

Interreg North-West Europe DGE-ROLLOUT

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Introduction

North-West Europe (NWE) has to reduce its carbon dioxide (CO₂) emissions. One major source of CO₂ is the production of electricity and heat by burning fossil fuels, which could be replaced by using deep geothermal energy (DGE). However, the exploration of DGE in most NWE regions requires specific expertise and technologies in complex geological situations (strongly faulted high permeable carbonates and coarse clastic rocks) that lie across the borders between Germany, France, the Netherlands and Belgium.

The DGE-ROLLOUT project facilitates, as part of the Interreg program, the use of DGE as climate friendly energy resource to reduce CO₂ emissions and to protect the environment in NWE. It is the objective of DGE-Rollout to produce energy and reduce CO₂ emissions by replacing fossil fuels through the increased usage of DGE for large-scale infrastructures requiring heat supplies to cover their basic energy loads. This will be achieved by carrying out several work packages (WPs): mapping and networking (WP 1) with the application of innovative decision and exploration strategies (WP 2) and testing for production optimization (WP 3).

This deliverable is part of the first WP (Mapping and Networking) to prepare the market by providing and harmonizing the knowledge baseline of DGE. This to develop the market in NWE, including DGE resource potential, the market/investor correlation and the current legal frameworks. The DGE-rollout project tries to obtain an overall view through an online map application merging the baseline sources to identify regional investment hotspots according to investor profiles. A DGE Network will be established to share experiences and build new interactions.

Content of Report

In this report, current legal frameworks of existing DGE regulations for all partner countries will be discussed. This will include: DGE definition, licensing perimeter and environmental regulations. The report will be based on previous projects (e.g. GeoENVI and GeoELEC) with an up-to-date adjustment of the legal framework useable for DGE in all partner countries.

The goal of this technical report is to give easy access to existing regulatory information of partner countries for geothermal project developers, local/regional/national public authorities and enterprises and share this knowledge between the countries. It aims to provide guidance for project planning and provide policy advice of best practices to public authorities. The research question studies how the legal framework concerning DGE infrastructures is formulated, how permitting and licensing processes take place, and what specific regulations exist for specific environmental impacts in partner countries. This allows further research how to harmonise and improve these existing regulations.

The first chapter in this report gives a description of the general types or topics of legal frameworks that are relevant when developing a DGE project. First, the legislations related to the subsurface regarding exploration, exploitation and safety are discussed. Also, the impact on surroundings, regulations related to environmental laws, groundwater, nature protection, spatial planning and data availability are discussed in general. It is specified what is regarded within these regulations, relevant to DGE.

In the second chapter, a description of the legal framework per country is given and discussed. Firstly, an overview of European legislations is given. Belgium is divided in the regions of Flanders and Wallonia as regulations regarding the subsurface and environment are formulated on the regional level. Brussels is not discussed as DGE infrastructures are not likely to occur in this very densely populated region. In the third chapter, an analysis of the different legal regulations is given per country. Also, a comparison between countries is made. Eventually, recommendations are prepared which can be communicated to relevant regional and national policy makers. In the last chapter, a general conclusion of the legal frameworks is formulated.

Methodology

The methodology followed in this report starts with studying regulatory topics which may be of importance to DGE projects. These include topics on the subsurface (exploration, exploitation and safety), environment, groundwater, nature, spatial planning, impact on surroundings and data availability. Information in this report is largely factual and based on existing work. For each country, a partner of the project has prepared an overview document of the most important regulations relevant for DGE projects. These documents will be used as a basis for this report, hereafter regulations will be further studied in detail.

This research is in line with the [Multi-Level Governance principles](#) of the European Union (EU). This implies “working in partnership between the different levels of government (local, regional, national and European) and applying a set of principles that should guide efficient policy-making, such as participation, cooperation, openness, transparency, inclusiveness and policy coherence, all of which are essential conditions to guarantee the success of public policies in the interest of the citizens”. The EU is the highest level of this governance. These are translated to national legislations and eventually also to regional and local levels. In the report, before discussing national and regional regulations, an overview of relevant EU regulations is given and described in short. These policies will be the building blocks used for national, regional and local regulations. URLs will be provided to websites containing the mentioned regulations providing more information to those interested. A transparent overview of relevant legislations will be given per country/region. The analysis is based on comparison between countries and regions. Recommendations are given based on ‘field’ experience of stakeholders of DGE projects (project partners). These formulate what worked well and what needs improvement.

To discuss the regulations per country, a general workflow is followed. Firstly, general data and context of the country is summarised regarding their institutional context. This will include information on which governance levels are involved in DGE regulations, visions of these levels towards DGE and definitions they have formulated on DGE. Secondly, a systematic overview of the different legislations for each governance level is given and shortly described per topic. This includes information on the licencing and authorisation process: which permits are required, what do these permits comprise, authorities involved and timing. A URL will be provided to websites of the mentioned legislations providing more information to those interested.

1. Description Legal Framework

In this section, relevant topics of regulations regarding DGE are discussed. For each topic, a short description is given of what is included in this topic. The topics discussed are subsurface (exploration – exploitation – safety), environment, groundwater, nature, spatial planning, impact on surroundings and data availability.

1.1. Subsurface

1.1.1. Exploration

Exploration is the phase in the project when information is gathered from the subsurface for possible geothermal energy activities. An important part is surveying the subsurface to see if any geothermal sources are available and if they are accessible for exploitation. Regulations related to the topic of exploration include those related to the deep subsurface and the geological survey of it. During the survey it is important to know who the owner is of a geothermal resource and what is understood under geothermal energy. It includes permits which need to be requested before this surveying can start and will include seismic surveys and exploration drilling. In most countries, a large part of the legislative information will be found in mining codes.

1.1.2. Exploitation

Exploitation is the phase in the project where the production of geothermal energy starts. It includes the set-up of the necessary infrastructure, activities during and after the production and the production of energy itself. Regulations related to the topic of exploitation include those which have effect on the production process. Regulative information in most countries will be included in mining codes. Regulations include an exploitation/production permit and other permits needed to start with the production process. However, it does not only include subsurface production activities but also regulations related to surface operations such as environmental impact assessments, permits, reporting and monitoring.

1.1.3. Safety

The topic of safety is related to the phases of exploration, exploitation and the period after production. These regulations ensure safe working conditions but also safety for the surrounding areas and neighbours. Regulations include insurances such as for the geological risks but also for the risk of leakage due to malfunctioning of surface installations and operations. Also, safety related to seismicity or other movements of soil created during the exploration and/or exploitation phases are included. For the period after production, legislations for decommissioning the production site and of drilled wells is included.

1.2. Environment

Environment includes the water, air and land where people, plants and animals live. The (ground)water and nature (condition of plants and animals) are discussed in separate sections below. Regulations related to the topic environment include air quality and soil quality. These regulations are mainly related to environmental liability which is generally based on the polluter pays principle. Air quality regulations include emission standards of certain gasses and pollutants to the environment during the production process. It also includes degassing from the reservoir itself.

1.3. Groundwater

Groundwater is the water which can be found in the subsurface. It occurs in high concentrations in aquifers (permeable layers). Also, surface water is included in this topic, which can be found aboveground mainly concentrated in rivers. Regulations related to the topic groundwater include preservation of the physical and chemical conditions of the groundwater but secondary also on the surface water, e.g. when re-injection in the subsurface is not allowed. Also, interconnection of aquifers and disturbance of non-targeted aquifers are included.

1.4. Nature

Regulations related to the topic of nature aim to prevent possible incidents with a negative effect on fauna and flora or their natural habitat, with particular attention to protected nature areas.

1.5. Spatial Planning

Spatial planning is the spatial organisation of functions and infrastructures within a certain area trying to achieve an optimal arrangement. It is related to urban planning. Plans and programmes are created by authorities to achieve an image they want to see completed in the (near) future. It decides where certain buildings or activities (e.g. residential or industry) may take place. Legislations related to the topic of spatial planning include procedures and permits which need to be followed/requested before a DGE project can be initiated. These are based on existing plans and programmes set up by authorities. It includes subsurface and aboveground infrastructures and looks at the setting of these in its environment.

1.6. Impact on Surroundings

The impact on surroundings is a very broad topic and includes all effects caused by the exploration and/or exploitation phase which may influence its immediate surroundings. Only effects not discussed in one of the previous topics are considered here. Regulations related to the topic of impact on surroundings include surface disturbances such as noise, vibration (e.g. by transport), visual effects and landscape, dust and smell, waste production (solid, liquid and gas), ground surface deformation

and radioactivity. Visual effects and landscape are already partially incorporated in the topic of spatial planning.

1.7. Data Availability

Data availability relates to databases managed by authorities. These data might be publicly available in online geoportals or might be stored in physical form in archives. Also, data which is not publicly available because e.g. it falls within its confidentiality period, is included. Legislations related to the topic of data availability both include data which is made available for assistance in DGE projects as well as data which needs to be provided to authorities as part of an agreement in the permit received.

2. Description per country

In this chapter, relevant legislations regarding DGE are given and described in short for each of the partner countries. First, an overview of relevant EU legislations is given as these apply to all partner countries. All countries have translated these EU Directives into their own national or regional legislations. Also, other international agreements and objectives are discussed as these have a direct effect on EU legislations. Belgium is subdivided in the regions of Flanders and Walloon as these regions have the regulatory power of the subsurface. The same order of topics is followed as is given in the previous section. Certain legislative tools have a more “transversal” approach, laying down a legal framework which concerns several themes/activities. Others have a more "vertical" scope setting up a specific framework for a category specific activities and/or facility.

2.1. EU

EU legislations under the form of Directives are a first line of legislations which need to be considered for DGE projects. A "Directive" is a legislative act setting up a certain goal which must be achieved by all EU countries by translating it to national or regional legislations. Directives are translated to national and regional regulations and will come back in the individual description of the legal framework of a country. The countries themselves can decide how they formulate laws to be able to achieve these goals. A “regulation” is a binding legislative act which needs to be applied in all EU countries, they are part of the EU legal framework ([EU, 2020a](#)). For this reason, they are summarised here and referred to in the individual descriptions. No relevant EU Regulations regarding DGE projects were found and thus only EU Directives are formulated below.

In the following sections, Directives are organised per topic and are summarised in tables. Relevant Directives, articles and definitions for DGE projects are discussed in more detail outside of these tables. For each mentioned EU Directive or other legislative texts, a direct link to the webpage with the legislation is provided¹.

EU Transition towards Clean Energy

In 2019 the EU updated their 2016 energy policy with the agreement [‘the Clean energy for all Europeans package’](#) to facilitate the transition towards cleaner energy and EU’s long-term strategy of achieving carbon neutrality by 2050. At the same time, it tries to deliver on the EU’s 2015 Paris Agreement commitments for reducing greenhouse gas emissions ([EU, 2017b](#)). In the Paris Agreement participating countries set-up a framework to limit global warming bellow 2°C and try to achieve a limit of 1.5°C. Secondary, it aims to assist countries in their ability to deal with the impact climate change

¹ The webpage gives the most recent version of a legislation including changes which were carried out. It gives an overview of all adaptations made; however, it is not binding. The original legislative text can always be consulted through the same webpage.

has ([EU, 2020b](#)). The 2019 EU agreement also contributes to the 2015 ‘[energy union strategy](#)’ of the EU to provide EU consumers secure, sustainable, competitive and affordable energy ([EU, 2017a](#)). Within the Clean energy for all Europeans package eight legislative acts are published and are transposed to national law in 2019. One of these legislative acts relates to renewable energy with setting the ambition to achieve 32% of renewable energy sources in the EU’s energy mix by 2030 ([EU, 2017b](#)).

As part of this new agreement, the original Directive on the promotion of the use of energy from renewable sources ([2009/28/EC](#)) was revised and recast in 2018 into a new Renewable Energy Directive ([2018/2001/EU](#)). They are formulated to adhere to the ‘Kyoto Protocol (1997)’ which commits parties to greenhouse gas emissions reductions ([EU, 2004](#)). The goal of this Directive is to provide a common framework for the promotion of energy from renewable sources. Renewable resources are non-fossil sources including wind, solar (solar thermal and solar photovoltaic) and geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas. It contains a binding definition for geothermal energy in Article 2(3):

“‘geothermal energy’ means energy stored in the form of heat beneath the surface of solid earth;”

EU Environmental Legislations

EU legislations regarding the **environment** include the preservation of the air quality and environmental liability. The different Directives are summarised in Table 1.

Table 1 Overview environmental EU Directives

Directive	Code	More information
Directive on national emission ceilings for certain atmospheric pollutants	2001/81/EC	It limits emission of certain acidifying and eutrophying pollutants and ozone precursors for the protection of the environment and human health.
Directive on ambient air quality and cleaner air for Europe	2008/50/EC	It gives standard methods and criteria for measuring and monitoring the air quality, makes information available to the public, promotes cooperation between member states and tries to maintain or improve air quality. It focusses on sulphur dioxide (SO ₂), nitrogen dioxide (NO ₂), particulate matter, lead, benzene and carbon monoxide (CO) as pollutants.
Directive relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air	2004/107/EC	It establishes target values for the concentrations of these pollutants and to prevent or reduce any harmful effects on the environment and human health. It also determines common methods and criteria for the assessment of these concentrations and good information is obtained and made available for the public.

Directive on the reduction of national emissions of certain atmospheric pollutants	2016/2284/EU	It establishes commitments for the emission reduction of SO ₂ , nitrogen oxides (NO _x), non-methane volatile organic compounds (NMVOC), ammonia (NH ₃) and fine particulate matter (PM _{2,5}). It requires national air pollution control programmes to be drawn up, adopted and implemented as well as the impacts on environment and human health to be monitored and reported.
Directive on environmental liability with regard to the prevention and remedying of environmental damage	2004/35/CE	It is based on the polluter pays principle of the EU to prevent and remedy environmental damage.

EU (Ground)Water Legislations

Legislations regarding **(ground)water** are described separately from the environmental legislations.

Four Directives are of importance to DGE projects, these Directives are summarised in Table 2.

Of particular interest for DGE projects is Directive [2000/60/EC](#) regarding groundwater as a renewable natural resource, it includes a definition in Article 2 (2):

“Groundwater’ means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.”

Article 8 of the Directive formulates programmes for the monitoring of groundwater with technical specifications and standardised methods for analysis. In Article 7(j), the Directive sets a prohibition of direct discharges of pollutants into groundwater. However, member states can authorise the reinjection of groundwater into the same aquifer when used for geothermal purposes.

Table 2 Overview groundwater EU Directives

Directive	Code	More information
Directive on establishing a framework for Community action in the field of water policy	2000/60/EC	For the protection of inland surface waters, transitional waters, coastal waters and groundwater. It wants to protect, enhance and prevent further deterioration of the aquatic ecosystems and promote sustainable water use. It tries to protect and improve water systems by specific measures and contributing to mitigating the effects of floods and droughts.
Directive on the protection of groundwater against pollution and deterioration	2006/118/EC	It formulates specific measures for Directive 2000/60/EC in Article 17(1) and (2) for the prevention and control of groundwater pollution. It includes measures of good groundwater chemical status and provisions for preventing and limiting the input of pollutants.
Directive on environmental quality standards in the field of water policy	2008/105/EC	It lays down environmental quality standards (EQS) for priority substances and certain other pollutants to achieve good surface water chemical status.

Directive laying down technical specifications for chemical analysis and monitoring of water status	2009/90/EC	It establishes minimum performance criteria for methods of analysis when monitoring water status, sediment and biota. It also includes rules on the presentation of the quality of these analytical results.
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EU Nature Legislations

Legislations regarding **nature** include the protection of fauna and flora. These two Directives are the foundation of the Natura 2020 Network and are summarised in Table 3.

Table 3 Overview nature EU Directives

Directive	Code	More information
Directive on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)	92/43/EEC	For the preservation, protection and improvement of the quality of the environment, including the conservation of natural habitats and of wild fauna and flora. These are an essential objective of general interest pursued by the community.
Directive on the conservation of wild birds (Birds Directive)	2009/147/EC	It relates to the conservation of all species of naturally occurring birds in the European territory. It covers the protection, management and control of these species and lays down rules for their exploitation. It applies to the birds, their eggs, nests and habitats.

EU Spatial Planning Legislations

Legislations regarding **spatial planning** and the impact of constructions on the environment are summarised in Table 4.

In Directive [2011/92/EU](#), lists of projects which may have a negative influence on the environment are included in the annexes, e.g. Annex 1(11):

“Groundwater abstraction or artificial groundwater recharge schemes where the annual volume of water abstracted or recharged is equivalent to or exceeds 10 million cubic metres.”

and in Annex 2 (2-d) deep drillings including geothermal drilling. For these projects, an assessment report of the impact on the environment is needed.

Table 4 Overview spatial planning EU Directives

Directive	Code	More information
Directive on the assessment of the effects of certain plans and programmes on the environment	2001/42/EC	It contributed to the integration of environmental considerations into the preparation and adoption of plans and programmes. It promotes sustainable development by ensuring an environmental assessment is carried out for certain plans and programmes which are likely to have significant effects on the environment.

Directive providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment	2003/35/EC	To improve public participation and implementing obligations under the ' Århus Convention (1998) ' ² .
Directive on the assessment of the effects of certain public and private projects on the environment	2011/92/EU	For projects which have a likely effect on the environment. Lists of these projects are included in the annexes

EU Prevention of the Impact on Surroundings Legislations

Legislations regarding the **impact on surroundings** include waste management, noise and vibration and radioactivity. These Directives are summarised in Table 5.

The definition of environmental noise is given in Article 3(a) of Directive [2002/49/EC](#):

“environmental noise’ shall mean unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic, and from sites of industrial activity. “

Table 5 Overview impact on surroundings EU Directives

Directive	Code	More information
Directive on waste	2008/98/EC	To prevent or reduce the impact of generation and management of waste to protect the environment and human health. This Directive does not include waste waters and radioactive waste.
Directive on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors	2000/14/EC	It tries to harmonise laws of member states relating to noise emission standards and standard assessment procedures marking, technical documentation and collection of data concerning the noise emission in the environment of outdoor use equipment.
Directive relating to the assessment and management of environmental noise	2002/49/EC	It defines a common approach to avoid, prevent or reduce harmful effects due to the exposure to environmental noise.
Directive laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation	2013/59/Euratom	It establishes uniform basic safety standards for the protection of the health of individual subjects against the dangers arising from ionising radiation

² The subject of the Århus Convention (1998) was on the access to information, public participation in decision-making and access to justice in environmental matters and its Protocol on Pollutant Release and Transfer Registers (EU, 2020c).

Legislations regarding to **data availability** relevant for DGE projects are summarised in Table 6.

Table 6 Overview data availability EU Directives

Directive	Code	More information
Directive on public access to environmental information	2003/4/EC	It guarantees access to environmental information held by public authorities for the public.
Directive establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)	2007/2/EC	It lays down general rules to establish an infrastructure for spatial information operated by member states for the purposes of Community environmental policies and policies or activities which may have an impact on the environment.
Directive on open data and the re-use of public sector information	2019/1024/EU	To promote the use of open data and stimulate innovation in products and services. It establishes a set of minimum rules and practical arrangements for the re-use of public sector information.

2.2. Belgium

This section with the description of the legal framework of Belgium is divided in two subsections, dividing Belgium in its regions of Flanders and Wallonia. The region of Brussels is not discussed in this report as no legal framework covering the deep subsurface exists. However, they do have a legal framework for open geothermal systems and closed vertical loops at shallow depth. The reason why these regions are subdivided for the legal framework, is because regulations regarding the deep subsurface and its energy resource fall under the regions. Only legislations regarding radioactivity fall under the federal level.

Protection against Radioactivity

The main legislation on radioactivity is the [royal order of 2001](#) concerning general regulations for the protection of the population, employees and the environment to the hazards of ionising radiation (ARBIS). This legislation is a national transposition of the EU Directive 96/29/Euratom, later recast to 2013/59/Euratom, as discussed in [section 4.1](#). Radioactivity is monitored by the Federal Agency for Nuclear Control (FANC) which also advises the regions. The presence of Naturally Occurring Radioactive Material (NORM) is evaluated through Environmental Impact Assessments (EIA) which are carried out and evaluated on the regional level.

2.2.1. Flanders

For each mentioned legislation, a link to its information page is provided. The regulations themselves can be found through these webpages, however, they can only be consulted in Dutch.

The Deep Subsurface and its Geothermal Energy

A main legislation of importance to the **subsurface** and DGE projects in Flanders is [the Decree on the Deep Subsurface](#) of 2009. This degree is adapted multiple times to its present form including a chapter on the exploration and exploitation of geothermal energy added in 2016. It defines the deep subsurface as the subsurface starting from a depth of at least 500m (Article 2).

‘deep subsurface: the subsurface starting from a depth of at least 500 meters with regard to the TAW-reference point (Tweede Algemene Waterpassing);’

Geothermal energy present in the deep subsurface of Flanders is property of the Flemish government, the exploration and exploitation of it requires a permit. The decree also gives definitions for geothermal energy, exploration of geothermal energy, exploitation of geothermal energy and its respective permits for exploration and exploitation (Article 2). Geothermal energy is defined as heat in the subsurface created by natural means or by heat storage.

Exploration for Geothermal Energy

For the **exploration** of geothermal energy, research to the presence of extractable geothermal energy or other related data when using a borehole needs to be carried out. Drilling of boreholes should be reported to Dienst Ondergrond Vlaanderen (DOV) via their online portal. For exploration in Flanders, you need an exploration permit³ which is an exclusive written permit to search for extractable geothermal energy in the deep subsurface and exploit this energy during the period of the permit as is mentioned in the permit conditions. The permit is opened for 90 days to allow for fair competition. Permits are valid for a standard period of five years⁴. Afterwards, it gives the permit holder ownership of the data which is obtained during the exploration (Article 63/1).

Exploitation of Geothermal energy

The **exploitation** of geothermal energy is the extraction of this energy from the subsurface using a borehole and, if wanted, including the re-injection of the extracted water in the same geothermal reservoir. For exploitation, an exploitation permit and a production plan are required which gives you an exclusive written permit to extract geothermal energy from the subsurface (Article 63/12). The permit holder needs to deliver an annual report giving the carried-out activities of that year or activities which will be carried out if the previous year no activities were done (Article 63/13). Next to this exploitation permit, also an environmental permit is required before production can be initiated.

Safety during DGE Projects

The decree also includes articles related to the **safety** during DGE projects. It is within the obligations of the permit holder to prevent any activities which can cause a disturbance of the environment, damage by ground movement, seismicity and damage the public safety (Article 63/10). The Flemish government can give a regional insurance for geological risks on a short term (Article 63/25/1).

Insurance Scheme, Guidelines and Models for the Exploration and Exploitation of Geothermal Energy

The decree on the deep subsurface was put into action in 2011 by the [decision](#) of the Flemish Government. In 2018, a [ministerial decision](#) was released on guidelines and models as part of the insurance scheme⁵ for the exploration and exploitation of geothermal energy in the deep subsurface. It contains guidelines and models for preparing and making of a geological survey, execution and interpretation of borehole measurements, making of a project plan and final report.

³ The permit grants the exclusive right for a well-defined 3D volume at the depth of exploration to determine how much heat might be produced and what the boundary conditions are

⁴ For an exploration permit the timing depends on the submission of competing offers. Standard periods are 90 days for the confirmation of completeness of the submission and 120 extra days for the decision on the granting of the permit. In case competing offers are submitted, timings will shift.

⁵ This insurance scheme covers three short-term geological (uncertainty) risk. Long-term performance, technical failures and geohazards are not included. The maximum amount for each project is € 18.7 million, only 85% of the eligible costs can be insured. A participation fee of 7% is required. The applicant must validate the expected thermal power (P90 value) by a set method and perform adequate testing to prove the outcome.

The Flemish Government financially supports projects and their users which provide/use energy from renewable energy resources such as geothermal energy. This support is defined in in the [Decision](#) of the Flemish Government on the general provisions on the energy policy of 2010.

Protection of the Environment through Environmental Permitting

Legislations related to the **environment** in Flanders can be found in multiple different decrees and orders. The [decree on environmental permitting](#) of 2014 gives the activities for which an environmental permit⁶ needs to be requested, these are activities which may have an influence on the environment including the construction of infrastructures. Special attention is given to activities which have received a 'class' with class 1 activities the most and class 3 least impactful. The list of classified activities is documented as Appendix 1 to the Order of the Flemish Government handling the general and sectoral stipulations concerning environmental hygiene ([VLAREM II](#)). In this list the following activities related to geothermal projects are found:

- *53: pumping of ground water*
- *54: replenishment of ground water*
- *55.2: drilling of wells deeper than 500m*

Section 53 on the pumping of groundwater includes several subtypes of pumping for different purposes. The reinjection of treated or non-treated water is included with requirements for DGE projects as is formulated in the Decree of the deep subsurface and included in the exploitation permit. The drilling of wells deeper than 500m is considered as a class 1 activity.

Protection of the Soil

The Decree of Soil remediation and Soil ([Bodemdecreet](#)) of 2006 takes actions for the protection of the soil against pollution, formulates target values to preserve its conditions, takes action when they are contaminated and encourages sustainable use. As the Decree of the Deep Subsurface starts at 500m, this decree will be in effect for soil until a depth of 500m.

Protection of the Environment by Sustainable Use

The Decree concerning general environmental policy regulations ([DABM](#)) of 1995 for the protection of the environment by sustainable use of its resources and nature. This decree protects the environment against pollution and extraction with special attention to ecosystems which are important for the biosphere. It applies the standstill and polluter pays principle. However, consideration is given to socio-economical aspects with an international dimension and based on scientific and technical information. This decree is controlled by the Order of the Flemish Government regarding the implementation of

⁶ The application for an environmental permit has to be done by an [online platform](#). It is advised to have several preparatory meetings with the authorities before submitting the application. A normal procedure takes 150 days before the decision can be made. The filling out of an EIA project can cause additional delays and is advised to be carried out beforehand.

title XVI of the DABM ([Milieuhandhavingsbesluit](#)) which formulates enforcement measures and penalties.

Protection of the Environment from Emission of Pollutants

The Order of the Flemish Government regarding the regulations on emissions with respect to the environment ([VLAREL](#)) on sampling, measuring and analysing of environmental disturbances. These disturbances include polluted soil samples, air emissions, noise and vibration. Within VLAREM II also air quality and emission legislations are included with threshold values for the emission of certain molecules.

Environmental Impact Assessment

In the Decision of the Flemish Government on the rules of an Environmental Impact Assessment (EIA) for projects and environmental safety ([MER- besluit](#)) and [Decision of the Flemish Government on the Environmental Impact Assessment of plans and programmes](#) practical information and what should be included in EIA reports is given. In [VLAREM II](#) categories of project are determined which should make an EIA or give a motivated request for an exception, this includes geothermal wells deeper than 500m. The permitting authority is not the same as the EIA office, the permitting authority will ask advice to the EIA office before delivering a permit. For each project which requires an EIA, meetings with the EIA office will need to be arranged to decide which information should be included in the report.

Protection of the Groundwater and aquifers

Most legislations regarding the **groundwater** are already mentioned above, related to the protection of the environment. The [Decree with measures for the groundwater control](#) of 1984 includes regulations for the protection of the groundwater against pollution and extractions. The protection of the physical and chemical conditions of the groundwater is included in [VLAREM II](#) (section 2.4 Environmental quality norms and quantity criteria for groundwater, Annex 2.4.1) with thresholds to preserve the water quality. The disturbance of non-targeted aquifers and interconnection of aquifers is also included in VLAREM II under sector-specific environmental conditions for high-risk activities (section 5.55 Drilling, Annex 5.53 code for good practice for drilling).

Protection of Nature

The protection of **nature** is included in above mentioned environmental legislations and is ensured through permits and EIA reports.

Permitting, Plans and Programmes Regarding Spatial Planning

Spatial planning is included within the [Environmental Permitting Decree](#) as part of the building permits which fall under the integral environmental permit (omgevingsvergunning). In the Flemish Codex Spatial Planning ([VCRO](#)) plans and programmes are discussed including the permitting policy and administrative protocols. Plans and programmes decide where certain activities are permitted to be carried out. In the [Decree Complex projects](#) alternative procedures for complex projects for which

exceptions to VCRO and environmental legislations are discussed, however, the same protection of the environment is ensured. The complex projects include projects which may have a large impact on the environment, traffic, socio-economical state or which are of environmental, social or economic importance.

Prevention of the Impact on Surroundings

Legislations on **impact on surroundings** can be found in different separate texts; however, a lot of information is included in [VLAREM II](#). Noise is regulated in VLAREM II (section 2.5 Environmental quality norms and values for air and assessment and management of air quality, section 4.4 management of air pollution, target values and measuring methods for high risk activities) dividing a day in three periods and thresholds depending on these periods and on land use categories. A general regulation of noise is the [Law to combat noise disturbances](#) to restrict disturbances caused by noise for which technical restrictions to the building of these infrastructures can be set-up. In the [VLAREL](#) technical specifications for the measuring of noise and vibrations is included. Vibrations are monitored by the Royal Observatory of Belgium. Visual and landscape impacts are regulated through permitting and EIA reports as stated in [DABM](#). Disturbances caused by dust and smell are regulated through the good practice principle in Flanders. Ground surface deformation is included in the [Decree of the Deep subsurface](#) and falls under the responsibility of the permit holder.

The production of waste including liquid and solid effusion are regulated through [VLAREM II](#) in the good practices of drilling and the Decision of the Flemish Government to the establishment of the Flemish regulation on the sustainable management of material cycle and waste ([VLAREMA](#)). In the VLAREMA more general regulations related to waste are formulated. Also, within the EIA the impact on the environment at cause of waste can be included.

Data Availability in Flanders

Several legislative texts ensure **data availability** in Flanders. By the [Decision](#) of the Flemish Government on the distribution of environmental information of 2005, certain data related to the environment, as is given in Article 2, is made available for the public by electronic resources. For the transposition of the [EU INSPIRE Directive](#), a [cooperation agreement](#) between the Federal state, Brussels, Flanders and Wallonia was made in 2010 for the coordination of a spatial information infrastructure. Each region will be responsible for making environmental data available online, however, the Federal level will oversee the coordination. For Flanders, relevant information regarding the deep subsurface is made available on the geoportal of Databank Ondergrond Vlaanderen (DOV). As a permit holder, you are obliged to release certain information you have gained as part of your permit. This type of information is always mentioned in the permit itself. For boreholes, you need to deliver the borehole report and other specific information related to the type of borehole (e.g. lithological description).

2.2.2. Wallonia

For each mentioned legislation, a link is provided to its information page where the complete text can be found. These webpages can only be consulted in French.

In Wallonia, the legal framework for the deep subsurface and its resources should evolve in the same direction as the Flemish Decree on the Deep Subsurface, with a new decree for underground resource management and a similar insurance system being discussed. However, there is currently (June 2020) no specific framework developed particularly for this theme. At the moment there is almost no direct reference to (deep) geothermal energy in any Walloon legislation. However, the environmental legislations sometimes mention geothermal energy.

The Exploration and Exploitation of Geothermal Energy

Legislations related to **exploration** and **exploitation** can be mainly found under the environmental legislations in the [Environmental Law Code](#) of 2005 and [Decree related to Environmental permitting](#) of 1999. For drilling, the implementation, construction, control and monitoring are regulated since 2012 in the Decree of the Walloon Government determining the sectoral conditions relating to drilling and the equipment of wells intended for a future underground water intake and amending the decree of the Walloon Government of 4 July 2002 relating to the procedure and various implementing measures of the decree of 11 March 1999 relating to the environmental permit ([MB 10.10.2012](#)).

Procedures and Measures for DGE Projects

In the [Walloon Government Decree of July 4, 2002](#) relating to the procedure and various measures for implementing the decree of 11 March 1999 relating to the environmental permit, a list of projects, classified installations and activities is given which need to be subjected to an impact study. If the activity is class 1 (most impactful), an environmental impact assessment (EIA) must be carried out as part of the permit application. All key activities listed below making up DGE projects can be identified in this list, except one, the stimulation of the geothermal field (B). If a geothermal project needs a stimulation phase, this activity should be considered in the environmental permit as this can have a significant impact on the environment.

- A. Drilling
- B. Stimulation of the geothermal reservoir
- C. Water pumping
- D. Water reinjection
- E. Water discharge
- F. Electricity production
- G. Heat production
- H. Heat distribution
- I. Electricity distribution

Following these activities and their respective class, DGE projects are classified as class 1 activities by the reinjection of groundwater. Thus, DGE projects will require an EIA report when requesting a permit. If groundwater is not reinjected, it would be a class 2 activity, no EIA report would be required but an environmental notice should be made. Guidelines for the content of an EIA study do not exist, but Annex VIII of the Order of 2002 provides elements to consider regarding the reinjection of groundwater. These are the minimum of elements which need to be considered together with the possible interaction of surface layers and the geothermal reservoir.

Environmental Permit During Exploration and Exploitation

A temporary environmental permit is required during exploration phase for drilling operations and carrying out tests necessary for newly installed wells (test pumping, temperature measurement, other logs, etc.). A final environmental permit is required for the exploitation of geothermal wells and other related (classified) activities and installations of the project⁷, with the completion of the EIA study beforehand (considering scientific results from the construction of wells and tests performed in accordance with the latter)⁸.

Approval for Carrying out DGE Activities

The Decree of 2018 of the Walloon Government relating to the approval of persons carrying out drillings or well equipment intended for a future underground water intake, the installation of geothermal probes, geological reconnaissance, prospecting, to the installation of piezometers and amending various orders ([MB.29.03.2019](#)). With the [ministerial decision](#) establishing a form relating to water intakes, boreholes, well equipment and facilities for the recharge or tests of artificial groundwater recharge, anyone carrying out a drilling operation on Walloon territory must fill out this form aimed at guaranteeing the quality of their work, while ensuring compliance with environmental legislation and avoiding unfair competition. Approval must be requested from the Service Public Wallonie (SPW (DGO3)). It is granted for a fixed term of 5 years and can be renewed for a second term⁹.

⁷ In view of similarities between a project that aims to exploit water underground (installation of pumping wells) and DGE projects (exploitation geothermal resource via the installation of geothermal wells), the licensing procedure for the operation of such systems (deep geothermal energy with reinjection) roughly follows the same procedure.

⁸ Forms required for a unique permit and appendixes related to specific activities related to DGE can be found on the Regional portal. Since September 2019, a new portal is offered to submit permit requests. Specific activities include in the Appendices are:

- The drilling permit procedure (Appendix XVIII, “drilling and sounding operations”);
- The water extraction procedure (Appendix III “document related to water extraction”);
- The water injection procedure permit (Appendix VIII “document related to artificial recharge of groundwater”).

⁹ The decision to grant a permit is taken in 90 days for class 2 activities and 150 days for class 1 activities.

Safety During Projects Regarding Ground Surface Deformation and Seismicity

Regarding legislations of **safety**, ground surface deformation and seismicity are not regulated in Wallonia but can also be taken as part of harm to the environment as included in the environmental legislations. At the moment seismicity in Belgium is monitored by the Royal Observatory of Belgium. In the new legislative text of the deep subsurface, it is foreseen to include the management of seismological risks prior to drilling, including a public information campaign and the installation of a seismological surveillance network which will operate throughout the testing and operation of DGE plant.

Environmental Legislations and Permitting

As mentioned before, legislations of the **environment** are included in the [Environmental Law Code](#) of 2005 and [Decree related to Environmental permitting](#) of 1999. The Environmental Law Code is the framework legislation relating to the environment in the Walloon Region. A key element in this legislation is the environmental permit where each activity and/or installation which can have an impact on the environment, and which is of primary importance (class 1) or second (class 2) must have an environmental permit. Without a permit, the operator cannot operate, relocate, transform or extend a class 1 or 2 establishment. The permit determines the period and conditions which the permit holder should adhere to related to carrying out certain activities.

Preservation of the Air Quality

Degassing of the reservoir and the air quality are regulated by the [Walloon Government Decree of July 4, 2002](#) fixing the general conditions of exploitation related to the environmental permit on air quality preservation. Also, in the [Order of the Walloon Government of 15 July 2010](#) on the assessment and management of the ambient air quality, the air quality of Wallonia is controlled¹⁰. It defines notions related to air, the formulas, units of measurement, evaluation and management. The operator must capture emissions or limit their production and transmission.

Water Protection Regulations

Legislations related to the **groundwater** are already partially mentioned in the above environmental legislations. In the [Water Code](#), more general regulations of water protection are given. The exploitation of groundwater with its restrictions is discussed in the [Walloon Government Decree of July 4, 2002](#) Annex VIII in which information¹¹ related to the environmental impact needs to be

¹⁰ transposes Directive 2008/50/CE, Directive 2004/107/CE, and Directive 2015/1480.

¹¹ a) a detailed description of the planned infiltration technique.

b) a description of the measures planned to avoid pollution of the underground water table.

c) the origin of the infiltration water.

d) a complete analysis of the recharge water and the groundwater, making it possible to judge the compatibility of these waters and to check the possible absence of alteration of the aquifer and the basement.

e) a hydrogeological study of the zone concerned by the recharge which includes at minimum a geological section, an extract from the geological map and the main characteristics of the tablecloth being reloaded.

delivered to authorities. This Decree also includes general conditions for the preservation of the water quality related to underground water pumping such that the quality does not diminishes. The total quantity of water pumped cannot exceed the annual average volume of the natural stream. The interconnection of aquifers and disturbances of non-targeted aquifers are included in sectorial conditions related to drilling and equipment of wells destined to future underground water pumping of 2012. These wells must be located in such a way that they prevent all risks of alteration of water quality by migration of surface or underground pollutants, or by mix of different underground waters. During drilling operations, the drilling must be performed such as it does not alter the neighbour geological structure and the qualitative state of underground water. Reservoir physical and chemical modifications are regulated in The Ministerial Order destined to all operators of drinkable water pumping non-drinkable water pumping, located in the Walloon Region ([MB. 17.01.2018](#)), it determines the monitoring of environmental data of underground waters in application of the European Directive on water (2000/60/CE). The order gives methods to collect qualitative and quantitative data on water quality. This monitoring is completed by the Water code part II, integrated management of natural water cycle, appendix IV, concerning surveillance of chemical state of underground water, and completes the environmental permit.

Protection of Nature

Legislation related to **nature** are included in the environmental legislations.

Spatial Planning Legislations and Permitting

Spatial planning is included in the [Walloon Code of Spatial Planning, Town planning and Heritage](#) of 1984 regulating all spatial and town planning. A key element in the planning legislation is the planning permission. With the environmental permit, the town planning permit can be combined into a unique/single permit since 2002. The application for an urban planning permit to drill a borehole needs to include the characteristics of the drilling, the number of drillings, the dimensions (diameter, depth, lithology), the flow, possible positioning of the pump, location, etc. An environmental notice must accompany the associated class 2 permit application. This aims for a more succinct assessment (than that included in an EIA) of the foreseeable effects of the project on the environment (this notice is now incorporated in the permit application form class 2). Since a deep geothermal project will normally always be associated with an installation/building above ground, an urban planning permit is required.

f) A description and an estimate of the proposed measures to protect the aquifer. This information is in accordance with Art. 11. of the AGW of July 4, 2002 fixing the general conditions on the conditions of water intakes (see above: water intake activity) and gives an important indication of the minimum content of an EIA in this context.

Regulations Preventing the Impact on Surroundings

Legislations on activities which may have an **impact on surroundings** can be mainly found in the Walloon Government Decree of July 4, 2002. Threshold values for noise are given according to a day divided in three periods¹², however, exceptions can be granted according to specific rules. Also monitoring measures are included. For dust and smell it is stated that the operator should capture or if not, must limit the emissions and their transmission to the environment. Also, the general conditions of exploitation related waste production from surface operations are included and related to the environmental permit. Liquid and solid effusion of waste are part of code of good practice for drilling. For the drilling, an operator must have a drilling certification with condition acceptance of this code. Visual and landscape are mitigated through the environmental permit's conditions and EIA.

Data Availability in Wallonia

In Wallonia, a legislation related to **data availability** of environmental data is the Decree of 2006 modifying the Environmental Law Code for the availability of information related to the environment to the public. Companies need to deliver information to a responsible authority if there are risks for the environment or people. These companies are obliged to deliver information which is put online. Also, a 'drilling agreement' exist in which companies announce drilling and provide some information which is not put online but can be requested. For the transposition of the EU INSPIRE Directive, a cooperation agreement between the Federal state, Brussels, Flanders and Wallonia was made in 2010 for the coordination of a spatial information infrastructure. Each region will be responsible for making environmental data available online, however, the Federal level will oversee the coordination.

Three geoportals are available on the website of Service Géologique de Wallonie, one with a geological map of Wallonia, one with a hydrogeological map of Wallonia and one with multiple thematic themes of the subsurface in Wallonia. Information in these portals is provided if risks for the environment exist.

¹² Day (7-19h), transition period (6-7 & 19- 22h), and night (22-6h), and different zones Day: btw 55 and 60 dBA
Transition: btw 45 and 55 dBA Night btw 40 and 50 dBA.

2.3. France

For each mentioned legislation, a direct link to the webpage containing this legislative text is given. The active version of the text can be directly consulted, older versions or versions not yet active can be viewed on the same webpage. These legislative texts can only be consulted in French.

In France, DGE is a centralised activity with central and regional bodies holding the most competences. These authorities are responsible for the safety of the population and environment during these activities. In the regions, the Regional Directorate for the Environment, Planning and Housing (DREAL/DEAL) are responsible to specify the conditions in which a DGE project can be carried out from the exploration phase to the long-term exploitation and consider territorial specifications. The territorial authorities (communes, regions) play a key role showing (or not) the will to welcome/develop DGE projects on their territories and often participating in its funding. They are also the main contact with the local population, regarding the overall “acceptability” of geothermal projects. However, the state has ownership of the geothermal energy resources.

Exploration and Exploitation of Geothermal Energy

Main legislation regarding **exploration** and **exploitation** are given in the new [Mining code](#) of 2011. Geothermal resources are classified as ‘mines’ and are defined by following definition

“resources enclosed within the earth from which energy can be extracted through the production of hot waters and vapours”

The Mining Code has three main objectives:

- Optimise the exploitation of sub-surface mining resources property of the state;
- Minimise risk and pollution of the human and natural environment associated with exploration and exploitation of mining resources;
- Guarantee safety and health of workers.

What is Geothermal Energy?

In the past, there used to be a division of geothermal energy based on the temperature which could be produced with the boundary on 150°C. This boundary value was chosen based on the expected minimum value needed to produce electricity. However, as of 2019, because of recent Organic Rankine Cycle (ORC) plants and to facilitate geothermal development in areas with not well-known geology and temperature predictions, this boundary was replaced by 20 MW ‘primary power’ for the exploration phase.

Mining Titles for Exploration and Exploitation

The right of use of a geothermal resource is determined by the state or one of its regional bodies.

When applying for an exploration or exploitation permit, the petitioner should choose the most adequate mining title as can be seen in Table 7 together with the procedure to follow.

Table 7 Permitting procedure for DGE projects France

Mining titles required for EXPLORATION		
	The petitioner chooses:	
Mining Title in French (English Translation)	Autorisation de Recherches (AR) <i>(Research Authorization)</i>	Permis Exclusif de Recherche (PER) <i>(Exclusive Research Permit)</i>
Delivered by	Local deconcentrated Authority (Prefecture)	Central Authority (Ministry)
Competitive call	Yes	Yes
Public Enquiry	Yes	No public enquiry but an electronic consultation
Initial Duration	3 years	3 to 5 years
Extension of the Duration	No	Yes - Can be extended twice for 5 years each time, without competition ¹ . The holder must have fulfilled its obligations, and must subscribe a financial commitment at least equal to the previous financial commitment.
Mining titles required for EXPLOITATION		
	Primary power <20 MW	Primary power >20 MW
Mining Title in French (English Translation)	Permis d'Exploitation (PE) <i>(Exploitation Permit)</i>	Concession <i>(Concession)</i>
Delivered by	Local deconcentrated Authority (Prefecture)	Conseil d'Etat
Competitive call	No – can be delivered only to the holder of the Research Authorization or Exclusive Research Permit during its duration.	No – if requested during the validity of the Exclusive Research Permit or Research Authorization Yes – if the Exclusive Research Permit or the Research Authorization has expired
Public Enquiry	Yes, except if the Research Authorization is valid	Yes
Initial Duration	Open	Open ²
Extension of the Duration	Yes – for periods up to 15 years each	Yes – for periods up to 25 years each

Mining Titles and Permitting in the Exploration Phase

For the exploration phase, there are two mining titles: Research Authorisation and Exclusive Research permit. The first permit is delivered by a regional authority with a three-year duration which cannot be extended. It includes a competitive call and a public enquiry. The second type of permit is delivered by the state (central authority) with a three to five-year duration which can be extended twice for 5 years each time without competition if the holder has fulfilled all his obligations and the financial commitment equals the previous one. It also includes a competitive call, but no public enquiry is needed, however, an online public consultation is available.

Mining Titles and Permitting in the Exploitation Phase

For the exploitation phase also two mining titles are available based on the amount of primary power: Exploitation Permit (< 20 MW) and Concession (> 20 MW). The first permit is delivered by a local/regional authority and can only be given to a holder of an exploration permit. A public enquiry is needed except if the Research Authorisation permit is still valid. The initial duration of this permit is open to be decided and can be extended to period up to 15 years each. The second type of permit is delivered by the state. A competitive call is included when the exploration permit has been expired. A public enquiry needs to be carried. The initial duration is open and can be extended, here by periods of 25 years each.

Prefectural Decrees and Work Permits During the Exploitation Phase

The exploitation titles (Exploitation Permit or Concession) are completed by prefectural decrees (work permit, see below), established in collaboration with local mining authorities (DREAL). Those texts explicitly define the operator's obligations in terms of general exploitation conditions, definitive cessation of exploitation, safety on the facilities, prevention against pollution and nuisances, seismological monitoring, boreholes and pipes monitoring, relationships with and information to local mining authorities, regional and national administrative authorities. It means that within a common framework, some specific guidelines can be defined for each site. Those "tailor made" guidelines imply a strong adaptation potential, to the geological, geographical, even sociological context.

The Mining Code enforces a strict control on mining work by imposing the obligation to obtain a Work Authorisation (or Work Permit). For DGE project, this corresponds mainly to the drilling operations and to the plant exploitation (for direct use of heat or electricity generation). A company or operator who is going to carry out one of these activities during the exploration or exploitation phase is required to apply for a Work Permit through a DAOTM (Demande d'Autorisation d'Ouverture de Travaux Miniers) application. This Work Permit does not substitute for Mining Titles. During the exploration phase or the exploitation phase, an application for new Work Permit must be submitted each time the operator is implementing a new operation which represents a significant change compare to the initial state (new drilling for example, or addition of a new unit). For implementing operations of minor extent (like well cleaning or repair, well logging, plant maintenance...), the operator only needs to inform the local authority (Declaration). The preparation and submission of an application for a Work Permit is governed by the Decree relating to mining works, underground storage works and to the police of mines and underground storage ([2006-649](#)) of 2006.

Regulations Regarding Safety During DGE Projects

With the application for a permit, several **safety** related documents need to be presented. A first is a report featuring the health and safety policy during work. Secondly, a document stating the terms of abandonment of the exploration or exploitation work and its estimated cost. Thirdly, a document

assessing the potential impacts of the exploration or exploitation activities on the water resources and the mitigating measures envisaged if necessary and finally also a document featuring the main risks induced by the project on the public safety.

Protection of the Environment, Groundwater and Nature

Legislations related to the **environment, groundwater and nature** are given in the 2010 [Environmental Code and Water Act](#) and in the [Mining code](#). The exploration and exploitation of geothermal resources must comply with the requirements of the Environmental Code and Water Act. However, in order to facilitate the implementation of geothermal projects, the legislator has established some links between the Mining Code and the Environmental Code. For example, the drilling permit and the exploitation permit for geothermal resources are also in compliance with the requirements of the Environmental Code and the Water Act.

Environmental Impact Assessment

For the exploration and exploitation permits mentioned, an impact study needs to be carried as mentioned in the Environmental code (Article R.122-5). In some cases, the exploitation of geothermal resources can be also regulated by the Environmental Code and Water Act. These projects involve large capacity heat pumps and binary plants which are using large content of organic gases such as pentane or ammoniac which present a main risk for the natural and human environment. In the French nomenclature, these facilities are termed as *Classified Installations for the Protection of the Environment* (ICPE).

The ICPE procedure includes a public enquiry and a consultation process in which the environmental authority is consulted. The application for requesting an exploitation permit must be accompanied with specific Environmental Impact Assessment (EIA) and Risk assessment. The content of the EIA is proportional to the environmental and activity context and evaluated by the administration “case by case”. The risk assessment justifies the fact that the project, in acceptable economic conditions, reaches the lowest possible level of risks. Its content is related to the risks importance and includes a presentation of the potential accidents’ probability and kinetics and the organisation of the emergency services.

The air quality is also regulated through the [Environmental Code](#) and based on the European Directive. It sets up thresholds and limits for certain polluting gasses with measures and monitoring.

Legislations for the Harmonisation of Spatial Planning

Legislations related to **spatial planning** are also partially included in the [Mining code](#), however, also the [Spatial Planning Code](#) of 2015. The Spatial Planning Code contains all general legislations related to the harmonisation of spatial planning in France. Local authorities are mainly responsible for spatial planning, there needs to be support of the community for certain projects/activities.

Prevention of the Impact on Surroundings

Legislations related to the **impact on surroundings** are mainly included in the [Mining code](#) as also stated above to minimise these impacts. Furthermore, the use of geothermal resources has to be in compliance with the Public [Health Code](#) of 2002 in special cases where it is used in cascade. For example, firstly they are used for energy extraction purposes (i.e. heating with or without heat pump) and then for human consumption (drinkable water). Low volume withdrawals (family uses) are subject to declaration to the municipality only. Other withdrawals for distribution by public or private networks are subject to a request for authorization.

Role of the Public Health Code

Another example of a specific case when the mining regulation must comply with the Public Health Code deals with the protection of workers and population if they can be exposed to ionizing radiations caused by the presence of naturally radioactive material on the geothermal installation. Also, noise is included in this Public Health code stating that no noise may, by its duration, repetition or intensity affect the tranquillity of the neighbourhood or health of man in a public or private place (Article R.1336-5). There is however a differentiation of allowed noise levels between day (7-19h) and night-time (19-7h). Regulations related to waste are included in the [Environmental Code](#) and are aimed at minimising effects on humans and environment.

Data Availability in France

The **data availability** is regulated through the [Environmental Code](#) chapter 4 which gives the rights to information related to the environment. However, this will not include all information such as related to the geology, drilling and borehole measurements. As part of [Mining code](#) certain data needs to be made available to local authorities.

2.4. Germany

For each mentioned legislation, a direct link to the webpage containing this legislative text is given. Most legislative texts can only be consulted in German, however, some translations to English are available and indicated on the webpage.

Legislations Related to the Exploration and Exploitation of Geothermal Energy

In Germany, approval of deep geothermal plants is subject to various federal and state regulations. Legislations related to the **exploration, exploitation and safety** including planning, construction and operation of a DGE project is mainly directed by the Federal Mining Act ([BBergG](#)) of 1980 but also the Mining ordinance for all mining related aspects (Allgemeine Bundesbergverordnung - [ABBergV](#)) of 1995 and the Social and technical occupational health and safety regulations (Arbeitsschutzgesetz - [ArbSchG](#)) of 1996. The Federal Mining Act regulates and promotes mining activities in order to secure the supply of raw materials, guarantees the safety of mining operations and their employees and takes precautions against risks to third parties. However, next to the federal authority, also different legislations occur in the individual states (Bundesländer), these will not be discussed separately.

Mining Permits

Various mining permits are required for exploration, exploitation, operation and the cessation of operations. These are issued upon written application to the mining authority. Activities under the mining act include not only surface and subsurface mines and pits but also drillings with depths greater than 100 m. The act is a federal law but is enforced by the mining authorities of the federal states with their own interpretations. For example, the question of timing of the transition from "permission to search" to "permission to grant subsidies" is handled differently in different federal states. Even within a federal state, changes in application practice may occur over time.

Geothermal energy is unimpeached for mining¹³ and therefore not part of the property ownership. Exploration for and exploitation of geothermal energy is only permitted with a mining licence¹⁴. In a hydrothermal project, the geothermal heat is bound to the brine as the carrier medium. The latter is also considered to be unimpeached for mining, for the exploitation of which a mining licence is required, unless it is a co-production¹⁵. Since water is the carrier medium for the extracted geothermal energy, the provisions of the Water Resources Act ([WHG](#)) of 1960 and the water laws of the individual states need to be considered.

¹³ § 3 para. 3 no. 2 b BBergG

¹⁴ § 6 BBergG

¹⁵ §§ 41 and 42 BBergG

For the exploration and exploitation, four types of mining permits must be requested: an exploration permit¹⁶, an exploration operation plan, an exploitation approval¹⁷ and an exploitation plan¹⁸.

An Exploration Permit

For the exploration of a geothermal energy resource, permission for exploration must be issued by the competent mining authority. The exploration permit covers all activities in connection with the investigation of the subsurface for the assessment of geothermal potential up to the statement of commercial success of the discovery and the performance of a circulation. In the event of a successful discovery, an exploitation approval¹⁹ must be requested to exploit geothermal energy or thermal water in the long run. The exploration permit is limited to a maximum of five years with the possibility of an extension of three years each²⁰.

Drilling deeper than 100 m is subject to the obligation to disclose pursuant to § 127 para. 1 no. 1 BBergG. The mining law with the corresponding and applicable guidelines for the approval of geothermal installations is to be applied. In addition, an operating plan obligation exists²¹.

An Exploitation Permit and Plan

The exploitation approval covers all exploitation activities and permanent extraction of geothermal energy. The prerequisites include proof of discovery²² and the existence of a technical work program²³. Proof of an economic deep hydrothermal resource is provided by carrying out circulation tests after the completion of the wells. Additionally, an examination of the impact on neighbouring wells must be provided. The technical work program includes the presentation of the extraction from the permit field (e.g. operation in a doublet). In addition, credibility is required for the financing, a heat mining expertise (simulation of operation) to assess the sustainability of the system and a procedure of participation. The approval shall be granted for a reasonable period, arguments of a 'reasonable' period are provided based on a heat mining expertise. The approval may be granted for a maximum period of 50 years.

Approval of Permits

If the legal requirements are met, there is in principle a legal entitlement to the granting of an exploration permit and approval for exploitation. Both may only be refused for the reasons listed in §§ 11, 12 BBergG. Due to the legal entitlement to grant, the authority has only a certain margin of discretion when deciding whether to grant or refuse a permit. However, it must in principle take

¹⁶ § 7 BBergG in conjunction with § 3 para. 3 no. 2 letter b and § 11 no. 1 BBergG

¹⁷ § 8 BBergG in conjunction with § 3 para. 3 no. 2 letter b BBergG

¹⁸ §§ 51 et seq. BBergG

¹⁹ § 8 BBergG

²⁰ § 16 para. 4 BBergG

²¹ § 51 para. 1 BBergG

²² § 12 para. 1 no. 3 BBergG

²³ § 12 para. 1 no. 4 BBergG

‘preponderant public interests’ into account²⁴. Public interests include interests and requirements of nature conservation, landscape conservation, regional planning, land use planning, traffic and water protection. The authority needs to balance these reasons with significant public interest in renewable energy and, if necessary, decide in favour of the geothermal plant following the Water Resources Act.

The Operating Plan Procedure

The operating plan procedure forces the planning of the project from the beginning of the exploration work up to plug and abandonment of the borehole with the deconstruction and recultivation of the project site. The mining authority's responsibility for the deep geothermal plant extends to the first above-ground heat exchanger on the production well site and the injection well with its above-ground facilities such as pumps, pipes and fittings. Deep geothermal plants are not exempted from the obligation to draw up operating plans unless it is an operation with a low level of danger and significance. Since the drilling of boreholes involves the operation of various facilities, the handling of substances with hazard potential and intervention in the water balance, § 51 para. 3 BBergG does not apply and the obligation to draw up operational plans applies without restriction. If the authority grants an approval for exploitation (mining of geothermal energy), only private appropriation and activity rights are justified. In order to be able to exercise these rights under public law, an operating plan approval is required.

In order to construct and operate a geothermal plant, a main operating plan²⁵ must be drawn up. It describes in detail the planned work and measures, including all substances used. The main operating plan is valid for two years. In addition, a framework operating plan covering a longer period may be submitted to the authority. This regulation is at the discretion of the respective mining authority. However, a framework operating plan must be delivered to the authority if the project requires an environmental impact assessment (EIA)²⁶. The EIA is then carried out as part of a planning approval procedure²⁷.

²⁴ § 11 no. 10 BBergG

²⁵ The conditions under which an operating plan is approved are laid down in § 55 BBergG. The authority shall also apply § 48 para. 2 BBergG for the approval, according to which the extraction of geothermal energy may be prohibited, without prejudice to other public-law provisions, if this is contrary to preponderant public interests. If the public interests also include the protection of the rights of third parties, the competent authority may interpret the plan if more than 300 persons are likely to be affected or if the group of persons affected is not conclusively known. This only applies, however, if the protection of the relevant provisions is not already guaranteed by other public law provisions in an approval or licensing procedure. Public interests include but are not limited to the emission control requirements of § 22 BImSchG of the Emission Control Law, the permissibility under Building Code unless it has already been examined in a building permit procedure and the provisions of nature conservation law. If there is no reason for refusal due to conflicting public interests, the entrepreneur shall be given an approval title following § 48 para. 2 BBergG. The legislator therefore grants the authority neither discretion nor planning competence in the sense of freedom for planning.

²⁶ see § 57 c BBergG in comparison with the [EIA regulation](#) on mining and §§ 4, 18 UVPG

²⁷ § 57 a and § 57 b BBergG

Environmental Impact Assessment

If it is intended to construct the geothermal plant in a nature and/or bird protection and/or fauna flora habitat (FFH) conservation area or to extract geothermal energy beneath such areas from depths >1,000 m, an EIA and a planning approval procedure must be initiated in any case²⁸. Although a planning approval procedure also includes a regional planning procedure for mining projects, which precedes the planning approval procedure, this presupposes that the geothermal plant is of supra-local importance and spatial significance as formulated in the Regional Planning Act ([ROG](#)). Since geothermal power plants take over the decentralised energy supply locally, the prerequisites for a regional planning procedure are not yet fulfilled, unless the legislator decides otherwise in the future.

Protection of the Environment

Legislations related to the **environment** are already largely included in the above Federal Mining Act and the below Building Code as part of the conditions required for the permits. Other legislations are the Environmental Impact Assessment (EIA) Act (Umweltverträglichkeitsprüfung - [UVPG](#)), as discussed above and the Soil Protection law (Bundes-Bodenschutzgesetz - [BBodSchG](#)) which is under the authority of the water authorities.

Preservation of the Air Quality

Geothermal plants are not subject to any licensing obligation under the Emission Control Law, neither for aboveground nor subsurface plant components²⁹, the general requirements must be implemented. These are basic obligations according to which the plant operator must construct and operate the plant not requiring a permit in such a way that:

- prevent harmful effects on the environment, which are avoidable according to state of the art;
- state of the art is such as to minimise unavoidable harmful effects on the environment, and;
- the waste arising from the operation of the installations is properly disposed of.

Groundwater Management

Legislations related to the protection of the **groundwater** during DGE projects can be found in the Water Resources Act (Wasserhaushaltsgesetzes - [WHG](#)) of 1960. The aim is to sustainably protect or restore the natural functions of surface waters with their banks, groundwater and soil. With regard to a DGE project, the management of water bodies in terms of quantity and quality for the benefit of the general public, the prevention of harmful waste water discharges into water bodies or their minimisation according to the state of the art, as well as precautionary measures for the protection of groundwater are of central importance.

²⁸ § 1 No. 8 of the [EIA ordinance on mining](#); FFH directive [2009/147/EC](#)

²⁹ (§ 4 para. 2 BImSchG)

[BBergG](#) stipulates that the water law is also to be applied to drillings deeper than 100 m. There is an independent obligation to obtain a water law permit. The use of thermal water by geothermal plants to a considerable extent is regulated in accordance with WHG. The mining authority decides in agreement with the water authority on the granting of a permit. In principle, the mining authority does not have the competence to issue permits but the authority may be granted decision-making authority under state law.

Nature Protection

A legislation related to the protection of **nature** is the Nature Conservation Act (Bundesnaturschutzgesetz - [BNatSchG](#)). Before being approved, projects must be checked for compliance with the conservation objectives of an FFH or nature conservation area or a European bird sanctuary in accordance with § 34 BNatSchG and the corresponding state laws.

Regulations and Permits regarding Spatial Planning

Legislations related to **spatial planning** are included in the Building Code (Baugesetzbuch - [BBauG](#)), Monument Protection Law (Denkmalschutzgesetz - DSchG) which differ between states and the Regional Planning Act (Raumordnungsgesetz - [ROG](#)).

Pipeline construction for the heating network, construction of the geothermal heat and power plant are subject to building law. Before the actual building permit procedure is initiated, a preliminary examination (preliminary building application) can be carried out for the construction project. It regulates the admissibility of various projects for the generation of renewable energy in outskirt areas. It additionally refers to specific requirements of the project for the environment (geological conditions) or to adverse effects on the environment (noise nuisance), which allow the project to be carried out only in outskirt areas. It must therefore be clarified whether a deep geothermal project for power and heat generation fulfils the requirements. In the case of an existing decision on this, the building permit authority has no discretionary scope in the further decision on a building application. If the preliminary building permit has become incontestable, the final and binding decision is made with the preliminary building permit. The preliminary building permit is valid for three years and can be extended by up to one year on application. The subsequent building application is made in accordance with the provisions of the respective state building regulations.

According to § 36 BBauG, the agreement of the municipality is required for all outskirt construction projects. The deadline for the decision on the municipal agreement is two months. The building permit expires if the execution of the construction project has not commenced within three years of the granting of the permit or if the execution of construction has been interrupted for one year³⁰.

³⁰ The drill site construction is carried out under mining law and does not require a building permit.

Protection against Impact on Surroundings

Legislations related to the **impact on surroundings** is included in the Emission Control Law (Immissionsschutzgesetz - [BImSchG](#)), Waste Act (Kreislaufwirtschaftsgesetz - [KrWG](#)) and Act on the search and selection of a site for a repository for high-level radioactive waste (Standortauswahlgesetz - [StandAG](#)).

Construction Noise and Chemical Working Materials

For deep drilling and power plant operations, the guidelines for construction noise must be obeyed. In addition, regarding the chemical working materials used, appendix 2 of the 4th federal emission control ordinance contains lists and quantity thresholds for the use or storage of which a plant requires a permit.

Competing Use of the Subsurface

The regulations of StandAG stipulate that in the case of boreholes and civil engineering projects requiring approval with a depth of more than 100 m, it must be examined whether a rock formation is fundamentally suitable for the final disposal of radioactive waste or can be expected to be in the project area at a depth of 300 to 1500 m. If this is the case, a case-by-case examination is required to determine whether further criteria specified in the StandAG nevertheless permit approval of the project, and the licensing authority must reach an agreement with the Federal Office for the Safety of Nuclear Waste Management (BfE).

Data Availability in Germany

Legislations related to **data availability** are also included in the [Federal Mining Act](#) which states that boreholes with a depth greater than 100m need to be declared two weeks in advance to the respective state geological survey and to a responsible mining authority. Upon completion, raw data (no interpretations, concepts and models) need to be made available to the respective geological survey including core samples. However, all subsurface data stays property of the company which collected it. Only this company can decide to share (mostly at a charge) information to a certain extent with others and under which conditions. In a new Geologic Data Act ([Geologiedatengesetz](#)), these limitations of data sharing are tackled to improve geodata availability for exploration. This new act is being discussed at the moment of writing. The [Geodata Access Act](#) is the German federal law of the transposition of the EU INSPIRE Directive for the availability of spatial data, spatial data services and metadata.

2.5. The Netherlands

For each mentioned legislation, a link is provided to a website giving the full legislative text. These texts can only be consulted in Dutch.

The deep subsurface, geothermal energy and related subjects and their legislations are under the authority of the Federal state with the Ministry of Economic affairs and Climate Policy as responsible. A definition for geothermal energy is provided in the Mining Act ([Mijnbouwwet](#)) of 2002 where it states 'in the subsurface present heat created by natural processes'. Also, other legislations related to **exploration** and **exploitation** of geothermal energy are included in the Mining Act. These activities require possession of a permit. The Mining Act is further elaborated in the [Mining Decision](#) of 2002 and the [Mining Regulation](#) of 2019. It should be noted that this Mining Act is being revised at the moment.

Explorative phase

The exploration can be subdivided in the explorative and the detecting phase. The explorative phase includes doing research to the presence of a geothermal resources without a borehole (Article 1 Mining Act). When carrying out a seismic survey, regulations as found in chapter two of the Mining Decision and Mining Regulation should be followed. For this, permission of the concerning municipalities needs to be requested. The requirements for obtaining such permission depends on their spatial planning plans. Often this includes the possession of an environmental permit and sometimes dispensation by provinces and notices. The environmental permit is include in the [Environmental law Act](#) of 2008 and the [Environmental law decision](#) of 2010 and the dispensation in the [Dispensation Act](#) of 1965. The results of the seismic survey should be provided to the ministry of Economic Affairs and Climate Policy within the year of acquisition (Article 108 Mining Decision).

Detecting phase

For the detecting phase, exploration making use of a borehole, an exploration permit needs to be requested. The conditions of requiring such permit and reasons to not receive one are formulated in the Mining Act and Mining Regulation, here also provinces, municipalities and the regional water board may advice. After receiving a permit, an operation plan for the coming five years should be handed in by the Dutch State Supervision of Mines within four weeks giving the prospective activities, organisation scheme and maps of the subsurface structure. It should be renewed every year. For carrying out the activities themselves, an environmental permit needs to be requested and if required also an environmental impact assessment (EIA). The legislations related to an EIA are include in the [Decision EIA](#) of 1994. This environmental permit considers the effects on the environment and spatial planning. For several activities such as drilling of geothermal wells, an EIA-notice is required, this should be carried out before the environmental permit is requested. Operating plans for drilling should be provided to the Dutch State Supervision of Mines four weeks in advance. In general, it is advised to

carry out a permit scan by contacting the relevant authorities to ensure all permits can be acquired (e.g. related to soils, groundwater extraction, drilling under roads, etc.).

Exploitation phase

During the exploitation phase, an exploitation permit needs to be requested, also provinces, municipalities and the water board may advise. An exploitation plan is required which must include information as specified in Article 35 of the Mining Act. For carrying out the activities themselves, also an environmental permit and possibly an EIA is needed. An EIA-notice should be submitted for certain activities such as the drilling of geothermal wells. Also, operating plans for the drilling, repairing or decommissioning of boreholes need to be given to the Dutch State Supervision of Mines four weeks in advance of the activities. During activities, measurements of soil movement need to be carried out following a measurement plan and results should be provided to the ministry of Economic Affairs and Climate Policy. As for the exploration phase, a permit scan should be carried out to ensure all required permits are obtained.

Decommissioning

For the decommissioning of the plant, a decommissioning plan should be presented to the Ministry of Economic Affairs and Climate Policy within a year after stopping activities, also an environmental permit can be required.

Safety during DGE projects

In regard to **safety**, legislations are included in the Mining Act, Environmental law and in the 2004 [Decision](#) and [Regulation](#) of 2004, regarding external safety activities. Before receiving an exploration or exploitation permit, the operator must assure that all activities can be carried out in a safe and responsible manner. For receiving an exploitation permit, advice by the technical commission soil movement is given regarding possible movement of the soil.

Legislation and permits for the protection of the environment

Legislations related to the **environment** are already partially discussed above, as part of the environmental permit. Relevant legislation are: [Environmental Management Act](#), [Regulation Environmental Management](#), [Decision EIA](#), [Decision Regulation Environmental Mining](#), [Environmental law Act](#), [Environmental law decision](#), [Regulation Environmental Law](#), [Soil Protection Law](#) and the [Air Pollution Act](#). The Environmental Management Act, Decision EIA, Decision Regulation Environmental Mining and Regulation Environmental Management are legislation related to general environmental subjects such as waste, environmental zones, EIA, sound, regulations related to measurements and rapportage and permits. The Environmental law Act, Environmental law decision and Regulation Environmental Law are related to environmental permits for activities which may have an influence on the environment. The Soil Protection Law ensures the protection of the soil and prevention against soil

contamination. The Air Pollution Act gives regulations related to the prevention of air pollution wherefor restrictions are added to the environmental permit.

Preservation of the groundwater quality

Legislations of the **groundwater** are included in the [Water law](#) of 2009, [Water Decision](#) and [Water regulation](#). These legislations include general restrictions of the use of groundwater and its withdrawal from the subsurface for its protection. Restrictions are formulated through permits and are case dependent. They also included regulations regarding the monitoring and criteria of a good water status.

Protection of nature

Legislation for the protection of **nature** are included in the [Nature Protection Law](#) of 2015, [Decision Nature protection](#) and [Regulation Nature Protection](#). They include legislation and regulations for the protection of nature with monitoring rights and criteria of good preservation. These legislations are regulated through permitting.

Spatial planning regulations

Legislations related to **spatial planning** are included in the [Spatial Planning Law](#) of 2006 and spatial planning plans. In every step of the process to the exploitation of geothermal energy, provinces and municipalities are involved. For the set-up of these projects, depending on the spatial planning plans, some areas will be available but restricted to several conditions. These conditions will be dependent on the location and province and municipalities involved.

Restriction of the impact on surroundings

The **impact on surroundings** is legislated through multiple legislations: [Environmental Law Act](#), [Environmental Law Decision](#), [Regulation Environmental Law](#), [Environmental Management Act](#), [Regulation Environmental Management](#), [Decision EIA](#), [Decision Regulation Environmental Mining](#), [Law Noise Disturbance](#) and [Nuclear Energy Law](#). Most of these legislations also occurred for restricting the impact on the environment and are related to the environmental permit which gives the restrictions. The Law Noise Disturbance gives regulations related to limits of noise and its monitoring. The Nuclear Energy Law gives regulations related to the protection of the environment of radioactive materials and radiation.

Data availability in the Netherlands

Legislations affecting **data availability** in the Netherlands are included in [the Mining Act](#), [Mining Decision](#) and carried out by the [Mining Regulation](#). Chapter 7 of the Mining Act states the degree of reporting needed (e.g. drilling deeper than 500m). In chapter 7 of the Mining Decision, provision, management and use of data is discussed and gives an exact description of which information should be delivered. The Mining Regulation further states what information should be made available and

provides a more precise description of geophysical surveys, boreholes, measurements and production and injection tests.

3. Analysis

This section analyses the legislative frameworks of the participating countries of the DGE-rollout project. First, the significance of the role of EU Directives on the national and regional legislations is mentioned. Afterwards, for each country, an individual analysis of their legislative framework relating to DGE projects is made. This analysis includes an overview of the legal framework as well as what is seen as advantages and limitations. Finally, a general analysis between the countries is made to provide best practices which can be derived from the studied countries.

To start with, the importance of EU Directives must be pointed out. These legislations are transposed to national legislations and provide a minimal protection of the environment and humans. They are mostly related to the protection of nature and the environment. An advantage of EU Directives is that it sets a cross-border minimum to which countries need to adhere. Separate countries or regions can provide more strict legislations than compulsory by the EU Directives.

In Flanders, the exploration and exploitation of geothermal energy is regulated through the Decree of the Deep Subsurface. An insurance scheme for geological risk is provided by the authorities and creates a more stable environment to invest in DGE projects. The permitting processes and the related regulations are mostly project dependent as the exploration and exploitation phases are not specifically formulated in the decree. This can be of advantage as it allows for project dependent measures, however, also a larger uncertainty because of unclear regulations. Multiple permits need to be requested as well as an Environmental Impact Assessment (EIA) report is required, which can make the permitting process tedious. Intensive interactions with the authorities make it more likely to obtain these permits and the EIA report but will take time and thus make the process slow.

In Wallonia, no specific legislation of the deep subsurface and geothermal energy is in force. However, a new legislative text regarding this subject is on its way. More research is required to identify obligations and conditions of application which could discourage possible investors. Most relevant regulations for DGE projects are provided in environmental and town planning. Furthermore, these need to be supplemented and adapted to make it applicable. Currently, no definition of geothermal energy is available. Furthermore, different authorities are involved in this permitting process making it complex to obtain a permit. The new legislative text should bring more coherence with regards to the management of the subsurface and would consider deep geothermal energy as a strategic resource, such as fossil fuels and metallic substances to stimulate new investments.

In France, a clear definition and regulations related to geothermal energy are available creating a stable basis for investors. Geothermal energy is a state activity with two mining titles or permits regulating the activities together with work permits for the individual activities. While it is a state affair, also local

authorities are of great importance for DGE projects. They are often financially involved and are instrumental for the good public opinion related to DGE projects. Good relationship with these authorities during the legal process is thus important to ensure completeness and obtain approval.

In Germany, the most important legislation regulating DGE projects is the Mining Act. This law is an old mining law which does not make a distinction between natural resources such as coal and geothermal energy. A modernisation of this law with subdivisions depending on the natural resource would improve clarity. Meeting the federal authority is advised to have an indication of what is required to obtain permits. An advantage is that all involved stakeholders which need to give input to the permitting process, are contacted by the federal authority itself. As mentioned before, separate regions, have additional regulations regarding certain activities and thus is the process dependent on the region where it is carried out. This can make the permitting process tedious.

In the Netherlands, already legislations related to natural gas with data sharing, centralised decision making, and knowledge centrum are available. However, it can be difficult to translate these regulations to the use of geothermal energy. For this reason, the legal framework is being revised with the explicit addition of geothermal energy to it.

The subject of geothermal energy and especially deep geothermal energy is controlled at the federal level of most countries except for Belgium where the deep subsurface is in the jurisdiction of the regions. In all countries, local authorities are still of great importance regarding the feasibility of projects in a certain area and this in regard to the spatial planning and public opinion (often also financial support). As exploitation of deep geothermal energy is a very intensive activity, it is good that it is regulated by the federal state to ensure uniform regulations in the country or region. Also, the approval of local authorities provides support from the local population and makes the project more feasible.

Regarding legislations for the exploration and exploitation with the permitting process, France provides a very detailed framework especially focussed on geothermal energy. This focus on geothermal energy is also available in Flanders and will become available in Wallonia and the Netherlands. For the protection of nature and the environment, most regulations are national transpositions of EU Directives giving the same minimal requirements for the preservation of quality. Spatial planning is dependent on the vision of countries as well as regions, local authorities and communities. Relating to data sharing, most authorities add the obligation of providing data to authorities in permits. However, most of this data is not shared with the public.

4. Conclusion

This report has given an overview of the legal frameworks of Flanders, Wallonia, France, Germany and the Netherlands and a general overview of interesting EU Directives in relation to deep geothermal energy projects.

In Belgium, the deep subsurface is regulated by its regions of Flanders, Wallonia and Brussels. In this report, only Flanders and Wallonia were studied in more detail. No federal legislations besides those related to radioactivity influence DGE projects. In Germany, most legislations related to DGE are regulated by federal legislations but also the regions can have additional regulations.

Regarding the most complete legal framework for DGE projects in special, France provides the most detailed framework but where still room for project dependent regulations is present. In Wallonia, at the moment no specific legal framework is available making regulations spread out between different authorities and legislations making the process tedious. However, a new legislative text providing a definition for geothermal energy and regulations regarding the exploration and exploitation is in progress of being approved. Also, in the Netherlands, a more detailed legal framework regarding geothermal energy is on its way, however, now legislations related to natural gas provide a good basis. In Flanders, a relatively new legal framework for DGE projects is in place, however, most regulations are still very project dependent with the framework built based on past experiences. In Germany, no separate legal framework is available as it is included in the general mining act, this provides struggles also with the addition of regulations which are dependent on the regions.

In most countries, it is shown that it is very important to learn from experiences of past DGE projects. This is not only important for the technical aspects of the projects but also for the legal framework where collaboration with authorities is great added value and will help for future projects. Furthermore, it is shown that good public opinion is of importance where reliable information exchange is necessarily such that all parties are aware of planned activities.

A best practice that can be distilled from the analysis is that clear definitions and regulations regarding DGE projects in the legal framework help smooth development. The provided regulations should set clear requirements for the exploration, exploitation and decommissioning phases as well as safety during the projects. For the permitting process, it should be clear which permits need to be requested and which information should be provided (e.g. production and operating plan). A permit for a DGE project should provide room for project specific measures. The number of responsible authorities for granting permits should be minimised to make the process more efficient. Data sharing should be promoted with clear information on which data should be provided to authorities.

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