

Status quo report on regulatory and policy framework in the context of geoHC networks in Europe

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EXECUTIVE SUMMARY

This status quo report on regulatory and policy framework in the context of geoHC networks in Europe aims at better understanding the regulatory factors influencing project development. It has also the objective to list barriers.

Firstly, the key aspects of the current European and national regulatory and policy frameworks are detailed. It presents the EU and national policies on climate & energy for 2030, and it highlights new opportunities and challenges taken from these policies. The new EU framework on district heating and the key provisions on permitting and environmental regulation are also part of this first chapter. Finally, this chapter deals with financial and economic aspects. The taxation and financing framework influencing geoHC networks in Europe are analysed with an overview of the taxation of energy products and the energy price regulation. It reports the legislative framework for public-private partnerships and the TEN-e infrastructure regulation.

Market drivers and barriers in the policy and regulations framework are then mapped. This part presents both hindering factors and supportive factors. Market drivers and barriers are then analysed taking into account economic conditions.

An innovative exercise was performed to assess the political readiness level of a set of European countries. An evaluation scheme was developed with a methodology and critical indicators to apply the scheme on the study areas and map gap analyses. Project partners validated the data for their specific countries:

- Austria
- Denmark
- France
- Germany
- Italy
- Poland
- United Kingdom

Finally, existing gaps and good practices are presented to indicate the Political Readiness Level of these countries.

Recommendations will be produced in a follow up report once measures towards improving the regulatory and policy framework conditions are agreed and validated.

To sum up, the Project partners present here a picture of regulations and policies influencing geoHC networks in Europe, to better understand the barriers and then provide policy recommendations in order to improve regulatory and institutional framework conditions.

1 INTRODUCTION

The present report aims to assess the *status quo* on regulatory and policy framework in the context of geoHC networks. For the purpose of this report, a geoHC network can be defined as a thermal distribution grid network that operates at a scale from local communities to cities, with temperatures ranging from below 30°C to around 120°C and peak load capacities between 500 kW to hundreds of MW¹. It uses geothermal energy as either a primary or seasonal heat source, integrates on-site fluctuating heat sources, prioritises local, low-enthalpy inputs for resilience, and serves both new and existing infrastructures with a focus on reducing fossil fuel use and energy imports.

In the first section (Chapter 2), this report aims to summarize key aspects of the current European regulatory and policy framework and outline existing gaps and shortcomings as well as already available good practices, as regards the deployment of geoHC networks. As we will see, the EU legislation that has been recently revised on the impulse of the Green Deal Initiative do not mention explicitly geothermal energy, but it sets a strategy of substantial increase in efficiency and renewable energy, which creates great opportunities for geoHC networks.

In the second section (Chapter 3), it recalls the main market drivers and barriers in the policy and regulations framework. Here the reference is to some previous analysis made in the context of the SAPHEA project too, in particular the “Status report on key market drivers related to the implementation of geoHC network”². Those market drivers and barriers will therefore be seen in the light of the new European regulatory and policy framework outlined in the previous chapter.

Finally, the last section (Chapter 4), introduces and describes the Political Readiness Level Evaluation Scheme and exhibits its application on the project countries. The model proposed has the goal of providing a simplified tool to try to understand the readiness level of national legislation for the implementation of geoHC networks.

¹ See <https://www.saphea.eu/geodhc-networks-1>.

² Deliverable 2.1 of this project.

2 KEY ASPECTS OF THE CURRENT EUROPEAN AND NATIONAL REGULATORY AND POLICY FRAMEWORK

2.1 EU and national policies on climate & energy: new opportunities and challenges

The European Green Deal³, approved in 2020, is a set of policy initiatives by the European Commission with the overarching aim of making the EU climate-neutral in 2050. The plan was to review each existing law on its climate merits and introduce new legislation including on the circular economy, building renovation and innovation.

To deliver the Green Deal, existing legislation is revised, and new legislative initiatives are put in place, under the “Fit for 55” package⁴, launched in 2021. These legislative proposals under the ‘Fit for 55’ package are intended to ensure the EU achieves the -55% emission reduction target by 2030 compared with 1990 levels. In particular, the package launched the revision process of key legislation for the geothermal sector such as the Renewable Energy Directive (RED), the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD).

Moreover, in May 2022, the Commission presented its REPowerEU plan⁵ as a response to the hardships and global energy market disruption caused by Russia's invasion of Ukraine. The main purpose of the plan is to save energy, produce clean energy and diversify EU energy supplies. Among others, this plan has also translated into further measures to be included in the RED, EED and EPBD revision.

All the abovementioned legislation is coherent in developing the new EU ambition towards a decarbonised and renewables-based economy. At the moment of drafting this deliverable, RED and EED have completed their revision path, while EPBD is still under the revision process. As regards geothermal district heating and cooling (geoHC) networks, some provisions deserve specific attention. Below will follow an analysis of the opportunities and challenges coming from key articles in RED and EED.

2.1.1 Setting a new EU framework on district heating

2.1.1.1 RED III: relevant aspects for geoHC networks

This section provides an overview of the RED articles with a specific impact on the use of renewable energy and, more specifically, on district heating and cooling networks.

Article 23 on mainstreaming renewable energy in heating and cooling

Heating & cooling from renewable sources - binding target

³ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN>.

⁴ https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en.

⁵ https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3131.

The revised article provides for a gradual increase in renewable targets for heating and cooling, with a binding increase of 0.8% per year at the national level until 2026 and 1.1% from 2026 to 2030. The previous target was an indicative 1.3% increase for the whole period. The minimum annual average rate applicable to all Member States is complemented with additional indicative increases calculated specifically for each Member State. The calculation of renewable electricity used for heating and cooling towards the annual average increases must be for the first time specified and limited in the national energy and climate plans (NECPs)⁶.

The binding nature of the renewable heating and cooling sub-target is an important achievement, sending a clear signal to Member States. The reference to the NECPs is also to be welcomed as a means to keep track of Member States developments in this sense. The 0.8 and 1.1 percentage points increase are, however, much lower than the 2-percentage point binding target that is required to meet the Commission's own Impact Assessment for renewable heating and cooling in 2030.

Assessment of the potential of energy from renewable sources

New Article 23 on mainstreaming renewable energy in heating and cooling states that Member States shall now assess their potential for energy from renewable sources. The assessment shall consider the available and economically feasible technologies for industrial and domestic uses to set out milestones and measures to increase the use of renewable energy sources in heating and cooling.

A mandatory assessment of this kind is to be welcomed as it duly takes into account the different renewable energy sources and their possible implementation considering different starting conditions. In this context, geoHC networks can be a useful solution which can prove to be a better option compared to other renewable energies in certain situations and under certain conditions, especially when combined with a comprehensive mapping of geothermal resources at the national level. In subsequent revisions of the directive, within the assessment of their potential of energy from renewable sources, Member States should carry out guidance on permitting modelled on a "traffic light system". This should include the production and publication of areas for geothermal where just a notification is requested, drilling is required, or where it is prohibited. This would assure a more levelised starting point for all renewable options in view of the assessment carried out by local authorities to choose the best solution for their community.

Moreover, Distribution Service Operators (DSOs) should also be given a mandate to prepare renewable heating & cooling plans. Many local authorities are either directly responsible for their DSOs legal requirements or devolve these legal requirements to a recognised entity. Gas DSOs and electricity DSOs, at present, do not have a clear mandate to plan and deliver renewables and renewable district heating and cooling networks of community schemes.

⁶ The national energy and climate plans (NECPs) were introduced by the Regulation on the governance of the energy union and climate action (EU)2018/1999, agreed as part of the Clean energy for all Europeans package which was adopted in 2019. The national plans outline how the EU countries intend to address the 5 dimensions of the energy union: decarbonization, energy efficiency, energy security, internal energy market, research, innovation and competitiveness. See [here](#) for more information.

Threats can derive from the implementation and monitoring of this obligation. As mentioned before, NECPs should become more relevant and detailed documents reflecting both RED prescriptions and national measures put in place to reach them. The Commission should be strict in its monitoring activity.

Implementing measures to promote the use of renewable energy in the heating and cooling sector

Member States shall now implement at least two measures described in paragraph 4 of article 23 (before, indicatively one or more). The list has been further specified and enlarged, in particular with reference to local mapping and planning, risk mitigation frameworks, heating and cooling purchase agreements, local planning on H&C, promotion of DHC and specific renewable sources and technologies. Point (l) specifically mentions the “promotion of renewable based district heating and cooling networks, in particular by renewable energy communities, including through regulatory measures, financing arrangements and support”.

The list of measures has been positively enlarged and made mandatory for at least two elements of Member States' choice. In particular, the list now includes: local mapping and planning, risk mitigation frameworks, heating and cooling purchase agreements, local planning on H&C, promotion of DHC and specific renewable sources and technologies. However, given the long list of measures and the limited obligation of choosing at least two, the risk is paying little attention to some of these measures and the tendency from Member States to consider their obligations achieved by focusing only on a couple of measures. In this context, some measures with favourable effects for geoHC networks, such as risk mitigation schemes and local mapping and planning, may not be the first choice for being considered expensive, resource-consuming and difficult to implement.

As regards energy communities, it is important to underline that Article 22 of this directive was already defining them and inviting Member States to implement them. Therefore, once again what is needed is implementation at the national level.

Article 24 on district heating and cooling

The annual increase target of the share of energy from renewable sources and waste heat and cold in district heating and cooling is increased from 1% to 2.2%. The text also introduces provisions allowing for counting renewable electricity towards the target. Member States with a RES/waste heat (WH) share in DHC between 50% - 60% are granted favourable conditions for meeting the target increase (i.e. may count any such share as fulfilling half of the average annual increase referred to above).

The annual renewable increase target has significantly increased. However, while Article 24 presents an opportunity for the DHC sector to contribute more aggressively to renewable energy targets, the non-binding nature of the target and the lack of specific focus on geoHC networks could pose some challenges. For instance, GeoHC may not receive the attention or investment it really needs to fully contribute to the target.

Lastly, renewable electricity is fully considered highlighting the importance of large heat pumps and other power-to-x technologies.

New Article 22a on mainstreaming renewable energy in the industry

This new article sets an indicative (non-binding) target for Member States of a yearly 1.6% increase in the share of renewable sources used in the industry sector; this increase will be calculated as an annual average for the periods 2021-2025 and 2026-2030. Waste heat and cold can be counted up to 0.4%, provided it is supplied from efficient district heating; in that case, the overall annual increase shall increase by half of the waste H&C percentage points used.

Measures to achieve this target shall be included in the NECPs and shall promote the RES-based electrification of industrial processes, when cost-effective, and aim at reducing the use of fossil fuels for processes below 200 degrees. The contribution of renewable fuels of non-biological origin (RFNBOs) shall be at least 42% of the hydrogen used in industry by 2030 and 60% by 2035.

Moreover, Member States shall promote voluntary labelling schemes for industrial products that are claimed to be produced with renewables and RFNBOs, indicating the share of RES and RFNBOs used at each stage of the production.

The introduction of a new article signals the importance that the EU legislator gives to the decarbonisation of industrial processes. Geothermal DHC can certainly play a role in that by providing a stable and reliable share of renewable sources as required by the provision. The reference to the NECPs is also to be welcomed as a means to keep track of Member States developments in this sense. However, the non-binding nature of the target severely undermines its impact. This means that the lack of a binding mandate lessens the directive's influence considerably and may not push Member States to action as forcefully as a mandatory requirement would. Also, renewable heat is not explicitly mentioned in the article, unlike waste heat and cold, electrification, and RFNBOs.

Nonetheless, Article 22a offers a relevant argument to demand adequate measures to decarbonise industry (in particular industrial process heat) in the ongoing NECP update. In subsequent RED revisions, the target should be made mandatory and raised, while the role of renewable heating and cooling sources should be highlighted more clearly.

As regards the promotion of the labels, it would be important to avoid greenwashing and informed decisions by consumers. However, the voluntary nature undermines the impact of such labelling schemes.

2.1.1.2 New EED: relevant aspects for geoHC networks

This section provides an overview of the EED articles with a specific impact on DHC systems and heating and cooling assessment and planning.

New article 25 paragraph 6 on heating and cooling assessment and planning

The revised article creates a new provision regarding local heating and cooling plans (LHCP). Member States shall ensure that municipalities with more than 45,000 inhabitants conduct LHCP. The article details some key principles for the goal, process and content of the LHCP. It also obliges Member States to develop recommendations and strong technical and financial support for local authorities. This article therefore greatly strengthens the local dimension of the decarbonisation of heating and cooling,

as the 2018 version only vaguely encouraged this. Moreover, it specifically mentions that these plans should “provide an estimate and mapping of the potential for increasing energy efficiency, *including via low-temperature district heating readiness*, high efficiency cogeneration, waste heat recovery, and renewable energy in heating and cooling in that particular area”.

The mandatory nature of this article for Member States provides a strong push to implement a local transition in heating and cooling. The article also contains strong wording on the obligation for Member States to provide technical and financial support to local governments to achieve this, and to propose recommendations for local decarbonisation. It also explicitly supports DHC and RES and is relatively precise on the content of the plans, which may avoid certain pitfalls, such as having local plans focused only on security of supply issues.

However, the obligation does not rest directly on the municipalities, for the sake of subsidiarity, so it is up to each Member State to transpose this article at the national level and therefore to design the structure that suits it best for creating LHCPs.

Nothing is specified in the article for municipalities with fewer than 45,000 inhabitants, who should be encouraged to draw up these plans voluntarily at first, and then obliged to do so at a later date once the support mechanism at the national level is better established, to cover a larger proportion of the European population. The limit could have been less than 45,000 inhabitants and thus could have included a more important number of cities/villages. GeoHC networks could benefit also from a disposition which includes smaller cities that are currently left out, as they can also be effectively implemented in smaller contexts. However, as the obligation is “*at least* in municipalities having a total population higher than 45,000” and there is also the opportunity to have joint plans and joint investments with neighbouring municipalities, this can point in practice in the direction of regional plans including municipalities below 45,000 inhabitants.

Also, the recommendations included in the LHCPs are not mandatory to implement. The powers of local authorities vary greatly from one country to another, and most currently lack the appropriate skills to carry out LHCPs. There is therefore a risk that if the support mechanism is not optimal, these plans will be reworked on the margins and that they will never be implemented. A number of European countries have already introduced this type of obligation or incentive for local authorities, and can therefore serve as a model to inspire other Member States.

New article 26 on heating and cooling supply

Definition of efficient district heating and cooling systems

The new definition of efficient district heating and cooling systems has been improved significantly compared to the old definition. From a single definition, now a whole article is dedicated to it, which recognises the importance of the DHC sector and its potential to provide sustainable heat to buildings. It focuses on ensuring more efficient consumption of primary energy and increasing the share of renewable energy in the heating and cooling supply. It introduces specific criteria for efficient district heating and cooling systems based on the percentage of renewable energy, waste heat, and high-efficiency cogeneration used in the system over different timeframes. A new milestone is introduced into the definition for 2045, which no longer includes high-efficiency cogeneration, and states that

efficient DHC systems have to use 75% RES and waste heat. This means that cogeneration running on fossil fuels can be counted towards the energy source of efficient DHC systems until the end of 2045.

Paragraph 1 also sets specific targets for the share of renewable energy, waste heat, and high-efficiency cogeneration in district heating and cooling systems, which allows Member States to utilize available sustainable energies based on their decarbonisation pathway. These targets gradually increase over time until they reach a system that uses only renewable energy, waste heat, or a combination of both by 2050.

The new article places a strong emphasis on increasing the share of renewable energy in district heating and cooling systems, which aligns with EU efforts to reduce greenhouse gas emissions. Such a flexible target, towards which both renewable and waste heat jointly count, enables Member States to develop their DHC networks based on their locally available energy source in a flexible manner. This can of course be a great incentive for the implementation of geothermal DHC networks. By setting targets increasing over time, the paragraph allows for a transition towards more sustainable district heating and cooling systems, leading to more investments in DHC infrastructures. Moreover, the focus on renewable energy and high-efficiency cogeneration may drive innovation and technological advancements in the district heating and cooling sector.

However, the timeline that permits non-renewable energy sources in DHC systems until 2045 can be questioned, as it seems in contradiction with the rapid decarbonisation effort which generally inspires the Fit for 55 package.

Alternative definition for efficient district heating and cooling systems

This article creates also an alternative definition for efficient district heating and cooling systems, which instead of a share of RES and WH in the system refers to grams of CO₂ emitted for each kWh of heat produced.

It respects that different EU Member States have different decarbonisation pathways and gives the flexibility to MSs to choose the definition of their preferences. However, even though a CO₂ criterion is also favourable to geothermal DHC networks, this alternative definition was conceived to favour MSs utilizing waste heat from nuclear energy sources, bypassing the concept of renewable sources of energy.

Specific criteria for district heating and cooling systems to qualify as efficient

The new article sets specific criteria⁷ for district heating and cooling systems to qualify as efficient, particularly when they are built or substantially refurbished. It also ensures that DHC systems, to

⁷ These criteria are listed in paragraph 1:

“In order to ensure more efficient consumption of primary energy and to increase the share of renewable energy in heating and cooling supply going into the network, an efficient district heating and cooling system is a system which meets the following criteria:

comply with the definition, newly built or refurbished, should not use fossil fuels, except natural gas until 2030.

By discouraging fossil fuel use and promoting the use of renewable energy, it guarantees the development of renewable energy sources, the utilisation of waste heat in DHC and the contribution to reducing GHG emissions and environmental impacts associated with heating and cooling systems. The ban on new fossil fuel capacity, in particular natural gas from 2030, is a progress but could represent a difficulty for backup capacity in case of peak load, as there is no exemption. In this sense, geothermal energy should be considered as the most valid solution to give reliable baseload capacity.

Proactive measures for DHC systems operators

The new paragraph requires operators of existing district heating and cooling systems with a total heat and cold output exceeding 5 MW, which does not meet the requirements set out in the new paragraphs 1 or 2, to prepare a plan every five years on how they will increase energy efficiency and incorporate renewable energy and waste heat.

The article emphasises proactive measures by requiring operators of existing DHC systems, from 1 January 2025 and every five years thereafter, to develop plans for improving energy efficiency and incorporating renewable energy and waste heat. This promotes long-term planning and concrete actions toward a more sustainable sector. The requirement to increase the share of renewable energy in the heating and cooling supply provides a significant opportunity for the integration of renewable sources, reducing reliance on fossil fuels and contributing to climate goals.

The new article specifically targets existing DHC systems exceeding 5 MW. Other systems that fall below these thresholds may not be subject to the same level of scrutiny or efficiency improvement requirements. The plan requirement for existing DHC systems provides opportunities for infrastructure upgrades and modernisation, potentially leading to more efficient and sustainable systems. In addition, it creates opportunities for technical advancements and innovation in the DHC sector. Existing DHC networks will be eligible for EU funding only if it is invested to meet the criteria of the

-
- a. until 31 December 2027, a system using at least 50% renewable energy, 50% waste heat, 75% cogenerated heat or 50% of a combination of such energy and heat;*
 - b. from 1 January 2028, a system using at least 50% renewable energy, 50% waste heat, 50% renewable energy and waste heat, 80% of high-efficiency cogenerated heat or at least a combination of such thermal energy going into the network where the share of renewable energy is at least 5% and the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 50%;*
 - c. from 1 January 2035, a system using at least 50% renewable energy, 50% waste heat, 50% renewable energy and waste heat or a system, where the total share of renewable energy, waste heat or high-efficiency cogenerated heat is at least 80% and in addition the total share of renewable energy or waste heat is at least 35%;*
 - d. from 1 January 2040, a system using at least 75 % renewable energy, 75% waste heat or 75% renewable energy and waste heat, and using at least 95% renewable energy, waste heat and high-efficiency cogenerated heat and in addition the total share of renewable energy or waste heat is at least 35%;*
 - da. from 1 January 2045, a system using at least 75 % renewable energy, 75% waste heat or 75% renewable energy and waste heat.*
 - e. from 1 January 2050, a system using only renewable energy, only waste heat, or only a combination of renewable energy and waste heat."*

efficient district heating and cooling systems definition. For this reason, creating plans for that purpose would bring opportunities for how operators could apply for EU funds.

2.1.2 Key provisions on permitting and environmental regulation

2.1.2.1 New EU rules on permitting.

In December 2022, Member States agreed on accelerated permitting rules for renewables. These rules have been now integrated into the new RED directive⁸.

In particular, the concept of “renewable go-to areas” has been introduced. These have been defined as the areas for the deployment of renewable energy to identify the domestic potential and the available land surface, subsurface, sea or inland water as necessary for the installation of plants for the production of energy from renewable sources, and their related infrastructure necessary for national contributions towards the 2030 renewable energy target. Each Member State will have to map these areas within 18 months after the entry into force of this directive and adopt a plan or plans designating 'renewables go-to areas' within 27 months.

In the designated renewable go-to areas, permit-granting processes should not take longer than one year for renewables projects, and two years for offshore renewables projects (with exceptions). Moreover, a shorter deadline of 6 months for areas already designated as suitable for an accelerated renewables deployment. As for the repowering of plants and new installations with an electrical capacity of less than 150 kW, and co-located energy storage facilities as their grid connection, the processes should be limited to six months, and one year if they concern offshore wind energy projects (with exceptions).

For areas outside go-to areas, the permit-granting processes should not exceed two years, and three years for offshore renewables projects (with exceptions). The time during which the plants, their grid connections and the related necessary grid infrastructure are being built or repowered should not be counted within these deadlines.

It is welcome that for the first time, such a mapping is mandatory and involves Member States together with the relevant national, regional and local authorities. This "renewables acceleration areas" system will be very useful for a fast deployment of renewable energy sources by accelerating the permitting processes where possible and at the same time reducing as much as possible the negative environmental impacts as.

Availability and flexibility are key aspects when considering the deployment of renewable energy solutions for heating and cooling. Having seen the Member States' delays in the implementation of the RED II, the risk is that the deadlines of 18 and 27 months after the entry into force will not be respected in some cases. The Commission should be strict in its monitoring activity, as the provision states that the plan or plans designating renewables acceleration areas shall be made public and shall be reviewed periodically, as appropriate, in particular in the context of the update of the NECPs.

⁸ See in particular articles 15b, 15c, 16, 16a, 16b, 16c 16d.

Moreover, digitalisation of the ‘renewable go-to areas’ data would facilitate the licensing and permitting process as new capacity is added and recorded. Thus, the EU legislator should specify that such continuous updates should always be in electronic format to facilitate the permitting process and in favour of easy access from the stakeholders involved.

Lastly, with Council Regulation 2022/2577 of 22 December 2022 laying down a framework to accelerate the deployment of renewable energy, the EU legislator agreed on some temporary measures to accelerate the deployment of renewable energy⁹. This Council Regulation will be valid for 18 months, after which the Commission will review whether it is appropriate to extend it.

As regards geoHC networks, the most important provision is the one stating that renewable energy plants would be presumed to be of overriding public interest (article 3). This would allow new permitting procedures to benefit with immediate effect from a simplified assessment for specific derogations foreseen in EU environmental legislation.

2.1.2.2 *Environmental legislation*

Geothermal energy is subjected to a wide array of environmental legislation that minimises the possible environmental impacts linked to the development of industrial activity such as developing geothermal resources.

The European, national and regional regulations about geothermal energy technologies aim to avoid environmental impacts for any segment of the value chain, from drilling to f-gas used in heat pumps for individual geothermal heating systems. These regulations can be laid out at the European level, through directives or regulations, and may be monitored by the European Environmental Agency. Enforcement however usually happens at the local level where national and regional authorities and agencies play a key role in advising new projects, monitoring existing installations and enforcing regulations in case of infringement.

Key environmental policies and regulations for the geothermal sector include:

- Water Framework Directive¹⁰
- Environmental Impact Assessment (EIA)¹¹
- F-Gas regulation¹²

⁹ <https://data.consilium.europa.eu/doc/document/ST-16238-2022-INIT/en/pdf>.

¹⁰ [Directive](#) 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

¹¹ [Directive](#) 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.

¹² [Regulation](#) (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. This directive is currently being revised: see [Proposal](#) for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014.

Environmental assessment

An environmental assessment ensures that the environmental implications of a project are evaluated and taken into account. Environmental assessments can be undertaken for individual projects based on Directive 2011/92/EU (EIA Directive, as revised by Directive 2014/52/EU) or for public plans or programmes based on Directive 2001/42/EC (SEA Directive). Both Directives ensure that plans, programmes and projects likely to have significant effects on the environment are subjected to an environmental assessment before their approval or authorisation. According to the EIA Directive, the national authority determines whether and which geothermal drilling projects should be subject to an environmental impact assessment. A geothermal project has also to comply with Directive 92/43 on the conservation of natural habitats and wild fauna and flora (Habitats Directive). By Article 6 (3) of this directive, if a proposal is considered to have a significant effect on the conservation objectives of a Community Site an appropriate assessment will be required. One can distinguish cross-cutting themes - like water quality, air quality, waste and environmental liability - that apply to multiple environmental impacts, and themes that are specific to a particular impact. Each theme is covered by several EU directives as briefly described in the table below¹³.

¹³ For more information see the [Geoenvi](#) project, and in particular the [Decision-making process mapping](#) (Deliverable 4.1).

Topic	EU legislation	Scope
Water quality	2000/60/EC 2008/105/EC	Water Framework directive: protection of inland surface waters, transitional waters, coastal waters and groundwater
	2006/118/EC	Specific measures to prevent and control groundwater pollution
	2013/39/EU	Priority substances in the field of water policy
	2014/80/EU	Threshold values for groundwater pollutants and indicators of pollution
Air quality	2008/50/EC	Air quality directive: Monitoring requirements and threshold values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter (PM10 and PM2.5), lead, benzene, carbon monoxide, and ozone
	2016/2284	National Emission Ceilings Directive: 2016/2284/EU requires annual information on emissions of a number of pollutants from EU Members States
	2004/107/EC	Target values, mitigation measures, monitoring and information requirements for a specific group of pollutants (arsenic, cadmium, mercury, nickel, benzo(a)pyrene and polycyclic aromatic hydrocarbons)
	2003/87/EC	ETS Directive: establishing a scheme for greenhouse gas emission allowance trading (ETS)
Waste	2008/98/EC ; 2018/851 ; Decision 2014/955/UE and 2000/532/EC	Classifies different types of waste, inc. Ordinary Industrial Waste (most applicable for deep geothermal) and hazardous waste and stipulates requirements for handling hazardous waste
	2018/850/EC	Regulates landfill of waste targeting a progressive reduction and mitigate possible negative effects on the environment in line with the ambitions of a circular economy.
Noise and vibration	2000/14/EC	Harmonises the laws of the Member States relating to (amongst others) noise emission standards and data collection concerning the control of noise emission by outdoor equipment
	2002/49/EC	Regulates the assessment and management of environmental noise intended to mitigate the exposure to environmental noise
	2015/996/EC	Defines common assessment methods for the determination of the noise indicators
Landscape	2003/35/EC	Supports the involvement of the community in decisions concerning the landscape by providing for public participation in the preparation of plans and programmes relating to the environment
Soil quality	COM(2006) 232	Sets out common principles for protecting soils from various threats (e.g. erosion, decline in organic matter, contamination, sealing, compaction, decline in biodiversity, salinisation, floods, landslides)
Radioactivity	2013/59/Euratom	Safety standards and thresholds for dynamic and cumulative radioactive doses for any planned, existing or emergency exposure situation which involves a risk from exposure to ionizing radiation.
Pressure equipment	2014/68/EU	Sets requirements for the design, manufacture and conformity assessment of pressure equipment and assemblies (pressure > 0,5 bar) including e.g. inspection programs for different risk categories.
Liability	2004/35/EC	Liability directive: establishes a framework for environmental liability, based on the polluter-pays principle, for the prevention and remedying of environmental damage

Table: Main EU directives and legislation for the environmental themes considered (source: <https://www.geoenvi.eu>)

As regards the national legislation, the Geoenvi project illustrated that many of the environmental impacts related to deep geothermal associated with water quality, noise and energy regulations are well established in a large majority of countries in Europe. Other impacts like visual impacts on the landscape, or pressure and temperature decline at the production site, are less well regulated, although generally included in EIAs required for obtaining permits¹⁴.

2.2 The taxation and financing framework

¹⁴ For more information see the [Geoenvi](#) project, and in particular the [Decision-making process mapping](#) (Deliverable 4.1).

2.2.1 Overview of the taxation of energy products

Taxes account for a significant share of the final prices consumers pay for energy around the EU and can have a strong impact on consumption and investment patterns, the type of energy consumed and their use. This is reflected by the different rates of energy taxation in different EU countries, with important variations between households and industrial use, between different energy sources and with rates that bear little relation to the energy content or externalities, such as CO₂ emissions or air pollution. Taxation policy is also an important instrument for governments to ensure the achievement of the energy union objectives, and in particular to facilitate the clean energy transition. A different taxation of electricity and gas is seen as a driver, especially when gas is less taxed. A lower VAT rate for geothermal DHC networks is also seen as a supportive element. The lack of carbon pricing in the heat sector hampered the development of geoHC.

Under current Energy Taxation Directive provisions, geothermal heat pump technologies are more expensive compared to fossil gas, as the latter still benefit from low minimum rates and numerous exemptions. EU legislators recently agreed to introduce a carbon price on buildings and road transport fuels¹⁵. The new carbon price will apply to petrol, diesel and heating fuels such as natural gas.

As regards the national level, an important example is given by Finland, by letter of 6 August 2021, following the procedure laid down in Article 19 of Directive 2003/96/EC, requesting authorisation to apply a reduced rate of taxation to electricity supplied to heat pumps and electric boilers that generate heat for the district heating network, to heat pumps with a nominal thermal output of at least 0,5 MW not connected to the district heating network, and to recirculating water pumps in geothermal heating plants. On 17 June 2022, the Commission authorised this legislation for the period from 1 January 2022 until 31 December 2027¹⁶. The Finnish example should be considered as a best practice in terms of energy taxation.

To answer current challenges, we deem it necessary to further promote and not limit in time the applicability of legislative measures such as the Finnish ones. A reduced rate of taxation on electricity supplied to renewable heating solutions must be promoted. Similar solutions should be taken in other Member States to create a levelled playing field for geothermal DHC networks.

2.2.2 The importance of energy price regulation

Energy price regulation is another factor which can boost geoHC networks. For example, in Denmark, a new political agreement on price regulation for geothermal energy was adopted in December 2021¹⁷.

Pricing now can take place through a contract between the district heating company and the geothermal operator, which places a cap on the costs consumers will pay for the geothermal heat. The

¹⁵ The European Commission issued in 2021 its proposal to recast the Council Directive 2003/96/EC for restructuring the Community framework for the taxation of energy products and electricity ("Energy Taxation Directive" or "ETD"), which is still under negotiation in the EU Parliament and Council.

¹⁶ Council implementing decision (EU) 2022/1004 of 17 June 2022 authorising Finland to apply a reduced rate of taxation to electricity supplied to certain heat pumps, electric boilers and recirculating water pumps, in accordance with Article 19 of Directive 2003/96/EC.

¹⁷ See <https://danskfjernvarme.dk/aktuelt/nyheder/2022/politisk-aftale-giver-haab-for-at-vi-nu-kan-udnytte-potentialet-for-geotermi>.

Danish Supply Authority, as an independent authority, must approve the exemption and check that the conditions are met.

At the same time, it is ensured that consumers do not have to bear the risk associated with the kilometre-deep drilling in the underground.

2.2.3 Setting the right legislative framework for public-private partnerships

Public-Private Partnerships (PPPs) describe a form of cooperation between the public authorities and economic operators. The primary aims of this cooperation are to fund, construct, renovate or operate an infrastructure or the provision of a service. PPPs are characterised by:

- the duration of the relationship between the partners;
- the method of funding the project;
- the role of the partners in the definition of objectives, design, completion, implementation, and funding;
- the distribution of risks.

At EU level, three directives dealing with PPPs have been transposed into national law in EU countries:

- Directive 2014/24/EU on public procurement
- Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors
- Directive 2014/23/EU on the award of concession contracts

Indeed, another way national legislation can favour the development of geothermal DHC networks is through the creation of a legal framework to support public-private partnerships. This is the case of France, which in 2015 approved the Energy Transition for Green Growth Law¹⁸ which supports municipalities to access capital from the SAS-LTE (Energy Transition Law) to produce renewable energy. This allows public-private companies to be jointly established between the energy supplier and the local authority¹⁹.

For example, in 2019 a joint-stock company called Véligéo was created in the city of Vélizy-Villacoublay. It is jointly owned by the city (which has a 20% stake) and Engie (80% stake) to develop the geothermal resource which then feeds directly into the Vélidis district heating network²⁰. The supply contract is for 28 years after which ownership transfers to the city or can be issued to another company if the city desires. Véligéo is the very first example of this in the Île-de-France region. The geothermal plant was inaugurated on 7 December 2021.

¹⁸ See <https://www.legifrance.gouv.fr/loda/id/JORFTEXT000031044385>.

¹⁹ See next chapter for more information on public-private partnership models for geothermal DHC networks.

²⁰ See <https://www.engie.com/velizy-villacoublay-ville-precursur-zero-carbone>.

2.2.4 New sources of financing networks: the TEN-e infrastructure

The Trans-European Networks for Energy²¹ (TEN-E) and the Connecting Europe Facility²² (CEF) for Energy provide a framework for the selection and, if needed and justified, financing of cross-border infrastructure projects. The TEN-E is based on Europe-wide infrastructure planning and provides a framework to identify Projects of Common Interest (PCIs)²³. These projects contribute to the internal energy market, security of supply and sustainability in pre-defined energy infrastructure priority corridors and thematic areas. To be defined as a PCI, projects must have a significant benefit for at least two EU countries and must increase competitiveness, enhance the EU's energy security and contribute to sustainability. Financial assistance provided under CEF Energy aims to maximise its added value towards the decarbonisation of the energy sector. Geothermal energy is locally sourced and thus less subject to geopolitical tensions that might affect the supply of fossil fuels. By diversifying the energy mix to include more geothermal energy, the EU can enhance its energy security.

The 5th PCI list currently in force, adopted in November 2021, is defined under the rules set out in the Trans-European Network-Energy Regulation 2022/869²⁴. This TEN-E Regulation has been revised in June 2022. The revision entails updated infrastructure categories supporting renewable and low-carbon gases, such as hydrogen, and excludes gas infrastructure and oil pipelines.

Cross-border renewable energy projects aim to enable the cost-effective deployment of renewable energy. Any project meeting the criteria may obtain the status of cross-border renewable energy project (CB RES status) and therefore enter a list of projects eligible for CEF funding (CB RES list). In the current call for CB RES status, they expect applications from projects that promote cross-border cooperation between EU Member States in the field of renewable energy, as well as projects facilitating RES integration through energy storage facilities and contributing both to the strategic uptake of innovative renewables technologies and to the EU's long term decarbonisation strategy.

CB RES projects should contribute to the generation of renewable energy from, for example, on- and offshore wind, solar energy, sustainable biomass, ocean energy, geothermal energy or combinations thereof, their connection to the grid and additional elements such as storage or conversion facilities. CB RES projects are not limited to the electricity sector and can cover other energy carriers and potential sector coupling with, for example, heating and cooling, power-to-gas, storage and transport.

As an example, in the list of renewable energy cross-border projects adopted by the Commission on 30 August 2022, there is a cross-border district heating. Located near the cities of Goerlitz and Zgorzelec, between Germany and Poland, this project will be based on a mix of different RES, among which geothermal energy²⁵.

²¹ See https://energy.ec.europa.eu/topics/infrastructure/trans-european-networks-energy_en.

²² [Regulation](#) (EU) 2021/1153 of the European Parliament and of the Council of 7 July 2021 establishing the Connecting Europe Facility and repealing Regulations (EU) No 1316/2013 and (EU) No 283/2014.

²³ See https://energy.ec.europa.eu/topics/infrastructure/projects-common-interest_en.

²⁴ See [Regulation](#) (EU) 2022/869 of the European Parliament and of the Council of 30 May 2022 on guidelines for trans-European energy infrastructure, amending Regulations (EC) No 715/2009, (EU) 2019/942 and (EU) 2019/943 and Directives 2009/73/EC and (EU) 2019/944, and repealing Regulation (EU) No 347/2013.

²⁵ See https://ec.europa.eu/energy/maps/cbres_fiches/CbresFiche_2022-10.pdf.

3 MARKET DRIVERS AND BARRIERS FOR A SET OF GEOHC NETWORK SCENARIOS

3.1 Market drivers and barriers in the policy and regulations framework

As broadly analysed in “Status report on key market drivers related to the implementation of geoHC network”²⁶, several market drivers and barriers can be identified for the deployment of geoHC networks. In this chapter, to complete our analyses of how the current European and national legislative framework can affect the above-mentioned topic, we are going to pay particular attention to the market drivers and barriers in the policy and regulations framework.

3.1.1 *Hindering factors*

The strongest hindering factors in the policy and regulations framework are:

- **Gas market**

European and National regulations relating to the Internal Market for Gas give it a dominant market position at the expense of competition from renewable heating and cooling services, particularly from geothermal energy. Long-term gas supply and consumption contracts prevent measures to implement EU legislation on energy renovations in buildings. However, the revised provision of RER and EED showed in the previous chapter should act in the direction of creating a new level playing field with more favourable conditions for renewable energy sources.

- **Permitting for geothermal: level of complexity and duration**

The lack of harmonised guidance on licensing and permitting is a significant barrier to the deployment of geothermal and could jeopardise the achievement of the geoHC project. The following factors contribute to delays:

- Geological data availability: the acquisition of geological data can be a barrier when the data purchase is too expensive and when confidentiality blocks the communication of the data. In the case of publicly funded projects, data protection is rather short but for private developers the confidentiality can remain for several years, with a copy of the geological surveys. A Best practice comes from The Netherlands where geological data become publicly available after a short period. Access to geological information from previous exploration activities (e.g. oil and gas) is crucial.
- Complexity: geothermal energy is regulated by many entities and regulations, dealing with mining the underground and the surface as an industrial application, but also for the environmental, water and energy regulations. As illustrated in the delegated acts on EU taxonomy, the geothermal resource is combined with several engines: a turbine for Combined heat and power plants, District heating and Cooling systems, Heat pumps, and Underground Thermal Energy Storage. Each engine has additional regulations and technical standards.
- Capacity: the skillsets required for geothermal assessment are often underutilised or there is a lack of qualified professionals at national, regional and local levels to undertake the necessary checks and approvals. This is compounded by a lack of harmonised terminology

²⁶ Deliverable 2.1 of this project.

sometimes within a Member State and across the internal market. These factors create avoidable administrative delays and bottlenecks.

- Engagement: there is a lack of consistency and clarity in the formation required from project developers which causes delays. Furthermore, transparent and time-sensitive processes are required to manage potential legal challenges and subsequent mediation in an application.

The permit-granting process for geothermal technologies is different to all other Renewable Energy Sources (RES). This is because geothermal provides both small and large-scale applications to three final energy-consuming sectors – heating, cooling and power generation. Large-scale geothermal energy requires two permits – the first for exploration and the second for exploitation of renewable resources. Small-scale geothermal energy requires a tri-zonal approach to permitting, sometimes referred to as a ‘traffic light system’ indicating zones where a simple notification is required, zones where a permit is required and where drilling is prohibited.

From the project developer’s point of view, realising a geothermal project requires several authorisations and the compliance with a number of national and local regulations, and legal and financial safeguards.

The main requirements / permits that may be required for a geothermal district heating project development are the following:

- Water, mineral, and mining rights,
- Exploration permits,
- Well construction permit,
- Development rights,
- Payment of fees or royalties,
- Environmental impact assessment (EIA),
- Environmental permit,
- Building permit for the plant/distribution network, with a possible spatial planning obligation to realise a DH-network
- Dismantling permit,

Regulatory barriers and long-administrative procedures can result in additional costs. It is therefore crucial that a fair, transparent and not too burdensome regulatory framework for geothermal and district heating is in place.

On this topic, again some developments should come from the revised RED and EED and from the EU emergency measures on permitting. However, the biggest issue would be the implementation of this legislation at the national level.

3.1.2 Supportive factors

The stronger supportive factors include:

- **Local authority urban planning and sustainable energy action plans (e.g. SEAPs)**
 The deployment of an H&C network in a city or a district of a city requires urban planning. The design of the H&C system is managed by the local authority. The availability of an existing infrastructure to deploy geothermal HC networks is an enabler to develop geoHC. Municipalities showing ambition in terms of renewable energy deployment in their cities are a favourable condition for a geoHC. Heating and cooling for buildings and industry being the highest share of their energy consumption, cities must tackle this issue as a priority. It is also the sector emitting a high share of GHG and on which concerns about the security of energy supply are high. Sustainable energy action plans should plan at the city level the decarbonisation of H&C consumption, for which H&C networks are a solution to decarbonise at a large scale.
- **Translation of EU targets into national and local measures**
 RES targets decided at the EU level provide a positive signal to regions and cities to show ambition in developing renewable energy. The revised RED and EED targets should feed into the new National Energy and Climate Plans with detailed measures.
- **Support schemes**
 All support schemes presented as market drivers have been evaluated in this project with a strong supportive impact. “The right scheme for the right market maturity” could be the maxim for financing geothermal energy projects, as the geothermal sector is far from being uniform in terms of maturity and technology readiness across geographical, technology lines and uses. Suitable support schemes and financial instruments allow for the cost reductions necessary for a technology to reach the market and for the consolidation of an emerging renewable industry in a market that remains very favourable to incumbent fossil technologies.
 - **Risk mitigation scheme**
 Exploration is necessary to identify potential geothermal resources. However, beyond exploration, the bankability of a geothermal project is threatened by a resource risk: the short-term risk of not finding an economically sustainable geothermal resource after drilling; the long-term risk of the geothermal resource naturally depleting rendering its exploitation economically unprofitable.

 Mitigating this risk is crucial for the profitability of a geothermal project. At the technical level, this includes improved exploration techniques. Non-technical measures that have proven effective include sharing geological data from existing projects. A widely proven solution to facilitate market uptake of geothermal energy against this challenge however is the establishment of financial derisking schemes such as insurance.

 As a good practice in this sense, the French example should be taken into consideration. Since the 1980s, the SAF Environment Fund²⁷ has covered both the

²⁷ For more information see <https://www.ecologie.gouv.fr/geothermie>.

short-term risk (insufficient geothermal resources) and the long-term risk (reduced exploitability of the geothermal resource) for projects aimed at producing heat in the Paris region. It was based on one principle: successes pay for failures and thanks to the very low rate of failure in well-resourced regions (like the Paris basin), wells entailing higher risks can be drilled in regions where little exploration has been conducted. For short-term risk the premium payment is 1,5 % of the covered cost, while for long-term risk an initial payment of 3.2% of insured costs is required. The current reform will allow to cover the geological risks all over France.

Another good example comes from the Netherlands. The Dutch government provides a guarantee scheme (RNES Aardwarmte)²⁸, under which investors are protected against the financial risks of potential unsuccessful drilling. It requires a premium payment equal to 7% of the maximum subsidy amount, with separate maximum amounts applying to regular and ultradeep geothermal energy projects.

○ **Investment aid**

Grant-based financing is a stable of public support to renewable energy projects, notably when it comes to the support of innovative technologies, demonstration projects or high-risk ones. The grant, usually a fixed amount of money awarded by a public authority to a project, may cover a large share of the total costs or be a marginal part of the financing scheme. Different types of grant financing usually serve different purposes.

- Direct grant financing happens when a grant is provided to a project to finance it. The money awarded is given to the project operator without financial conditionality (such as equity or reimbursement), but some conditions may be set to ensure the money is properly used. The Heat Fund in France is a major and successful example of a large-scale facility providing grants to geothermal energy projects (usually at a larger scale) to correct the market imbalances due to the dominant position of gas or nuclear energy in the heat market.
- Repayable grant: a repayable grant is typically a grant that has to be repaid if certain conditions are met. In some cases, the grant may have to be repaid if the project is not successful. In other, the grant would only be repaid if the project is successful, which is quite a suitable scheme to reduce investment risk and helps in the early stage of marketability.
- Convertible grants are a more innovative type of financial instrument that is designed to ease the market development of innovative technologies. The funding, awarded as a grant, can be converted into another type of financing (equity, debt...) once the project attains a certain degree of success (this may be the successful completion of the drilling phase for a geothermal project for instance).

○ **Operational aid:**

²⁸ For more information see <https://www.rvo.nl/subsidies-financiering/rnes>.

In some European markets, the implementation of a feed-in tariff for renewable heating and cooling has been a successful strategy to support the deployment of geothermal energy projects. The feed-in tariff or premium (FiT/FiP) for heating and cooling has been a crucial factor in enabling the rapid deployment of privately led geothermal heating and cooling projects in the Netherlands over the past decade. When adequately targeted, feed-in-tariffs can be a winning solution in the heating and cooling sector as well as in the electricity sector. The Dutch case shows that tailoring the schemes to SMEs with high energy costs can be beneficial: such actors have the incentive to benefit from the tariffs and the capacity to invest to recoup their costs in the short to medium term. Such private investor-led investments (even when a FiT/FiP is available) however require the availability of some form of the geothermal derisking scheme to incentivize SME developers to deploy geothermal systems.

3.2 Market drivers and barriers linked to economic conditions

The majority of the economic factors influencing the implementation of geoHC networks are seen as strong but neutral (nor supportive neither hindering the project development, but requiring an adaptation) in terms of market drivers. However, in the few last years, especially after the energy and heating prices crisis, the importance of these factors has grown massively. In particular, the following aspects are more and more key to presenting geoHC networks as an economically valuable heating solution:

- **The legal statutes of the project developer/operator:** being a local public energy company, a public-private partnership or a private Utility sometimes can make a difference. As seen in the previous chapter, for example, legislation which is favourable for PPPs like the French one can lead to the development of new business models that can improve the exploitation and profitability of geoHC networks.
- **Heat sales and pricing:** the type of client determines the H&C demand profile in terms of temperature and load. The metering of the heat consumed at the supplier and customer interface for billing purposes of DH is quite highly regulated in most EU countries, as a result of the EED. Some countries in the EU defined some form of price rules and price control with price caps, price adjustment clauses etc.
- **Heat purchase agreement:** a heating and/or cooling purchase agreement is concluded directly between an energy producer and a consumer company. In recent years, this form of purchase agreement, historically reserved for very large consumers of grey electricity, has been developed more widely around the world for all types of consumers, especially those wishing to be supplied directly with renewable electricity. The company commits a renewable energy developer or energy supplier to purchase a given volume of electricity at a predefined price (fixed, indexed, bounded, etc.) for a period of 3 to 20 years. In return, it receives the energy produced as well as the associated guarantees of origin, directly participating in the creation of new renewable energy assets or in the continuity of operation of assets that are no longer under the purchase obligation. In the case of green heat, the production assets (biomass boiler, biomass cogeneration, waste treatment plant, geothermal system, solar thermal...) are

necessarily located near the site or on the site. They are connected via a dedicated hot water or steam network.

- **Taxation and carbon pricing:** different taxation of electricity and gas is seen as a driver, especially when gas is less taxed. A lower VAT rate for geoHC is seen as a supportive element. The lack of carbon pricing in the heat sector hampered the development of geoHC. EU legislators recently agreed to introduce a carbon price on buildings and road transport fuels. The new carbon price will apply to petrol, diesel and heating fuels such as natural gas.

4 POLITICAL READINESS LEVEL EVALUATION SCHEME

4.1 Political Readiness Level Evaluation Scheme

Given the new legal framework analysed in Chapter 2 and the market drivers and barriers mentioned in Chapter 3, a “Political Readiness Level Evaluation Scheme” has been created to assess the supporting framework at the national level for geoHC networks.

4.1.1 Methodology

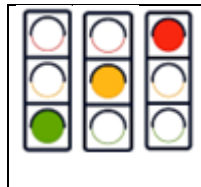
The model proposed has the goal of providing a simplified tool to try to understand the readiness level of national legislation for the implementation of geoHC networks. For this purpose, given the above analysis, eleven key requirements have been identified. Ideally, we assume that a Member State that includes in its legal framework all of these requirements has what is needed for a successful implementation of geoHC networks.

The eleven requirements identified are the following:

- legal requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out;
- provisions to ease the administrative procedures for the installation, connection, and renovation of HC networks;
- provisions to reduce the duration of licensing and commissioning procedures for geoHC networks
- de-risking instrument for the exploitation of geothermal projects;
- specific geothermal DH target;
- support for connection to HC networks;
- financial support schemes for clean heating technologies in HC networks;
- subsidies or schemes for the implementation of geoHC networks;
- legislative framework which allows a reduced rate of taxation to for electricity supplied to renewable heating solutions;
- legislation on energy price regulation;
- legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks.

To assess these requirements, the project partners have been consulted in relation to their respective countries, in order to cover the seven project countries represented: Austria, Denmark, France, Germany, Italy, Poland, UK. The data collection methodology relied on data collection based on publicly accessible data, statistics and policy reports.

The method proposes to translate these eleven requirements in eleven questions for which three answers are possible. Far from being a detailed and comprehensive method of evaluation, the evaluation scheme proposed is nonetheless a first useful general assessment to highlight the main gaps that the respective countries have in terms of policy and legal framework for a successful implementation of geoHC networks. To assess the readiness level, a ‘traffic light’ systems has been chosen.



While the ‘green’ answer means that the requirement in question is included in the national legislation at stake, the ‘red’ one means that such a requirement is not present. Lastly, the ‘yellow’ answer describes an intermediate situation, which differs for each requirement proposed (see the table below). For an overall assessment, each answer can give a maximum of 3 points (green answer) and a minimum of 1 (red answer). Therefore, a maximum of 33 and a minimum of 11 points can be assigned to each country. Three different ‘labels’ have been created accordingly:

11-18 points = RED

19-25 points = YELLOW

26-33 points = GREEN

For countries that have been assigned a ‘red label’, a lot has to be done in order to create a geoHC networks favourable framework. Countries with a ‘yellow label’ are on the right path but still need further efforts. Lastly, countries with a ‘green label’ have a generally favourable policy framework, even though some margin of improvement is possible regarding the requirements which have been rated the lowest.

For each of the seven project countries, the project partners made their assessment using this multiple-choice answers table.

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection, and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2)

	No (1)
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1)
Is there support for connection to HC networks?	Yes, direct support is available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3) Support for wider measures that can include RHC technologies in HC networks (2) No (1)
Is there any subsidy or scheme for the implementation of geoHC networks?	Yes (3) Support for a wider audience that can include geoHC networks (2) No (1)
Is there a legislative framework which allows a reduced rate of taxation for electricity supplied to renewable heating solutions?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there any legislation on energy price regulation?	Yes (3) Energy price regulation does not include geothermal energy yet (2)

	No (1)
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	Yes (3) Yes but no PPP have been established yet(2) No (1)
Total	X

4.2 PRL Application in study areas and gap analyses of critical indicators

Here follows the application of the scheme described in the previous subchapter on the seven project countries.

4.2.1 Austria

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2) No (1)
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1)
Is there support for connection to HC networks?	Yes, direct support is available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3) Support for wider measures that can include RHC technologies in HC networks (2) No (1)
Is there any subsidy or scheme for the implementation of geoHC networks?	Yes (3)

	<p>Support for a wider audience that can include geoHC networks (2)</p> <p>No (1)</p>
Is there a legislative framework which allows a reduced rate of taxation for electricity supplied to renewable heating solutions?	<p>Yes (3)</p> <p>A legislative proposal is in the pipeline or currently being discussed (2)</p> <p>No (1)</p>
Is there any legislation on energy price regulation?	<p>Yes (3)</p> <p>Energy price regulation does not include geothermal energy yet (2)</p> <p>No (1)</p>
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	<p>Yes (3)</p> <p>Yes but no PPP have been established yet (2)</p> <p>No (1)</p>
Total	20

4.2.2 Denmark

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2) No (1)
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1)
Is there support for connection to HC networks?	Yes, direct support is available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3) Support for wider measures that can include RHC technologies in HC networks (2) No (1)
Is there any subsidy or scheme for the implementation of geoHC networks?	Yes (3)

	Support for a wider audience that can include geoHC networks (2) No (1)
Is there a legislative framework which allows a reduced rate of taxation for electricity supplied to renewable heating solutions?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there any legislation on energy price regulation?	Yes (3) Energy price regulation does not include geothermal energy yet (2) No (1)
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	Yes (3) Yes but no PPP have been established yet (2) No (1)
Total	26

4.2.3 France

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) ²⁹ No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2) No (1)
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1)
Is there support for connection to HC networks?	Yes, direct support available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3)

²⁹ The French Energy and Climate Law imposes regions to publish a Schéma Régional du Climat de l’Air et de l’Energie (SRCAE). For cities, they have to publish a Plan local d’urbanisme (intercommunal) et transition énergétique dans le bâtiment. It is upon voluntary basis to have a proper heat plan, but with the implementation of REDIII it will become binding for large cities: e.g; Plans Air Energie Climat pour Paris et la Métropole.

	Support for wider measures that can include RHC technologies in HC networks (2) No (1)
Is there any subsidy or scheme for the implementation of geoHC networks?	Yes (3) Support for wider audience that can include geoHC networks (2) No (1)
Is there a legislative framework which allows a reduced rate of taxation to electricity supplied to renewable heating solution?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there any legislation on energy price regulation?	Yes (3) Energy price regulation does not include geothermal energy yet (2) No (1)
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	Yes (3) Yes but no PPP have been established yet(2) No (1)
Total	28

4.2.4 Germany

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2) No (1)
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1) ³⁰
Is there support for connection to HC networks?	Yes, direct support available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3) Support for wider measures that can include RHC technologies in HC networks (2) No (1)

³⁰ Not mandatory, there is a no binding road map and some targets are mentioned but not included in policies.

Is there any subsidy or scheme for the implementation of geoHC networks?	<p>Yes (3)</p> <p>Support for wider audience that can include geoHC networks (2)</p> <p>No (1)</p>
Is there a legislative framework which allows a reduced rate of taxation to electricity supplied to renewable heating solution?	<p>Yes (3)</p> <p>A legislative proposal is in the pipeline or currently being discussed (2)</p> <p>No (1)</p>
Is there any legislation on energy price regulation?	<p>Yes (3)</p> <p>Energy price regulation does not include geothermal energy yet (2)</p> <p>No (1)</p>
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	<p>Yes (3)</p> <p>Yes but no PPP have been established yet(2)</p> <p>No (1)</p>
Total	<p>22</p>

4.2.5 Italy

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2) No (1)
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1)
Is there support for connection to HC networks?	Yes, direct support available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3) Support for wider measures that can include RHC technologies in HC networks (2) No (1)
Is there any subsidy or scheme for the implementation of geoHC networks?	Yes (3)

	<p>Support for wider audience that can include geoHC networks (2)</p> <p>No (1)</p>
Is there a legislative framework which allows a reduced rate of taxation to electricity supplied to renewable heating solution?	<p>Yes (3)</p> <p>A legislative proposal is in the pipeline or currently being discussed (2)</p> <p>No (1)</p>
Is there any legislation on energy price regulation?	<p>Yes (3)</p> <p>Energy price regulation does not include geothermal energy yet (2)</p> <p>No (1)</p>
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	<p>Yes (3)</p> <p>Yes but no PPP have been established yet(2)</p> <p>No (1)</p>
Total	15

4.2.6 Poland

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2) No (1)
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1)
Is there support for connection to HC networks?	Yes, direct support available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3) Support for wider measures that can include RHC technologies in HC networks (2) No (1)
Is there any subsidy or scheme for the implementation of geoHC networks?	Yes (3)

	Support for wider audience that can include geoHC networks (2) No (1)
Is there a legislative framework which allows a reduced rate of taxation to electricity supplied to renewable heating solution?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there any legislation on energy price regulation?	Yes (3) Energy price regulation does not include geothermal energy yet (2) No (1)
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	Yes (3) Yes but no PPP have been established yet (2) No (1)
Total	25

4.2.7 United Kingdom

Measure	Assessment
Is there a requirement for local or regional authorities to develop heat plans and/or a supportive framework allowing carrying them out?	Yes (requirement AND support framework) (3) Heat plans mentioned (2) No (1)
Has the government introduced provisions to ease the administrative procedures for the installation, connection and renovation of HC networks?	Yes (3) Introduction of provisions to partially ease administrative procedures (only installation, connection, or renovation individually) (2) No (1) ³¹
Has the government introduced provisions to reduce the duration of licensing and commissioning procedures for geoHC networks?	Yes (3) Only in part (only licensing or commissioning) (2) No (1)
Is there any de-risking instrument in place for the exploitation of geothermal projects?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there a specific geothermal DH target?	Yes (3) There is an overall target for the deployment of geothermal energy (2) No (1)
Is there support for connection to HC networks?	Yes, direct support available (3) Connection to HC networks is encouraged without support (2) No (1)
Are there financial support schemes for clean heating technologies in HC networks?	Accessible support for multiple RHC technologies in HC networks (3) ³² Support for wider measures that can include RHC technologies in HC networks (2)

³¹ However, there are plans to make the installation of heat mains as easy as a water main utility.

³² The UK government will fund 50% but this is a competitive grant process and not automatic.

	No (1)
Is there any subsidy or scheme for the implementation of geoHC networks?	Yes (3) Support for wider audience that can include geoHC networks (2) No (1)
Is there a legislative framework which allows a reduced rate of taxation to electricity supplied to renewable heating solution?	Yes (3) A legislative proposal is in the pipeline or currently being discussed (2) No (1)
Is there any legislation on energy price regulation?	Yes (3) Energy price regulation does not include geothermal energy yet (2) No (1)
Is there a legislative framework which allows public-private partnerships for the deployment of geothermal energy in DH networks?	Yes (3) Yes but no PPP have been established yet(2) No (1) ³³
Total	17

³³ No specific legislation but this is seen as a welcome approach.

4.3 Indications from the Political Readiness Level Evaluation Scheme: existing gaps and good practices

From the table above, the result is the following: two red-labelled (Italy and UK), three yellow-labelled (Austria, Germany and Poland) and two green-labelled (Denmark and France) countries.

Countries	Political Readiness Level
Austria	Yellow
Denmark	Green
France	Green
Germany	Yellow
Italy	Red
Poland	Yellow
UK	Red

As regards the red-labelled countries, Italy has the lowest score with no green answers. Some general non-legislative support for connection to HC networks is not enough for the deployment of geoHC networks. In addition, subsidies to the geothermal sector are either part of wider support measures or only in the pipeline. The UK scores a bit better thanks to the presence of requirements for local or regional authorities to develop heat plans and a supportive framework allowing carrying them out. However, the only other requirements present are an accessible support for multiple RHC technologies in HC networks and legislation on energy price regulation.

For what concerns the yellow-labelled countries, Austria has three major weaknesses: the lack of a de-risking instrument; of provisions to reduce the duration of licensing and commissioning procedures; of a reduced rates of taxation to electricity supplied to renewable heating solutions. This last requirement is missing also in Germany, together with specific geothermal DH target, support for connection to HC networks and a legislative framework which allows PPPs. In Poland, specific geothermal DH targets are lacking as well as reduced rates of taxation to electricity supplied to renewable heating solutions and provisions to reduce the duration of licensing and commissioning procedures.

Finally, among the green-labelled countries Denmark only has three red answers, meaning that its major weaknesses consist of the lack of provisions to reduce the duration of licensing and commissioning procedures for geoHC networks, the lack of specific subsidies or schemes for the implementation of geoHC networks and the absence of a legislative framework which allows PPPs. France too, despite having the highest score, still has some room for improvement, especially regarding reduced rates of taxation to electricity supplied to renewable heating solutions and energy price regulation.

As regards a horizontal analysis of the specific requirements, on the one hand only one question received no green answers: *“has the government introduced provisions to ease the administrative procedures for the installation, connection, and renovation of HC networks?”*. Therefore, this seems to be the most common gap in national legislation. As seen in chapter 2, EU legislation through the revised RED and the Council Regulation is trying to intervene in this sense, also with emergency measures.

On the other hand, only one question received no red answers: *“are there financial support schemes for clean heating technologies in HC networks?”*. Thus, in each country analysed there is at least support for wider measures that can include RHC technologies in HC networks. What is more often missing is specific support for geoHC networks and geothermal technologies. Coherent and comprehensive support for the geothermal sector is still the big gap that must be overcome in many countries.

However, some good practices are already present throughout Europe, as seen in the previous chapters. Among others, it is important to highlight the French and Dutch risk mitigation schemes (see Chapter 3.1.2), Finnish legislation on the taxation of energy products (see Chapter 2.2.1), the Danish provisions on energy price regulation (see Chapter 2.2.2) and the French regulatory framework on PPPs (see Chapter 2.2.3).

5 CONCLUSIONS

Geothermal district heating has the characteristics to play a crucial role in our future energy mix: decarbonised, providing affordable heating and cooling for society, and allowing competitiveness of European industry.

On policies and regulations, the status quo shows that more attention to geoHC networks has to be given at national level, and key legislation adopted in the EU Green Deal and the REPowerEU Plan must be implemented. New provisions from the EU climate and energy package should foster the deployment of geoHC: risk mitigation schemes, heat purchase agreement...

Developing geothermal district heating requires an enabling framework beginning with clear and consistent national / regional strategies from public authorities.

Contrariwise, a persisting number of barriers are noted as being detrimental to any further market development of geothermal / district heating:

- Market sometimes closed to new entrants;
- Long and burdensome administrative procedures,
- Serious regulatory gaps such as a lack of dedicated licencing system for deep geothermal and unregulated right to use the geothermal resources,
- Lack of support, and
- Lack of a level-playing.

Moreover, the regulations on PPP, taxation and the funding programmes are also influencing the geoHC networks.

In this context, it is worth highlighting that in some countries the presence of some good practises may be largely offset by the persistence of barriers. It is therefore crucial to have a consistent enabling framework from start to finish.

Other three interesting aspects have emerged during the analysis of the present situation:

- Assessing the implementation of key articles of the EU RES Directive is not an easy task and should be properly carried out by the European Commission. In the target countries, it is generally observed that the EU 2020 and 2030 frameworks have indeed attracted some new interest in the sector. However, dedicated legislation and simplification of administrative procedures, when observed, were not stemming from the RES Directive but rather linked to reforms for the mining and oil & gas sectors. This issue should be addressed in the review of the relevant EU legislation and their implementation.
- Particularly in emerging and growing markets there is shortage of qualified specialists in the permitting authorities. The result is slow authorisation process and the inability to remove persisting market failures against conventional competitors. In this case, it is advised to policy-makers to create the initial conditions to attract investments and specialists from close fields such the mining and gas sectors;

- It is not only a lack of information which is detrimental; in certain cases misinformation over geothermal between policy-makers and citizens may bring about confusion and social opposition. While it is important to deal with communication at the very beginning of project development, it is still equally critical to launch large awareness and educational campaigns to improve the general knowledge about geothermal energy.

In order to remove the regulatory barriers and promote the best practices identified in the project countries and presented in this report, the SAPHEA consortium will now work on developing a set of recommendations collected in an ideal 'Regulatory Framework'.

This regulatory framework will be primarily addressed to national and regional public authorities in charge of regulations and local development, since they are deeply involved in licensing and other procedures related to geothermal energy exploration, development, and management.

These proposals should lead to regional and local regulations and policies favourable to geothermal DH development in Europe.

Ultimately, the aim would be for every country to be labelled as green according to the Political Readiness Level Evaluation Scheme. Nevertheless, no country, not even the green labelled, can be considered exempted from the need for further policy and legislative improvements in specific matters.

List of abbreviations

Abbreviation	Full name
DH	District heating and cooling systems
geoHC networks	Geothermal Heating and Cooling networks supplied by geothermal energy as a source, sink or storage for heat
GHG	Greenhouse Gas emissions
H&C	Heating and cooling
NECPs	National energy and climate plans
PCIs	Projects of Common Interest
PPP	Public-private partnerships
RES	Renewable energy sources
RFNBOs	Renewable fuels of non-biological origin
WH	Waste heat
kWth and MWth	Kilowatt thermal and Megawatt thermal of the geoHC capacity installed.