang=de

[2] http://www.bafu.admin.ch/publikationen/publikation/00378/index.html?lang=de

Grundwasserschutz, BUWAL, 2004). These two guidelines are not officially binding for the cantons but are – to a large extent – adopted by the cantons. Most of the cantons published cantonal planning aids (guidelines) or leaflets regarding the approval of NSGE which are based on the aforementioned BAFU (2009) guideline.

Overview on the national relevant publications (act, decree, guideline, standard)

- Act: Bundesgesetz über den Schutz der Gewässer (GSchG; SR 814.20[3]);24. January 1991
- Decree: Gewässerschutzverordnung (GSchV; SR 814.201[4]); 28. October 1998
- Guideline: Vollzugshilfe – Wärmenutzung aus Boden und Untergrund (Bundesamt für Umwelt BAFU 2009)
- Technical Standard: Schweizer Norm – Erdwärmesonden SIA 384/6[5];1. January 2010
- Technical Standard: Schweizer Norm – Grundwasserwärmenutzungen SIA 384/7[6];1. April 2015

Cantonal legislation and legislation by municipalities:

The deployment of NSGE in Switzerland is also influenced by regulations of the building legislation, which is regulated on the cantonal (regional) or even local (municipality) level. Therefore, there are manifold solutions which can't be described in this report. But the influence on the regulation of NSGE is only minor. It is only relevant in respect to the minimum distance of vertical NSGE to buildings (in some cases they can be located under the building, in other cases they need to have a specific distance) or neighbouring plots. Furthermore, the necessity of a building construction approval depends on the canton resp. the municipality.

In contrast, the distance between vertical NSGE and the construction/dimensioning of groundwater wells are given by recommendations on the national level (guideline BAFU, 2009 resp. technical Standards SIA 384/6 and SIA 384/7).

The regulation of NSGE in areas with geological and hydrogeological challenges, e.g. artesian aquifers, gas occurrences, karst area, contaminated or unstable soil, etc., is not standardized on the national level. The national guideline (BAFU, 2009) lists these challenges and recommends the individual cantons to formulate specific requirements or to forbid the installation.

For the thermal utilization of groundwater another cantonal legislation has to be considered: the water utilization legislation (*Wassernutzungsrecht: Gesetz/Verordnung*). In the canton Graubünden, Wallis and Tessin, the municipalities have the water rights.

[3] https://www.admin.ch/opc/de/classified-compilation/19910022/index.html

[4] https://www.admin.ch/opc/de/classified-compilation/19983281/index.html

[5] http://www.webnorm.ch/null/null/erdw%c3%a4rmesonden/D/Product

[6] http://shop.sia.ch/normenwerk/architekt/384-7_2015_d/D/Product

Regulation level	**1**	**2**	**3**	**4**
NATIONAL	*"Schweizerische Bundesversammlung"* Parliament	*"Schweizerischer Bundesrat"* Government	Offices: Federal Office for the Environment (FOEN) "Bundesamt für Umwelt (BAFU)"	Societies: Swiss Society of engineers and architects "Schweizerischer Ingenieur und Architektenverein" SIA
Legal instrument	act (water protection)	decree (water protection)	indirect: act + decree guidelines (in respect to water protection) direct: Approval (water protection) of Federal projects	technical standard SIA
REGIONAL	"*Kantonsparlament"* Parliament	*"Regierungsrat"* Government	Cantonal offices for the environment	
Legal instrument	act (building act)	decree (building decree) decision	planning aid/ guideline leaflet decision approval (water protection)	

LOCAL	Municipalities			
Legal instrument	building act, decree in canton Graubünden decision (building sector) approval (building sector)			

Dictionary of Legal instruments: English - National

English term	National term	Remark
1. Act	Gesetz	binding on the national resp. cantonal level
2. Degree	Verordnung	binding on the national resp. cantonal level
3. Guidelines	Vollzugshilfe, Wegleitung	not officially binding, but the national guidelines are (in general) adopted by the cantons the guidelines ("*Vollzugshilfen/Wegleitungen*") show how the national regulations should be implemented on the cantonal levels
4. Planning aid	Planungshilfe Weisung etc.	binding on the cantonal level different names in the individual cantons
5. Leaflet	Merkblatt	binding on the cantonal level
6. Technical standard	Technische Schweizer Norm (SIA)	not officially binding, but (in general) adopted by the cantons
7. Decision	Beschluss, Entscheid	different names in the individual cantons

English term	National term	Remark
8. Approval	Bewilligung	approval for the construction *("Baubewilligung"*) by the municipally, approval in respect of groundwater protection ("*gewässerschutzrechtliche Bewilligung*") by the canton

2.1.2.2 Tables of regulation elements

2.1.2.2.1 Implementation of NSGE application

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Regulation level
Drilling /excavating below groundwater table	not allowed, allowed	for borehole heat exchangers (V) and horizontal heat exchangers not allowed allowed in case the aquifer is no drinking water reservoir and the groundwater is also no potential drinking water resource for the future NSGE – W and energy piles But not everywhere, depends on the water protection zones	act decree	national
Reinjection for NSGE-W	obligatory	reinjection of water into the same aquifer (exceptions only when reinjection cannot be realized)	act, decree	national

Regulation element	**Legal regulation**	**Legislative conditions**	**Legal instrument**	**Regulation level**
Minimum distance to installations a. next building, b. drinking water well, c. other uses wells d. other public installations	obligatory	the standard SIA 384/6 recommends to build NSGE-V next to buildings and to only construct the system below buildings when the space is limited the regulation depends on the individual canton <u>cantonal examples:</u> Bern: 2 m Graubünden: not regulated Schwyz: not allowed below buildings, distance not regulated Tessin: not regulated Valais: not regulated b) no specific distances, it depends on the individual hydrogeological conditions c) + d) it is not allowed to impact other users; no specific distances are provided	standard SIA 384/6 planning aid Leaflet	national cantonal, municipality

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Regulation level
Minimum distance between neighbouring NSGE installations a. heat exchanger or b. groundwater well	obligatory	recommended in the standards and in general adopted by the cantons 5 m individual, large enough so that they don't interact (based on hydrogeological investigations/simulations)	standard SIA 384/6 SIA 384/7	national, cantonal
Minimum distance to neighbouring plot (property line)	obligatory	depends on the canton resp. municipality In general 2.5 m (to guarantee minimum distance between two individual heat exchangers; see above) <u>cantonal examples:</u> Bern: 3 m (less with agreement of the neighbour) Graubünden: depends on the municipality, the canton recommends 2.5 m Schwyz: 2.5 m Tessin: 5% of the drilling length Valais: no minimum distance		cantonal, local
Minimum distance between pumping and reinjection site	obligatory	depends on hydrogeological simulation	standard SIA 384/7	national, cantonal

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Regulation level
Temperature difference of the reinjected water (W)	obligatory	normally ±3 °C after mixing; can be more locally restricted to the injection well (100 m)	decree (water protection) guideline standard (SIA 384/7) planning aid leaflet	national, cantonal
Temperature drop (H, V) a. absolute allowed Tmin, b. absolute allowed Tmax, c. relative value describing the accepted ΔT between disturbed and ambient undisturbed temperature.	obligatory	heating mode: Average minimal temperature of the heat carrier fluid -1.5 °C (difference between entry and exit of the BHE) not allowed to fall below defined boundary in 50 years of operation ΔT at the entry/exit heat pump: 3-4 K cooling mode: max. allowed heat carrier fluid temperature depends on the materials of the BHE and back filling (must be guaranteed for 50 years of operation)	standard SIA 384/6	national

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Regulation level
Heat carrier fluid type	obligatory	possible heat carrier fluid types are listed in Appendix 6 of the guideline BAFU, 2009. The cantons are allowed to permit other heat carrier fluid types, given that they doesn't contain substances that could pollute water	guideline BAFU, 2009	National, cantonal
. Refrigerant type	obligatory	if possible natural refrigerant; content of lubricating oil as low as possible	guideline BAFU, 2009	national
. Tightness – ground loop and refrigerant tubing	obligatory	should be tested in accordance with the technical standard SIA 384/6.	guideline BAFU, 2009, standard SIA 384/6	national
. Backfilling of BHE	obligatory	requirements for the backfilling are described in the Appendix 7 of the guideline BAFU, 2009; further requirements in the standard SIA 384/6	guideline BAFU, 2009, standard SIA 384/6	national
. Liquidation procedure after abandonment of NSGE installation a. heat pump b. heat exchanger	obligatory	not regulated NSGE-V and H: extraction of heat carrier fluid, cleaning and complete backfilling NSGE-W: complete backfilling	guideline BAFU, 2009	national

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Regulation level
. Monitoring	recommended	NSGE-V and H: pressure monitoring of the heat carrier fluid system to detect possible leakages NSGE-W: periodic control of the wells	guideline BAFU, 2009	national

2.1.2.2.2 Installation of NSGE in special geological conditions

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
. Artesian aquifers	recommended not allowed or allowed with specific requirements	not regulated on the national level, but the guideline recommends to regulate it on a cantonal level as not allowed <u>cantonal examples:</u> Bern: not allowed Graubünden: partly allowed: needs additional investigations and eventually requirements Schwyz: possibly allowed after additional investigations and with depth limitation Tessin: not allowed Valais: warning message based on current geological knowledge: either additional investigations or limitation of the drilling depth	guideline BAFU, 2009 planning aid, leaflet	national cantonal
. Very shallow water table where reinjection can be problematic	not regulated			
. Perched groundwater layers	not regulated			

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
. Two or multiple aquifer layers	recommended not allowed	NSGE-V: should in general not be allowed NSGE-W: water should not be modified, therefore it is not allowed to drill through (and utilise) two or more aquifer layers NSGE-V: not allowed NSGE-W: <u>cantonal examples:</u> Bern: not allowed Graubünden: not allowed Schwyz: not regulated Tessin: not allowed Valais: not allowed	guideline BAFU, 2009	National , cantonal
. Mineral water resources	not regulated	not specifically regulated but treated like groundwater resources		
. Thermal water resources	not regulated	not specifically regulated but treated like groundwater resources		

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
. Gas occurrences	recommended	not regulated on the national level, but the guideline recommends to regulate it on a cantonal level as not allowed or allowed with specific requirements	guideline BAFU, 2009	national
	not allowed or allowed with specific requirements	<u>cantonal examples:</u> Bern: not allowed Graubünden: not allowed Schwyz: possibly allowed after additional investigations and with depth limitation Tessin: not allowed Valais: warning message, additional investigations, limitation of the drilling depth	planning aid, leaflet	cantonal

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
. Unstable ground a. compressible soil b. landslide c. evaporate (with the risk of swelling / dissolution)	recommended not allowed or allowed with specific requirements	not regulated on the national level, but the guideline recommends to regulate it on a cantonal level as not allowed or allowed with specific requirements <u>cantonal examples:</u> Bern: not allowed (in special cases (very few) allowed with specific requirements after additional investigations) Graubünden: not allowed Schwyz: possibly allowed after additional investigations and with depth limitation Tessin: not allowed Valais: warning message based on current geological knowledge: either additional investigations or limitation of the drilling depth	guideline BAFU, 2009 planning aid, leaflet	national cantonal

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
. Contaminated soil	recommended	not regulated on the national level, but the guideline recommends to regulate it on a cantonal level as not allowed or allowed with specific requirements	guideline BAFU, 2009	national
	not allowed or allowed with specific requirements	<u>cantonal examples:</u> Bern: not allowed Graubünden: not allowed Schwyz: possibly allowed after additional investigations Tessin: not allowed Valais: not allowed	planning aid, leaflet	cantonal

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
. Karst area	recommended	not regulated on the national level, but the guideline recommends to regulate it on a cantonal level as not allowed or allowed with specific requirements	guideline BAFU, 2009	national
	not allowed or allowed with specific requirements	<u>cantonal examples:</u> Bern: not allowed Graubünden: not allowed Schwyz: possibly allowed after additional investigations and with depth limitation Tessin: not allowed Valais: warning message based on current geological knowledge: either additional investigations or limitation of the drilling depth	planning aid, leaflet	cantonal

2.1.2.2.3 Installation of NSGE on protected areas or endangered areas

Regulation element	**Legal regulation**	**Legislative conditions**	**Legal instrument**	**Level**
. Water protection area (WPA)	not allowed, allowed	groundwater protection zones S1,2,3, S_h, S_m: S1, S2 and S_h: not allowed S3, S_m: NSGE-H, energy piles and thermo-active elements only allowed under specific conditions	act, decree	national
. Natura 2000 area	not regulated			
. Nature protected ecosystem area	not regulated			
. Flood and erosion areas	not regulated			

Regulation element	**Legal regulation**	**Legislative conditions**	**Legal instrument**	**Level**
. Landslide area	not regulated not allowed or allowed with specific requirements	not regulated on the national level, but the guideline recommends to regulate it on a cantonal level as not allowed or allowed with specific requirements Bern: not allowed (in special cases (very few) allowed with specific requirements after additional investigations) Graubünden: not allowed Schwyz: possibly allowed after additional investigations Tessin: not allowed Valais: warning message based on current geological knowledge: either additional investigations or limitation of the drilling depth	guideline BAFU, 2009 planning aid, leaflet	national cantonal
. Riparian / coastal zone	regulated	NSGE in general possible in densely populated zones	decree	national
. Other areas a. … b. …				

2.1.2.2.4 Public services for NSGE applications

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
32. NSGE (GSHP) objectives a. in NREAP b. in LEC c. …	not regulated	there are no specific objectives in the Swiss energy strategy 2015 and the corresponding new act. NSGE are indirectly considered by the objective to reduce the energy consumption per person until 2035 to 43% compared to the year 2000	act	national
33. Subsidies	not regulated, obligatory	many cantons and some municipalities provide financial subsidies for heat pumps, in a few cases there are tax incentives; In general, the prerequisite to achieve the subsidy is the quality label “Wärmepumpen-System-Modul”	decision	cantonal, local
34. Insurance system	not regulated, recommended	there is no insurance system for investments, all other insurances are recommended, but not organized systematically: Drilling insurance (drilling company); principal's liability insurance artesian aquifer insurance	planning aid, leaflets	cantonal, local

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
35. Certification a. professionals b. organization	obligatory, recommended	according to the national water protection act , the person who plans, constructs, modifies and controls NSGE must have the knowledge, experience etc. to guarantee the state-of-the-art the important Swiss institution in respect of certification (and quality labels) is the Swiss heat pump association (“Fachvereinigung Wärmepumpen Schweiz, FWS)”	act	national
36. Borehole drilling report	obligatory	yes, done by the machine operator	guideline BAFU, 2009, standard SIA 384/6	national
37. Pumping test report	obligatory	yes, necessary for the approval, concession the exploration well and pumping tests need a separate approval	guideline BAFU, 2009	national
38. Thermal response test report	not regulated			

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
39. Reception of borehole by the investor	not regulated	this aspect is not regulated, but is considered by the quality label "Wärmepumpen-System-Modul"		
40. Water pumping data periodic report	recommended / obligatory	every 14 days sum groundwater quantity (m^3) current groundwater flow (m^3/h) current temperatures before and after heat pump, difference in K	standard SIA 384/7	national
41. Heat energy production data periodic report from NSGE	obligatory	annual Swiss geothermal statistics		
42. Register/Evidence of heat pumps	Obligatory	heat pump statistics		
43. Register/Evidence of heat exchanger	not regulated			
44. Register/Evidence of NSGE production	obligatory	heat pump statistics		

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
45. Register/Evidence of drilling data	obligatory	all cantons have a register of drilling data; sometimes publicly available in the Internet Bern: yes Graubünden: yes Schwyz: yes Tessin: yes Valais: yes		
46. Register/Evidence of geothermal data	obligatory	annual Swiss geothermal statistics		
47. Register/Evidence of groundwater abstraction		all cantons have a register of groundwater abstraction; In some cantons publicly available maps for NSGE-W Bern: no Graubünden: yes Schwyz: yes Tessin: yes Valais: no		

2.1.2.2.5 Permitting and charging procedures for NSGE applications

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
48. Research/drilling permit	obligatory	approval in the context of the water protection legislation	guideline BAFU, 2009	national

Regulation element	Legal regulation	Legislative conditions	Legal instrument	Level
49. Declaration / Recorded special use of water	not required			
50. Water consent	obligatory	declaration during the approval, concession procedure; normally on a regional (cantonal) level, in Graubünden local level (municipality)	decree	cantonal, local
51. Water permit	partly obligatory	in many cases a concession is necessary	act, decree	cantonal, local
52. Water fee	obligatory	in most cases yes (depends on the quantity of water used and/or if special rights from former times can be claimed (“ehehafte Rechte”) it is sometimes called “water fee”, sometimes “concession fee” (depending on the canton)	decree	cantonal, local
53. Concession	partly obligatory	sometimes an approval is enough (depends on the quantity of water used)	act, decree	cantonal, local
54. Royalty / concession fee	in most cases obligatory, not required	NSGE-W: in most cases obligatory NSGE-V and H: not required	act, Decree	cantonal, local
55. Energy fee	not required			

Dictionary of permitting and charging terms: English – National language

English term	National term	Remark
Water right a. Water permit c. Concession	Wassernutzungsrecht Bewilligung Konzession	
Water fee / Water charge	Wasserzinsen	
Royalty	Abgaben	
Concession fee	Konzessionsgebühren	