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HotLime partners' legislation synopsis

Synopsis outlining the regulations for licensing the exploitation of geothermal energy in the HotLime partner countries.

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INTRODUCTION

This document represents a synopsis outlining the regulations for licensing the exploitation of geothermal energy in the HotLime partner countries. HotLime partners from following nine countries/states, **Austria**, **Baden-Württemberg** (Germany), **Bavaria** (Germany), **Croatia**, **Ireland**, **Italy**, **Slovenia**, **Catalonia** (Spain) and **The Netherlands** have submitted the legislation overview based on the questionnaire (Appendix 1). The content of each paragraph is arranged in a way to first give a general overview, synthesis of key information regarding the topic, followed by a detailed explanation provided by each project partner. It should be mentioned in the beginning that **Ireland** does not have a specific licensing system for geothermal energy so the majority of topics touched within this document were left undiscussed for this project partner.

1. DEFINITION OF GEOTHERMAL ENERGY AND THERMAL WATER IN THE NATIONAL LEGISLATION

GEOTHERMAL ENERGY

Baden-Württemberg, Bavaria, Croatia, Ireland, Slovenia and **The Netherlands** have a definition of geothermal energy in the national legislation. **Austria** has no legal definition for geothermal energy itself. Ireland has defined the term *geothermal energy* but has no specific legislation covering geothermal energy.

In **Croatia**, the law Tariff system for electricity production from renewable energy sources and cogeneration (*OG 113/13*) defines geothermal energy as the energy potential of the geological reservoir used in the production of electricity and / or heat in a sustainable cycle free of emissions of carbon dioxide and other harmful gases that are disposed of and stored in the same geological reservoir from which the energy resource is exploited (eg. geothermal power plant).

Italy's classification of geothermal resources is based on the temperature and the thermal power that can be supplied with a wastewater temperature equal to 15 ° C (*Decreto Legislativo 11 febbraio 2010, n. 22*). In Article 1 *D.L. 11 febbraio 2010, n. 22* the types of geothermal energy are defined according to the temperature of the fluid found:

- High enthalpy geothermal with T> 150 ° C
- Medium enthalpy geothermal with 90 ° C <T <150 ° C
- Low enthalpy geothermal with T <90 ° C

Depending on the type of geothermal energy and the size of the plant, it is established that: high enthalpy geothermal resources are of national interest, all plants that ensure a power equal to or greater than 20MWt at a conventional temperature of 15 ° C, and all geothermal resources found in marine areas; while resources with medium and low enthalpy are of local interest, those economically feasible with a power lower than 20MWt (with t = 15 ° C).

In **Slovenia**, according to the definition in the Mining Act, a geothermal energy resource is thermal energy which is stored in the geological strata beneath the surface of solid Earth and which is being recovered by the heat flow from Earth's interior.

The Netherlands legislation defined geothermal energy as the heat that is present in the subsurface and has its origin by natural processes (*article 1b of the Mining Law*). The Mining Law only refers to geothermal heat deeper than 500 meters (*article 2.2 of the Mining Law*). Mining Law: see https://wetten.overheid.nl/BWBR0014168/2020-07-01.

Baden-Württemberg and **Bavaria** legislation state that all projects with an expected yield of > 0.2 MW are subject to regulation according to the federal mining law (*Bundesberggesetz*, https://www.gesetze-im-internet.de/bbergg/), for the exploration permit as well as the exploitation permit (approval).

There is no legal definition for geothermal energy itself in **Austria**n legislation.

In **Catalonia** (Spain), the main national legislation of reference for exploration, investigation and exploitation of geothermal resources is the Mining Law 22/1973, the Royal Decree 2857/1978 and the Law 54/1980 of modification of the Law on Mines. Geothermal energy is not defined itself but is considered as a geological energy resource of the section "D" in the same way together with hydrocarbons, radioactive minerals, and bituminous rocks (3rd article of the Mining Law 22/1973).

THERMAL WATERS

Ireland, Baden-Württemberg, Bavaria and **The Netherlands** didn't provide information on thermal water definition in their national legislation. **Italy**'s legislation doesn't have univocal definition of thermal waters. **Slovenia** and **Austria** have similar classification of thermal water based on temperature, which is at least 20 °C. On the contrary **Italy** doesn't distinguish thermal waters based on temperature, and thermal waters are generally the waters used in thermal establishments for therapeutic purposes.

According to the **Slovenia**n Water Act, thermal water is a groundwater from a well, spring or capture that is heated in geothermal processes in the Earth's crust and its temperature at the spring or artificial outlet is at least 20 °C. Thermal water, in **Austria**, is defined by balneological legislation regarding the water temperature (at least 20 °C), legal framework organized by the Austrian federal states (*Heil- und Kurmittelgesetze*). In **Croatia**, there are two laws that define the use of geothermal water, depending on the type of use, the Water Act and the Mining Act (and the Law on Exploration and Exploitation of Hydrocarbons). Geothermal waters used for health, balneological or recreational and other purposes are regulated with the Water Act. The Mining Act regulates the geothermal waters, as mineral raw resource, which accumulated heat can be used for energy purposes or for the extraction of mineral resources. The Water Act (https://narodne-novine.nn.hr/clanci/sluzbeni/2009_12_153_3744.html), Mining Act (https://narodne-novine.nn.hr/clanci/sluzbeni/2013_05_56_1133.html), the Law on Exploration and Exploitation of Hydrocarbons (https://narodne-novine.nn.hr/clanci/sluzbeni/2018_06_52_1024.html).

In **Catalonia**, water is considered as Thermal Water in the Mining Law 22/1973 (resource classified within the section "B") when the outlet water temperature remains nearly constant during the whole year and is at least 4 °C higher than the mean annual air temperature in the same location where the water source is located (23rd article of the Spanish Mining Law 22/1973).

2. OWNERSHIP OF GEOTHERMAL RESOURCES

Baden-Württemberg, Bavaria, Croatia, Italy, Slovenia and **The Netherlands** consider geothermal energy resources and thermal water state-owned. **Ireland**'s ownership of geothermal energy has not been clarified in legislation. **Austria** legislation states that the groundwater, and therefore also the heat content, belongs to the land property owner without any limitation of depth (law: *WRG 1958*, https://www.ris.bka.gv.at/GeltendeFassung/Bundesnormen/10010290/WRG%201959%2c%20Fassung%20vom%2026.06.2020.pdf).

In **Croatia**, mineral resources including geothermal energy resources and thermal water are owned by the Republic of Croatia. Private parties or private person, or a legal person (public or private body) could acquire the exploration and exploitation right on the basis of a granted research permit and utilization concession. **Slovenia**n legislation state similar to Croatian: Mineral resources including geothermal energy resources and thermal water are owned by the Republic of Slovenia. Private parties or private person could acquire the exploration and exploitation right on the basis of a granted research permit and utilization concession. **Baden-Württemberg** and **Bavaria** legislation consider geothermal resources as "bergfrei" (unimpeached for mining), means state-owned. In **Italia**n legislation, depending on the type of geothermal energy and the size of the plant, it is established that: high enthalpy geothermal resources are of national interest, all plants that ensure a power equal to or greater than 20 MWt at a conventional temperature of 15 ° C, and all geothermal resources found in marine areas; while resources with medium and low enthalpy are of local interest, those economically feasible with a power lower than 20 MWt (with t = 15 ° C). **The Netherlands** state that the subsurface and its resources are owned by the state. The government gives our licenses to produce geothermal resources. Ownership resides with the state. The license to operate/produce the resources is a sort of contractual agreement in which the financial issues are also arranged.

In the case of **Catalonia**, all the subsoil resources (including geothermal energy) are of public domain. This means that the owner of the land is not the owner of the subsoil resources below his land property. The Spanish government can directly assume or give the geothermal resources exploration, investigation and/or exploitation to others under the conditions and requirements defined by the Spanish Mining Law. To obtain the authorization for exploration, investigation, or extraction of geothermal resources the interested person or company must apply for a temporary limited permit. The target area should be defined using the official Spanish mining grid by selecting one or more squares of land. Also, the Spanish government has the priority on geothermal resources exploration, investigation and/or exploitation over specific areas declared by an official proceeding as "reserved areas".

a. GRANTING ACCESS TO EXPLORATION AND EXPLOITATION OF GEOTHERMAL RESOURCES

In countries where the geothermal resources are state-owned, exploration permits and exploitation approval are generally granted by the state. These countries are **Baden-Württemberg, Bavaria, Croatia, Italy, Slovenia** and **The Netherlands**. Although geothermal resources are considered of public domain in **Catalonia**, the granting permits for exploration and exploitation of geothermal resources are in purview of the General Directorate for Energy Policy and Mines, dependent organisation of the Energy State

Secretary from the Ministry of Ecological Transition and Demographic Challenge (Spanish government). Even so, the granting process can be carried out through the autonomous communities and their reference administration bodies, which in the case of **Catalonia** corresponds to the General Directorate of Energy, Industrial safety and Mining Safety of the Business and Labour Department (Autonomous Government of Catalonia).

In **Ireland**, there is no specific licensing system for geothermal energy. In **Austria**, the regional water authorities (regulating the use of groundwater) and the mining authority regulating boreholes of depths larger than 300 meters are in charge of granting access to exploration and exploitation of geothermal resources. In **Ireland**, it is possible to explore and carry out activities integral to developing geothermal energy, under the following regulations which include: Planning - Geothermal projects for district heating would come under the provisions of the Planning and Development Act 2000, and subsequent amendments, and the Planning and Development Regulations, implemented by 31 local authorities. Deep drilling - An amendment to the Planning and Development Act 200 (*S.I. No. 543* of 2014), which gives effect to EU *Directive 2011/92/EU*, specifically includes geothermal drilling among the deep drilling activities that may require an environmental impact assessment if the planning authority consider the activity would be likely to have significant effects on the environment. Water abstraction and discharge - The Environmental Protection Agency (EPA) and local authorities monitoring and enforce groundwater regulations, many of which stem from the EU *Water Directive Framework (2000/60/EC*). Discharge licences must be obtained for discharges to surface waters or to groundwater. In **Croatia**, the concession grantor can be The Croatian Parliament and the Government of the Republic of Croatia, on behalf of the Republic of Croatia or state administration body, on behalf of the Republic of Croatia. Geothermal water exploration permit means a decision or decisions of the Ministry granting the investor the right to explore geothermal waters for energy purposes and the right to directly grant a license for geothermal waters and enter into contracts for the exploitation of geothermal waters, provided that all preconditions for geothermal exploitation are met, prescribed by the Law on exploration and exploitation of hydrocarbons. **Slovenia** state that the exploration of geothermal resources is granted only by state. The landowner has to allow access to the exploration site in a written form. In **Baden-Württemberg**, exploration permits as well as the exploitation approval are granted by the State Ministry of the Environment, Climate Protection and the Energy Sector as the supreme Mining Authority. In **Bavaria**, exploration permits as well as the exploitation approval are granted by the State Ministry for Economy as the supreme Mining Authority. In **Italy**, Directorate-General for Infrastructure and Security of Energy and Geomineral Systems (DGISSEG) UNMIG - National Mining Office for Hydrocarbons and Georesources grants access to exploration and exploitation of geothermal resources of national interest, while considering geothermal resources of local interest the local authorities responsible for the authorization phases are the regions or provinces. In the **Netherlands**, the body in charge of granting access to exploration and exploitation is the Ministry of Economic Affairs and Climate (www.minezk.nl or https://www.rijksoverheid.nl/ministeries/ministerie-van-economische-zaken-en-klimaat).

b. FOREIGN INVESTMENT

Exploration or exploitation of geothermal resources is open to foreign investment in **Austria, Baden-Württemberg, Bavaria, Catalonia, Croatia, Ireland, Italy, Slovenia** and **The Netherlands** (under conditions specified below).

Bavaria is open to foreign investment, but factually all geothermal projects in Bavaria are "owned" by communities or power authorities transacted in collaboration with national or international geothermal companies.

In **Austria**, exploration or exploitation of geothermal resources is in general open to foreign investment, as long as they own the land property of the planned use or have an agreement with the land property owner. In **Slovenia**, an exploration permit and a mining right for exploitation may be acquired by a legal or natural person in the manner and under the conditions laid down in this act:
- which is established in the Member States of the European Union, the European Economic Area and the Swiss Confederation and in the Member States of the Organization for Economic Cooperation and Development (hereinafter referred to as: the Contracting States) or is a national of a Contracting State, and
- which is not from a Contracting State, but from a third country, but only if the condition of material reciprocity is met. This condition shall be deemed to be fulfilled if an interested party who is from a third country has a seat or residence in the Republic of Slovenia and is able to engage in an activity in the same country under the same or similar conditions under which he may pursue an activity in the Republic of Slovenia.

3. EXPLORATION AND EXPLOITATION LICENSING

It is not possible to explore or exploit geothermal resources without some kind of permit or concession (license) in all project partner countries (**Baden-Württemberg, Bavaria, Catalonia, Croatia, Ireland, Italy, Slovenia and The Netherlands**) except in **Austria** and **Ireland**. In **Austria**, exploration is not regulated; the legal framework only regulates the use of the groundwater for geothermal purposes (*WRG 1958*) as well as the construction and use of the borehole as a well (law: *MinroG*, https://www.ris.bka.gv.at/GeltendeFassung/Bundesnormen/10008040/MinroG%2c%20Fassung%20vom%2026.06.2020.pdf). In **Ireland**, there is no specific licensing system for geothermal energy. It is possible to explore under the regulations specified in subsection 2.a.

Granted Water or Mining concession is mandatory to exploit geothermal resources in **Slovenia**. Exploration permits as well as the exploitation approval are mandatory for any kind of mining/resource utilization liable to mining law in **Baden-Württemberg** and **Bavaria**. In **Italy** and **Croatia**, all phases of exploration and exploitation of the geothermal resource are subject to licenses/authorization procedures such as the research permit and the concession for exploitation. In **The Netherlands**, first an exploration license is required, after that, a production license. Once you have a production license you are only allowed to produce if the filed production plan is awarded.

In **Catalonia**, the Spanish Mining Law defines three different stages for which permits are mandatory: a) exploration (no drilling), b) investigation and c) exploitation. Exploration (a) is defined as the study of large areas by quick recognition methods (land cannot be modified) during short periods of time, in order to select the most interesting areas and obtain the corresponding investigation permit. Investigation (b) is the stage to achieve detailed definition and quantification of the geothermal resources and additional field work can be carried out. Finally, exploitation under the granting of an administrative concession, is defined as the stage of recovery of the geothermal resources within the target area for which the permits have been granted. It is not possible to explore and/or exploit without these permits.

4. THE ROLE OF THE LANDOWNER IN THE PROCESS OF LICENCE GRANT FOR EXPLORATION AND EXPLOITATION

In **Austria, Slovenia, Croatia, Italy** and **The Netherlands** it is possible to come to an agreement with landowner in the process of license grant and there is no exploration or exploitation without the landowner's permit/authorization. This means, if there are no problems in reaching the mutual deal, there is no need for land expropriation. In **Baden-Württemberg** and **Bavaria** the applicant in the process of license grant for exploration and exploitation must be the landowner.

Ireland didn't provide any information on the topic since they did not have clarified ownership of geothermal energy in national legislation.

In **Croatia**, the future concessionaire is obliged to regulate property rights with the owner of the land. An opposition of a landowner can slow down the procedure of getting concessions if the landowner is not satisfied with the deal.

In **Austria**, the landowner plays a role in both procedures: i.) land owners have to permit surface measurements (e.g. seismic), and ii.) the land owner is involved in the permitting procedure if thermal water is used at his/her land property or the drilling path crosses the land property. Land owner can hamper the licensing procedure but can barely prevent licenses unless they can prove that they are willing and able to use the thermal water by themselves.

In **Baden-Württemberg** and **Bavaria**, the applicant is the landowner. For the legal treatment of the application the ownership of the real estate (or full usage rights of it) must be large enough for the drilling actions and processing plant, which has to be proven. All environmental concerns and emission protection issues of adjoining owners are dealt with in Environmental Impact Assessment, mandatory for all projects.

In **The Netherlands**, in principle the landowner does not have a role in the process of granting a license. On the other hand, the operator needs to acquire a small acreage to install the wells. The landowner may refuse to make available an area for installing the wells. The landowner, like all other Dutch citizens, can file a "zienswijze" (vision) at certain moments in the license procedure which, if granted, may alter of the license or, in the worst case, cause a denial of the license grant.

In **Italy**, the landowner of the land included in the perimeter of the Research Permit and / or Mining Concession cannot oppose the works, without prejudice to the right to compensation for damages. Furthermore, within the perimeter of each mining title, exploration and cultivation activities are

considered works of public utility, urgent and non-postponable, and therefore subject to a privileged authorization process. However, the opposition of the landowner can slow down the authorization process for the purposes of research, and especially of exploitation.

In **Catalonia**, the role of the landowner is limited. The owner of an exploration/investigation and/or exploitation permit (administrative concession) or the successful bidder of a "reserved zone" (provisional or officially recognized by the corresponding Spanish Ministry) will have the right for "temporary occupation" of the land where it would be necessary to carry out the working plan approved (articles 103, 104 and 105 of the Mining Law 022/1973). So, in practice, if no agreement is reached with the landowner, the legal entity interested in geothermal resources gets a temporary occupation permit almost automatically, due to what is established in the Spanish "Forced Expropriation Law" from 1954.

a. LAND EXPROPRIATION FROM PRIVATE OWNER

In **Austria, Croatia, Italy, Slovenia, The Netherlands** it is possible to expropriate land from private owner for a geothermal project if it is declared of national interest. In **Catalonia** is also possible to expropriate land from private owner, or at least temporary occupy his land, by the owner of an exploration/ investigation and/or exploitation permit or the successful bidder of a "reserved zone". **Ireland** did not provide any information on this topic since there is no specific licencing system for geothermal energy. **Baden-Württemberg** and **Bavaria** state that entry rights can be enforced at adjoining owners for drilling implementation and plant maintenance. Theoretically, land expropriation from the private owner is possible, if public interest has been demonstrated; in reality, this did not happen yet for geothermal energy use in **Austria**. By law, it is possible to limit or confiscate property in the interest of the Republic of **Croatia**, with compensation of market value. The decision that the construction of a building or the execution of works is in the interest of the Republic of Croatia is made by the Government of the Republic of Croatia at the proposal of the expropriation beneficiary. Law on Exploration and Exploitation of Hydrocarbons states that geothermal waters, geological structures suitable for natural gas storage and permanent disposal of carbon dioxide are goods of interest to the Republic of Croatia and have its special protection (https://narodne-novine.nn.hr/clanci/sluzbeni/2014_06_74_1389.html).

5. LICENSING FOR VARIOUS TYPES OF GEOTHERMAL RESOURCES OR FOR DIFFERENT UTILIZATION MODALITIES

Croatia, Italy and **Slovenia** have similar division of types of geothermal resource use and therefore, types of licenses. They have two types of licenses, one for thermal water use for medical and balneological purposes and the other one for energy purposes. **Ireland** does not have specific licensing system for geothermal energy.

In **Austria**, the laws differ between the type of use (closed loop and open loop systems) and the depth of the geothermal energy source (shallow depths < 300m). Closed loop systems are not subject to licensing unless a significant impact on a groundwater body or public interests and existing water rights can be expected as well as if the installation is in an area with artesian groundwater. Open loop systems are

always subject to water permissions according to the Austrian Water Act (WRG 1958). Geothermal energy used at drilling depths larger than 300 meters are in all cases subject to the Austrian Mining Act (MinroG).

In **Baden-Württemberg** and **Bavaria**, except for balneological uses, all (hydro-) geothermal projects are licensable only as closed loop installations whereby 1.1 applies. HDR or other engineered extraction methods are excluded by law (in other words, fracking is a *no-go* in Germany).

For **Italy**, in Article 10 (D.Lgs 11 Febbraio 2010) the "small local uses" of geothermal heat are defined as the resources whose construction allows plants with power below 2 MWt (with t = 15 ° C), and obtained through wells with depths up to 400m; and the plants obtained using geothermal probes. The competent authority decides whether to authorize the injection and re-injection of water used for geothermal purposes in the same aquifer, for the geothermal system considered. For geothermal resources of national or local interest the licences are regulated by D.Lgs 11 Febbraio 2010. For the "small local uses" the licences are regulated by Regio Decreto 11 dicembre 1933, n. 1775 (consolidated text of the provisions of the law on water and electrical systems). For balneology/thermal waters the licenses are regulated by Regio Decreto n. 1443 del 29 luglio 1927 and by subsequent laws of local authorities (regions) due to the delegation of national government to local authorities.

The Netherlands states that there is a difference in various types of geothermal resources based on the depth at which are geothermal activities taking place. Geothermal activities shallower than 500 m are not subject to the Mining Law.

In Croatia, there are differences in licensing, depending on the type of geothermal water use. There are two types: water concession for drinking and bathing waters (balneology, medical use, recreation and other purposes) and mining concession (for heating and electricity production).

Slovenia has two different procedures and permits: If one would like to exploit geothermal energy according to the Mining Act, a geothermal doublet (a pair of production and reinjection wells) with 100% re-injection is obligatory. If re-injection is not 100%, the licensing is subjected also to the Water Act. According to the Water Act, the licensing is possible without or with partial re-injection except in groundwater bodies with poor or non-defined quantity state. There, 100% re-injection of newly licensed quantities is needed.

In **Catalonia**, the Spanish Mining Law doesn't differentiate between different types of geothermal resources. Nevertheless, the article 3.2 of the Mining Law establishes that the resources extracted "occasionally" for the exclusive use of the land owner, where no mining techniques are applied, could avoid the exploration, investigation and exploitation permits. Shallow geothermal resources are usually considered one of these cases, and the permits for its exploitation are not regulated by the Mining Law. On the other hand, there are other types of licensing related with shallow geothermal resources (in both closed-loop and open-loop systems) related with the protection and preservation of groundwater. For shallow geothermal systems a permit for their installation must be obtained through the Catalan Water Agency (ACA) or the Ebro River Basin Authority (CHE), depending on the area where the installation is located.

a. SUBMITTING DOCUMENTATION AND CRITERIA FOR OBTAINING A LICENCE FOR EXPLORATION AND EXPLOITATION

It is clear that every country, except **Ireland** and partially **Austria** have well defined submitting documentation and criteria for obtaining a license for exploration and exploitation of geothermal resources.

Exploration is not regulated in **Austria**. One needs to prove that your installation corresponds to the technical state of the art and does not lead to unacceptable environmental damage; furthermore, the planned use must not have a negative impact on existing water licenses and public interest.

According to the **Croatia**n Law on Exploration and Exploitation of Hydrocarbons: Petroleum-mining works on geothermal water exploration for the purpose of determining geothermal water reserves may be performed exclusively on the basis of a geothermal water exploration permit. Petroleum mining works on the exploitation of geothermal waters may be performed exclusively on the basis of a license for the acquisition of geothermal waters and contracts on the exploitation of geothermal waters. All decisions shall be made by the Ministry responsible for energetics.

Documents required for obtaining license for exploration are:

1. map position, boundaries and area of the proposed exploration area which must be limited by the coordinates expressed in the official reference coordinate system of the Republic of Croatia (HTRS) and the name of the proposed exploration area;
2. program of total exploration works by type and scope with cost estimate and detailed plan of oil and mining works that will be performed in each individual year of exploration;
3. the total amount of funds required for conducting planned exploration works and the manner of their provision;
4. excerpt from the court register from which it is evident that the applicant is registered for exploration and exploitation of geothermal waters;
5. geological or other documentation on the possibility of the existence of geothermal waters in the proposed exploration area, if any;
6. proof that there are no obstacles in the spatial planning documents for conducting the research.

The procedure of conducting the tender for the selection of the most favourable bidder for geothermal water research begins with the decision of the Ministry on conducting the tender for the selection of the most favourable bidder for geothermal water research for the purpose of issuing a license for geothermal water.

The criteria for selecting the most favourable bidder in the tender procedure for issuing permits for geothermal water exploration are:

- technical, financial and professional capacity of the tenderer or the community of tenderers
- the ways in which the tenderer or the community of tenderers intends to carry out the activities which are the subject of the license for exploration of geothermal waters
- overall quality of the submitted bid

- financial conditions offered by the bidder for the purpose of issuing a permit for geothermal water exploration
- any lack of efficiency or accountability in any form demonstrated by the oil and mining undertaking in other States, and in previous activities subject to authorization.

In **Slovenia**, the exact licensing requirements have to be checked individually for each individual area. The most convenient way to check this is to obtain the "Information of conditions for constructing" by the competent administrative unit. Hydrogeological study should be submitted. Boreholes deeper than 300 m (are classified as complex mining works according to Mining Act) require revised mining project as appendix to the research permit application. Water consent is required for interventions/constructions on waterside and coastal land, on protected areas or natural risk zones, for special uses of water (water exploitation), waste water emissions or where impact on groundwater is possible (aquifer recharge, reinjection) as well as for other interventions/constructions that could have impact on water regime (Water Act). Hydrogeological study in which geothermal system is outlined and quantity of water abstraction and temperatures of thermal water is defined should be submitted to ministry responsible for waters or mining.
Environmental permit and water consent are needed before concession is granted. The concession for performing public utility service for heat distribution is needed if distributor supplies more than a hundred household customers according to Public Utilities Act (*Official Gazette RS 30/1998-ZZLPPO, 127/2006-ZJZP, 38/10-ZUKN* and *57/2011*), the Public Private Partnership Act (Official Gazette RS 127/2006), the Act on Local Self-Government (*Official Gazette RS 94/2007-UPB2, 27/2008, 76/2008, 100/2008, 79/2009, 14/2010, 51/2010, 84/2010, 40/2012*), the Energy Act (*EC-1, Official Gazette RS 17/2014, 81/201*5), the Public Procurement Act (*ZJN-2-UPB5, Official Gazette RS. 12/2013* and *19/2014*) and the Municipality local Decree on activity and concessions for the local economic public service of district heating in the area of the Municipality. Slovenian Energy Agency have to issue a consent to the starting price of heat for the district heating distribution system on the basis of the first paragraph of Article 302 of the Energy Act (EZ-1, Official Gazette RS 17/2014 and 81/2015) and Article 207 of the General Administrative Procedure Act (*Official Gazette RS. 24 / 2006- UPB, 105/2006-ZUS-1, 126/2007, 65/2008, 8/2010* and *82/2013*).

In **Baden-Württemberg** and **Bavaria** one should submit following documentation: (i) Proof of a promising geological situation (verified by the Geological Survey within the licensing procedure), plot ownership resp. access rights, proof of capability resp. accreditation of drilling company, detailed working plan for exploration. (ii) Proof of minability, pumping test/stationary flow endurance test, principal operating plan.

To obtain the exploration research permit, in **Italy**, technical-administrative documents such as the research work program and possible environmental impact studies due to the type of work program are required; the technical-economic capacity of the proposer is also important. The concession for the exploitation of geothermal resources recognized as being of national or local interest is issued by the competent authority, with a provision which includes the approval of the work program and the geothermal project, following the positive outcome of a single procedure in which the administrations concerned and the positive outcome of the environmental impact assessment procedure, where required by current legislation.

For obtaining the exploration license in **The Netherlands**, a document needs to be submitted specifying the area applied for, and a geological study in which is stated clearly what data and techniques have been used to model the reservoir. For an exploration license a detailed list of documents to be submitted is specified and can be found in the document (in Dutch) via this link: https://www.nlog.nl/sites/default/files/2020-03/handreiking_aanvragen_opsporingsvergunningen_aardwarmte_def.pdf

In the case of **Catalonia**, the Mining Law defines in a quite general way the documents to be submitted for the obtention of the investigation and exploitation permits (not for the initial exploration license). Investigation and exploitation licenses are granted by the General Directorate for Energy Policy and Mines, dependent organisation of the Energy State Secretary from the Ministry of Ecological Transition and Demographic Challenge (Spanish government) through the corresponding competent authorities of each autonomous community which in the case of Catalonia corresponds to the General Directorate of Energy, Industrial safety and Mining Safety of the Business and Labour Department (Catalan Government). For the exploration permit, an exploration programme specifying all techniques used must be submitted, while for the investigation permit it is necessary to submit the research project signed by a mining engineer which must include the working plan, the budget for the investments to be made and the economic study of its financing. After verifying and accepting the submitted documentation, the General Directorate of Energy, Industrial safety and Mining Safety refers the investigation permit requested to a public hearing during 15 days before its approval.

To obtain the exploitation permit it is necessary to submit the exploitation project which must include the working plan, the budget of the total investments to be made and a financial study with the guarantees that the exploitation is viable from an economic point of view. The General Directorate for Energy Policy and Mines (Ministry of Ecological Transition and Demographic Challenge) will grant or deny the exploitation license being able to impose special conditions it deems appropriate, including those related with environmental protection.

6. LICENSE DURATION AND RENEWAL

For all project partner countries, the maximum duration of a license for exploration is from 1-5 years and 25-30 years for exploitation, with possibility of extension periods.

The maximum duration of a water license, in **Austria**, is limited to 30 years; the license can be renewed through a simplified licensing procedure according to the criteria mentioned in 5.2.

The maximum duration of a license for exploration in **Croatia** is 5 years, and 25 years for exploitation, according to Law on Exploration and Exploitation of Hydrocarbons. In case of exploration, the Ministry may extend the validity of a geothermal water exploration permit, at the justified request of the investor, when the established deadline is not sufficient to complete the exploration in question in accordance with the geothermal water exploration permit, where the financial incapacity of the investor cannot be a justifiable reason for extension periods. In case of exploitation, if an addendum to the geothermal water exploitation contract is concluded, it may not extend the term from the geothermal water exploitation contract, except at the justified request of the investor, for the purpose of rational exploitation of geothermal water.

Exploration permits, in Slovenia, according to Mining Act may be issued for a maximum period of 5 years. The period of validity of exploration permits cannot be extended, except in case of force majeure, when the period of validity of the exploration mining permit may be extended for the duration of force majeure. Exploration license, according to the Water Act (*Official gazette of RS 67/02*) may be issued for the period of 2 years with possible prolongation. One could apply for mining concession for a geothermal doublet according to the Mining Act (*Official gazette of RS 14/14*) for a period of maximum 50 years or for water concession according to the Water Act (*Official gazette of RS 67/02*) for the period of maximum 50 years with possible prolongation. Usually, the latter are granted for 30 years.

In **Baden-Württemberg** and **Bavaria**, the maximum duration of license for exploration is 1-2 years, max. 5 years, according to the working plan, and 30 years for exploitation license. Prolongation or renewal is possible under the claim of "good reasons" / force majeure, adjusted operations plan.

In **Italy**, the maximum duration of the research (exploration) permit is 4 years, which can be extended for no more than two years. The duration of the exploitation concession is thirty years. Three years before the expiry of a concession and in cases of forfeiture, renunciation and revocation, the competent authority, where it does not consider there is an overriding public interest incompatible in whole or in part with the maintenance of the concession, calls for a public tender, in compliance with current legislation and the fundamental principles of competition protection.

There is no maximum duration for an exploration license in **The Netherlands**, but in practice licenses are granted for a period of 3 to 6 years. It is possible to apply for an extension. The period of extension is variable, but typically in the order of 1 to 2 years. Multiple extensions are possible. The maximum duration of a production (exploitation) license is 35 years. This is not in the law but is a general rule applied. Extension of the license term is possible.

In **Catalonia**, the maximum duration of an exploration permit is 1 year, and renewal is possible for another year. For the investigation permit the duration is 3 years and renewal is possible for 3 years more, or exceptionally more under specific conditions. For the exploitation license the maximum duration is 30 years, and renewal is possible for 60 years more, in periods of 30 by 30 years.

7. GENERAL CONTENTS OF THE LICENSES FOR EXPLORATION AND EXPLOITATION

The content of **Austria**n license covers the description of the technical installation, given by the applicant, and the granted yield (maximum, total annual sum); the license may also contain conditions for the granting of the water use (e.g. compulsory monitoring).

For exploration license content in **Croatia** please see paragraph 5.1. The contract (license) on exploitation of geothermal waters contains: 1. the amount and manner of payment of the fee for obtaining geothermal waters, 2. name, map position, boundaries and area of the determined exploitation field, 3. total determined geothermal water reserves, 4. verified project of elaboration and exploitation on the basis of which the permit for extraction of geothermal waters is issued, 5. the estimated amount of the costs of rehabilitation of the exploitation field and the deadline by which the investor must submit a guarantee for the costs of rehabilitation of the exploitation field, 6. deadline by which oil-mining works

must begin, 7. deadline for concluding the contract on exploitation of geothermal waters, 8. a provision enabling amendments to the contract on the exploitation of geothermal waters to the extent provided for in the tender documentation for a permit for the exploration of geothermal waters and a provision on force majeure.

Slovenian water license for exploration contains: 1) application form (applicant, spatial delineation of the site with new geothermal object, expected yield and depth of the well, list of existent users of the same groundwater resource); 2) hydrogeological grounds or programme; 3) well project if planned depth is more than 50 m; 4) revised mining well project if planned depth is above 300 m; 5) copy of the parcel plan with location of the planned object; 6) consensus of the parcel owner (if other); 7) official opinion of the public drinking water provider if drinking water resource is to be exploited; Slovenian water license for exploitation contains: 1) application form (applicant, geothermal object, way of utilization; 2) spatial plan of the site; 3) geodetic plan; 4) Land parcel extract; 5) legal and professional documents related to the object; 6) operating permit; 7) official opinion of the Institute of the Republic of Slovenia for Nature Conservation ; 8) official opinion of the public drinking water provider if drinking water resource is to be exploited; 9) hydrogeological report on the geothermal objects.

Exploration mining license for geothermal energy resource (in Slovenia) contain: 1) application form (applicant, type of mineral resource, proposed name of research area, cadastral information, geodetic plan with delineation of the exploration area, quantity and type of exploration works, proposal of the permit period). Exploitation mining license for geothermal energy resource contain: 1) application form (applicant, spatial planning document for mining, proposal of name of research area, exploitation area with cadastral information, elevation of the deepest site, resource type, methodology for exploitation, period of the concession, exploited quantity, restoration plan for the site and activities connected to the exploitation); 2) geodetic plan; 3) consent of the land owner; 4) consent of the existing mining right owner of other than applied for resources.

In **Baden-Württemberg** and **Bavaria**, general contents of the licenses for exploration is the same as in the working plan. General contents of the licenses for exploitation is defined in the operations plan, if applicable considering adaption of the mining authority / water administration authority.

In order to maintain the research (exploration) permit in **Italy**, the proposer must respect the time schedule of the research work and all the specifications / prescriptions issued by the competent authorities during the authorization process. In order to maintain the exploitation concession, the concessionaire must respect and implement what is contained in the final project for the cultivation of the geothermal resource, respecting the time schedule of the cultivation and exploitation works of the resource and all the specifications / prescriptions issued by the competent authorities during the concession authorization process.

The Netherlands states that in general there can be overlapping license for different resources (Hydrocarbon, salt and geothermal) and each resource needs a separate license. (You are not allowed to produce salt or hydrocarbons in as a geothermal license owner). If there is a storage license under the mining law present in an area then exploration or production licenses of natural resources and geothermal energy cannot overlap.

In **Catalonia**, the investigation and exploitation licenses contents are variable. In general, they contain the name of the ownership, the grant date, the target area defined by means of geographical coordinates. Sometimes they describe the minimum works to be carried out as defined in the research or working plans, the total investment or budget, the environmental protection measures and a brief summary of the restoration plan.

a. AUTOMATIC CONVERSION OF SUCCESSFUL EXPLORATION LICENCE INTO EXPLOITATION LICENCE

The Netherlands, Slovenia and **Catalonia** do not support the possibility of automatic conversion of the exploration to exploitation license. **Baden-Württemberg, Bavaria, Croatia** and **Italy** find the process of getting exploration license to obtaining exploitation license (permit) a continuous process. **Austria** finds this not applicable.

The issuance of a license for the extraction of geothermal water in **Croatia** is carried out, by Ministry responsible for energetics, on the basis of a single tender in a single procedure that begins with the selection of the most favourable bidder for the issuance of a license for geothermal water exploration and ends with the conclusion of geothermal water exploitation contracts.

In **Slovenia**, in case of successful exploration, the exploration licensee cannot be automatically converted into exploitation licensee. The concession application has to be submitted to the ministry responsible for waters (Ministry for Environment and Spatial Planning - MOP) or internal resources (Ministry for Infrastructure - MzI).

For the water concession the Decree on concession is granted by the Government of RS and published in the Official Gazette of the RS. A public tender follows and the same body issues the concession act for on-a-tender selected concessionaire. In special cases, the concession can be granted without public tender.

If the geothermal energy source (100% reinjection) is in place, the concession is granted according to the Mining Act. The concession application has to be submitted to the ministry responsible for mineral resources (Ministry for Infrastructure - MzI). The Decree on concession is granted by the Government of RS and published in the Official Gazette of the RS. A public tender follows and the same body issues the concession act for on-a-tender selected concessionaire. If more than one applicant exists, the winner is selected according to the height of the offered mining fee. In special cases, the concession can be granted without public tender. The mining concession contract defines quantity of mineral resource exploitation, payment to the state and monitoring.

If the pre-requisites as under 5.1., for **Baden-Württemberg** and **Bavaria**, are met then automatic conversion of successful exploration (license) into exploitation license is possible.

In **Italy**, within six months of the recognition of the national or local character of the resources found, the permit holder has the right to submit application for a cultivation concession to the competent authority. Once this term has elapsed in vain, the concession may be requested, in competition, by other operators. If the concession request does not cover the entire area of the original research permit, other operators may request a concession for areas related part or all of the remaining surface.

The Netherlands does not allow automatic conversion of the exploration to exploitation license. the operator needs to apply for a production license. The owner of the exploration license has the primary right to apply for the production license. Besides a production license an operator needs to file a production plan and the Minister has to approve this production plan. A production plan describes the production prognosis and risks like subsidence and a seismic hazard and risk analysis.

8. LICENCE HOLDER RIGHT TO ASK FOR THE REVISION OF THE EXPLORATION OR EXPLOITATION LICENCE

Exploration or exploitation license holder in all of the project partner countries has the right to ask for their revision and adaptation, but under different conditions for each country, except in the **Catalonia**n case where this is not defined in the Spanish national legislation of reference.

In **Austria**, water utilization grants can be adapted by a simplified water permitting procedures in case the grant holder can justify the change of demand and all criteria of 5.1 are fulfilled.

License holder in **Croatia** has the right to ask for revision of the exploration or exploitation license, and the preparation of a new elaborate (study) is necessary.

License holder, in **Slovenia**, has the right to ask for the revision of licenses. If any change of the license is desired, the license holder has to officially inform the granting authority and provide the documents based on which it is possible to make decisions on acceptability of requested changes.

License holder, in **Baden-Württemberg** and **Bavaria**, has the right to ask for the revision of licenses under the same condition as the prime application: Proof of capability, pumping test/stationary flow endurance test, adjusted operating plan, heat production: determination of demand and availability of grid.

During the exercise of the concession, in **Italy**, the concessionaire may request a revision / variant of the same having particular regard to a program of environmental improvement and remediation of the area and of increasing the energy produced or installed power, in order to safeguard the geothermal resource.

In **The Netherlands** licenses can be changed, for instance the size, if a license holder abstains from a part of the license. The license holder submits a request with the Ministry. On the other hand, the license can also be extended if, for instance, cooling takes place beyond the license boundary. In such a case, a full application for the extra area needs to be submitted. Additionally, for changing the production strategy, a new production plan needs to be submitted.

a. GRANTING AUTHORITY POWER TO REWOKE OR TERMINATE LICENCES

Granting authorities of all project countries, except Austria, have to power to revoke or terminate licenses.

Austrian license granting authority does not have the power to revoke or terminate licenses.

The concession agreement (license), in **Croatia**, may be unilaterally terminated if the user does not respect rights which are determined by the concession, provided by the Law on Concessions. Revenue

from damages owed by the concessionaire to the grantor is the revenue of the grantor. The Ministry may terminate the contract on the exploitation of geothermal waters if the investor does not fulfil the obligation from the contract on the exploitation of geothermal waters: 1. if the investor does not respect the deadlines and obligations determined by the license for exploration of geothermal waters, 2. if the prescribed safety measures at work and the necessary measures for the safety of people, property and protection of nature and the environment, ordered by a decision of the oil and mining inspection of the Ministry, have not been implemented, 3. if the exploration interferes with or endangers the exploration of hydrocarbons in the same exploration area or the exploration of hydrocarbons in adjacent exploration areas, 4. if the exploration endangers the future exploitation of hydrocarbons, 5. if the exploitation hinders or endangers the exploitation of hydrocarbons in the determined exploitation fields, 6. if exploitation is performed within the research, unless it is allowed by the permit for exploration of geothermal waters, 7. if the exploited geothermal water is not disposed of in a lawful manner within the framework of research for the purpose of technological testing and determination of conditions of exploitation, 8. if the exploration is carried out outside the boundaries of the exploration area specified in the permit for exploration of geothermal waters, 9. if exploration works are carried out without a proven right to use the land or if it has subsequently ceased, 10. if it does not submit a guarantee for remediation in the amount, form and deadline specified in the geothermal water exploration permit. (8) The Ministry shall refuse to conclude a contract on the exploitation of geothermal waters if the investor has not obtained an inspection of the development and exploitation project.

Slovenian granting authority has the power to terminate licenses. The granting authority and other agencies (e.g. Environmental Agency) have the right and duty to regularly monitor fulfilling of the conditions in the concession contract. If they are not reached by the concessionaire, first an official call is issued to mitigate the shortcomings, if this does not succeed a responsible inspector is noticed and field inspection is performed and possible financial and other measures proposed. If the conditions are still not met, the authority has the right to terminate the license either by reducing the granted quantity, by adding some other conditions in the contract or by totally terminating the license. The latest is only seldom happened.

Baden-Württemberg and **Bavaria** granting authorities have the power to terminate licenses. In case of non-compliance with (i) working plan or (ii) operating plan without claiming of "good reasons" / force majeure. → Cessation of the project.

Granting authorities in **Italy** have the power to terminate or revoke licenses. The holder loses the mining title when: a) does not start work within the prescribed time limits; b) fails to comply with the work programs and the geothermal project within the times and in the manner provided for by the mining title; c) the fee due is not paid within the terms; d) sells shares of the security without the authorization of the competent authority; e) fails to comply with the obligations envisaged by the title under penalty of forfeiture; Furthermore, the concession issued for the use of geothermal resources of local interest can be revoked if, following the recognition of the national character of the field geothermal, the owner does not prove to have adequate technical and economic skills to carry out a geothermal project of national interest.

Granting authorities in **The Netherlands** have the power to terminate or revoke licenses. Licenses come with certain requirements which can differ from license to license, for instance the timely submission of monitoring reports, an obligation to plan or drill a well before a certain moment, or repetitive disrespect for HSE issues. Usually, this is discussed with the license holder. No forced revoking has occurred until now.

Granting authorities in **Catalonia**, Spain, have the power to terminate or revoke licenses. The Mining Law defines in a very detailed way all the cases in which the license could be cancelled. These cases are mainly related with the non-compliance with what is defined in the working or research plans and/or the research or working plan schedule approved.

b. THE LICENSE GRANTING AUTHORITY ABILITY TO SET FORTH CONDITIONS INTO LICENSES WHICH PROVIDE FOR STRICTER OR MORE PERMISSIVE TERMS AND CONDITIONS FOR LICENSEES

In all project partners' countries, except in **Croatia**, the granting authority is allowed to set forth conditions into licenses which provide for stricter or more permissive terms and conditions for licenses, when such terms and conditions are not otherwise provided by the law.

During the permitting procedure, in **Austria**, the granting authority is allowed to set forth conditions into licenses which provide for stricter or more permissive terms and conditions for licenses, when such terms and conditions are not otherwise provided by the law.

In **Croatia**, license granting authority cannot set forth conditions into licenses without revision of the concession contract. A new request is required and the new permit is needed.

In **Slovenia**, the granting authority is allowed to set forth conditions into licenses which provide for stricter or more permissive terms and conditions for licenses, when such terms and conditions are not otherwise provided by the law. Conditions are set based on coordination with several agencies and they have the right to adjust the general requirements to local settings/conditions. For example, if strict monitoring is demanded in the Decree but is physically and economically not feasible to perform it, adjustments can be made based on professional justification of needed exceptions. Other example is that if increase in licensed quantity is requested, the authority cannot grant it if the groundwater body is in poor quantity state and therefore other solutions (e.g. reinjection) has to be proposed.

Baden-Württemberg and **Bavaria** state that there is always room for a certain allowance at discretion in jurisprudence. Normally there is no deviation from the provisions as laid down in the legal text.

For **Italy**, in general, the terms and conditions for the exploration and exploitation of the geothermal resource are contained in the deeds of issue of the research permit or in those of the concession for exploitation, however referring to the laws in force. Depending on the type of research or exploitation project, greater or lesser requirements may be introduced in the implementation of the work program, especially in relation to possible environmental impacts, safety and induced seismicity.

In **the Netherlands**, the granting authority is allowed to set forth conditions into licenses which provide for stricter or more permissive terms and conditions for licenses, when such terms and conditions are not

otherwise provided by the law. Both the license granting authority and the Mining authority can do that. The latter is more often the case. I think it is sensible to note that the granting authority is supplemented with the mining authority which looks after adherence to the license terms and additionally checks on QHSE issues. The mining authority is allowed to impose additional conditions.

In **Catalonia**, the General Directorate of Energy, Industrial Safety and Mining Safety of the Business and Labour Department (Catalan Government) may accept the investigation and exploitation projects or ask for arrangements including more stricter terms and conditions. If the applicant of the licenses does not accept the proposed modifications, then the proceeding is cancelled. Furthermore, for the investigation license grant, if the granting authority considers that the program is not rationally feasible from the financial point of view, it could require a bond of ten percent of the investment planned for the first year, which will be reimbursed to the petitioner once having invested the difference between the required bond and the planned investment.

c. TOOLS AND ACTIONS WHICH SUPPORT LICENCE GRANTING AUTHORITY TO ENFORCE COMPLIANCE TO THE TERMS AND CONDITIONS OF A LICENSE

All project partners' countries, except **Austria**, reported the existence of tools or actions which license granting authorities have in order to enforce compliance to the terms and conditions of a license. The control authority, inspection is the main tool for assurance of compliance to the terms and conditions of licenses.

Austria reported no existence of tools or actions which license granting authorities have in order to enforce compliance to the terms and conditions of a license.

In **Croatia** and **Catalonia**, mining and water inspection represent tools which enable granting authority control of the compliance to the terms and conditions of licenses.

In **Slovenia**, penalties foreseen by Acts and specified in Licenses and Concession contracts according to inspection and Inspectors decision serve as a tool which enable granting authority control of the compliance to the terms and conditions of licenses.

Compliance with the working plan resp. operating plan is regularly examined by the mining control authority (Bergaufsicht) in **Baden-Württemberg** and **Bavaria**. In case of non-compliance the usual enforcement measures apply: from penalty payments to revocation of license.

The local mining offices (regions) or the "UNMIG" at **Italia**n national level monitor the implementation of the work program and the payment of the various concession fees. Before reaching the revocation of the license they can solicit the concessionaire in the fulfilment of his duties but they cannot do anything else. If the concessionaire does not comply with the requirements and the payment of the fees, the license will be revoked.

The State Supervision of Mines authority, in **the Netherlands**, can enforce compliance to the terms and conditions of a license. Tools for this enforcement are fines or a forced shut-down of the facility.

d. LICENCE HOLDER TECHNICAL ABANDONMENT OF THE WELL AFTER EXPLOITATION PERMIT EXPIRATION

In the **Netherlands, Austria, Baden-Württemberg, Bavaria** and **Catalonia**, the license holder is obliged to technically abandon the well after the exploitation permit expires.

In **Austria**, the license holder is obliged to technically abandon the well after the exploitation permit expires. There is no statutory provision but it is defined as state of the art (guidelines describing the technical state of the art: *OEWAV Regelblatt 207* - shallow geothermal, *OEWAV Regelblatt 215* - deep geothermal).

The license holder in **Croatia** is not obliged to technically abandon the well after the exploitation permit expiration (see 13.1). According to the Law on exploration and exploitation of Hydrocarbons, the geothermal water acquisition permit prescribes the estimated amount of the costs of remediation of the exploitation field and the deadline for submission of the guarantee for the costs of remediation of the exploitation field. A termination and remediation procedure should be listed already at the time of submitting application for the license.

According to the **Slovenia**n Mining Act, a termination procedure should be listed already at the time of submitting application for the license. There are no by-laws or standards how to liquidate the exploration well, also criteria to adjust the exploration well into observation well is absent.

In **Baden-Württemberg** and **Bavaria**, the license holder is obliged to technically abandon the well after the exploitation permit expires in case the expected yield definitely is not met or any failure inhibits the routine production in line with the operating plan a complete removal of the well and renaturation of the drill site is mandatory.

In the event of the natural expiry of the concession in **Italy**, the call for tenders provides for the transfer of ownership of the business unit relating to the exercise of the concession, including all legal relationships, from the outgoing concessionaire to the new concessionaire, according to methods aimed at guaranteeing management continuity and upon payment of a fee, both pre-determined by the competent authority and the outgoing concessionaire before the offer phase and disclosed in the tender documents. In case of forfeiture, renunciation and revocation of the concession, all the plants of the same, in a state of regular operation, become the property of the competent authority, without compensation. The competent authority may request their safety and the complete or partial environmental restoration of the affected area. The competent authority also has right to enter the immediate possession of any other building, machinery, utilization, transformation and distribution plant inherent to the concession, by paying to those entitled to a price equal to the estimated value of the material in place, calculated at the time of entry into possession, abstracting from any evaluation of the income derived from it.

In **the Netherlands**, the license holder is obliged to technically abandon the well after the exploitation permit expires. Standards are generally described in the mining law and detailed in additional documents. State Supervision on the Mines / Mining Authority looks after the compliance of the abandonment plan and procedures with the law.

In **Catalonia**, the license holder is obliged to technically abandon the well after the investigation and exploitation permit expires. Mining Law does not define in detail the terms and conditions, but a restoration plan procedure should be submitted (so, reviewed or accepted by the competent authority) at the same time as the other documentation submitted for the license grant proceeding.

9. REGULATORY AUTHORITES SURVEILLANCE DURING THE LICENSE PERIODS

In every project partner country, the regular and formal reporting of compliance with the operating plan examined by the mining control authority is needed during license period.

In **Austria**, the applicant needs to report the accomplishment of the geothermal installation and the authority has the right to execute on site checks to verify that the installations have been completed as planned. The authority may demand monitoring data (water extraction, injection, wellhead pressure, wellhead temperature), which can be evaluated by the authority in periodic intervals.

Every year, users of licenses in **Croatia**, have to report to the authority how much resources are exploited. For time to time field inspection is done by authority. At any time during the duration of the agreement (contract), the competent authorities of the Republic of Croatia have the right to supervise and inspect the activities of investors in accordance with the provisions of the agreement and applicable laws and regulations of the Republic of Croatia.

In **Slovenia**, the Water concessioners have to provide several documents to the Environmental Agency. It checks the 3-year monitoring programs, the annual reports on operational monitoring and notices them if the documents are compliant with the requirements. If they are not (after several calls for improvement), inspectors are assigned to make a site visit. Annual production data have to be reported to DRSV to accrue the concession fee and water reimbursement. The Mining concessioner has to report just amount of produced water to the mining authority and the produced heat to DRSV for water reimbursement. No reporting on monitoring is obliged for the only one mining concessioner.

In **Baden-Württemberg** and **Bavaria**, regular and formal reporting of compliance with the operating plan examined by the mining control authority (Bergaufsicht) is needed. If doubtful on-site examination.

The supervision of the competent **Italia**n authority in relation to local interest licenses depends on the various mining offices present on the national territory (regions) and each of them normally establishes methods and times for the on-site monitoring and control of the activities. If the geothermal resource is of a national nature, the competent mining office is the "UNIMIG" of the Ministry of Economic Development. As regards the "Small Local Uses", no particular checks are normally carried out in situ.

The Mining Authority of **the Netherlands** visits the geothermal sites with a certain regularity. The supervision strategy and arrangements are published. See https://www.sodm.nl/sectoren/geothermie/documenten/publicaties/2020/07/01/toezichtarrangement-geothermie. Reporting of production figures is mandatory. They are used for the monitoring of the system and adherence to the license conditions.

a. EXPLORATION AND EXPLOITATION INFORMATION REQUIRED FOR SUBMISSION TO REGULATORY AUTHORITIES DURING THE LICENSE PERIOD

In **Austria**, license holders generally need to report: amount of extracted and injected groundwater, shutdown wellhead pressure, wellhead temperature at the production well in terms of time series.

In case of exploration in **Croatia**, the investor shall without delay and fully submit to the Ministry and the Agency information on petroleum-mining works performed by him or his subcontractors, and the investor shall without delay submit to the Ministry and the Agency free of charge all source data obtained under the agreement, including, without limitation, seismic data, geological, geophysical, geochemical, petrophysical, engineering data, well logging, maps, magnetic strips, cores, drilled rock fragments and exploitation data, and interpretive and derived data, including reports, analyses, interpretations and assessments prepared with respect to petroleum-mining works. In case of exploitation, the Investor shall submit to the Ministry, the Agency and authorized representatives of the Government data, reports, records and financial reports related to petroleum-mining works in the contract area in accordance with the schedule and procedures that may be required and described in detail in the provisions of the agreement, the Law and all other applicable laws and regulations of the Republic of Croatia.

During the license period in **Slovenia**, hydrogeological study with estimation of thermal water temperature and quantity, chemical composition of thermal water, as well as reservoir characterization has to be submitted to regulatory authorities. As well as temperature, quantity, chemical and isotope composition of thermal water, piezometric head in the well, temperature, quantity and chemical parameters of waste thermal water, annual amount of sold heat (MWht), price of sold energy and availability of distribution.

In **Baden-Württemberg** and **Bavaria**, license holders generally need to report almost the same information for drilling progress reports and yearly operations reporting according to water law: extraction amount, temperature trend, seismic monitoring, surface levelling (nivellements).

Normally, during the research or cultivation phase in **Italy**, it is necessary every 3 months to produce a technical report containing information regarding the progress and results of the work program, the data produced by monitoring and / or the progress of exploitation of the geothermal resource. There are also national guidelines for the seismic monitoring of the area, the results of which must be periodically communicated to the competent authority.

In **the Netherlands**, license holders generally need to submit monthly production data, as specified in the Mining Law on a high level. This includes amounts of produced and injected liquids, produced and injected temperatures and pressures.

In **Catalonia**, the competent authority visits the geothermal sites before the grant of the investigation and exploitation licenses. The information required to be submitted to regulatory authorities during the license period are similar for the investigation and exploitation license:

a) In the case of the investigation permit, the owner must begin the works planned within a period of six months, from the date on which he is available to temporary occupy the target land. Within a period of four months from the same date, a detailed working plan to be executed in the first year must be

submitted to the competent authority (General Directorate of Energy, Industrial Safety and Mining Safety of the Business and Labour Department - Catalan Government). Annually this working plan must be updated and submitted to the same competent authority. Failure in submitting the mentioned working plan would be penalized with a fine. The initial working plan and the following ones are considered approved if the competent authority does not impose arrangements or changes within two months.

b) For the exploitation license, the owner must begin the works planned within a period of one year from the grant license date. Within a period of six months from the same date, a detailed working and installation plan to be executed in the first year must be submitted to the competent authority (General Directorate of Energy, Industrial Safety and Mining Safety of the Business and Labour Department - Catalan Government). Annually this working plan must be updated and submitted to the same competent authority. Failure in submitting the mentioned working plan would be penalized with a fine. The initial working plan and the following ones are considered approved if the competent authority does not impose arrangements or changes within three months.

10. REGULATION OF GENERAL TERMS AND CONDITIONS OF POWER/HEAT PURCHASE AGREEMENTS

Austria, The Netherlands and **Catalonia** do not regulate the general terms and conditions of power/heat purchase agreement.

Austria states that the general terms and conditions, such as duration of Power/Hear Purchase Agreement are not regulated.

In **Croatia**, the general terms and conditions, such as duration of Power/Hear Purchase Agreement are regulated. In the Republic of Croatia, the Law on the market of thermal energy which regulates general terms and conditions of Heat Purchase Agreements is in force (i.e. prescribes mandatory parts of such Agreements).

In **Sloveni**a, all general terms and conditions, such as duration of Heat Purchase Agreements are regulated in Energy Act (*Official Gazette RS 17/2014 and 81/2015*).

For **Baden-Württemberg** and **Bavaria** regulations, the general terms and conditions, such as duration of Power/Hear Purchase Agreement are integral part of the approved operating plan.

The production and purchase of electricity and heat are regulated by law in **Italy**. Generally, the production of electricity is sold to the national electricity grid on the basis of a feed tariff which has a duration established by law. As regards thermal energy, the sale and sale are normally regulated by the internal market; in addition, the competent authority can also grant dedicated feed tariffs in this case based on the mode and quantity of thermal energy production, always for a certain period of time.

In **the Netherlands**, the general terms and conditions, such as duration of Power/Hear Purchase Agreement are not regulated. This is between private parties. The government has no part in the agreements.

a. PERMITTED OR GENERAL DURATION OF POWER/HEAT PURCHASE AGREEMENTS

Austria and **the Netherlands** do not have specific law that regulates the duration of power/heat purchase agreement but because of different reasons, stated later. General duration of power/heat purchase agreement is: 14 years in Croatia, 10 – 35 years in Slovenia, 25 years in Italy. For Baden-Württemberg and Bavaria countries, the duration is not explicitly stated.

Austria and **Catalonia** state that the general terms and conditions, such as duration of Power/Heat Purchase Agreement are not regulated, so the topic is not applicable for the country.

The contract on the purchase of electricity produced from generating plants using renewable energy sources and cogeneration plants is concluded for a period of 14 years in **Croatia**. https://narodne-novine.nn.hr/clanci/sluzbeni/2013_11_133_2888.html

In **Slovenia**, the permitted or general duration of power/heat purchase agreement is written in the concession contract between the Municipality as user and Geothermal heat distributor. Usually the duration is 10 years with possibility of further prolongation. Energy Act states that duration of distribution concession should not exceed 35 years.

In **Baden-Württemberg** and **Bavaria**, permitted or general duration of power/heat purchase agreement is integral part of the approved operating plan.

The rate recognized by the GSE, in **Italy**, depends on the type of geothermal plant and is all-inclusive, constant in current currency, recognized for a period of 25 years from the date of entry into operation of the plant. There is a national ranking based on different power thresholds to which the licensee must ask questions in order to access.

In **the Netherlands**, purchase agreements are settled between producer and client, and there is no specific law regarding the duration.

b. PUBLIC AND/OR NATIONAL REGULATORY AUTHORITIES PARTICIPATION IN FORMING THE TERMS OF HEAT PURCHASE AGREEMENTS

In **Austria, Baden-Württemberg, Bavaria** and **The Netherlands** public and national regulatory authorities do not participate in forming the terms and conditions of heat purchase agreements. In **Slovenia** and **Croatia**, they do participate.

To topic is not applicable for **Austria** and **Catalonia**.

In **Croatia**, public and national regulatory authorities participate in forming the terms and conditions of heat purchase agreements. Several public bodies affect the conditions of the Heat purchase agreement, the most important is the Croatian Energy Regulatory Agency (HERA) which determines the methodology for the calculation of tariff items and provides the general terms for delivering of energy. The terms of the contract must be in accordance with the Law on the market of heat energy and the Law on consumer protection. Croatian energy market operator (HROTE) performs the activity of organizing the electricity market and the gas market as a public service, under the supervision of the Croatian Energy Regulatory Agency.

In **Slovenia**, public and national regulatory authorities participate in forming the terms and conditions of heat purchase agreements. Slovenian Energy Agency have to issue a consent to the starting price of heat for the district heating distribution system on the basis of the first paragraph of Article 302 of the Energy Act (EZ-1, Official Gazette RS 17/2014 and 81/2015) and Article 207 of the General Administrative Procedure Act (Official Gazette RS. 24 / 2006- UPB, 105/2006-ZUS-1, 126/2007, 65/2008, 8/2010 and 82/2013). Also, on a basis of Article 311 of the Energy Act (EZ-1) is necessary annually report to Energy Agency about distribution network and devices, produced and distributed quantities of heat, tariffs and prices.

Baden-Württemberg and **Bavaria** state that terms of heat purchase agreements are purely private-law agreements of the operator. Most of the heat production operators are (public) utilities owning (or establishing) their own consumer grid.

The **Italia**n state through laws promulgates financial measures (feed tariff and / or tax credit) to promote the use of renewable thermal energy such as geothermal energy.

In **the Netherlands**, public and national regulatory authorities do not participate in forming the terms and conditions of heat purchase agreements. There is however a best practices document compiled for the Dutch Association of Geothermal Operators (DAGO) on legal issues and contracts. See https://www.kasalsenergiebron.nl/onderzoeken/20045_contract_management_geothermie/.

11. STATUTORY REQUIREMENTS REGARDING ENVIRONMENTAL IMPACT ASSESSMENT PRIOR TO EXPLORATION/EXPLOITATION OF GEOTHERMAL ENERGY

Environmental impact assessment prior to exploration and exploitation of geothermal energy is compulsory in all the project countries (**Austria, Slovenia, Ireland, Italy, The Netherlands, Bavaria** and **Baden-Württemberg**), except in **Croatia**, where the Ministry responsible for environmental and nature protection decides on the request for assessment of the need to assess the impact of the project on the environment.

Until now, in **Austria**, geothermal energy use itself was not the subject to environmental impact assessment procedures; the drilling might be subject to a simplified environmental impact assessment when placed in protected areas. Authorities might demand groundwater monitoring in case geothermal energy is used in sensitive groundwater areas.

In case of exploitation of **Croatia**n mineral and thermal water used for medical, balneological and recreational purposes and exploitation of mineral and geothermal waters from which accumulated heat can be used for energy purposes, the Ministry responsible for environmental and nature protection decides on the request for assessment of the need to assess the impact of the project on the environment. When the need for an environmental impact assessment is determined for the project, the Ministry also decides on the request for instructions on the content of the study on the impact of the project on the environment. According to regulation on environmental impact assessment. https://narodne-novine.nn.hr/clanci/sluzbeni/2014_05_61_1138.html

Geothermal energy activities in **Ireland** are regulated under other environmental regulations. These include: Planning - Geothermal projects for district heating would come under the provisions of the Planning and Development Act 2000, and subsequent amendments, and the Planning and Development Regulations, implemented by 31 local authorities. Deep drilling - An amendment to the Planning and Development Act 200 (S.I. No. 543 of 2014), which gives effect to EU Directive 2011/92/EU, specifically includes geothermal drilling among the deep drilling activities that may require an environmental impact assessment if the planning authority consider the activity would be likely to have significant effects on the environment. Water abstraction and discharge - The Environmental Protection Agency (EPA) and local authorities monitoring and enforce groundwater regulations, many of which stem from the EU Water Directive Framework (2000/60/EC). Discharge licenses must be obtained for discharges to surface waters or to groundwater.

In **Slovenia**n decree on environmental encroachments that require environmental impact assessments (*Official Gazette RS, No 51/14, 57/15 in 26/17*) states that D.III.7 Geothermal drilling and other facilities for the exploitation of a geothermal energy source, other than shallow geothermal systems (in accordance with regulations governing mining), and E.II.2 Exploitation of mineral or thermal water (according to regulations governing waters) are environmental interventions for which the environmental impact assessment is compulsory if it is established in the preliminary procedure that they could have significant environmental impacts. If EIA is compulsory, the Initiator has to obtain Environmental consent to be able to proceed with further license procedures.

Before drill-site construction, in **Baden-Württemberg** and **Bavaria**, commences an EIA and a species protection mapping is mandatory.

In **Italy**, all the authorization procedures relating to the work program of the research permit and the cultivation project may be subject to environmental impact assessment pursuant to Legislative Decree 152/2006 "Environmental regulations". Only in some cases "small local uses" are excluded from the EIA procedure.

An environmental permit is required before drilling any wells in **the Netherlands**. It can be applied for at the same time as the Exploration License. Check out all the WABO regulations (the WABO (*Wet algemene bepalingen omgevingsrecht*) is a law on general provisions of environmental law).

In **Catalonia**, the current legal framework regarding the environmental impact assessment of projects is regulated by Law 21/2013, of December 2013, on environmental assessment (BOE no. 296 11.12.2013). The EIA is mandatory depending on the type of project considered. Annex I of Law 21/2013 of 9 December includes projects to which the environmental impact assessment procedure applies. This is the case of boreholes for geothermal energy of medium and high enthalpy exploitation or investigation purposes, which require the use of hydraulic fracturing. For projects included in Annex II the competent environmental body must decide on whether or not they should be subjected to the EIA, considering the criteria set out in Annex III of the aforementioned standard. For instance, deep geothermal projects that do not incorporate 'hydraulic fracturing' techniques fall within Annex II.

a. EXPLORATION AND EXPLOITATION OF GEOTHERMAL ENERGY WITHOUT EIA

In **Austria**, this is the general approach unless the authority does not demand measures for assessing and monitoring the environmental impact. It is possible to explore and exploit geothermal energy without EIA.

It is possible to explore and exploit geothermal energy without EIA in **Croatia**, if in the preliminary procedure it is established that they do not have significant environmental impacts (see 11.).

It is possible to explore and exploit geothermal energy without EIA in **Slovenia**, if in the preliminary procedure it is established that they do not have significant environmental impacts

In **Baden-Württemberg, Bavaria** and **Catalonia**, it is not possible to explore and exploit geothermal energy without EIA.

Italian legislative Decree 152/2006, "Environmental regulations", establishes the emission limits into the atmosphere for geothermal plants. And, as defined in Annex III of the second part, it submits activities relating to geothermal resources to EIA.

For exploration of geothermal energy, no EIA is required in **the Netherlands**. As long as the exploration is limited to desk studies. If seismic acquisition is involved or drilling an exploration well Environmental laws kick-in.

b. OTHER PARTIES INVOLVED TO EIA PROCESS

It is not applicable for **Austria**.

The competent authority of Croatia and the competent authority of Catalonia refers the EIA study to a public hearing before its approval.

In **Slovenia**, other parties may also be involved in the process of obtaining the Environmental permit in so far as the Environmental Agency gives them a status of a side participant during the review procedure after the public announcement. They are equal participants in the continuation of procedure.

As project owners/operators are usually public utilities, in **Baden-Württemberg** and **Bavaria**, a referendum/public consultation is held before the project goes into detailed planning. Any arrangement with private right owners or NGOs is subject to private law.

All national and/or local public bodies interested in the area of the research permit and / or concession are involved in the environmental impact assessment process in **Italy**. Citizens or associations can submit comments and requests for clarification during the environmental impact assessment process

Parties like provinces, municipalities, water authorities, etc., act as advisors for the Ministry during the licensing process in **The Netherlands**.

12. OTHER LICENSES NEEDED IN ORDER TO COMMENCE EXPLORATION/EXPLOITATION OF GEOTHERMAL ENERGY

Austria: Permit of landowners for surface exploration at their properties and commercial license to run a geothermal heating supply facility.

Croatia: Building permit, Location permit, Usage permit.

Slovenia: Building permit and operating permit for related infrastructure.

Baden-Württemberg and **Bavaria**: Beyond the details regulated in the working plan / operating plan, none.

Italy: In case of exploration: as part of the research permit, once the authorization from the competent authority (regional mining office) has been obtained and any environmental impact assessment has been passed, no other specific licenses are required for the start of mining works. In case of exploitation: even in the context of the exploitation concession, once the authorization from the competent authority (UNMIG/national or regional mining office) has been obtained and the environmental impact assessment has been passed, no other specific licenses are required for the start of mining/project works. In this case it should be emphasized that in order to complete the project work, previous agreements with third parties are necessary in the field, for example, of the land, the construction and connection of the power line, on possible design solutions for environmental mitigation, etc.

The Netherlands: Environmental permit, building permit etc; in fact, all 'WABO' licenses (WABO (*Wet algemene bepalingen omgevingsrecht*) is a law on general provisions of environmental law).

Catalonia: Beyond the details regulated in the research and working plans or related with the license grant proceeding itself, none.

a. DENIAL OF LICENSE GRANTING DUE TO POSSIBLE USE CONFLICT, OR CONFLICT BETWEEN THE LEGISLATION

This was not yet the case in **Austria** and neither in **Catalonia**.

Not yet in **Croatia**, but there is conflict in legislation when the water from same spring/well is used for medical, balneological and energetical purposes (heating). These two types of geothermal water usage are regulated by different regulations (see 1.1).

Not in the Acts of **Slovenia** but in management of Acts. There is still rather little or slow cooperation among authorities during the granting process, different control and requirements in licenses. Some Water concession decrees were not issued in a regional geothermal aquifer used by multiple users as its capacity was estimated to be already fully exploited.

In **Baden-Württemberg** and **Bavaria**, certain areas are excluded a priori, such as water protection / catchment areas or priority areas for other (deep) mining operations.

In order to avoid possible causes of mining conflict in **Italy**, it is necessary that the perimeter of the research permit or concession does not overlap with other existing permits / concessions in the field.

Furthermore, the downhole objective must be at least 500 meters away from the border of the permit / concession in order to maintain at least a possible linear distance of 1 km between the wells located in different permits / concessions. On the other hand, it is possible that a geothermal research permit / concession intersects a hydrocarbon permit / concession, unless the downhole objectives are different and mineral isolated from each other. If liquid or gaseous hydrocarbons are found in the course of drilling, immediate communication must be given to the UNMIG. The mining authority, where the quantity discovered is significant for the purposes of an energy use, and pending the necessary investigations, may order the suspension of drilling works. The operations of research and cultivation of geothermal resources can be resumed, if compatible and with the subsequent authorization of the mining authority, with any precautions and safety measures provided for this purpose, as well as the specific environmental protection procedures provided for by current legislation. In the event that the discovery of hydrocarbons gives rise to the issue of a new mining license for these minerals to another holder, the latter is required to reimburse direct expenses and indirect costs incurred under the previous title.

The Netherlands responds positively on the question about legislation conflict.

b. REGULATIONS ON RE-INJECTION

For **Slovenia, Austria, Italy, The Netherlands, Baden-Württemberg** and **Bavaria** (except for balneology) re-injection is obligatory and regulations encourage license holder of re-injection into the same aquifer. **Croatia** does not have defined regulation on geothermal water re-injection after their use (heat exchange).

In **Catalonia** regulations on re-injection for deep geothermal resources exploitation doesn't exists. The development of geothermal exploration and consequently exploitation is in a very early stage and there are no precedents to refer on.

Geothermal water only used for energetic purpose, in **Austria**, must be re-injected in the same hydrostratigraphic unit; balneologically used water must not be re-injected. There are no general criteria defined for the distance between production and reinjection well. There are no general criteria defined for the period of time for which the cold-water front must not have influence on the production well. For geothermal energy use, it is not allowed to discharge used water into aquifer which is different than aquifer of production well, or into surface recipient, except for initial pumping test.

Croatian Law on Exploration and Exploitation of Hydrocarbons, which regulates exploration and exploitation of geothermal waters and the Water Act do not provide re-injection regulations. In practice, geothermal water shall be cooled down and connected with drinking wastewater disposal.

In **Slovenia**, regulation about reinjection is only written in Mining Act, where it states that exploiting a geothermal energy source by reinjection means that the geothermal heat is taken from the geological layers with two wells that are interconnected on surface, and which are in the geological structure at least 25 m away. Groundwater which is pumped from aquifer is used as heat carrier in one well, and after the extraction of heat from it, this water returns to the original geological structure or aquifer through the second well. So, it means that 100 % reinjection is obligatory. Guidelines on official recognition of

reinjection will be prepared in 2020. According to the Water directive, reinjection has to be done in the same aquifer and only of unpolluted water (meaning used only for heat abstraction). In the Water concession decrees, reinjection is included in the equation for concession fee. If water is re-injected, the water fee can be significantly reduced.

For **Baden-Württemberg** and **Bavaria**, re-injection into the same aquifer is the rule for licensing (except for balneological use). There are no legal requirements defined for the distance between production and reinjection well. As in the operator's interest, as far apart as possible, but within the license area. Also, not a legal requirement but acknowledged best practice to avoid induced seismicity when re-injecting into a fault: a moderate ΔT. There is no legal requirement for the period of time for which the cold-water front must not have influence on the production well. But, as in the operator's interest to avoid the temperature breakthrough, model calculations are carried out, usually as a 50 years prediction. To cover cross-claim effects such temperature modelling usually is carried out jointly for several adjoining license areas. It is not allowed to discharge used water into aquifer which is different than aquifer of production well, or into surface recipient, except during exploration, e.g. initial pumping test, under strict water protection regulations.

In the context of the exploitation of a geothermal reservoir in **Italy**, whether national, regional or as a "small local use", it is almost always necessary, unless the characteristics of the geothermal fluid are qualitatively compatible with the surface discharge and depending on the regional regulations, that the fluids after the heat exchange are reinjected into the same reservoir / aquifer of origin. In some cases, depending on the regional regulations, for small local uses surface discharge is allowed.
There are no legal criteria for the distance between a doublet wells but the same is identified on the basis of the mining / hydrogeological characteristics of the reservoir through the use of analytical calculations or numerical modelling. Also, there is no specific period for hydraulic and thermal interference between the well doublet. In this case the return time of the "thermal plume" towards the extraction well can be estimated through analytical calculations and with numerical modelling according to the characteristics of the reservoir and the methods (flow rate, delta T, times of use ...) of exploitation. As previously specified, it is not possible that the geothermal fluids after their use (heat exchange) are re-injected into a different reservoir / aquifer from that of origin. On the other hand, it is possible that, by satisfying the parameters contained in the annexes of the *Legislative Decree 152/2006 "Environmental regulations"*, the geothermal fluids can be discharged to the surface. In addition to the qualitative parameters, it is normally necessary to demonstrate that by doing surface discharge is no impoverishment of the geothermal resource (depressurization, decrease in the static level, etc.). The water bodies in which it is possible to discharge are drainage canals, hydrographic networks, lakes and also in some cases and within certain criteria in sewers.

In **the Netherlands**, it is compulsory to inject into the same aquifer. The distance between production and injection well is chosen in such a way that thermal breakthrough does not occur before the end of the economic lifetime. Similarly, the well placement is performed in such a way that, on the border of the production license, the maximum cooling during the duration of the production license does not exceed 1 degree Celsius. No other fluids than the produced fluids are to be re-injected, with the exception of additions like corrosion inhibitors e.g. i) for geothermal systems yes compulsory; for balneology

apparently not; ii) not legally defined operators' choice; iii) not legally defined may be a point in the audit on efficient and effective harvesting of the heat; iv) no, not for geothermal at this moment.

13. STATUTORY REGULATIONS ON SHUTDOWN AFTER LIFE UTILITY - PROPER REMOVAL OF SUBSURFACE INFRASTRUCTURE / DEMOLITION OF PLANT / REMEDIATION OF ENVIRONMENT

In **Italy, Croatia** and **Sloveni**a the shutdown regulations after life utility are part of the exploration permit or exploitation license (concession).

In **Austria**, criteria on shutdown after life utility is listed in the Mining Act (*MinroG*).

In **Croatia**n legislation, as part of exploitation license (contract), according to the Law on exploration and exploitation of hydrocarbons, states: No later than six years before the expected date of field remediation or as soon as possible before the termination or abandonment of part of any contract area, the investor shall submit to the Agency an appropriate detailed remediation plan with an appropriate budget prepared in accordance with a verified development and operation project. An engineering description of the remediation, removal and disposal of facilities and installations, and site clean-up and remediation measures, including an estimate of the remediation costs The Agency shall grant approval through a written opinion on the remediation plan. In addition to those facilities and assets for which the Ministry has notified the investor that their removal is not necessary upon termination of the Contract or leaving part of the contract area, the investor: a) removes or leaves in place from the contract area or part of the contract area all wells, facilities and property used in the performance of oil and mining works, including, without limitation, pipelines, equipment, facilities for exploitation and processing, electrical facilities, landing areas and telecommunications facilities and b)carries out all necessary rehabilitation and restoration to original condition of the site. The regulation is an integral part of the exploitation license.

For the thermal water use in the **Slovenia**, the regulation on decommission of all objects is stated in Water Act which is referenced in the concession decree. For the use of geothermal energy, the liability of liquidation of all subsurface infrastructure is govern by Mining Act.

The technically correct sealing of the wells is compulsory in **Baden-Württemberg** and **Bavaria**. If outside of built-up areas, the complete removal of the well and operations buildings and renaturation of the drill site must be exercised.

In I**taly**, at the end of the cultivation concession, the concessionaire is obliged to close the wells and to decommission the surface plant with annexed environmental recovery. In fact, the issue of the research / concession permits remains subject to the presentation of a suitable bank or insurance guarantee commensurate with the value of the recovery works. Expected following the activities and based on the technical and economic capabilities of the proposer / concessionaire. These regulations are contained in the authorization release of the research permit or concession for exploitation.

In **the Netherlands**, the subsurface infrastructure needs to be removed in accordance with the law and the terms set by the State Supervision of the Mines in the Mining Law. The surface installation is not required to be removed as the land on which it is located is usually owned by the producer.

In **Catalonia** there are no statutory regulations on shutdown specifically for geothermal resources exploitation. There are specific regulations and guidelines on shutdown after water wells life utility. For those wells placed in an identified groundwater body (management unit under the Water Framework Directive) there is the 1/2017 law which regulates the shutdown and removal of wells infrastructure. For other infrastructures a restoration plan procedure should be submitted (so, reviewed or accepted by the competent authority) at the same time as the other documentation submitted for the license grant proceeding.

a. REGULATIONS ON LIABILITY FOR CONSEQUENTIAL DAMAGE - BEARING LIABILITY IN CASE OF INSOLVENCY OF A PRIVATE OPERATOR

Generally, in all partner countries, the license holder is responsible for any consequential damage.

In general, the license holder in **Austria** is responsible for any damage caused; in contrast to mining areas (*MinroG*) the Austrian state is not liable for any damage caused by a private license holder.

In **Croatia**, the Law on the market regulates a liability for consequential damage. The operator is fully liable for consequential damage.

There are regulations on liability for consequential damage in **Slovenia**n Water Act. There is no legal practice that anybody else takes liability in case of insolvency of private operator. Usually, the site is closed until new concessionaire takes it over.

In **Baden-Württemberg** and **Bavaria**, consequential damage is full liability of the operator. Insolvency of public operators is virtually impossible. Private operators, likewise with any construction enterprise, have to depose a bank guarantee or insolvency protection insurance for any incurring costs related to after project claim for defects.

In **Italy**, in case of forfeiture, renunciation and revocation of the concession, all the plants of the same, in a state of regular operation, become the property of the competent authority, compensation. The competent authority may request their safety and the complete or partial environmental restoration of the affected area. The competent authority also has right to enter the immediate possession of any other building, machinery, utilization, transformation and distribution plant inherent to the concession, by paying to those entitled to a price equal to the estimated value of the material in place, calculated at the time of placing in possession, abstracting from any evaluation of the income derived from it. In the event of damage or insolvency, steps are taken in connection with the relative determination of the damage through qualified and independent third parties, appointed by the President of the Court, according to tested financial methods that take market values into account.

In **the Netherlands**, the operator is responsible for consequential damage. The operator is required to demonstrate his operations are financially sound, in case of problems.

In **Catalonia** there is no regulation on liability for consequential damage specifically for geothermal resources exploitation. There is the general Spanish regulation on liability for consequential damage which is called "civil responsibility".

14. CONCLUSIONS

A cross-section of legislation related to topics of research and exploitation of geothermal energy and thermal water use in different project partner countries was presented. This summary is a short review which gives insight to a reader about the key practices and legislation in nine project partner countries: Austria, Baden-Württemberg, Bavaria, Catalonia, Croatia, Ireland, Italy, Slovenia, and The Netherlands.

- **Ireland** does not have a specific licensing system for geothermal energy so clearly the majority of topics within this document were left undiscussed by the project partner.
- **Baden-Württemberg, Bavaria, Croatia, Ireland, Slovenia** and **the Netherlands** have a definition of geothermal energy in the national legislation. **Austria** has no legal definition for geothermal energy itself. Ireland has defined the term *geothermal energy* but has no specific legislation covering geothermal energy. In **Catalonia** geothermal energy in not defined itself in the national legislation of reference but is considered as a geological energy resource of Type "D" together with hydrocarbons, radioactive minerals and bituminous rocks.
- **Ireland, Baden-Württemberg**, **Bavaria** and **the Netherlands** didn't provide information on thermal water definition in their national legislation. **Italy**'s legislation doesn't have unequivocal definition of thermal waters. **Slovenia** and **Austria** have similar classification of thermal water based on temperature, which is at least 20 °C. On the contrary, **Italy** doesn't distinguish thermal waters based on temperature, and thermal waters are generally the waters used in thermal establishments for therapeutic purposes. In **Catalonia** water is considered thermal when the outlet water temperature is annually constant and at least 4°C higher than the mean annual air temperature in the same location where the water source is located.
- **Baden-Württemberg, Bavaria, Croatia, Italy, Slovenia** and **The Netherlands** consider geothermal energy resources and thermal water state-owned, while in **Catalonia** it is considered to be public domain. **Ireland**'s ownership of geothermal energy has not been clarified in legislation. **Austria**n legislation states that the groundwater, and therefore also the heat content, belongs to the land property owner without any limitation of depth.
- In countries where the geothermal resources are state-owned, exploration and exploitation permits are generally granted by the state. These countries are **Baden-Württemberg, Bavaria, Croatia, Italy, Slovenia** and **The Netherlands**. In **Catalonia** investigation, exploration and exploitation permits are granted by the General Directorate for Energy Policy and Mines, dependent organism of the Energy State Secretary from the Ministry of Ecological Transition and Demographic Challenge (Spanish government). Even so, the granting process can be carried out through the General Directorate of Energy, Industrial Safety and Mining Safety of the Business and Labour Department (Catalan Government).
- Exploration or exploitation of geothermal resources is open to foreign investment in **Baden-Württemberg, Bavaria, Croatia, Ireland, Italy, the Netherlands, Austria, Slovenia** (under conditions specified below) and **Catalonia**.

- It is not possible to explore or exploit geothermal resources without some kind of permit or concession (license) in project partner countries (**Baden-Württemberg, Bavaria, Croatia, Ireland, Italy, The Netherlands, Slovenia** and **Catalonia**) except in **Austria** and **Ireland**.
- In **Austria, Slovenia, Croatia, Italy** and **the Netherlands** it is possible to come to an agreement with landowner in the process of license grant and there is no exploration or exploitation without the landowner's permit/authorization. This means, if there are no problems in reaching the mutual deal, there is no need for land expropriation. In **Baden-Württemberg** and **Bavaria**, the applicant in the process of license grant for exploration and exploitation must be the landowner. **Ireland** didn't provide any information on the topic since they did not have clarified ownership of geothermal energy in national legislation. In **Catalonia** the role of the landowner is limited. The owner of an exploration/investigation and/or exploitation permit or the successful bidder for a "reserved zone" could obtain the right for "temporary occupation" of the registrable land where geothermal energy is of interest if no agreement with the landowner is achieved.
- It is possible to expropriate land from private owner for a geothermal project if it is declared a project of national interest in following countries: **Austria, Catalonia, Croatia, Italy, Slovenia**, and **The Netherlands**.
- **Croatia, Italy** and **Slovenia** have similar division of types of geothermal resource use and therefore, types of licenses. They have two types of licenses, one for thermal water use for recreational, medical and balneological purposes and the other one for energy purposes. **Ireland** does not have specific licensing system for geothermal energy. In **Catalonia**, the Spanish Mining Law doesn't differentiate between different types of geothermal resources.
- It is clear that every country, except **Ireland** and partially **Austria**, have well defined submitting documentation and criteria for obtaining a license for exploration and exploitation of geothermal resources.
- For **all project partner countries**, the maximum duration of a license for exploration is from 1-5 years and 25-30 years for exploitation, with possibility of extension periods.
- **The Netherlands, Slovenia** and **Catalonia** do not support the possibility of automatic conversion of the exploration to exploitation license. **Baden-Württemberg, Bavaria, Croatia** and **Italy** find the process of getting exploration license to obtaining exploitation license (permit) a continuous process. **Austria** finds this not applicable.
- Exploration or exploitation license holder in **all of the project partner countries** has the right to ask for their revision and adaptation, but under different conditions for each country.
- Granting authorities of **all project countries**, except **Austria**, have the power to revoke or terminate licenses.
- In **all project partners' countries**, except in **Croatia**, the granting authority is allowed to set forth conditions into licenses which provide for stricter or more permissive terms and conditions for licenses, when such terms and conditions are not otherwise provided by the law.

- **All project partners countries**, except **Austria**, reported the existence of tools or actions which license granting authorities have in order to enforce compliance to the terms and conditions of a license. Different inspection types are the main tool for assurance of compliance to the terms and conditions of licenses.
- In **the Netherlands, Austria, Catalonia, Baden-Württemberg** and **Bavaria** the license holder is obliged to technically abandon the well after the exploitation permit expires.
- In **every project partner country**, the regular and formal reporting of compliance with the operating plan examined by the mining authority is needed during license period.
- **Austria, The Netherlands** and **Catalonia** do not regulate the general terms and conditions of power/heat purchase agreement, while the other project partner countries do.
- **Austria, The Netherlands** and **Catalonia** do not have specific law that regulates the duration of power/heat purchase agreement, but because of different reasons. General duration of power/heat purchase agreement is: 14 years in **Croatia**, 10 – 35 years in **Slovenia**, 25 years in Italy. For **Baden-Württemberg** and **Bavaria**, the duration is not explicitly stated.
- In **Austria, Baden-Württemberg, Bavaria, The Netherlands** and **Catalonia** public and national energy regulatory authorities do not participate in forming the terms and conditions of heat purchase agreements. In **Slovenia** and **Croatia**, they do participate.
- Environmental impact assessment prior to exploration and exploitation of geothermal energy is compulsory in all the project countries (**Austria, Slovenia, Ireland, Italy, The Netherlands, Catalonia, Bavaria and Baden-Württemberg**), except in **Croatia**, where the Ministry responsible for environment and nature protection decides on a case to case basis is there a need to conduct an environmental impact assessment.
- For **Slovenia, Austria, Italy, The Netherlands**, **Baden-Württemberg** and **Bavaria** (except for balneology) re-injection is obligatory and regulations encourage license holder to re-inject into the same aquifer. **Croatia** does not have defined regulation on geothermal water re-injection after their use (heat exchange). **Catalonia** doesn't have a specific regulation for deep geothermal energy.
- In **Italy, Croatia** and **Slovenia** the regulations on abandoning geothermal utilisation facilities after project lifetime are part of the exploitation license (concession).
- Generally, **in all partner countries**, the license holder is responsible for any consequential damage.

This overview presents the *state-of-the-art* of regulatory framework at the end of HotLime project implementation (June 2021). In some countries the regulations change more often than in the others so one must read the report considering its delivery date. Following Appendix 1, the reader can also see the questionnaires filled in by the partners from each country.

The report makes it clear that the regulatory framework in partner countries is very different, which is the consequence of different legal traditions in general, and the fact that geothermal energy specifically has been in wider use for a shorter period than fossil fuels, other mineral resources, or water for water supply purposes. For this specific reason, it is visible that some countries are only starting to develop the

legislation governing the exploration and exploitation of geothermal waters and energy. The differences start already with the (non)existence of definition of geothermal water and energy, ownership of the resources in the subsurface, and continue all along the spectrum of acquiring licenses/permits/ concessions for exploration and/or exploitation, monitoring and controlling the utilisation in accordance with the permit, assessing the impact on the environment and abandoning the sites after project lifetime.

Some legislative solutions should be emphasised as best practice examples, e.g. Dutch legislation on data availability after exploration and during exploitation which strongly favours data accessibility, and thereby further research; or Slovenian legislation on reinjection. The geological survey organisations are not the granting authority in any of the countries, but they do have a consulting role in many of them. The networking and learning about different legislative solutions have increased the competences of partner GSOs to provide advice on best practices when they are called upon by the regulators or legislators. Many such institutions were identified as stakeholders of the HotLime project, but their involvement was severely hindered by the onset of COVID-19 crisis in the second half of HotLime implementation. However, the knowledge and experience exchanges which took part inside the project consortium will certainly lead to transfer of good solutions into future legal framework and avoiding the ones which have been unfavourable.

15. QUESTIONNAIRE TEMPLATE AS USED IN THE SURVEY

COUNTRY	**SITUATION** (short answer + link to legislation, even if it is only available in national language)
1.1. Is there a definition for geothermal energy /thermal water in the national legislation? If yes what are the criteria?	
2.1. What are the rules on ownership of geothermal resources?	
2.2. Which body is in charge of granting access to exploration and exploitation of geothermal resources?	
2.3. Is exploration/exploitation open to foreign investment?	
3.1. Is exploration/exploitation of resources subject to licensing? / Is it possible to explore/exploit without licence?	
4.1. Does the landowner have a role in the process of granting a license for: (i) exploration, (ii) exploitation?	
4.2. Will an opposition of a landowner have a bearing on the process of granting a license for exploration, exploitation or heating/power plant?	
4.3. Is it possible to expropriate land from private owner for a geothermal project? Under which conditions?	
5.1. Are there differences in licensing for various types of geothermal resources or for different utilization modalities? (e.g. according to different depths, utilization types, technologies, e.g. for energy use, only for balneology, heat exploitation with or without groundwater extraction, with or without re-injection, etc.)	
5.2. What documents need to be submitted and what is the criteria for obtaining a license for: (i) exploration, (ii) exploitation? Focus on exploration and exploitation licences. If different licences exist (5.1 .), please specify separately.	
6.1 What is the maximum duration of a license for: (i) exploration, (ii) exploitation? Is it possible to renew the license? If yes, for how long and under which conditions? If different licences exist (5.1.), please specify separately.	

7.1. What are the general terms/contents of the license for: (i) exploration and (ii) exploitation? If different licences exist (5.1.), please specify separately.	
7.2. In case of successful exploration, are the exploration licenses automatically converted into exploitation licenses? If yes, are there any conditions?	
8.1. Does the licence holder have the right to ask for revision of the exploration/exploitation licenses? If yes, under which conditions? Which actions are needed from the license holder? (e.g. increased amount of production)	
8.2. Does the license granting authority have the power to revoke or terminate licenses? Under which conditions? What are the consequences?	
8.3. Can the license granting authority set forth conditions into licenses which provide for (i) stricter terms and conditions for licensees or (ii) more permissive terms and conditions for licensees, when such terms and conditions (whether stricter or more permissive) are not otherwise provided for by law?	
8.4. Which actions/tools does the license granting authority have in order to enforce compliance to the terms and conditions of a license, other than withdrawing the license?	
8.5. Is the license holder obliged to technically abandon the well after the exploitation permit expires? Are there any standards or is this evaluated on an individual basis? Which are the (legislative) criteria to abandon a well or to convert it into an observation well?	
9.1. Briefly outline the surveillance carried out by the regulatory authorities during the license period, e.g. with regards to reporting duties and/or on-site visits?	
9.2. Which information is required to be submitted to regulatory authorities during the license period for: (i) exploration, (ii) exploitation. What are the monitoring and reporting requirements?	
10.1 Are general terms and conditions, such as duration of Power/Heat Purchase Agreements regulated? If no, are there any soft laws or general recommendations in place?	

10.2. What is the permitted or general duration of Power/Heat Purchase Agreements?	
10.3. Are public and/or national regulatory authorities involved in any way in forming the terms of Heat Purchase Agreements, either directly or indirectly?	
11.1. Which statutory requirements are in force regarding environmental impact assessment prior to exploration/exploitation of geothermal energy?	
11.2. Is it possible to explore/exploit geothermal energy without environmental impact assessment? If yes, under which conditions?	
11.3. Are there other parties to be involved to EIA process (e.g. potentially affected right owners, NGOs, etc.)? If yes, what rights do they have?	
12.1 What other licenses are needed in order to commence exploration/exploitation of geothermal energy?	
12.2. Has any license granting been denied due to possible use conflict, or has any conflict become apparent between water, mining, energy, hydrocarbon, environmental protection (or other) legislation on geothermal water/energy utilization?	
12.3. (i) Is there a regulation on re-injection? Please specify details (e.g. Is it compulsory to reinject into the same aquifer?) (ii) Is there a criterion for the distance between production and reinjection well? (iii) Is the period defined for which cold water front must not have influence on the production well? If yes, what is that period, or other criteria? (iv) Is it allowed to discharge used water into aquifer which is different that aquifer of production well, or into surface recipients? Where and in what way can it be allowed? Is the reason for such practice specified?	
13.1. Are there any statutory regulations on shutdown after life utility (proper removal of subsurface infrastructure / demolition of plant / remediation of environment)? Are those regulations integral part of the exploitation license?	
13.2. Are there any regulations on liability for consequential damage? Who bears liability in case of insolvency of a private operator?	