Recommendations for European harmonisation

Towards a common geothermal environmental framework across Europe

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GEOENVI

Table of Contents

Executive summary

The main objective of this report to present a set of recommendations for establishing an European frame for environmental regulations of deep geothermal. GEOENVI aim is to find the best strategy to harmonize and empower the existing environmental regulations, adapting life cycle thinking, also engaging the relevant national and local authorities (e.g. environment ministries, mining authorities) to facilitate the change.

Decision makers such as energy or environmental ministries, mining authorities, public funding, local authorities, are the main target of this report. For an efficient engagement, it is important to set some prioritization strategy by analysing relevant existing regulations, and identifying the owners of the regulations, their level of influence or authority and their openness to changes.
For establishing a consistent geothermal environmental framework across Europe, two ways are considered:

1) A top down approach: In the European Union, harmonisation of law is the process of adopting regulations with common standards across the internal market. Harmonisation aims at having the same rules to apply to market actors that operate in more than one member state. It allows to avoid that the actors in one Member state do not obtain an economic advantage over those in another as a result of different rules.

2) A bottom-up approach: Each EU member state has primary responsibility for the regulation of most matters within their jurisdiction, and consequently each has its own laws. A mutual recognition of national regulations can also lead to a common European framework, if it is done together with the establishment of minimum standard at EU level

Both approaches aim to create consistency of laws, regulations, standards and codes of practices in the EU. It allows to establish a strong framework, e.g. on environmental impact of deep geothermal, and to reduce regulatory burdens for market actors operating nationally or trans-nationally.
GEOENVI envisages both ways for a series of recommendations on regulating seven topics for deep geothermal (air, water, underground, waste…).
It exists already a solid frame of environmental regulations for deep geothermal at international, European, national levels and sometimes regional level too. One issue concerns the consistency of different pieces of regulations but also the implementation of these rules. This report also envisages the establishment of a common framework on topics not yet regulated at EU level: well integrity and seismicity monitoring.
This report (D4.3) drafts recommendations on these two topics: well integrity and seismicity monitoring, aiming at having a European common approach. In the next report (D4.2), a concrete detailed proposal will be made on the content of such a code of good practices.

Finally, GEOENVI present recommendations for setting environmental criteria for financial institutions investing in geothermal energy, as for the EU sustainable finance framework.

Introduction

The GEOENVI project addresses ways to tackle the environmental concerns for deploying deep geothermal energy in Europe. GEOENVI aims at engaging with both decision-makers and geothermal market actors, to adopt recommendations on regulations and to see the LCA methodology implemented by geothermal stakeholders.

In previous reports a sound overview of possible environmental impacts and risks has been provided (deliverable 2.1), as well as ways to avoid or minimise them to the extent possible using current technologies and practices (deliverable 2.2). Furthermore, new ways of analysing the life cycle impacts of geothermal energy through Life Cycle Assessment (LCA) are being developed in work package 3: Harmonized methodology for environmental impact assessment with a life-cycle perspective for geothermal systems. Deliverable 4.1, Decision Making Process Mapping, provided an extensive overview of the environmental regulatory framework at the European level and its national implementation for geothermal energy projects. The present report aims to build on previous conclusions to issue a set of recommendations towards a better regulation of the environmental impacts of geothermal energy.

This report proposes a summary of the implementation of the existing framework for environmental impacts and risks of geothermal energy projects, providing an evaluation of best practices. From there, it proposes recommendations for European and National policy makers. Finally, it provides a perspective on how the emerging discussion around sustainable finance and the work of the GEOENVI project on understanding and minimising the environmental impact of geothermal energy projects connect.

Inventory of international and European regulations, standards and codes

The GEOENVI publication *Decision Mapping Process* for geothermal energy environmental policy making provides valuable information to identify the best European practices on this issue. Policy making at the European level determines the type of regulations, standards and codes implemented at the national and local level. Conversely, best practices at the local and national level can be applied at a European scale. This multi-level governance allows a constant improvement of the policy framework, enabling local feedback to be reflected at the European level.

3.1) Definitions and classification

Geothermal energy licensing and authorization are directly impacted by the definition used for classifying geothermal energy. The Renewable Energy Directive set a harmonized definition of geothermal energy as “energy stored in the form of heat beneath the surface of the earth” to be used in all implementation and delegated acts at Member State level. This directive is a particularly relevant underlying common framework. Classifications however vary among the countries as a definition has different objectives. It can be used to define a source and its environmental impact, but also to provide criteria for a public support schemes and for collection of statistical data.

There are cases where no classifications are (yet) adopted (e.g. in Belgium, Hungary), and cases based on temperature and depth (Iceland), and cases where also potential production power is considered (Italy, France). Geothermal resources are mostly state owned across Europe. The definition of geothermal is sometimes confused with the classification for energy statistics.

Defining properly geothermal is key for assessing and regulating its environmental risk and impact as an industrial activity.

Issue 1: The problem is the lack or the wrong transposition of a European harmonized piece of legislation: a directive. The geothermal definition in the RED is binding.

3.2) Authorisation and Licensing

Geothermal projects are subject to a strict authorisation and licensing procedure. Exploration and exploitation permits or concessions are typically needed to start an industrial project development. Various other licenses may be required, such as an environmental permit, and permits for power plant construction and operation.

The precise schemes differ. For example in France the petitioner can choose its specific title for the exploration phase (Research authorization or Exclusive Research Permit) to facilitate the exploration in areas where the temperature is less predictable. In Italy, beside the classical exploration permit and concession, there is a separate type of geothermal permit for the demonstration of innovative power plants that provide additional benefits compared to conventional technologies. If the demonstration is completed successfully the exploitation concession will be issued. Permit durations are broadly similar among the countries considered, with roughly 3-6 years for exploration, and from 30 up to 65 years for exploitation. Exclusivity arrangements are equally similar – with open competition for exploitation, after which the exploitation permit holder is granted exclusive rights for a certain time period – although different specific arrangement for dealing with land ownership and expropriation may apply.

From one country to the other, the amount of authorities involved in the permitting process can vary greatly, which may impact the length and efficiency of procedures. Stated timing for permit applications are broadly similar among countries, often taking some 200 days for exploration and exploitation, with similar duration to be added for environmental permits and EIA. Turkey seems to have a relatively rapid handling of permits, with reported durations of 5 and 15 days for exploration and exploitation license respectively, although the environmental impact assessment (EIA) may take up to 1 year. Royalties generally apply for concessions, but the beneficiaries of those royalties may differ, from competent authorities to resource owner, or local municipalities for environmental compensation. Finally, some form of EIA is required, although the way it is incorporated in the overall permitting procedure differs. In some cases it is part of a separate environmental permit (c.f. Belgium, Hungary), whereas in other cases it is integrated in another permit, such as the work permit in France. Another similar procedure among countries is the possibility to be exempted from a full EIA based on an Environmental Preliminary Study (EPS) or ‘EIA screening’.

Issue 2: Regulations on Authorisation and Licensing are well defined at European, national and regional levels. The problem comes for their execution. In some countries the delay in the

delivery of the permits is a real administrative barrier. A simplification of the procedures can be done through an European exchange of best practices for simplifying the procedures.

3.3) The European environmental common framework

A high level of protection and improvement of the quality of the environment is one of the objectives of the EU (Art.3 Treaty on European Union); in consequence, the body of secondary legislation is very comprehensive. For the geothermal sector, the most relevant EU directives are the following:

- Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive) ;
- Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (SEA Directive); and
- Directive 2000/60/EC establishing a framework for Community action in the field of water policy.

The EIA and the SEA directives align the EU acquis with a number of international treaties, chiefly the 1991 UNECE Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) and the 1998 UNICE Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention). In general, an environmental assessment is always part of the process to obtain a license for a deep geothermal project. However, the rules in the 27 member states may differ due to the fact that the national authorities can determine when a geothermal project requires to go through an EIA in the sense of the EIA directive (Art. 4(2) and Annex II).

The Strategic Environmental Assessment (SEA) Directive extends the evaluation of the environmental impact to certain plans and programmes, e.g. an urban or energy plan including a geothermal district heating project, prepared or adopted by a national, regional or local authority and required by legislative, regulatory or administrative provisions.

As far as the protection of water quality is concerned, Directive 2000/60/EC (Water Framework Directive) represents the main piece of legislation on the matter in Europe. It requires member states to implement the necessary measures to prevent the deterioration of the status of all bodies of surface and groundwater. Concerning the latter, for which pollution prevention and

quality monitoring and restoration are more difficult mostly due to its inaccessibility, the directive takes the precautionary approach and establishes a general prohibition on direct discharges to groundwater. An important exemption is however provided for geothermal energy: in this case member states are given the option to authorise reinjection into the same aquifer, provided it does not compromise the environmental objectives of the directive (Art. 11). It is therefore within the competence of the national governments to decide as to whether reinjection of the geothermal fluids is allowed or even required.

Issue 3: The environmental regulatory framework is solid. But some topics are not yet covered at EU and national levels such as well integrity and seismicity monitoring.

National level implementation of environmental regulations

The European environmental regulatory framework is a precious background for guaranteeing a good protection of the environment throughout the European Union and to provide clarity for the geothermal industry across the various European Member States. This contributes to unifying the regulatory framework for geothermal developers across the EU, provided the national level implementation is robust and in line with the European framework.

Some of the key EU regulatory texts impacting the geothermal industry include the Water Framework Directive 2000/60/EC and related updates, Directive 2006/118/EC to prevent and control water pollution, Directive 2008/50/EC addressing ambient air quality and cleaner air for Europe, ETS (Emission Trading System) directive (2003/87/EC), European Directive 2008/98/EC on waste regulation, Directive 2000/14/EC on noise emissions standards, European Directive 2003/35/EC on community engagement in planning related to environment, European Directive 2004/35/EC establishing a framework for environmental liability. Other relevant regulatory texts include the Environmental Impact Assessment Directive, or framework protections for natural areas such as Natura 2000.

The GEOENVI Report on Decision Making Process Mapping takes stock of the implementation of international and EU regulations on the national level. It shows that at the national level, there is typically a robust implementation of the European environmental regulatory framework whether through dedicated legislation, or the incorporation in environmental impact assessments and permitting processes (see Table 1).

Table 1. Implementation of environmental regulatory frameworks for geothermal energy projects with an exhaustive list of environmental potential risks and impacts linked to deep geothermal energy activity

Topic	State of implementation at the national level
Surface disturbance: noise and vibration, visual impact	Noise and vibration appear to be well regulated, as an industrial sector, both for workers and surrounding residents. Visual impacts and landscape are treated in Environmental Impacts Assessments (EIAs), with the Tuscany region in Italy hosting the most developed regulations in this respect. National regulations on dust and smell follow general EU air quality regulations, with various dust and smell specific legislation and guidelines in place.
Air quality	It is already generally well regulated, often with reference to the relevant EU directives. If relevant[1], projects may be subjected to specific regulations concerning for instance the abatement of pollutants.
Ground deformation	Although it is difficult to underline specific threshold values for ground surface deformation, guidelines for monitoring ground deformation are present in most countries and best practices for prevention and mitigation are implemented by project developers and operators. A variety of guidelines for monitoring and mitigation of micro-seismicity is present in most countries and geothermal operators use best available technologies and practices.
Ground water	National legislation on ground water quality and protection, are thoroughly addressed in permitting processes.
Energy and water consumption	It is already generally well regulated, often with reference to the relevant EU directives, including the water framework directive and air quality directives. The case of France shows how these impacts are regulated via, amongst others, reporting procedures and the voluntary compliance to ISO standards.
Waste production	The issue of waste production during the project development and operation is well regulated as part of national waste legislation, including waste classifications, and special rules for dealing with hazardous waste as for all industrial processes.
Radioactivity	In most countries, regulatory frameworks for radioactivity are in place in the context of public health. According to the relevance of the radioactivity topic for geothermal in countries and regions, projects may be subjected to specific regulations concerning e.g. the characterization and treatment of possible radioactive waste.

[1] The type of geothermal resource and technology used determine the relevance of the application of this framework.

One of the main takeaways of this report is the role of countries with an established geothermal energy market in serving as role model for the replication of best practices, as they are typically ahead in the process of implementing the regulatory framework. The report also insists upon the role of environmental impact assessments and permitting processes in ensuring the good environmental quality of geothermal energy projects, often driving forward the implementation by geothermal projects of higher environmental standards than those guaranteed by the regulatory framework alone.

Policy recommendations for a harmonised environmental regulatory framework in geothermal energy

Building on the observation carried out in other GEOENVI reports, the objective of this publication is to bring forward recommendations for setting a common European framework of the environmental regulatory framework of geothermal energy across Europe. A common framework brings many benefits for the geothermal industry and for communities in which projects are being developed. First, it guarantees a high quality of geothermal projects, minimising local environmental impacts. This increases the confidence of communities that risks are minimised by project developers. A common framework also enables a more integrated internal market for geothermal energy project development, equipment provision and services. This is a crucial factor in the consolidation of the industry, and accelerating the market uptake of geothermal throughout Europe, as projects can easily be replicated – having to comply with the same requirements.

This common European framework can be done through an European harmonization via EU regulations or through a mutual recognition of national rules with the setting of minimum European standards.

While the review of the current regulatory framework highlights the quality of the European environmental regulations, to further consolidate the European common framework, the GEOENVI project consortium recommendations include:

- **A consistent implementation of the definition of geothermal energy**,

The definition of geothermal energy in the European Renewable Energy Directive is clear, encompasses all utilisations of this versatile renewable energy source. It nevertheless allows for varying implementations at the national level that reflect the specific conditions and requirements of the different European Member States. This is particularly relevant when considering the various environmental regulations that relate to geothermal energy: the replication of best practices requires a unified definition of what is geothermal energy and how to classify the resources.

In the perspective of the GEOENVI consortium, to facilitate the spread of best practices for defining the authorisation and permitting process, an indicative reference classification that

take into account both the resource's characteristics, in terms of temperature and depth, and the possible installation and technology could be relevant. A clear classification helps in defining the different levels of potential impacts and risks, and the required environmental control.

- **A better application for the licensing of geothermal to improve community engagement and create trust between citizens and geothermal developers**

Although geothermal projects indeed must be as environmentally sound as possible, too unclear and complex a permitting process becomes a major hurdle to market uptake of these environmentally friendly technologies. Clarity on timelines and procedures and strict timing requirements is the only way to avoid that projects wait - as long as a decade - to know whether they can proceed or not. Some EU Member States, with a dynamic geothermal market, have successfully implemented a reliable and transparent framework for authorization, licensing and permitting procedures. These are best practices that should be replicated across Europe.

Moreover, the licensing and permitting process has a crucial impact in defining the environmental requirements of the geothermal project. Here again, a recommendation of the GEOENVI consortium is to learn from the best practices, to favour a process that provides clarity to developers on the requirements they are to comply to. It is also key to favour process that provides transparency to local communities on the benefits they can expect from the geothermal projects and how developers are working to mitigate the environmental risks linked to the project.

Creating trust between developers and communities is a keystone to accelerate geothermal market uptake, as projects are often led by local authorities – especially for heating and cooling. The permitting and licensing process contributes to this.

- **A streamlined framework to enable geothermal energy development**

a) Environmentally friendly production of strategic minerals

Current rules for licensing and permitting often determines and restrict what the geothermal project can produce. As geothermal resources are located underground, and the legal framework in most of Europe gives the State ownership of underground resources, developers need to apply for licenses or permits to enable the production of geothermal energy. These licenses and permits notably determine what the geothermal project can produce. As there is an emerging trend towards the production of strategic raw materials from geothermal brines, it is increasingly important that the permitting and licensing process is not a barrier to the

deployment of this environmentally friendly technology, which is also a key opportunity for the European clean energy technologies value chains.

Geothermal lithium is a technology that is close to market, with a global race to develop the technologies that allow the economic extraction of lithium from geothermal brine. However, other raw materials such as rare earths are also in the scope of ongoing research and innovation, and the permitting and licensing framework should look to enable such developments.

Since producing strategic raw materials from geothermal brine is an environmentally friendly process that has tremendous benefits compared to traditional mining processes[2], the environmental impact assessment of the geothermal project should reflect the corresponding benefit.

b) Well integrity

Deep drilling for geothermal is a potential source of environmental risk, impacts and incidents. One main objective is to avoid malfunctions or incidents that could jeopardise the sustainability of operations.

Some countries in Europe (France) and in third countries (New Zeland has a Code of Practice for deep geothermal wells (NZS 2403: 2015)) have published a national guide of good practices. Some standards (ISO and CEN) already exists for deep drilling but they do not cover all environmental issues. It is the reason why Dutch stakeholders are currently working on such a scheme for deep geothermal wells.

One recommendation is then to first elaborate a European code of good practices for deep geothermal wells.

c) Seismicity monitoring

A European code of best practices for seismicity monitoring (not only for geothermal, but also for mining, oil & gas industry) should also be established. This topic is covered in some regiosn or countries, but not at a european level. An harmonization is hardly possible but a European code is required. It would defined monitoring network and thresholds from different parameters such local natural seismicity, local geology, surrounding buildings, depth… This common code would need to involve mining authorities, experts in seismicity, experts in civil engineering and representants of the geothermal, oil&gas, mining industry.

[2] EGEC Policy Paper on Geothermal Lithium.

- **Apply GEOENVI LCA approach for geothermal environmental impact assessment.**

The GEOENVI project puts forward a life-cycle assessment methodology for geothermal energy projects. This methodology, based on the available practices in life cycle assessment for renewable energy project, allows to establish the basis for comparability of projects. The use of the simplified tool proposed by GEOENVI by project developers also reduces the burden on the early stages of project development.

Another clear benefit of the GEOENVI methodology is to provide transparency and confidence to authorities and local communities in the geothermal project, thanks to a transparent, comparable and proven methodology that clearly addresses the life-cycle environmental impacts of geothermal projects.

Setting environmental criteria for financial institutions investing in geothermal energy

Although the public sector continues to play a structuring role in shaping the energy system, as much by enabling the emergence of renewable energy technologies, as it is maintaining the dominant position of fossil fuels through massive subsidies (for instance for natural gas infrastructure in the Connecting Europe Facility and the TEN-E), private finance will increasingly be the driving force in enabling the deployment of new geothermal energy projects. The private financial sector however requires a set of unified criteria that allows to guarantee the environmental quality of projects. Private investors need clear indicators that they are investing in a project that is indeed environmentally friendly. These indicators notably serve to allow the diffusion of sustainable finance products throughout the financial systems by providing confidence that the assets backing the financial products are indeed contributing to environmental objectives.

For geothermal energy projects, the mainstreaming of such a typology is crucial to increase the amount of financing that can be directed to this renewable energy source. The sustainable finance regulation proposes a taxonomy that rightfully identifies geothermal electricity, combined heat and power, heat supply and heat pumps as eligible to be considered a “sustainable investment”. This eligibility is however conditioned to some requirements, from the application environmental regulations – which as we have seen as well enforced throughout Europe – to an emission performance standard.

The carbon footprint figure used to estimate whether the geothermal project’s greenhouse gases impact comply with the emission performance standard need to be obtained through the use of the GEOENVI methodology which integrates all the best practices for the life cycle assessment of the environmental impacts of geothermal energy projects.

Moreover, considering the emergence of strategic raw material production from geothermal brine, this taxonomy should also cover the environmental impact of producing raw materials, in particular the materials strategic to many clean energy technology value chains such as lithium, rare earth and so on.

Conclusion/key takeaways

The European common environmental regulatory framework for geothermal energy projects is rather well implemented at the national level, with national or local best practices that be replicated in emerging markets. The implementation of the European framework should focus on clarity for both developers and local communities to improve trust and accelerate the deployment of projects. For a clear framework, fit for the market uptake of geothermal energy technologies, the GEOENVI project issues the following recommendations:

- **A consistent implementation of the Renewable Energy Directive definition of geothermal energy**,
- **A better application of the rules for the licensing of geothermal to simplify the process, to improve community engagement and create trust between citizens and geothermal developers**
- **A streamlined framework to enable geothermal energy development, notably regarding well integrity, seismicity monitoring and the environmentally friendly production of strategic minerals**
- **The consistent and clear application of the best practices identified by the GEOENVI consortium for geothermal energy environmental impact assessment over the lifecycle of projects,** including the valuation of the impact of natural emission in the lifecycle of a project

The policy and regulatory recommendations need to be accompanied by a framework that ensure the quality of the projects benefiting from sustainable finance, as well as the quality of the sustainable finance products themselves. In that regard, a robust taxonomy of technologies eligible as financial investments, enabling a fully decarbonised value chain (for instance by highlighting the value of zero-carbon raw material production such as lithium from geothermal brine) is an effective keystone. To increase confidence of investors, regulators, and citizens this taxonomy and “sustainable financing” need to be supported by a robust methodology to assess environmental impacts. The geothermal sector is quite pioneer in that regard and can be a best practice to replicate for other technologies, thanks to the life-cycle assessment methodology developed in the framework of the GEOENVI project.

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