

New specific innovation policy measures and report on internal reforms implemented during the project

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Executive summary

This report presents the work carried out under Task T3.2 – Policy Analysis and Development, Facilitating S3 Clustering. The aim was to lay the conceptual, methodological and empirical groundwork for innovation policy measures that support the deployment of deep and shallow geothermal energy across Europe. The work is meant to drive interregional action, help companies build innovation and internationalisation capacity, and support regional policymakers in making full use of European initiatives, including building and reviving European Smart Specialisation (S3) Geothermal Partnerships. It draws on evidence from several complementary project activities: the value chain benchmarking exercise, the regional stakeholder consultations run with Greet GEO partners and regional actors, and the regional innovation ecosystem analysis carried out to de-risk geothermal investment.

The analysis covered the regions in the Greet GEO partnership: the Pannonian Region (Croatia, Hungary, Slovenia), Tuscany (Italy), and the outermost regions represented by the Azores (Portugal) and the Canary Islands (Spain). Alongside a policy review, this evidence base was used to examine ecosystem maturity, innovation capacity, financing conditions, regulatory frameworks, market development and the barriers holding back both deep and shallow geothermal applications. Across the regions studied, geothermal energy is increasingly seen as a strategic resource for decarbonisation, energy security, industrial competitiveness and regional development. Deep geothermal systems are technologically further along and better integrated into district heating and large-scale energy use, but are held back by high upfront costs, exploration risk, slow permitting and a lack of dedicated financing instruments. Shallow geothermal systems carry lower geological risk, but run into fragmented demand, underdeveloped supply chains, low market awareness and skills shortages. Collaboration across the ecosystem is already strong — public authorities, research organisations, industry, SMEs and intermediary organisations are all willing to work together — but stakeholders consistently pointed to a gap between planning and follow-through, calling for more emphasis on implementation, project development support and coordinated access to finance.

Based on the analysis, this report sets out fifteen innovation policy measures covering financing and investment support, regulatory improvement, innovation and technology deployment, SME support, skills development, societal engagement, data accessibility and interregional cooperation. These measures are meant to help regional policymakers and stakeholders create better conditions for geothermal deployment, strengthen regional innovation ecosystems, and open up access to investment, expertise and market opportunities. None of this happens without coordinated action from policymakers, financial institutions, industry, research organisations and intermediary bodies. The measures in this report offer a practical way to tackle existing barriers, speed up implementation and build a more resilient, innovative and connected European geothermal ecosystem.

This report is also meant to support the process of rebuilding and creating new European geothermal Smart Specialisation (S3) partnerships. The findings feed into three S3-based geothermal roadmaps developed within Greet GEO, covering shallow geothermal in Croatia and in the Azores, and geothermal priorities in the Canary Islands. Those roadmaps give each place a concrete implementation path that complements the horizontal measures here, and support ongoing interregional cooperation, policy learning and investment planning.

Abbreviations and acronyms

Abbreviation	Definition
CAPEX	Capital Expenditure
CCS	Carbon Capture and Storage
CRMA	Critical Raw Materials Act
DHC	District Heating and Cooling
EGEC	European Geothermal Energy Council
EPBD	Energy Performance of Buildings Directive
ESCO	Energy Service Company
ETIP-DG	European Technology and Innovation Platform on Deep Geothermal
I3	Interregional Innovation Investments Instrument
IADC	International Association of Drilling Contractors
IEA	International Energy Agency
JRC	Joint Research Centre
NECP	National Energy and Climate Plan
NKFIH	National Research, Development and Innovation Office (Hungary)
NIMBY	Not In My Back Yard
NZIA	Net-Zero Industry Act
OPEX	Operational Expenditure
PNIEC	Integrated National Energy and Climate Plan (Plan Nacional Integrado de Energía y Clima)
RED	Renewable Energy Directive
RIS3	Research and Innovation Strategy for Smart Specialisation
ROI	Return on Investment
S3	Smart Specialisation Strategy
S5	Slovenian Sustainable Smart Specialisation Strategy
SRIP	Strategic Research and Innovation Partnership
TEN-E	Trans-European Networks for Energy
WFD	Water Framework Directive

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1. Introduction

The transition towards a climate-neutral European economy requires a substantial increase in the deployment of renewable energy technologies that deliver reliable, secure and affordable energy. While considerable progress has been achieved in the deployment of solar and wind energy, the decarbonisation of heating and cooling remains one of the most significant challenges facing European regions. In this context, geothermal energy represents an underutilised but strategically important renewable energy source capable of providing both baseload electricity and sustainable heating and cooling solutions.

Geothermal fits well with European policy priorities: it helps decarbonisation, cuts reliance on imported fossil fuels, gives industry a stable energy supply, and opens up regional economic development. Both deep and shallow geothermal have a role to play in the energy transition, though how they get deployed, how their markets work, and what policy they need are quite different.

The Greet GEO project seeks to strengthen regional innovation ecosystems and accelerate geothermal deployment by enhancing cooperation among regional authorities, research organisations, industry actors and innovation support organisations and puts special weight on Smart Specialisation Strategies (S3), interregional collaboration, and finding innovation-driven policy measures that address the barriers to geothermal development.

This report presents the results of policy analysis and development activities undertaken within Task 3.2 Regional policy analysis and development. The analysis combines evidence from two main complementary sources. On one hand, it draws upon the value chain benchmarking exercise conducted under Task 2.2, which assessed the maturity and performance of geothermal innovation ecosystems across selected domains including innovation, collaboration, financing, policy, technology readiness and market. On the other hand, it incorporates the results of a regional consultation process involving Greet GEO consortium partners representing Croatia, Italy, Hungary, Slovenia, the Azores and the Canary Islands. In addition, the work presented in this report was closely coordinated with activities under Task 4.1. that focuses on the improvement of regional innovation ecosystems for improved de-risking of geothermal investment. This approach ensures consistency between the proposed policy measures and broader efforts to strengthen regional innovation ecosystems and address barriers to geothermal deployment.

The objective of the report is to identify the principal barriers and opportunities affecting geothermal deployment, assess the role of regional policy frameworks and innovation ecosystems, and develop a set of actionable innovation policy measures to support geothermal development across participating regions. Greater attention is given to the needs of SMEs, implementation challenges, financing mechanisms, stakeholder cooperation and opportunities for interregional learning and S3 clustering.

1.1. Target Groups

As a public (PU) deliverable, this report aims to give an overview of how geothermal energy features in European, regional and national policies and development programmes, to explain how it is perceived by key players across the value chain, and to support actions that favour the wider use of this energy source.

The following five target groups are considered the main audiences this report wishes to address, and it recommends that they work together on the fifteen policy measures proposed.

Target groups:

- **Regional policy-making bodies and public authorities:** The report provides a structured evidence base and a ready-to-use set of policy measures to strengthen investment support, streamline permitting and better integrate geothermal energy into regional planning.
- **EASME, EU bodies and public programmes providing innovation funding:** The report identifies concrete financing and risk-sharing gaps that can inform the design of future calls and funding instruments supporting geothermal deployment.
- **Industry associations, clusters, universities and RTOs:** The report highlights opportunities to strengthen research-industry collaboration and points to measures that can accelerate the commercialisation and market uptake of geothermal innovations.
- **SMEs, start-ups, specialised geothermal project developers and providers of private finance:** The report sets out dedicated support measures, from one-stop-shop services to risk-sharing and financing instruments, that can help bring their projects to investment readiness.
- **End-users and citizens:** The report explains the practical benefits of geothermal energy, such as lower-cost, secure and locally produced energy, and outlines measures to improve public awareness and address common misconceptions.

2. EU-Level Analysis

2.1. Geothermal in the EU transition

The European Union has committed to achieving climate neutrality by 2050 while simultaneously strengthening energy security, industrial competitiveness and resilience against external energy shocks. Achieving these objectives requires the accelerated deployment of renewable energy technologies across all sectors of the economy. While significant progress has been achieved in electricity generation from renewable sources, the decarbonisation of heating and cooling remains one of the most challenging aspects of the energy transition.

Geothermal energy represents a strategic renewable energy source capable of contributing to multiple European policy objectives. Unlike intermittent renewable technologies such as solar and wind, geothermal systems can provide continuous and reliable energy throughout the year. Deep geothermal resources can be used for electricity production, district heating and industrial heat applications, while shallow geothermal systems provide efficient heating and cooling through ground-source heat pumps.

The role of geothermal energy has gained increasing attention in recent years due to rising concerns regarding energy security, fossil fuel dependency and the need to accelerate the deployment of sustainable heating and cooling solutions. As a result, geothermal energy is increasingly recognised as an important component of Europe's future low-carbon energy system.

2.2. EU regulatory framework for deep and shallow geothermal

Although geothermal energy development remains primarily governed by national legislation, several European policy initiatives create an enabling framework for geothermal deployment. In recent years, geothermal energy has received increased attention within EU energy, climate and industrial policies due to its contribution to decarbonisation, energy security, renewable heating and cooling, industrial competitiveness and strategic autonomy.

From RED I to RED III

The **Renewable Energy Directive (RED)** has progressively strengthened the position of renewable energy within the European energy system. The original Renewable Energy Directive (RED I) established the first binding renewable energy targets for Member States, while RED II expanded the framework and introduced stronger provisions for renewable heating and cooling. The latest revision, **RED III** (Directive (EU) 2023/2413), significantly increased the level of ambition by establishing an EU-wide binding target of at least 42.5% renewable energy by 2030, with an aspiration to reach 45%. This directive is specifically relevant for geothermal energy as it places greater emphasis on the decarbonisation of heating and cooling, simplifies permitting procedures for renewable energy projects, requires stronger integration of renewable energy within buildings and industry, and encourages Member States to develop measures such as risk mitigation schemes, heat planning and support mechanisms for renewable heating technology.¹

REPowerEU Plan

The **REPowerEU Plan**², introduced in 2022 in response to the European energy crisis, accelerated efforts to reduce dependence on imported fossil fuels while strengthening domestic renewable energy production. The plan emphasises renewable heating and cooling, electrification, energy efficiency and diversification of energy supplies. Geothermal energy has been increasingly recognised within this context as a domestic, reliable and continuously available energy source capable of contributing to both energy security and decarbonisation objectives.

AccelerateEU – Energy Union

In April 2026, the European Commission adopted **AccelerateEU – Energy Union**, a policy initiative aimed at reducing dependence on imported fossil fuels, strengthening energy security and accelerating the deployment of clean energy technologies. Building on REPowerEU, the initiative promotes electrification, renewable energy deployment, energy system integration and investment in resilient energy infrastructure. Within this framework, geothermal energy is recognised as a reliable energy source that can accelerate the shift to homegrown clean energy thus contribute to secure, affordable and decarbonised energy systems.³ The AccelerateEU plan outlines a series of measures that, when fully implemented, will speed-up the deployment of geothermal energy projects across the whole of the EU: creating an EU-level database of geological data; establishing geothermal derisking schemes and insurance schemes; and promoting international cooperation on geothermal energy projects. EGEC calls on policymakers, industry stakeholders, and financial institutions to support the implementation of these proposals.

¹ <https://eur-lex.europa.eu/eli/dir/2023/2413/oj/eng>

² https://commission.europa.eu/topics/energy/repowerEU_en

³ https://energy.ec.europa.eu/strategy/accelerateEU-strengthen-eu-energy-resilience_en

Industrial and strategic autonomy legislation

Geothermal energy is also increasingly relevant within the EU's industrial competitiveness agenda. The **Net-Zero Industry Act (NZIA)**⁴ seeks to strengthen European manufacturing capacities and accelerate the deployment of strategic clean energy technologies, among which geothermal energy technologies have been included. While geothermal technologies are not regulated separately, the act provides a more favourable environment for investment, industrial deployment and permitting of net-zero technologies. Similarly, the **Critical Raw Materials Act (CRMA)**⁵ has increased interest in geothermal resources due to the growing potential for recovering strategic materials, such as lithium and other critical minerals, from geothermal brines. This creates new opportunities for combining geothermal energy production with strategic raw material extraction and strengthens geothermal's role within European industrial policy. In 2025, the European Commission designated two geothermal lithium initiative as official Strategic Projects to accelerate domestic supply and fast-track permitting.

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Buildings, heating and cooling policies

The growing focus on heating and cooling decarbonisation further strengthens the role of geothermal energy. The update of the **Energy Efficiency Directive (EED)**, which was initially introduced in 2012, was adopted in September 2023. Local authorities of municipalities with 45 000 and more inhabitants will be required to prepare plans for heating and cooling networks. To ensure a fully decarbonised district heating and cooling supply by 2050, the definition of efficient district heating and cooling was revised and the minimum requirements are gradually changed to allow for a progressive integration of renewable energy, especially geothermal, and waste heat and cold in the system. **The Energy Performance of Buildings Directive (EPBD)**⁷ promotes the transition towards zero-emission buildings and encourages the integration of renewable heating and cooling solutions. Ground-source heat pumps and other shallow geothermal technologies are well positioned to contribute to these objectives, particularly within building renovation programmes and sustainable urban development initiatives. The **Delegated Act on renewable cooling**, adopted in 2023, complements the RED by setting rules on how energy used for cooling can count towards the directive's targets. This methodology rewards the best available technologies, such as highly efficient reversible heat pumps and free cooling by district cooling networks, while also incentivising the future deployment of innovative cooling technologies. It further enables EU countries to submit their own, more accurate methodologies.⁸ The European Commission announced the preparation of a **new Heating and Cooling Strategy**, expected in 2026, to accelerate the decarbonisation of the heating and cooling sector and strengthen energy system integration. The initiative builds on the objectives of RED III, REPowerEU and the **Affordable Energy Action Plan**⁹, and responds to calls from the Council and the European Parliament for stronger action on renewable heating and cooling and geothermal energy. The strategy

⁴ https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en

⁵ https://commission.europa.eu/topics/competitiveness/green-deal-industrial-plan/european-critical-raw-materials-act_en

⁶ Eramet / ÉS: Ageli geothermal lithium project officially recognized as a "strategic project" by the European Union - 25 March 2025 - News - [Eramet; Vulcan Energy receives "Strategic Project" status from the European Commission - Natürlich Pfalz](#)

⁷ https://energy.ec.europa.eu/topics/energy-efficiency/energy-performance-buildings/energy-performance-buildings-directive_en

⁸ https://energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en

⁹ https://energy.ec.europa.eu/strategy/affordable-energy_en

is expected to address barriers related to fossil fuel dependency, renewable heat deployment, district heating and cooling networks, industrial heat decarbonisation and energy efficiency.¹⁰

Electricity market integration and network development

The **EU electricity market directive** with reforms adopted in May 2024 aims at supporting consumers in benefiting from more stable energy prices, less dependency on fossil fuels and better protection from future crises on the way to a carbon-free European Union. As geothermal electricity can provide dispatchable baseload generation and system flexibility, it has strategic value within a highly renewable energy system that creates opportunities for stronger integration with electricity markets, thermal storage and sector-coupling applications.¹¹ Another EU policy, **Trans-European Networks for Energy (TEN-E)** provides the framework for developing strategic cross-border energy infrastructure that supports the integration, security and sustainability of the European energy system. The revised TEN-E Regulation focuses on electricity, smart grids, hydrogen, offshore energy and CO₂ infrastructure, thereby creating conditions for a more integrated and resilient energy market. Although geothermal energy is not explicitly addressed as a separate infrastructure category, geothermal projects may indirectly benefit from improved energy system integration and regional infrastructure development.¹²

The recently published Electrification Action Plan announced the launch of a Strategic Geothermal Partnership by next year to help lifting regulatory, technical and investment barriers and accelerating the deployment of geothermal energy.

Water Framework Directive (WFD)

The **Water Framework Directive** (Directive 2000/60/EC) establishes the EU framework for the protection and sustainable management of surface water and groundwater resources. It is highly relevant to geothermal projects that involve groundwater abstraction, reinjection or direct interaction with aquifers. The directive requires Member States to prevent the deterioration of water bodies and ensure good groundwater status, influencing project design, environmental assessments and permitting procedures. For geothermal developments, especially deep geothermal systems and open-loop shallow geothermal installations, compliance with WFD requirements is an important component of environmental regulation and resource management.¹³

Emerging European Geothermal Strategy

Following calls from the European Parliament, Member States and industry stakeholders, the European Commission has initiated work towards a dedicated **European Geothermal Strategy and Action Plan**. The strategy is expected to address key challenges affecting geothermal deployment, including access to finance, geological risk mitigation, permitting procedures, skills development, geological data availability and supply chain development. To support this process, the European Geothermal Energy Council (EGEC) published the policy document **The European Geothermal Strategy and Action Plan: Making Europe Competitive, Secure and Affordable** in December 2025, outlining recommendations for accelerating geothermal deployment across Europe. Key priorities include reducing permitting timelines, improving access to geological data, strengthening financing mechanisms, supporting innovation and demonstration activities, expanding workforce development programmes and increasing public awareness of geothermal technologies. The document also

¹⁰ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=intcom:Ares%282025%296932016>

¹¹ <https://www.consilium.europa.eu/en/policies/electricity-market-reform/>

¹² https://energy.ec.europa.eu/topics/infrastructure/trans-european-networks-energy_en

¹³ https://environment.ec.europa.eu/topics/water/water-framework-directive_en

emphasises the role of regional authorities, Smart Specialisation Strategies (S3) and interregional cooperation in creating favourable conditions for geothermal investment and innovation.¹⁴

Many of the priorities identified by EGECE correspond to common challenges affecting geothermal deployment across European regions, especially regarding financing, permitting, skills development and ecosystem coordination. The document therefore provides an important reference for future geothermal policy development at both European and regional levels and is considered as a key reference for the regional policy recommendations developed within the Greet GEO project.

Smart Specialisation Strategies (S3)

Smart Specialisation Strategies provide a place-based innovation policy framework that helps regions identify and develop their unique strengths and competitive advantages. Supported by the European Commission, S3 promotes collaboration between public authorities, research organisations, industry and civil society to foster innovation-led regional development and interregional cooperation. In the geothermal sector, S3 offers an important mechanism for aligning innovation priorities, investment initiatives and stakeholder cooperation while facilitating knowledge exchange and the development of joint projects across regions with shared geothermal interests and complementary capabilities. The Greet GEO project contributes directly to this objective through the development of geothermal S3 roadmaps and support for the emerging European geothermal S3 partnership.¹⁵

Policy implications for Greet GEO

The evolving EU policy framework creates improved conditions for geothermal development. However, **successful implementation depends largely on the ability of regions and Member States** to translate European objectives into effective support mechanisms, investment programmes and regional innovation policies. For the Greet GEO regions, the combination of RED III, REPowerEU, industrial policy initiatives and the forthcoming European Geothermal Strategy provides an important opportunity to strengthen geothermal ecosystems, improve project bankability and accelerate the deployment of both deep and shallow geothermal solutions.

2.3. Barrier clusters identified at EU level

Despite the increasingly supportive European policy framework, geothermal deployment remains uneven across Europe. A range of regulatory, financial, technical and market barriers continue to limit investment and implementation. While some of these challenges affect the geothermal sector as a whole, important differences exist between deep and shallow geothermal applications.

Regulatory and Permitting Barriers

Regulatory complexity remains one of the most frequently cited barriers to geothermal deployment across Europe. For deep geothermal projects, permitting procedures are often lengthy and involve multiple authorities responsible for environmental assessment, water management, mining regulations, spatial planning and energy infrastructure. The resulting administrative complexity can increase development timelines and project costs.

In contrast, shallow geothermal systems generally benefit from more straightforward permitting requirements. However, regulatory frameworks vary considerably between Member States and regions, creating uncertainty for market actors and limiting the development of harmonised

¹⁴ <https://www.egec.org/policy-documents/european-geothermal-strategy-and-action-plan/>

¹⁵ https://ec.europa.eu/regional_policy/policy/communities-and-networks/s3-community-of-practice/about_en

deployment approaches. Lack of standardisation and inconsistent administrative practices may also slow market growth.

Information and Geological Data Barriers

Access to reliable geological information remains greatly important for deep geothermal development, where resource uncertainty directly affects investment decisions. Insufficient subsurface data, limited exploration information and restricted access to geological databases increase exploration risks and reduce investor confidence.

For shallow geothermal, geological uncertainty is generally lower, but stakeholders often face challenges related to the availability of technical guidance, mapping tools, market information and practical implementation data.

Improved access to geological databases, geothermal maps, resource assessments, market intelligence and technical guidance can facilitate project planning, reduce uncertainty and increase investor confidence across both segments.

Financial and Investment Barriers

Financial barriers represent one of the most significant challenges for geothermal deployment, although their character differs between deep and shallow applications.

Deep geothermal projects face exceptionally high upfront costs associated with exploration, drilling and resource confirmation. Significant investment is required before commercial viability can be demonstrated, creating substantial financial risks for project developers. Access to dedicated financing instruments, guarantee schemes and risk-sharing mechanisms remains limited in many European regions.

For shallow geothermal systems, investment requirements are generally lower and geological risks are minimal. However, deployment remains constrained by high initial installation costs, limited access to tailored financing products and insufficient financial incentives, especially for households, SMEs and public authorities. Market fragmentation can further reduce economies of scale and increase transaction costs.

Skills, Supply Chain and Capacity Barriers

The geothermal sector continues to face shortages of specialised skills and technical expertise. For deep geothermal, there is a need for geologists, drilling specialists, reservoir engineers and project development professionals capable of managing complex infrastructure projects. In addition, competition for drilling rigs, specialised equipment and experienced contractors can create bottlenecks and increase project costs.

In the shallow geothermal market, challenges are more frequently associated with insufficient numbers of trained designers, installers and maintenance professionals. Fragmented supply chains and uneven availability of specialised service providers can hinder market development and large-scale deployment.

Public authorities across both segments may also face capacity limitations that hinder their ability to evaluate projects, manage permitting procedures and support geothermal development effectively.

Market Development and Awareness Barriers

Deep geothermal technologies are often constrained by financing and project development risks, whereas shallow geothermal deployment is more strongly affected by market-related barriers. Limited awareness among building owners, SMEs, municipalities and investors can reduce demand for geothermal solutions despite their technical and economic benefits.

The lack of visible demonstration projects, limited dissemination of business cases and insufficient understanding of lifecycle cost advantages can further hinder adoption. Strengthening market awareness, communication activities and demonstration initiatives is therefore particularly important for accelerating geothermal uptake.

Planning and Integration Barriers

Geothermal energy is not yet systematically integrated into regional energy planning, urban development strategies, building renovation programmes or industrial decarbonisation policies across many European regions. As a result, geothermal resources are often insufficiently considered during energy infrastructure planning and building investment decisions, resulting in missed opportunities for decarbonisation and local energy production.

Table 1: Barriers of geothermal deployment in the EU

Barrier clusters	Deep geothermal	Shallow geothermal
Financing	Very high exploration and drilling risk	Higher upfront installation costs
Regulation	Complex permitting and licensing	Fragmented and inconsistent rules
Data	Geological uncertainty	Limited market and technical information
Skills	Geologists, drilling experts, reservoir engineers	Installers, designers, maintenance staff
Market	Project finance and development risks	Awareness and demand creation
Integration	District heating, industrial heat	Buildings, renovation, heat pumps

For deep geothermal, integration with district heating systems, industrial processes and thermal storage solutions represents a significant opportunity. For shallow geothermal, stronger links with building renovation programmes, heat pump deployment strategies and local energy planning frameworks could accelerate market growth.

Implications for Policy Development

The distinction between deep and shallow geothermal is important from a policy perspective. Deep geothermal systems demonstrate relatively high technological readiness and stronger integration into large-scale energy applications, but remain constrained by exploration risks, permitting complexity and financing challenges. Shallow geothermal systems benefit from lower technical and geological risks, but face barriers related to fragmented demand, market activation, supply chain development and awareness.

These differences suggest that geothermal policy frameworks should combine horizontal measures applicable to the entire sector, such as regulatory simplification, skills development and access to information, with targeted interventions responding to the specific needs of deep and shallow geothermal value chains. At the same time, geothermal energy offers significant opportunities for decarbonisation, energy security, industrial competitiveness and regional innovation, particularly when aligned with Smart Specialisation Strategies and interregional cooperation initiatives. These opportunities are explored further through the regional analysis presented in Chapter 3.

3. Greet GEO Regional policy analysis

3.1. Methodology

The regional policy analysis conducted within the Greet GEO project focuses on the participating regions represented within the consortium, including Italy, Croatia, Hungary, Slovenia, the Azores (Portugal) and the Canary Islands (Spain). The objective is to assess how geothermal energy is reflected in regional policy frameworks, identify barriers and opportunities affecting geothermal deployment, and derive evidence-based policy implications to support innovation and implementation.

The analysis follows a mixed-method approach combining policy review, benchmarking and stakeholder consultation. It examines national and regional policy frameworks, including National Energy and Climate Plans (NECPs) and Smart Specialisation Strategies (S3), and draws on three complementary sources: the value chain benchmarking exercise conducted under Task 2.2, which assessed the maturity of geothermal innovation ecosystems across key domains such as innovation, collaboration, financing, policy, technology readiness and market development; the structured regional consultation carried out under Task 3.2, through which Greet GEO partners provided qualitative and quantitative assessments of regional barriers, drivers, stakeholder roles and policy needs; and coordination with Task 4.1, which focused on strengthening regional innovation ecosystems and improving the de-risking of geothermal investments.

This approach ensures consistency between the identified barriers, the assessment of regional innovation ecosystems and the policy measures proposed later in the report, resulting in a comprehensive overview of the current state of geothermal development across the participating regions. The findings serve as the analytical foundation for the innovation policy measures presented in Chapter 4, supporting geothermal deployment through enhanced regional cooperation and Smart Specialisation (S3) clustering.

3.2. Geothermal energy in regional policies and Smart Specialisation (S3) strategies

The Greet GEO partnership brings together regions with diverse levels of geothermal development, different geological conditions and varying policy priorities. Despite these differences, all participating regions recognise the importance of renewable energy, decarbonisation and sustainable economic development. Geothermal energy is increasingly considered a strategic resource capable of contributing to regional energy security, climate objectives and industrial competitiveness. However, the extent to which geothermal energy is reflected in regional policies and Smart Specialisation Strategies (S3) varies considerably across the participating territories. The following overview examines their National Energy and Climate Plans (NECPs) and how geothermal energy is positioned within the policy and innovation frameworks of the six Greet GEO countries/regions and highlights its relevance for regional development, energy transition and future innovation activities.¹⁶

Croatia

Croatia has a significant geothermal potential, predominantly within the Pannonian Basin area, where favourable geological conditions support both deep and shallow geothermal applications. Geothermal

¹⁶ https://energy.ec.europa.eu/strategy/energy-union/national-energy-and-climate-plans_en

energy is increasingly recognised as an important resource for decarbonisation, energy security and sustainable economic development, primarily in district heating, agriculture, tourism and industrial heat applications (**National Energy and Climate Plan of the Republic of Croatia, 2024**)¹⁷.

The **Croatian Smart Specialisation Strategy 2021–2029** identifies sustainable energy, environmental technologies and green transition priorities as important drivers of innovation and economic development¹⁸. Within this framework, geothermal energy is also increasingly recognised as a strategic opportunity capable of supporting industrial competitiveness, regional development and innovation-driven growth. Recent policy developments have further strengthened the framework for geothermal deployment. Amendments to the Act on the Thermal Energy Market¹⁹ introduced progressive decarbonisation requirements for district heating and cooling systems, while the Energy Efficiency Act²⁰ requires large cities to assess renewable heating and cooling opportunities, including geothermal energy, within local energy planning processes. In addition, Croatia is currently advancing a new legal framework through the Draft Act on the Exploration and Exploitation of Energy Geo-Resources²¹, which would establish comprehensive rules for the management of geothermal resources and other energy-related subsurface resources. The proposed legislation aims to simplify and accelerate permitting procedures, improve legal certainty for investors, support the reuse of existing oil and gas infrastructure, and align geothermal development with broader energy transition and decarbonisation objectives. The draft also includes provisions supporting geothermal applications in agriculture and the implementation of relevant requirements under the EU Net-Zero Industry Act (NZIA).

Croatia benefits from a developing geothermal ecosystem involving public authorities, geological institutions, research organisations and private sector actors. Ongoing exploration activities and increasing policy support are creating new opportunities for geothermal deployment, specifically in district heating and direct heat applications. At the same time, challenges related to financing, geological risk and project development continue to highlight the need for targeted support measures and innovation-oriented policy interventions. As geothermal development accelerates, Croatia is increasingly positioning itself as an emerging geothermal region capable of combining favourable resource conditions with supportive policy frameworks and innovation-driven approaches to renewable energy deployment.

Italy

Italy represents one of the most mature geothermal markets in Europe and has a long history of geothermal utilisation, particularly in Tuscany, where geothermal electricity production has been established for more than a century. Geothermal energy is recognised within national and regional energy and climate strategies as an important contributor to renewable energy production, industrial competitiveness and decarbonisation objectives²². Tuscany remains Europe's leading geothermal region, hosting 34 geothermal power plants that provide a substantial share of regional renewable electricity generation and contribute significantly to regional energy security. Within Tuscany, geothermal energy forms part of broader regional development priorities related to sustainable

¹⁷ https://commission.europa.eu/system/files/2023-07/CROATIA_%20DRAFT%20UPDATED%20NECP%202021%202030%20%282%29_0.pdf

¹⁸ Croatian Smart Specialisation Strategy 2021–2029, <https://depp.oecd.org/policies/HRV353>

¹⁹ Act on Amendments to the Act on the Thermal Energy Market, Official Gazette 67/2025

²⁰ Energy Efficiency Act, Official Gazette 155/2025

²¹ https://www.sabor.hr/sites/default/files/uploads/sabor/2026-07-09/141811/PZE_321.pdf

²² https://commission.europa.eu/publications/italy-final-updated-necp-2021-2030-submitted-2024_en
Tuscany RIS3 2021–2027

energy systems, industrial innovation and the transition towards a low-carbon economy. The Research and Innovation Strategy S3 of Tuscany (RIS3) 2021–2027 identifies ecological transition, sustainable energy, circular economy and advanced manufacturing among the region's key innovation priorities. Within this framework, geothermal energy is regarded as a strategic regional asset supporting research and innovation, industrial competitiveness and the development of sustainable value chains. The strategy promotes collaboration between research organisations, enterprises and public authorities and supports the deployment of innovative technologies capable of strengthening the region's leadership in renewable energy and sustainable industrial development²³. The region benefits from a strong research and innovation ecosystem involving universities, research centres, technology providers and energy companies. In addition to electricity production, increasing attention is being given to direct heat applications, district heating systems and industrial process heat.

A significant recent policy development was the 2025 extension of Tuscany's geothermal concessions until 2046, providing long-term investment certainty and supporting further sector development and modernisation. Despite its advanced market position, challenges related to permitting procedures, investment conditions and public acceptance continue to require policy attention and stakeholder engagement.²⁴

Hungary

Hungary possesses significant geothermal resources and is among the leading European countries in geothermal heat utilisation. The **Final Updated National Energy and Climate Plan (NECP) 2021–2030**, adopted in 2024, identifies geothermal energy as an important domestic renewable resource contributing to energy security, decarbonisation and reduced dependence on imported fossil fuels. Geothermal energy already plays a significant role in district heating, municipal energy systems and greenhouse agriculture, while national policy ambitions foresee a substantial increase in geothermal heat production in the coming years²⁵. A major recent development is the adoption of the **Hungarian Geothermal Strategy** in 2024, which aims to increase geothermal production by 20% by 2026 and approximately double production by 2030, supported by a dedicated national funding programme. The strategy highlights geothermal energy as a key contributor to energy sovereignty, district heating decarbonisation and the reduction of natural gas dependence, while promoting further deployment in agriculture, municipal heating and industrial applications.²⁶

The **Hungarian Smart Specialisation Strategy (S3) 2021–2027** supports priorities related to sustainable energy, environmental technologies, resource efficiency and the green transition. Within this framework, geothermal energy is recognised as a strategic asset with strong potential to support innovation, regional development and industrial competitiveness. Considerable opportunities remain for expanding geothermal applications in district heating, agriculture and industrial heat use through stronger collaboration between public authorities, research organisations and industry stakeholders. Despite favourable geological conditions and growing policy support, barriers related to financing, project development and market uptake continue to limit wider implementation. As a result, policy efforts increasingly focus on improving investment conditions, reducing project risks and strengthening the role of geothermal energy within regional and local energy planning processes²⁷.

²³ <https://www.regione.toscana.it/verso-la-strategia-di-specializzazione-intelligente-2021-2027>

²⁴ <https://www.thinkgeoenergy.com/geothermal-concessions-of-enel-in-italy-to-be-extended-to-2046/>

²⁵ https://commission.europa.eu/publications/hungary-final-updated-necp-2021-2030-submitted-2024_en

²⁶ Hungarian geothermal strategy 2024 - chrome-extension://efaidnbmnnnibpcajpcgiclfindmkaj/https://mgte.hu/wp-content/uploads/2025/01/Hungary-EGEC-Country-Brief.pdf

²⁷ https://commission.europa.eu/publications/hungary-final-updated-necp-2021-2030-submitted-2024_en

Slovenia

Slovenia recognises geothermal energy as a promising renewable energy source that can support decarbonisation, energy diversification and sustainable regional development, especially in the north-eastern part of the country within the Pannonian Basin, where geothermal resources are most favourable. Geothermal energy is already utilised for heating applications, tourism, greenhouse and agriculture. The **Final Updated National Energy and Climate Plan (NECP) 2021–2030** identifies renewable heating and cooling as an important component of the energy transition and emphasises the increased use of domestic renewable energy sources to reduce dependence on fossil fuels and strengthen energy security²⁸.

The **Slovenian Sustainable Smart Specialisation Strategy (S5)** provides the main innovation and development framework for the 2021–2027 programming period. The strategy is built around the twin green and digital transition and promotes innovation-driven, low-carbon and knowledge-based economic development. Its priority areas include smart communities, smart buildings, sustainable food production and circular economy solutions, creating favourable conditions for geothermal applications in sustainable heating, building renovation, local energy systems and regional development. The strategy also encourages collaboration between businesses, research organisations and public authorities through Strategic Research and Innovation Partnerships (SRIPs), strengthening the innovation ecosystem relevant to geothermal technologies²⁹.

Special opportunities exist in the **Pomurje region**, where favourable geological conditions are combined with existing geothermal infrastructure and a legacy of oil and gas exploration. This creates potential for the repurposing of former hydrocarbon wells for geothermal production or reinjection, reducing investment costs and environmental impacts compared with greenfield developments. Despite this potential, geothermal deployment remains relatively limited and continues to face barriers related to regulatory complexity, geological and technical risks, financing and the development of investment-ready projects. Further progress will depend on improved project preparation, technical de-risking, clearer permitting pathways and stronger integration of geothermal resources into local heating and cooling planning processes.

The Azorean Islands

As an autonomous region of Portugal, the Azores' regional energy transition is supported by Portugal's **Final Updated National Energy and Climate Plan (NECP) 2021–2030**, which was adopted in 2024. The NECP prioritises the expansion of renewable energy, energy efficiency, decarbonisation and energy security, while reducing dependence on imported fossil fuels. Although geothermal energy is not a major component of mainland Portugal's energy system, the plan recognises the importance of endogenous renewable resources and provides a supportive policy framework for further geothermal development in the Azores, where geothermal energy represents one of the region's most significant renewable energy assets.³⁰ The archipelago considered an outermost region of the EU, represents one of the most advanced geothermal regions within the Greet GEO partnership. Due to its volcanic origin, geothermal energy already plays a significant role in the regional energy system, primarily in electricity generation, and is recognised as a strategic resource for enhancing energy autonomy, reducing dependence on imported fossil fuels and supporting the transition to a low-carbon economy. The

²⁸ https://commission.europa.eu/publications/slovenia-final-updated-necp-2021-2030-submitted-2025_en

²⁹ <https://www.gov.si/zbirke/projekti-in-programi/slovenska-strategija-trajnostne-pametne-specializacije-s5/>

³⁰ https://commission.europa.eu/publications/portugal-final-updated-necp-2021-2030-submitted-2024_en

Azorean Energy Strategy 2030 places strong emphasis on renewable energy deployment and sets ambitious targets for increasing the share of renewable electricity across the archipelago³¹.

The **Azores Regional Smart Specialization Strategy - RIS3 Açores 2022–2027** identifies Tourism and Heritage, Agriculture and Agro-industry, and Health and Wellness as its priority domains, with the valorisation of Azorean resources, environmental sustainability, and social development and quality of life as cross-cutting priorities. Although geothermal energy is not identified as a standalone thematic priority within RIS3 Açores, it supports the strategy's objectives indirectly, mainly through opportunities in tourism, agriculture, health and wellness, sustainable construction and energy services. The strategy also promotes collaboration between research institutions, businesses and public authorities to strengthen the regional innovation ecosystem. Recent policy initiatives have reinforced the region's mature, high-enthalpy geothermal electricity sector, with investments aimed at expanding generation capacity and modernising existing facilities. At the same time, shallow geothermal applications for heating and cooling remain largely untapped, representing the next stage of regional geothermal innovation and a growing opportunity for economic diversification beyond the electricity sector³².

Canary Islands

Spain's **Integrated National Energy and Climate Plan (PNIEC) 2021–2030** promotes the accelerated deployment of renewable energy, decarbonisation, energy efficiency and energy security. Within this framework, the Canary Islands are recognised as a strategic territory for increasing the share of locally available renewable energy sources and supporting the energy transition³³. The Canary Islands possess significant geothermal potential due to their volcanic geology. Although geothermal electricity generation has not yet reached the level observed in the Azores, recent years have seen growing political and financial support for geothermal exploration and resource assessment. A major milestone was reached in 2026 with the commencement of deep geothermal exploration drilling in Vilaflor (Tenerife), representing the most advanced geothermal development initiative currently underway in the archipelago³⁴. Similar geothermal exploration initiatives are planned for Gran Canaria and La Palma, reflecting growing interest in geothermal energy across the archipelago. Additional volcanic islands, including El Hierro and Lanzarote, may also offer opportunities for future geothermal development. Continued progress will depend on successful resource confirmation, access to investment, stakeholder engagement and the development of a supportive regulatory and innovation framework. If current exploration activities prove successful, geothermal energy could become an important component of the Canary Islands' long-term decarbonisation and energy transition strategy.

The **Canary Islands' extended Smart Specialisation Strategy (RIS3 ampliada 2021–2027)** provides the main framework for research and innovation policy in the region. It is organised around five sectoral priority areas — sustainable and digital tourism, health and wellness, the blue economy, astrophysics, space and aeronautics, and emerging industries — together with two cross-cutting priorities: digitalisation and sustainability. While geothermal energy is not identified as a standalone priority area, it connects to several of these themes, including the blue economy and sustainability priorities, and to the emerging industries community through geothermal exploration and resource

³¹ <https://portaldaenergia.azores.gov.pt/portal/Politica-energetica/EAE-2030?portalid=0>

³² Azores Regional Energy Strategy - [RIS3 Açores 2022–2027](#)

³³ https://commission.europa.eu/publications/spain-final-updated-necp-2021-2030-submitted-2024_en 1

³⁴ <https://www.thinkgeoenergy.com/reykjavik-geothermal-announces-start-of-geothermal-drilling-in-tenerife-canary-islands/>

development. The RIS3 also emphasises place-based innovation and island-specific development pathways³⁵.

Comparative Perspective

Across the Greet GEO regions, significant differences exist in terms of geothermal maturity, policy integration and market development.

The analysis reveals three broad categories of regional development characteristics. Tuscany and the Azores represent the most mature geothermal ecosystems, where geothermal energy already contributes significantly to regional energy systems and is supported by established research, industrial and policy capacities. In these regions, the focus is increasingly shifting from resource development towards innovation, modernisation, diversification of applications and long-term sustainability. Hungary and Croatia demonstrate strong resource potential and growing policy commitment. In both countries, geothermal energy is explicitly recognised within energy and innovation strategies, while recent policy reforms seek to improve investment conditions and accelerate deployment. District heating, agriculture and industrial heat applications represent important areas for future growth. Nevertheless, financing constraints, project development risks and implementation challenges continue to limit the pace of market expansion. Slovenia and the Canary Islands remain at an earlier stage of geothermal development. Although both territories have incorporated geothermal energy into broader sustainability, innovation and energy transition objectives, current efforts focus primarily on resource assessment, demonstration activities, market activation and capacity building. In these regions, the creation of supportive ecosystems and investment-ready project pipelines remains a key priority.

Despite their different levels of maturity, the participating regions share several common characteristics. All have integrated renewable energy, sustainability and innovation objectives into their policy frameworks and Smart Specialisation Strategies. At the same time, stakeholders across regions identify similar challenges, including access to finance, regulatory complexity, permitting procedures, skills shortages, market development and stakeholder coordination. **The complementary strength of the Greet GEO partnership lies in bringing together more mature geothermal regions that provide practical experience in deployment, governance and ecosystem development to regions with good potential and emerging political support.** It offers opportunities for innovation, market creation and the testing of new policy approaches. Together, these characteristics create favourable conditions for interregional collaboration, Smart Specialisation partnerships and the development of targeted policy measures capable of addressing both shared and region-specific challenges.

3.3. Insights from value chain benchmarking

To support the development of targeted innovation policy measures, the Greet GEO project carried out a value chain benchmarking exercise under Task 2.2 dedicated to the analysis of selected value chains, innovation niches and domains. The maturity of geothermal ecosystems was assessed across key domains, including innovation capacity, collaboration, financing, policy and regulation, market maturity and technology readiness. The benchmarking covered both deep and shallow geothermal value chains and provided a comparative assessment of ecosystem performance across the participating regions. The results confirm a consistent pattern across the participating regions. Collaboration emerged as the strongest-performing domain for both deep and shallow geothermal ecosystems, indicating well-developed stakeholder networks and strong potential for interregional cooperation. By contrast, innovation, technology readiness, financing and market maturity achieved

³⁵ <https://www.gobiernodecanarias.org/conocimiento/temas/innovacion/RIS3ampliada/>

only moderate scores, highlighting the need for further policy support, investment and market development measures. Deep geothermal systems demonstrate higher levels of market maturity, technology readiness and access to finance, while shallow geothermal performs slightly better in policy and regulatory conditions. Overall, the benchmarking confirms that financing, regulatory and market barriers remain the principal constraints to geothermal deployment across the Greet GEO regions. The results also support the distinction between deep and shallow geothermal value chains. Deep geothermal systems are more mature and integrated into district heating and large-scale energy applications but continue to face challenges related to exploration risk, project financing and permitting complexity. Shallow geothermal systems benefit from lower technical and geological risks but remain constrained by fragmented demand, limited awareness, skills shortages and scaling challenges. Emerging innovation niches, including thermal energy storage, hybrid geothermal systems, infrastructure reuse, geothermal brine valorisation and digitalisation, provide opportunities for further market development and ecosystem strengthening.

From a policy perspective, the **benchmarking highlights the importance of improving access to finance, supporting innovation and technology deployment, streamlining regulatory procedures, strengthening market development and leveraging existing collaboration networks**. These findings provide an important evidence base for the regional consultation results presented in the following section and directly inform the innovation policy measures proposed in Chapter 4.

3.4. Regional consultation

Under Task 3.2, a structured consultation was carried out to validate and extend the benchmarking findings with region-specific input from Greet GEO partners.

Consultation Methodology and Framework

A structured questionnaire was distributed within the consortium. Partners were requested to provide input based on their expertise, knowledge of the geothermal ecosystem, and interactions with relevant regional stakeholders, including public authorities, research organisations, industry actors, SMEs and intermediary organisations. The consultation aimed to identify not only the principal barriers affecting geothermal deployment but also the policy interventions considered most relevant for supporting implementation, innovation and market development at regional level.

The questionnaire consisted of two complementary sections. The first component focused on a **structured assessment of geothermal deployment barriers**. Respondents were asked to evaluate the relevance of a set of predefined barriers affecting both deep and shallow geothermal applications. The assessment covered twelve predefined barriers to be assessed separately for deep and shallow geothermal energy using a 0–5 relevance scale.

The barriers covered:

1. Investment costs and exploration risks
2. Regulatory complexity
3. Permitting procedures
4. Workforce and skills shortages
5. Policy support
6. Public acceptance
7. Access to finance

8. Geological data availability
9. Market information availability
10. One-stop-shop support services
11. Cross-sectoral integration
12. Region-specific barriers

The second component consisted of **open-ended questions designed to capture qualitative insights on regional perspectives on key challenges, market drivers, stakeholder roles and policy priorities**. Attention was given to identifying implementation barriers, SME needs, financing challenges and opportunities for improving cooperation within regional innovation ecosystems.

The questionnaire addressed the following thematic areas:

- key challenges affecting geothermal deployment;
- supply and demand drivers;
- relevant actors and intermediaries;
- policy-led and market-led actions;
- recommendations for regional policymakers.

The questionnaire template is included in Annex I.

The consultation covered the six regions represented within the Greet GEO consortium: the Pannonian Basin region of Croatia, Tuscany in Italy, the Pannonian Basin region of Hungary, the South-Eastern part of Slovenia within the Pannonian Basin, the Azores in Portugal, and the Canary Islands in Spain. Together, these regions represent a diverse range of geothermal development contexts, levels of market maturity and policy environments, enabling the identification of both common and region-specific challenges affecting geothermal deployment.

Table 2: Greet GEO regions and Their Geothermal Context

Region / Country	Geothermal context
Pannonian Basin / Croatia	Significant geothermal potential with growing interest in district heating, agriculture and industrial heat applications
Tuscany / Italy	Long-established geothermal region with extensive experience in geothermal energy utilisation
Pannonian Basin / Hungary	Advanced geothermal heat utilisation with strong district heating and agricultural applications
Pannonian Basin / South-Eastern part of Slovenia	Emerging geothermal market with growing interest in renewable heating and cooling solutions
Azores / Portugal	Volcanic island region with established geothermal electricity generation and strong focus on energy autonomy
Canary Islands / Spain	Significant geothermal potential with ongoing deep geothermal exploration and growing policy interest for energy security, decarbonisation and economic diversification

Barrier Assessment Results

To complement the qualitative findings obtained through the regional consultations, the responses were consolidated into a comparative barrier assessment covering the participating regions. The relevance of eleven common barriers that affect geothermal development using a scale from 0 (not relevant) to 5 (very high or critical barrier.); the twelfth, region-specific barriers, is treated separately below. Separate assessments were conducted for deep and shallow geothermal applications to capture differences in market maturity, investment requirements and regulatory conditions.

The responses were aggregated and analysed to identify common patterns across regions and to compare the perceived importance of barriers affecting deep and shallow geothermal development. The resulting heat maps reveal a high degree of convergence across regions despite their different geographical, institutional and market contexts. Several barriers consistently received high scores

GREET GEO Barrier Heat Map - Deep Geothermal							
Ratings use a 0-5 scale: 0 = not relevant / very low, 5 = very high / critical barrier.							
Barrier	Croatia	Italy	Hungary	Slovenia	Azores	Canary	Average
1. Investment costs & exploration risks	5.0	4.0	4.0	4.0	4.0	5.0	4.3
2. Regulatory framework	3.0	2.0	4.0	3.0	1.0	4.0	2.8
3. Permitting procedures	2.0	4.0	4.0	4.0	2.0	4.0	3.3
4. Skills & workforce	3.0	2.0	3.0	5.0	3.0	4.0	3.3
5. Political support / prioritisation	2.0	4.0	2.0	5.0	2.0	2.0	2.8
6. Public awareness / acceptance	2.0	4.0	2.0	5.0	2.0	4.0	3.2
7. Access to finance / risk-sharing	5.0	5.0	4.0	5.0	4.0	4.0	4.5
8. Geological data availability	1.0	3.0	2.0	4.0	3.0	4.0	2.8
9. Market data & statistics	1.0	3.0	2.0	4.0	2.0	4.0	2.7
10. One-stop-shop services / qualification schemes	2.0	3.0	3.0	3.0	3.0	4.0	3.0
11. Cross-sector integration opportunities	3.0	4.0	2.0	4.0	5.0	4.0	3.7

Legend	
1	Very low
2	Low
3	Moderate
4	High
5	Very high / critical

Figure 1: Regional Barrier Assessment – Deep Geothermal Heatmap

across all participating regions, indicating common challenges that require coordinated policy responses at regional, national and European levels.

The **deep geothermal assessment** demonstrates that access to finance and risk-sharing mechanisms constitutes the most significant barrier across the analysed regions, achieving the highest average score. High upfront investment costs and exploration risks also represent a major challenge, especially in regions where drilling costs and resource uncertainty continue to discourage private investment. Cross-sector integration opportunities received a relatively high score, suggesting that geothermal potential remains insufficiently connected to industrial processes, district heating systems and other direct-use applications. Permitting procedures and public acceptance also emerged as significant barriers, reflecting the long development timelines and stakeholder concerns often associated with deep geothermal projects.

At the regional level, the Canary Islands and Croatia reported particularly high concern regarding investment risks, while Slovenia highlighted skills shortages and political prioritisation as important constraints. The Azores assigned the highest score to cross-sector integration opportunities, emphasising the need to expand geothermal utilisation beyond electricity generation and strengthen links with broader regional economic activities.

The **shallow geothermal assessment** reveals a somewhat different barrier profile. While financing remains a major constraint, market-related barriers become more prominent. One-stop-shop services and qualification schemes, market data and statistics, political support and public awareness all

received relatively high scores. These results indicate that shallow geothermal deployment is often constrained less by technical feasibility and more by market development, administrative complexity and limited awareness among building owners, SMEs and public authorities. The results also suggest

GREET GEO Barrier Heat Map - Shallow Geothermal

Ratings use a 0-5 scale: 0 = not relevant / very low, 5 = very high / critical barrier.

Barrier	Croatia	Italy	Hungary	Slovenia	Azores	Canary	Average
1. Investment costs & exploration risks	3.0	4.0	2.0	2.0	5.0	2.0	3.0
2. Regulatory framework	2.0	4.0	3.0	3.0	3.0	3.0	3.0
3. Permitting procedures	1.0	3.0	2.0	3.0	2.0	2.0	2.2
4. Skills & workforce	3.0	3.0	3.0	4.0	3.0	4.0	3.3
5. Political support / prioritisation	2.0	5.0	3.0	4.0	5.0	3.0	3.7
6. Public awareness / acceptance	2.0	4.0	2.0	4.0	4.0	4.0	3.3
7. Access to finance / risk-sharing	3.0	5.0	4.0	3.0	5.0	3.0	3.8
8. Geological data availability	3.0	4.0	3.0	4.0	3.0	2.0	3.2
9. Market data & statistics	3.0	4.0	4.0	4.0	4.0	4.0	3.8
10. One-stop-shop services / qualification schemes	3.0	4.0	4.0	4.0	3.0	5.0	3.8
11. Cross-sector integration opportunities	4.0	4.0	3.0	4.0	5.0	4.0	4.0

Legend	
1	Very low
2	Low
3	Moderate
4	High
5	Very high / critical

Figure 2: Regional Barrier Assessment – Shallow Geothermal Heatmap

that market activation rather than technological development represents the main challenge for shallow geothermal deployment across the participating regions.

Compared with deep geothermal systems, shallow geothermal applications generally face lower investment and exploration risks but encounter greater challenges related to market uptake, visibility and support services. The Canary Islands also reported major barriers associated with one-stop-shop services and support mechanisms, while the Azores consistently identified financing, political prioritisation and cross-sector integration as major challenges. Tuscany highlighted financing constraints and insufficient political attention, whereas Slovenia emphasised skills development and market activation needs.

Additional Regional Barriers

An additional question was opened for region-specific barriers not covered by the common assessment framework. Although responses varied across regions and were therefore excluded from the comparative heat map analysis, several recurring themes emerged. Regional responses highlighted challenges including social acceptance and *not-in-my-backyard* (NIMBY) attitudes towards geothermal projects, especially in regions with existing geothermal development. Other responses referred to distorted energy market conditions created by fossil fuel subsidies and regulated energy prices, which reduce the competitiveness of renewable heat solutions. Stakeholders also identified limited market demand, insufficient visibility of geothermal business opportunities, fragmented governance structures and weak coordination between public authorities as additional obstacles affecting project implementation. Although these issues were not consistently reported across all regions, they provide important contextual insights and reinforce the need for broader policy interventions addressing market conditions, stakeholder engagement, institutional coordination and long-term public acceptance.

Comparison between barriers for deep and shallow geothermal systems

The comparative assessment confirms that deep and shallow geothermal systems, while sharing a common contribution to decarbonisation, energy security and regional competitiveness, face distinct and largely structural — rather than region-specific — implementation challenges. Deep geothermal development is constrained primarily by investment costs, permitting complexity and financing risk,

while shallow geothermal deployment faces greater barriers around market development, support services and public awareness; both, however, encounter similar gaps in skills availability and cross-sectoral integration. This high degree of convergence across the participating regions creates clear opportunities for policy learning and interregional cooperation within the emerging Smart Specialisation (S3) Geothermal Partnership.

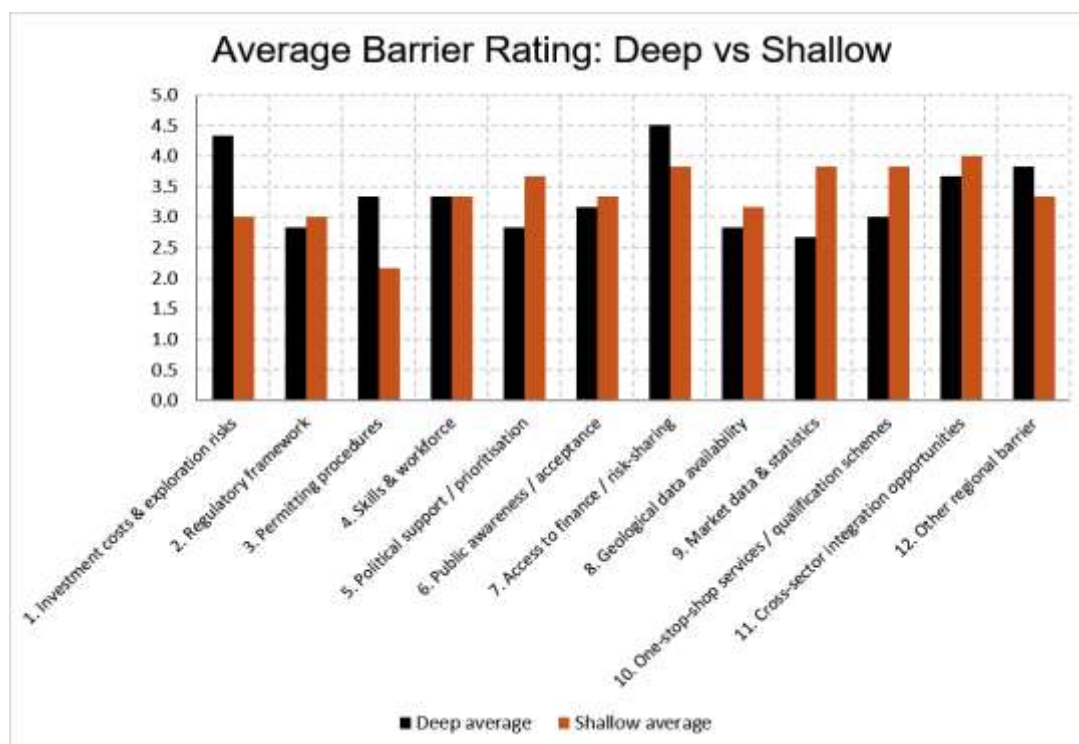


Figure 3: Comparison of Deep versus Shallow geothermal barriers

Regional Perspectives and Open Consultation Results

While the structured assessment above shows which barriers score highest, the open-ended responses reveal why they matter to stakeholders and how they play out in practice across the participating Greet GEO regions. Regional circumstances differ considerably, but the responses reveal several common themes that can inform future policy development and implementation activities.

Main Challenges to Overcome

The consultation responses reveal a clear distinction between the challenges affecting deep and shallow geothermal development, although several barriers are common to both value chains. Across all participating regions, stakeholders identified access to finance, market development and policy support as critical factors influencing the pace of geothermal deployment.

For deep geothermal, the most frequently cited challenges relate to high upfront investment costs, exploration risks and the difficulty of securing financing for early-stage project development. Stakeholders from Croatia, Hungary, the Canary Islands, the Azores and Tuscany highlighted that drilling activities require substantial capital investment before resource viability can be confirmed, creating significant uncertainty for both private investors and public authorities. While some regions have introduced risk-mitigation instruments and public support mechanisms, respondents emphasised that financing remains the principal barrier to wider deployment. Regulatory complexity and lengthy permitting procedures were also frequently mentioned, with focus on projects requiring environmental assessments, spatial planning approvals and coordination between multiple

authorities. In addition, several regions identified shortages of specialised expertise in geothermal engineering, drilling operations and project development.

For shallow geothermal, the main challenges differ somewhat from those affecting deep geothermal systems. Stakeholders highlighted limited market awareness, insufficient visibility of geothermal solutions among building owners and SMEs, and the absence of dedicated support mechanisms capable of stimulating market uptake. Although shallow geothermal technologies generally involve lower technical and geological risks, respondents noted that high initial investment costs remain a barrier when competing against conventional heating and cooling technologies. Several regions also reported limited availability of market data, fragmented installer networks, and a lack of specialised training and qualification schemes. In some cases, shallow geothermal deployment is further constrained by policy frameworks that prioritise other renewable energy technologies, such as solar photovoltaics or biomass.

A common theme across both segments is the need for stronger policy coordination and improved integration of geothermal energy into broader regional development, energy transition and climate strategies. Stakeholders repeatedly emphasised that geothermal technologies remain underrepresented in strategic planning despite their potential contribution to decarbonisation, energy security and industrial competitiveness. The findings suggest that overcoming these challenges will require a combination of financial de-risking measures, regulatory improvements, market activation initiatives and targeted capacity-building actions.

Key Supply and Demand Drivers

The consultation responses indicate that decarbonisation objectives, energy security concerns, gas substitution and the need for stable baseload renewable energy primarily drive **deep geothermal** deployment. Across the participating regions, geothermal energy is increasingly recognised as a strategic resource capable of providing reliable, locally available and low-carbon heat and power while reducing dependence on imported fossil fuels. This is greatly relevant in outermost island regions, where energy independence has emerged as a major driver for investment. Barriers to converting this demand into deployment are consistent with those identified above.

For shallow geothermal, the main drivers are building decarbonisation, energy efficiency improvements, lower operating costs and the growing demand for sustainable heating and cooling solutions. Stakeholders highlighted significant opportunities in commercial buildings, public facilities, tourism, hospitality and industrial applications. Compared with deep geothermal, shallow geothermal technologies are generally perceived as more mature and less technically risky, though deployment still faces the market-related and awareness barriers described above. Respondents emphasised the importance of communicating clear economic benefits through case studies, practical guidance and business-focused messaging, with major targets on SMEs.

Overall, the responses show that geothermal deployment is driven not only by climate and energy policy objectives but increasingly by economic considerations related to competitiveness, cost reduction, energy security, and long-term resilience. Successful market development depends on a supportive innovation ecosystem involving public authorities, research organisations, financial institutions, industry associations and other intermediary actors. Unlocking the full potential of both deep and shallow geothermal will require improved access to finance and risk-sharing instruments, greater availability of demonstration projects and pilot investments, stronger skills development and more effective communication strategies that clearly demonstrate the economic value of geothermal solutions for businesses, municipalities and investors. SMEs would benefit from simplified support structures and trusted advisory services to facilitate investment decisions.

Relevant Actors and Intermediaries

The consultation responses show that geothermal deployment depends on effective cooperation between public authorities, geological surveys, research organisations, energy agencies, financial institutions, industry associations, project developers and intermediary organisations. While the actors involved differ between regions and between deep and shallow geothermal applications, respondents consistently highlighted the need for stronger coordination between technical, financial and regulatory stakeholders.

For deep geothermal, geological surveys, research institutions, energy agencies, permitting authorities, geothermal associations and specialised engineering companies were identified as key actors. Stakeholders emphasised the importance of geological expertise in reducing exploration risks and improving resource assessment, while industry associations and clusters can help bridge gaps between researchers, municipalities, developers and investors. Demonstration projects and knowledge transfer activities were also highlighted as important tools for building confidence and supporting project development.

Financial institutions were identified as essential partners for geothermal deployment. Development banks, national energy funds, commercial banks, European funding programmes and risk-sharing mechanisms can improve project bankability and facilitate investment, chiefly for deep geothermal projects facing high upfront costs and exploration risks.

For shallow geothermal, municipalities, local energy agencies, installer associations, engineering firms, SME contractors and training organisations were considered the most important intermediaries. These actors support awareness raising, skills development and implementation, while commercial banks, ESCOs, subsidy schemes and green loan programmes can improve access to finance for SMEs, households and building owners.

A recurring finding across all regions concerns coordination gaps between permitting authorities, municipalities, financial institutions, technical experts and project developers. Stakeholders noted that fragmented governance structures often create delays and increase project complexity. In sum, the consultations suggest that stronger coordination mechanisms, improved knowledge transfer and integrated support structures such as geothermal one-stop-shops could significantly reduce barriers to investment and accelerate geothermal deployment.

Policy-Led and Market-Led Actions

Stakeholders generally agreed that effective geothermal deployment requires a balanced combination of policy-led interventions and market-driven implementation. While public authorities play a critical role in creating enabling conditions and reducing investment risks, private sector actors are expected to lead project development, technology deployment and commercialisation activities.

For deep geothermal, respondents consistently identified exploration support, risk-sharing mechanisms, financing instruments and regulatory frameworks as areas requiring strong public intervention. Given the high levels of geological uncertainty and capital investment associated with drilling activities, stakeholders emphasised the importance of public guarantees, grant schemes, dedicated financial instruments and risk-mitigation programmes capable of improving project bankability. Public authorities were also seen as having a key role in streamlining permitting procedures, improving coordination between competent authorities, providing access to geological information and integrating geothermal energy into district heating, industrial decarbonisation and regional energy planning strategies.

Market actors, on the other hand, are expected to lead project identification, resource development, drilling operations, plant construction and commercial operation. Respondents highlighted the

importance of private investment, technological innovation and entrepreneurial activity in expanding geothermal markets and developing new business models. Industry actors were also seen as key drivers of cross-sector integration opportunities, particularly in applications such as industrial heat, greenhouse agriculture, tourism and district heating and cooling systems.

For shallow geothermal, stakeholders considered the market to have a greater role in driving deployment, given the lower geological risks and higher technological maturity of ground-source heat pump systems. Nevertheless, respondents identified several areas where public intervention remains necessary, including awareness raising, installer training, quality assurance, standardisation and the provision of *one-stop-shop* advisory services. Financial incentives and dedicated support schemes were also considered important for accelerating market uptake, especially among households, SMEs and public building owners.

The consultations further highlighted the importance of aligning policy-led and market-led activities. Public authorities should focus on reducing barriers, creating stable regulatory conditions and supporting early-stage project development, while industry, financial institutions, technology providers and project developers should translate these enabling conditions into viable investments and operational projects. SMEs require specific focus here, as they often face disproportionate challenges in accessing finance, technical expertise and specialised advisory support. Effective cooperation between public and private actors will therefore be essential for ensuring the successful implementation and long-term sustainability of geothermal investments.

Recommendations for Regional Policymakers

The consultation responses show broad agreement on the actions needed to accelerate geothermal deployment. Across both deep and shallow geothermal value chains, stakeholders emphasised reducing investment risks, strengthening project development support, improving access to finance, and increasing awareness. **For deep geothermal**, key priorities include exploration risk-sharing schemes, grants for drilling and feasibility studies, blended finance mechanisms, better geological data, simplified permitting, and support for pilot and demonstration projects. Several regions also highlighted district heating networks, industrial parks and long-term heat contracts as ways to improve project viability. **For shallow geothermal**, respondents recommended financial incentives, tax relief, green loans and ESCO models, alongside simplified permitting, technical guidelines, installer certification and demonstration projects.

Communication and awareness activities should focus on practical benefits such as energy cost savings, competitiveness and energy security. Demonstration projects, site visits and case studies were identified as effective tools. Stakeholders also highlighted the importance of intermediary organisations and recommended establishing geothermal *one-stop-shop* services to support project preparation, permitting, financing and implementation, with special attention for SMEs. Access to finance remains a key priority, with recommendations including dedicated geothermal financing products, guarantee schemes, risk-sharing funds and stronger use of national and European funding programmes.

In short, the **responses point to three main priorities**: reducing project risks, improving coordination between stakeholders, and making geothermal opportunities more visible and accessible. These findings provide a practical basis for the policy measures presented in Chapter 4.

3.5. Synthesis of Regional Findings and Policy Implications

The analyses conducted under Tasks T2.2 and T3.2 provide complementary perspectives on the current state of geothermal development across the Greet GEO regions. While the value chain benchmarking exercise offered a structured assessment of ecosystem maturity across innovation, collaboration, financing, policy, technology and market dimensions, the regional consultation process provided deeper insights into the practical challenges, opportunities and implementation needs identified by regional stakeholders. Together, these activities provide a robust evidence base for the development of targeted innovation policy measures capable of supporting geothermal deployment and strengthening regional innovation ecosystems.

One insight that emerges specifically from combining the two evidence sources is the growing importance of energy independence and resilience, particularly in island and peripheral regions where reducing dependence on imported fossil fuels is becoming a major policy objective in its own right, distinct from climate motivations alone.

The barrier patterns identified through the benchmarking exercise (section 3.3) and confirmed through the regional consultation (section 3.4) point to one cross-cutting issue not yet addressed in either section individually: regulatory fragmentation affecting geothermal drilling activities, and the limited cross-border recognition of technical qualifications and drilling licences — particularly relevant for regions sharing geological characteristics, such as the Pannonian Basin. Improving recognition across borders could increase competition among drilling service providers, create more market-driven conditions, reduce project costs and improve access to specialised expertise.

The findings also demonstrate that geothermal deployment depends not only on technological readiness but equally on the existence of effective support ecosystems. Stakeholders repeatedly highlighted the need for stronger intermediary organisations capable of connecting project developers, SMEs, public authorities, research organisations and financial institutions. Energy agencies, geological surveys, cluster organisations, chambers of commerce, innovation hubs and development agencies were consistently identified as important actors for facilitating project development, improving access to expertise and supporting market uptake. A recurring recommendation across multiple regions was the establishment of geothermal one-stop-shop services capable of integrating technical guidance, permitting support, financing advice and project development assistance.

The consultation results further demonstrate that many of the necessary institutions and support mechanisms already exist within the participating regions. However, stakeholders repeatedly identified coordination gaps between permitting authorities, municipalities, technical experts, financial institutions and project developers. In many cases, these actors operate within separate governance structures, creating delays, increasing administrative complexity and limiting the effectiveness of existing support measures. As a result, improving stakeholder coordination emerged as a policy priority of equal importance to financing and regulatory reform.

Another important finding concerns the role of communication and market development. Stakeholders consistently emphasised that geothermal opportunities should be communicated through practical business outcomes rather than technological characteristics. Demonstration projects, feasibility studies, site visits, business case examples and sector-specific communication activities were identified as effective instruments for increasing awareness and strengthening the geothermal business case, particularly among SMEs. This reflects a broader need to move beyond

awareness raising towards practical support measures that help transform interest in geothermal energy into investment decisions and operational projects.

From a policy perspective, the analysis confirms that geothermal deployment requires a coordinated approach extending beyond energy policy alone. Effective implementation depends on the interaction of regulatory frameworks, financing instruments, innovation support mechanisms, skills development initiatives, stakeholder coordination structures and market activation measures. SMEs need specific focus, as they often face disproportionate challenges in accessing finance, technical expertise and specialised support services despite their important role within regional innovation ecosystems.

The evidence generated through the value chain benchmarking exercise and the regional consultations contributes directly to the development and strengthening of the emerging European geothermal S3 partnership. One of the key objectives of the Greet GEO project is the preparation of three Smart Specialisation (S3)-based geothermal roadmaps, representing an important project performance indicator and a practical mechanism for translating policy analysis into implementation-oriented action. The project is developing roadmaps supporting the deployment of shallow geothermal solutions in Croatia and in the Azores, and a roadmap for the Canary Islands addressing the geothermal segment considered most relevant to regional priorities and resource potential. Together, these roadmaps aim to provide place-based implementation pathways that complement the horizontal policy recommendations presented in this report and support ongoing interregional cooperation, policy learning and investment planning across regions of differing geothermal maturity.

As an outcome, targeted innovation policy measures have been developed to address the identified barriers, strengthen regional geothermal ecosystems and accelerate implementation. The measures focus mainly on financial de-risking, project preparation support, stakeholder coordination, SME engagement, intermediary organisations, market activation and stronger regional support ecosystems capable of facilitating geothermal deployment. Together with the regional roadmaps and the ongoing development of the geothermal S3 partnership, these measures are intended to support the transition from policy ambition to practical deployment, investment and long-term interregional cooperation. These measures are presented in Chapter 4.

4. Innovation Policy Measures recommended

The analyses conducted under Tasks T2.2 and T3.2 identified several recurring challenges affecting geothermal deployment across the Greet GEO regions. These include financing constraints, regulatory complexity, lengthy permitting procedures, limited market awareness, shortages of specialised skills, insufficient geological and market information, fragmented stakeholder coordination and a lack of implementation support mechanisms capable of transforming project concepts into operational investments. At the same time, the findings highlighted considerable opportunities for strengthening cooperation between public authorities, industry actors, research organisations, intermediary organisations and financial institutions. The analyses also confirmed the growing strategic importance of geothermal energy for supporting decarbonisation, energy security, energy independence and regional competitiveness, especially in regions seeking to reduce dependence on imported fossil fuels and improve the resilience of local energy systems.

The development of these policy measures was also informed by the findings of Deliverable D4.1, which analysed the geothermal innovation ecosystem across the participating regions and identified key enabling conditions for accelerating geothermal deployment. The report highlighted the need to

strengthen financial de-risking mechanisms and investment support, improve institutional and regulatory frameworks, enhance the technological capacity of the geothermal ecosystem, and increase societal engagement and acceptance of geothermal technologies. The report gave special weight to the introduction of risk-sharing instruments, clearer permitting pathways, improved coordination among public authorities, better integration of geothermal considerations into regional planning processes, stronger access to geological data and specialised expertise, and enhanced communication and awareness-raising activities. These findings strongly reinforce the conclusions derived from Tasks T2.2 and T3.2 and provide additional justification for the policy measures proposed in this chapter.

The regional consultations further demonstrated that many of the barriers affecting geothermal deployment are not solely related to technology or financing, but also to the limited availability of project preparation support, fragmented governance structures and insufficient coordination between stakeholders. Respondents repeatedly highlighted the need for geothermal one-stop-shop services, stronger intermediary organisations, demonstration projects, practical business-oriented communication activities and dedicated support mechanisms for SMEs. The consultation findings also confirmed that effective geothermal deployment requires an integrated approach combining financing, regulation, technical assistance, skills development, market activation and stakeholder engagement.

The proposed policy measures address the barriers and opportunities identified through the value chain benchmarking exercise, regional consultations and innovation ecosystem analysis. Together, they form a comprehensive policy framework designed to strengthen geothermal innovation ecosystems and accelerate the deployment of both deep and shallow geothermal solutions across the Greet GEO regions. The measures respond to a broad range of needs identified throughout the analysis. These include improving project bankability and access to finance, reducing investment and exploration risks, strengthening regulatory and governance frameworks, streamlining permitting procedures, improving regulatory interoperability and mutual recognition arrangements where appropriate, integrating geothermal energy into regional planning processes, supporting innovation and technology deployment, reinforcing collaboration between research and industry, expanding SME support services, addressing skills shortages, increasing public awareness and societal acceptance, improving access to geothermal data and knowledge, and strengthening interregional cooperation through Smart Specialisation (S3) partnerships.

The measures should not be viewed as standalone interventions but as mutually reinforcing actions capable of creating favourable conditions for geothermal investment and deployment. Their combined implementation can improve project development capacities, strengthen stakeholder coordination, enhance market uptake and support the transition from geothermal resource potential to operational projects and long-term economic, environmental and societal benefits. While individual regions may prioritise different actions depending on their specific circumstances and levels of geothermal maturity, the overall framework provides a coherent basis for supporting geothermal development across diverse regional contexts.

Policy Measure 1: Establish Regional Geothermal Investment Support Facilities

Regional authorities should establish dedicated support mechanisms to help geothermal project developers prepare investment-ready projects and access available funding opportunities. Such facilities should provide technical assistance, feasibility studies, business case development, financial modelling and guidance on regional, national and European funding instruments. Major attention should be given to the needs of SMEs and municipalities, which often lack the resources required to develop bankable geothermal projects. These should also support the development of regional geothermal project pipelines and encourage project aggregation where appropriate, helping to

improve investment readiness, reduce transaction costs and attract private finance. By strengthening project preparation and connecting developers with financial institutions and technical experts, these mechanisms can increase the number of geothermal projects reaching implementation.

Policy Measure 2: Develop Geothermal Risk-Sharing Mechanisms

Public authorities should promote financial instruments that reduce geological, exploration and investment risks associated with geothermal projects. Risk-sharing schemes, guarantee mechanisms, exploration funds, drilling support programmes and public-private financing instruments should help cover geological uncertainty, drilling risks and early-stage project development costs. Regional authorities should also explore the establishment of dedicated geothermal risk-sharing facilities, blended finance instruments and public guarantee schemes capable of improving project bankability and investor confidence. Improving access to risk-sharing mechanisms should be a priority for SMEs and smaller-scale geothermal projects.

Policy Measure 3: Create Regional Geothermal One-Stop-Shop Services

Dedicated geothermal one-stop-shop services should be established to provide coordinated support for project preparation, permitting, financing, technical requirements and regulatory procedures. These structures should facilitate coordination between water, environmental, mining, planning and energy authorities while providing clear guidance to project developers, municipalities, SMEs and investors. One-stop-shop services should also support business case development, matchmaking between project promoters and financing institutions, and access to technical expertise. The regional consultations consistently identified such integrated support structures as one of the most effective mechanisms for reducing administrative complexity and accelerating project implementation.

Policy Measure 4: Streamline Permitting Procedures

Regional and national authorities should review existing permitting frameworks and identify opportunities to simplify procedures, improve transparency and strengthen coordination among authorities involved in geothermal project approvals. Standardised procedures and clearer permitting pathways should be developed for both deep and shallow geothermal applications, with a specific focus on coordination between energy, environmental, water management, mining and spatial planning authorities. Policymakers should also explore opportunities for cross-border regulatory cooperation, including the mutual recognition of technical qualifications, certifications and geothermal drilling licences where equivalent standards exist. In regions with shared geological conditions and common geothermal development objectives, such arrangements could facilitate the participation of qualified drilling contractors across jurisdictions, broaden access to specialised expertise, increase competition and reduce project costs. Existing industry guidance, such as the well-drilling guidelines developed by the International Association of Drilling Contractors (IADC), may provide useful reference points for the harmonisation of technical, safety and operational requirements.

Policy Measure 5: Integrate Geothermal Energy into Regional Planning

Geothermal energy should be systematically incorporated into regional climate, energy, innovation and economic development strategies. Attention should be given to regional energy planning, spatial planning, heating and cooling strategies, industrial development policies and Smart Specialisation priorities to ensure greater policy coherence and project visibility. Integration of geothermal considerations into regional planning can also support long-term investment certainty and facilitate the development of district heating, industrial heat and building decarbonisation projects.

Policy Measure 6: Support Demonstration and Pilot Projects

Public support should prioritise demonstration projects capable of validating innovative geothermal technologies, reducing perceived risks and increasing confidence among investors, public authorities and end-users. Demonstration activities should include pilot projects, living labs, demonstration buildings, site visits and project showcase activities capable of communicating the practical benefits of geothermal solutions. Sectors such as district heating, tourism, agriculture, industry and building renovation deserve special focus, given the significant economic and environmental benefits geothermal technologies can generate there.

Policy Measure 7: Strengthen Research–Industry Collaboration

Regional innovation policies should encourage closer cooperation between research organisations, universities, industry actors and public authorities. Joint research projects, innovation partnerships, technology transfer initiatives and collaborative innovation platforms can accelerate commercialisation and market uptake. Stronger collaboration can also improve access to geological data, technical expertise and innovative business models while supporting the development of region-specific geothermal solutions.

Policy Measure 8: Promote Integrated Geothermal Energy Systems

Regional authorities should encourage integrated geothermal solutions that maximise resource utilisation and improve system efficiency. Greater attention should be given to cascade use concepts, thermal storage applications and cross-sector integration opportunities linking geothermal energy with district heating, cooling, buildings, agriculture and industrial processes.

Policy Measure 9: Strengthen SME Support Services

SMEs play an important role throughout geothermal value chains but often face barriers related to finance, expertise and market access. Regional support programmes should provide targeted advisory services, mentoring, project development assistance and business support tailored to SME needs. Support services should include energy audits, standardised business case templates, ROI calculators, project preparation assistance, advisory services and support for the development of turnkey geothermal solutions. Helping SMEs understand the economic benefits of geothermal investments and navigate available financing opportunities should be a key focus.

Policy Measure 10: Strengthen the Role of Intermediary Organisations

Energy agencies, cluster organisations, chambers of commerce, development agencies, geothermal associations and innovation support organisations should be further empowered to facilitate stakeholder cooperation, improve information exchange and support project development activities. These organisations can play a key role in connecting SMEs with expertise, funding opportunities and innovation support services. They should also act as facilitators between project developers, municipalities, financial institutions and public authorities, supporting project matchmaking, communication activities, knowledge transfer and policy networking. They can further contribute to interregional cooperation, the exchange of good practices and the implementation of Smart Specialisation partnership activities.

Policy Measure 11: Improve Access to Finance for SMEs

Regional authorities should facilitate stronger connections between SMEs and financial institutions, including commercial banks, public development banks and specialised investment funds. Improved access to financing is essential for increasing SME participation in geothermal markets and supporting the development of viable business cases. Specific instruments may include dedicated geothermal loan products, green loan schemes, guarantee mechanisms, leasing models, ESCO approaches and blended finance solutions tailored to SME investment cycles and financing needs.

Policy Measure 12: Develop Regional Geothermal Skills Programmes

Targeted education, training and certification programmes should be established to address workforce shortages and strengthen implementation capacity among engineers, installers, project developers and public administration staff. Training programmes should include installer certification schemes, vocational education, engineering capacity building and specialised training for municipal officials, permitting authorities and project evaluators involved in geothermal development. Building expertise within public authorities responsible for project assessment and permitting procedures.

Policy Measure 13: Increase Public Awareness and Societal Acceptance

Communication and awareness-raising activities should focus not only on geothermal technologies themselves, but also on their practical benefits, including energy cost savings, competitiveness, energy security, resilience and decarbonisation outcomes. Transparent information sharing, demonstration projects, monitoring data, feasibility studies, sector-specific case studies and early stakeholder engagement can contribute significantly to improving public acceptance and market uptake. Communication activities should be tailored to different target groups, including citizens, SMEs, municipalities, investors and policymakers.

Policy Measure 14: Strengthen the European Geothermal S3 Partnership

Regional authorities should actively support the further development of the emerging European geothermal Smart Specialisation partnerships through interregional cooperation, knowledge exchange and joint innovation activities. This should focus especially on the creation and implementation of S3-based geothermal roadmaps that provide practical implementation pathways and can support long-term cooperation, investment planning and policy learning across European regions while strengthening the foundations of future European geothermal S3 partnerships.

Policy Measure 15: Establish Regional Geothermal Data and Knowledge Platforms

Regional authorities should support the creation of shared geothermal data repositories and knowledge platforms providing geological information, market intelligence, technical guidance, regulatory information, case studies and good practices. Improved access to reliable information can reduce project uncertainty, strengthen decision-making and accelerate project development. Wherever possible, these platforms should facilitate interregional data sharing, improve access to subsurface information and support long-term knowledge sharing, interregional cooperation and evidence-based policy development.

5. Conclusion

This report presented the results of the policy analysis and regional consultation activities undertaken within Task T3.2 of the Greet GEO project. Drawing on the findings of Task T2.2, the regional stakeholder consultations and the ecosystem assessment conducted under Deliverable D4.1, it identified key barriers and opportunities for geothermal development across the participating regions.

The analysis confirmed that geothermal energy can make an important contribution to decarbonisation, energy security, industrial competitiveness and regional economic development. The benchmarking exercise and regional consultations demonstrated that, despite different levels of geothermal development and market maturity, the participating regions share several common barriers and opportunities that can be addressed through coordinated policy action. Key challenges include financing constraints, exploration risks, regulatory complexity, skills shortages and limited market awareness. At the same time, strong stakeholder networks, growing policy support and Smart Specialisation cooperation mechanisms provide favourable conditions for further deployment.

To address these challenges, the report proposes fifteen innovation policy measures covering financial de-risking, regulatory improvement, innovation and technology deployment, SME support, skills development, societal engagement, data accessibility and interregional cooperation. Together, these measures provide a practical framework for strengthening regional geothermal ecosystems and accelerating geothermal deployment.

The report also supports European geothermal Smart Specialisation (S3) partnerships and feeds into three geothermal roadmaps for Croatia, the Azores and the Canary Islands, which complement the policy measures and support future interregional cooperation and implementation. None of this works without coordinated action from policymakers, industry, research organisations and financial actors. Taken together with the ongoing S3 partnership and the regional roadmaps, the measures in this report offer a practical, implementation-focused way to reduce investment risk, strengthen innovation ecosystems, speed up market uptake, and build a more resilient, competitive and sustainable European energy system.

References

- European Commission. Affordable Energy Action Plan.
- European Commission. Smart Specialisation Platform (S3 Platform).
- European Commission (2019). The European Green Deal. Brussels: European Commission.
- European Commission (2022). REPowerEU Plan. Brussels: European Commission.
- European Commission (2024). Final Updated National Energy and Climate Plans (NECPs) 2021–2030. Brussels: European Commission.
- European Commission (2026). AccelerateEU – Energy Union. Brussels: European Commission.
- European Geothermal Energy Council (EGEC) (2024). European Geothermal Market Report 2024. Brussels: European Geothermal Energy Council.
- European Geothermal Energy Council (EGEC) (2025). European Geothermal Strategy and Action Plan: Making Europe Competitive, Secure and Affordable. Brussels: European Geothermal Energy Council.
- European Parliament and Council (2000). Directive 2000/60/EC Establishing a Framework for Community Action in the Field of Water Policy (Water Framework Directive).
- European Parliament and Council (2023). Directive (EU) 2023/2413 on the Promotion of the Use of Energy from Renewable Sources (RED III).
- European Parliament and Council (2024). Critical Raw Materials Act (CRMA).
- European Parliament and Council (2024). Net-Zero Industry Act (NZIA).
- ETIP-DG (2023). Strategic Research and Innovation Agenda for Deep Geothermal. Brussels.
- Government of Hungary (2024). Final Updated National Energy and Climate Plan (NECP) 2021–2030.
- Government of Hungary (2024). Hungarian Geothermal Strategy.
- Government of Portugal (2024). Final Updated National Energy and Climate Plan (NECP) 2021–2030.
- Government of Slovenia (2021). Slovenian Sustainable Smart Specialisation Strategy (S5) 2021–2027.
- Government of Slovenia (2025). Final Updated National Energy and Climate Plan (NECP) 2021–2030.
- Government of Spain (2024). Integrated National Energy and Climate Plan (PNIEC) 2021–2030.

Government of the Azores (2022). RIS3 Açores 2022–2027: Research and Innovation Strategy for Smart Specialisation in the Autonomous Region of the Azores.

Government of the Azores (2023). Azorean Energy Strategy 2030.

Government of the Canary Islands (2021). RIS3 Canarias 2021–2027.

Government of the Canary Islands. Canary Islands Energy Transition Strategy.

Government of the Republic of Croatia (2021). Croatian Smart Specialisation Strategy 2021–2029.

Government of the Republic of Croatia (2024). National Energy and Climate Plan of the Republic of Croatia 2021–2030 (Updated Version).

Government of the Republic of Croatia (2025). Act on Amendments to the Act on the Thermal Energy Market (Official Gazette 67/2025).

Government of the Republic of Croatia (2025). Energy Efficiency Act (Official Gazette 155/2025).

Government of the Republic of Croatia (2026). Draft Act on the Exploration and Exploitation of Energy Geo-Resources.

International Energy Agency (IEA) (2022). The Future of Heat Pumps. Paris: International Energy Agency.

Joint Research Centre (JRC) (2022). Heating and Cooling Decarbonisation Pathways in Europe. Luxembourg: Publications Office of the European Union.

Ministry of Environment and Energy Security, Italy (2024). Final Updated National Energy and Climate Plan (PNIEC) 2021–2030.

National Research, Development and Innovation Office (Hungary) (2021). Smart Specialisation Strategy (S3) 2021–2027.

Regione Toscana (2021). RIS3 Toscana 2021–2027.

Regional Directorate for Energy of the Azores (2026). Regional Energy Development and Clean Energy Transition Documentation.

ThinkGeoEnergy (2025). Geothermal Concessions of Enel in Italy Extended to 2046.

ThinkGeoEnergy (2026). Reykjavik Geothermal Announces Start of Geothermal Drilling in Tenerife, Canary Islands.

Annex I. Greet GEO Regional policy analysis & development - Stakeholder Interview Questionnaire Template

Purpose: To assess the relevance of key factors including barriers affecting geothermal energy development in the Canary Islands/ Azorean Islands / Pannonian Basin (Croatia, Slovenia, Hungary)/ Tuscany (Italy)

Respondent Information

Partner: _____

Region: _____

I. Barriers & Challenges Assessment

Please rate each barrier/challenge using the following scale:

- 0 – Not relevant at all
- 1 – Very low relevance
- 2 – Low relevance
- 3 – Moderate relevance
- 4 – High relevance
- 5 – Very high / critical barrier

1. High upfront investment costs, exploration risks and long development timelines for geothermal projects

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

2. Complex, fragmented or unclear regulatory frameworks

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

3. Long, costly or insufficiently transparent permitting procedures

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

4. Lack of qualified workforce and specialised expertise in both authorities and project developers

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

5. Insufficient political support or policy prioritisation for geothermal energy

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

6. Limited public awareness or acceptance of geothermal technologies

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

7. Limited access to financing or risk-sharing instruments for geothermal projects

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

8. Limited access to reliable geological data and standardised technical information

Rating (0-5)	Deep	Shallow

Comments / examples /recommendations:

9. Lack of detailed market data and statistics on geothermal installations and performance

Rating (0-5)	Deep	Shallow

Comments / examples / recommendations:

10. Lack of integrated ('one-stop-shop') services or uniform qualification schemes

Rating (0-5)	Deep	Shallow

Comments / examples / recommendations:

11. Failure to recognise cross-sectoral opportunities (e.g. desalination, agriculture, industrial heat, district heating/cooling)

Rating (0-5)	Deep	Shallow

Comments / examples / recommendations:

12. Any other barrier/challenge in your region: _____

Rating (0-5)	Deep	Shallow

Comments / examples / recommendations:

II. Open questions

1. What are the most important challenges to overcome in your region?

Please specify barriers related to regulation, market conditions, finance, public acceptance, skills, or data availability.

Which of these challenges most directly hinder implementation of geothermal projects?

What concrete regional-level actions would help overcome them?

Deep: _____

Shallow: _____

2. What are the key supply and demand drivers, and their priorities?

What drives geothermal development (e.g. energy demand, decarbonisation targets, industrial heat needs)?

What are the main constraints for SMEs in developing a viable business case?

How should geothermal opportunities be better communicated to SMEs, and which regional organisations should be involved?

Deep: _____

Shallow: _____

3. Who would be the right parties to address these challenges?

Which intermediaries (clusters, agencies, geological surveys, innovation hubs, etc.) should play a stronger role?

Which financial institutions or funding bodies need to be engaged to improve SMEs' access to finance?

Are there gaps in coordination between stakeholders?

Deep: _____

Shallow: _____

4. Which activities should be policy-led and which should be market-led?

What actions require public intervention at regional level (e.g. regulation, incentives, risk-sharing)?

What should be driven by market actors or industry?

How can both be aligned to ensure effective implementation and uptake, especially for SMEs?

Deep: _____

Shallow: _____

5. What should regional policy makers do?

Please provide specific, actionable recommendations at regional level. Indicate measures that would accelerate implementation (short-medium term). Identify actions to:

- *strengthen the geothermal business case for SMEs*
- *improve communication and awareness*
- *enhance the role of intermediaries and support organisations*
- *facilitate access to finance and investment*

Deep: _____

Shallow: _____

Annex II. Greet GEO policy measures

The following policy measures were developed within the Greet GEO project based on regional policy analysis, value chain benchmarking, stakeholder consultations and innovation ecosystem assessments carried out across the participating regions. They are intended to support the deployment of deep and shallow geothermal energy by addressing financial, regulatory, technical, market and governance barriers while strengthening regional innovation ecosystems and interregional cooperation.

Policy Measure 1: Establish Regional Geothermal Investment Support Facilities

Regional authorities should establish dedicated support mechanisms to help geothermal project developers prepare investment-ready projects and access available funding opportunities. Such facilities should provide technical assistance, feasibility studies, business case development, financial modelling and guidance on regional, national and European funding instruments. Major attention should be given to the needs of SMEs and municipalities, which often lack the resources required to develop bankable geothermal projects. These should also support the development of regional geothermal project pipelines and encourage project aggregation where appropriate, helping to improve investment readiness, reduce transaction costs and attract private finance. By strengthening project preparation and connecting developers with financial institutions and technical experts, these mechanisms can increase the number of geothermal projects reaching implementation.

Policy Measure 2: Develop Geothermal Risk-Sharing Mechanisms

Public authorities should promote financial instruments that reduce geological, exploration and investment risks associated with geothermal projects. Risk-sharing schemes, guarantee mechanisms, exploration funds, drilling support programmes and public-private financing instruments should help cover geological uncertainty, drilling risks and early-stage project development costs. Regional authorities should also explore the establishment of dedicated geothermal risk-sharing facilities, blended finance instruments and public guarantee schemes capable of improving project bankability and investor confidence. Improving access to risk-sharing mechanisms should be a priority for SMEs and smaller-scale geothermal projects.

Policy Measure 3: Create Regional Geothermal One-Stop-Shop Services

Dedicated geothermal one-stop-shop services should be established to provide coordinated support for project preparation, permitting, financing, technical requirements and regulatory procedures. These structures should facilitate coordination between water, environmental, mining, planning and energy authorities while providing clear guidance to project developers, municipalities, SMEs and investors. One-stop-shop services should also support business case development, matchmaking between project promoters and financing institutions, and access to technical expertise. The regional consultations consistently identified such integrated support structures as one of the most effective mechanisms for reducing administrative complexity and accelerating project implementation.

Policy Measure 4: Streamline Permitting Procedures

Regional and national authorities should review existing permitting frameworks and identify opportunities to simplify procedures, improve transparency and strengthen coordination among authorities involved in geothermal project approvals. Standardised procedures and clearer permitting pathways should be developed for both deep and shallow geothermal applications, with a specific focus on coordination between energy, environmental, water management, mining and spatial planning authorities. Policymakers should also explore opportunities for cross-border regulatory cooperation, including the mutual recognition of technical qualifications, certifications and

geothermal drilling licences where equivalent standards exist. In regions with shared geological conditions and common geothermal development objectives, such arrangements could facilitate the participation of qualified drilling contractors across jurisdictions, broaden access to specialised expertise, increase competition and reduce project costs. Existing industry guidance, such as the well-drilling guidelines developed by the International Association of Drilling Contractors (IADC), may provide useful reference points for the harmonisation of technical, safety and operational requirements.

Policy Measure 5: Integrate Geothermal Energy into Regional Planning

Geothermal energy should be systematically incorporated into regional climate, energy, innovation and economic development strategies. Attention should be given to regional energy planning, spatial planning, heating and cooling strategies, industrial development policies and Smart Specialisation priorities to ensure greater policy coherence and project visibility. Integration of geothermal considerations into regional planning can also support long-term investment certainty and facilitate the development of district heating, industrial heat and building decarbonisation projects.

Policy Measure 6: Support Demonstration and Pilot Projects

Public support should prioritise demonstration projects capable of validating innovative geothermal technologies, reducing perceived risks and increasing confidence among investors, public authorities and end-users. Demonstration activities should include pilot projects, living labs, demonstration buildings, site visits and project showcase activities capable of communicating the practical benefits of geothermal solutions. Sectors such as district heating, tourism, agriculture, industry and building renovation deserve special focus, given the significant economic and environmental benefits geothermal technologies can generate there.

Policy Measure 7: Strengthen Research–Industry Collaboration

Regional innovation policies should encourage closer cooperation between research organisations, universities, industry actors and public authorities. Joint research projects, innovation partnerships, technology transfer initiatives and collaborative innovation platforms can accelerate commercialisation and market uptake. Stronger collaboration can also improve access to geological data, technical expertise and innovative business models while supporting the development of region-specific geothermal solutions.

Policy Measure 8: Promote Integrated Geothermal Energy Systems

Regional authorities should encourage integrated geothermal solutions that maximise resource utilisation and improve system efficiency. Greater attention should be given to cascade use concepts, thermal storage applications and cross-sector integration opportunities linking geothermal energy with district heating, cooling, buildings, agriculture and industrial processes.

Policy Measure 9: Strengthen SME Support Services

SMEs play an important role throughout geothermal value chains but often face barriers related to finance, expertise and market access. Regional support programmes should provide targeted advisory services, mentoring, project development assistance and business support tailored to SME needs. Support services should include energy audits, standardised business case templates, ROI calculators, project preparation assistance, advisory services and support for the development of turnkey geothermal solutions. Helping SMEs understand the economic benefits of geothermal investments and navigate available financing opportunities should be a key focus.

Policy Measure 10: Strengthen the Role of Intermediary Organisations

Energy agencies, cluster organisations, chambers of commerce, development agencies, geothermal associations and innovation support organisations should be further empowered to facilitate stakeholder cooperation, improve information exchange and support project development activities. These organisations can play a key role in connecting SMEs with expertise, funding opportunities and innovation support services. They should also act as facilitators between project developers, municipalities, financial institutions and public authorities, supporting project matchmaking, communication activities, knowledge transfer and policy networking. They can further contribute to interregional cooperation, the exchange of good practices and the implementation of Smart Specialisation partnership activities.

Policy Measure 11: Improve Access to Finance for SMEs

Regional authorities should facilitate stronger connections between SMEs and financial institutions, including commercial banks, public development banks and specialised investment funds. Improved access to financing is essential for increasing SME participation in geothermal markets and supporting the development of viable business cases. Specific instruments may include dedicated geothermal loan products, green loan schemes, guarantee mechanisms, leasing models, ESCO approaches and blended finance solutions tailored to SME investment cycles and financing needs.

Policy Measure 12: Develop Regional Geothermal Skills Programmes

Targeted education, training and certification programmes should be established to address workforce shortages and strengthen implementation capacity among engineers, installers, project developers and public administration staff. Training programmes should include installer certification schemes, vocational education, engineering capacity building and specialised training for municipal officials, permitting authorities and project evaluators involved in geothermal development. Building expertise within public authorities responsible for project assessment and permitting procedures.

Policy Measure 13: Increase Public Awareness and Societal Acceptance

Communication and awareness-raising activities should focus not only on geothermal technologies themselves, but also on their practical benefits, including energy cost savings, competitiveness, energy security, resilience and decarbonisation outcomes. Transparent information sharing, demonstration projects, monitoring data, feasibility studies, sector-specific case studies and early stakeholder engagement can contribute significantly to improving public acceptance and market uptake. Communication activities should be tailored to different target groups, including citizens, SMEs, municipalities, investors and policymakers.

Policy Measure 14: Strengthen the European Geothermal S3 Partnership

Regional authorities should actively support the further development of the emerging European geothermal Smart Specialisation partnerships through interregional cooperation, knowledge exchange and joint innovation activities. This should focus especially on the creation and implementation of S3-based geothermal roadmaps that provide practical implementation pathways and can support long-term cooperation, investment planning and policy learning across European regions while strengthening the foundations of future European geothermal S3 partnerships.

Policy Measure 15: Establish Regional Geothermal Data and Knowledge Platforms

Regional authorities should support the creation of shared geothermal data repositories and knowledge platforms providing geological information, market intelligence, technical guidance, regulatory information, case studies and good practices. Improved access to reliable information can reduce project uncertainty, strengthen decision-making and accelerate project development. Wherever possible, these platforms should facilitate interregional data sharing, improve access to

subsurface information and support long-term knowledge sharing, interregional cooperation and evidence-based policy development.

Annex III. Preporučene mjere javne politike u okviru projekta Greet GEO (HR)

Mjere javne politike predstavljene u nastavku razvijene su u okviru projekta Greet GEO na temelju analize regionalnih politika, usporedne analize lanaca vrijednosti, savjetovanja s dionicima i procjene inovacijskih ekosustava u regijama uključenima u projekt. Njihova je svrha potaknuti širu primjenu duboke i plitke geotermalne energije uklanjanjem financijskih, regulatornih, tehničkih, tržišnih i upravljačkih prepreka te istodobno ojačati regionalne inovacijske ekosustave i međuregionalnu suradnju.

Mjera javne politike 1: Uspostava regionalnih mehanizama potpore ulaganjima u geotermalnu energiju

Tijela regionalne (područne) samouprave trebala bi uspostaviti namjenske mehanizme potpore kako bi nositeljima geotermalnih projekata olakšala pripremu projekata spremnih za ulaganje i pristup dostupnim izvorima financiranja. Takvi bi mehanizmi trebali osigurati tehničku pomoć, izradu studija izvodljivosti i poslovnih slučajeva, financijsko modeliranje te savjetovanje o dostupnim regionalnim, nacionalnim i europskim instrumentima financiranja. Posebnu pozornost treba posvetiti potrebama malih i srednjih poduzeća (MSP) te jedinica lokalne samouprave, koje često nemaju dovoljno resursa za razvoj geotermalnih projekata prihvatljivih za financiranje. Mehanizmi potpore trebali bi pridonijeti i uspostavi regionalnog portfelja geotermalnih projekata te, gdje je to primjereno, poticati povezivanje više projekata. Time bi se povećala njihova spremnost za ulaganje, smanjili transakcijski troškovi i olakšalo privlačenje privatnog kapitala. Unaprjeđenjem pripreme projekata te povezivanjem njihovih nositelja s financijskim institucijama i tehničkim stručnjacima ovi mehanizmi mogu povećati broj geotermalnih projekata koji dosežu fazu provedbe.

Mjera javne politike 2: Razvoj mehanizama podjele rizika za geotermalne projekte

Tijela javne vlasti trebala bi poticati razvoj financijskih instrumenata kojima se smanjuju geološki, istražni i ulagački rizici povezani s geotermalnim projektima. Programi podjele rizika, jamstveni mehanizmi, fondovi za istražne aktivnosti, programi potpore istražnom bušenju i instrumenti javno-privatnog financiranja trebali bi pomoći u pokrivanju rizika povezanih s geološkom neizvjesnošću i bušenjem te troškova razvoja projekata u početnim fazama. Tijela regionalne (područne) samouprave trebala bi razmotriti i uspostavu namjenskih mehanizama podjele rizika za geotermalne projekte, instrumenata kombiniranog financiranja te programa javnih jamstava. Time bi se poboljšala prihvatljivost projekata za financiranje i ojačalo povjerenje ulagača. Olakšavanje pristupa mehanizmima podjele rizika trebalo bi biti prioritet, osobito za mala i srednja poduzeća te geotermalne projekte manjeg opsega.

Mjera javne politike 3: Uspostava regionalnih jedinstvenih kontaktnih točaka (One-Stop-Shop) za geotermalne projekte

Potrebno je uspostaviti namjenske jedinstvene kontaktne točke (eng. One-Stop-Shop) za geotermalne projekte koje bi pružale koordiniranu potporu u pripremi projekata, ishođenju potrebnih dozvola,

osiguravanju financiranja te ispunjavanju tehničkih i regulatornih zahtjeva. Takve bi službe trebale olakšati koordinaciju među tijelima nadležnima za istraživanje i eksploataciju geotermalnih voda, vodno gospodarstvo, zaštitu okoliša, prostorno planiranje i energetiku. Istodobno bi nositeljima projekata, jedinicama lokalne samouprave, malim i srednjim poduzećima te ulagačima trebale pružati jasne smjernice o relevantnim postupcima. Jedinstvene kontaktne točke trebale bi pružati potporu i pri izradi poslovnih slučajeva, povezivanju nositelja projekata s financijskim institucijama te osiguravanju pristupa tehničkom stručnom znanju. Tijekom savjetovanja provedenih u uključenim regijama takve su integrirane službe potpore dosljedno prepoznate kao jedan od najučinkovitijih mehanizama za smanjenje administrativne složenosti i ubravanje provedbe projekata.

Mjera javne politike 4: Pojednostavljenje postupaka ishođenja dozvola

Tijela regionalne (područne) samouprave i nadležna nacionalna tijela trebala bi preispitati postojeći regulatorni okvir za ishođenje dozvola te utvrditi mogućnosti za pojednostavljenje postupaka, povećanje njihove transparentnosti i bolju koordinaciju među tijelima uključenima u odobravanje geotermalnih projekata. Potrebno je uspostaviti standardizirane postupke i jasnije definirati korake za ishođenje dozvola za projekte duboke i plitke geotermalne energije. Posebnu pozornost treba posvetiti koordinaciji među tijelima nadležnima za istraživanje i eksploataciju geotermalnih voda, vodno gospodarstvo, zaštitu okoliša, prostorno planiranje i energetiku. Donositelji politika trebali bi razmotriti i mogućnosti prekogranične regulatorne suradnje, uključujući uzajamno priznavanje stručnih kvalifikacija, certifikata i dozvola za geotermalno bušenje u slučajevima u kojima se primjenjuju istovrijedni standardi. U regijama sa sličnim geološkim uvjetima i zajedničkim ciljevima razvoja geotermalne energije takvi bi dogovori mogli olakšati angažiranje kvalificiranih izvođača radova bušenja iz različitih država, proširiti pristup specijaliziranom stručnom znanju, povećati konkurenciju i smanjiti troškove projekata. Postojeće strukovne smjernice, poput smjernica za bušenje bušotina koje je izradilo Međunarodno udruženje izvođača radova bušenja (International Association of Drilling Contractors – IADC), mogu poslužiti kao korisna osnova za usklađivanje tehničkih, sigurnosnih i operativnih zahtjeva.

Mjera javne politike 5: Uključivanje geotermalne energije u regionalno planiranje

Geotermalnu energiju trebalo bi sustavno uključivati u regionalne strateške i planske dokumente u području klime, energetike, inovacija i gospodarskog razvoja. Njezinu primjenu potrebno je uzeti u obzir pri regionalnom energetske i prostornom planiranju, izradi programa i planova energetske učinkovitosti, oblikovanju politika industrijskog razvoja te utvrđivanju prioriteta pametne specijalizacije (S3). Time bi se osigurala bolja usklađenost politika i povećala vidljivost geotermalnih projekata. Sustavno uključivanje geotermalne energije u regionalno planiranje pridonijelo bi boljoj usklađenosti politika, većoj vidljivosti geotermalnih projekata i sigurnijim uvjetima za dugoročna ulaganja.

Mjera javne politike 6: Podrška demonstracijskim i pilot-projektima

Javnu potporu trebalo bi prvenstveno usmjeriti na demonstracijske projekte kojima se mogu potvrditi primjenjivost i učinkovitost inovativnih geotermalnih tehnologija, smanjiti nesigurnost povezanu s njihovom primjenom te ojačati povjerenje ulagača, tijela javne vlasti i krajnjih korisnika. Demonstracijske aktivnosti trebale bi obuhvaćati pilot-projekte, „žive laboratorije“ (eng. living labs), demonstracijske zgrade, studijska putovanja i predstavljanje oglednih projekata kako bi se prikazale praktične koristi geotermalnih rješenja. Posebnu pozornost treba posvetiti sustavima daljinskog grijanja, turizmu, poljoprivredi, industriji i obnovi zgrada jer primjena geotermalnih tehnologija u tim područjima može donijeti znatne gospodarske koristi i koristi za okoliš.

Mjera javne politike 7: Jačanje suradnje između istraživačkog i gospodarskog sektora

Regionalnim inovacijskim politikama trebalo bi poticati užu suradnju između istraživačkih organizacija, sveučilišta, gospodarskih subjekata i tijela javne vlasti. Zajednički istraživački projekti, inovacijska partnerstva, inicijative za prijenos tehnologije i platforme za suradnju u području inovacija mogu ubrzati komercijalizaciju i tržišnu primjenu geotermalnih rješenja. Bolja suradnja može olakšati i pristup geološkim podacima, stručnim tehničkim znanjima i inovativnim poslovnim modelima te istodobno pridonijeti razvoju geotermalnih rješenja prilagođenih posebnostima pojedine regije.

Mjera javne politike 8: Promicanje integriranih geotermalnih energetske sustava

Tijela regionalne (područne) samouprave trebala bi poticati integrirana geotermalna rješenja kojima se omogućuju što potpunije iskorištavanje geotermalnih izvora i veća učinkovitost energetske sustava. Posebnu pozornost treba posvetiti kaskadnom korištenju geotermalne energije, primjeni spremnika toplinske energije i mogućnostima povezivanja različitih sektora, uključujući sustave daljinskog grijanja i hlađenja, zgradarstvo, poljoprivredu i industrijske procese.

Mjera javne politike 9: Jačanje usluga potpore malim i srednjim poduzećima

Mala i srednja poduzeća imaju važnu ulogu u svim dijelovima geotermalnih lanaca vrijednosti, ali se često suočavaju s preprekama povezanim s pristupom financiranju, stručnim znanjima i tržištu. Regionalni programi potpore trebali bi im omogućiti ciljano savjetovanje, mentorstvo, pomoć u razvoju projekata i poslovnu podršku prilagođenu njihovim potrebama. Usluge potpore trebale bi obuhvaćati energetske preglede, standardizirane predloške za izradu poslovnih slučajeva, alate za izračun povrata ulaganja, pomoć u pripremi projekata te potporu razvoju geotermalnih rješenja po načelu „ključ u ruke”. Posebnu pozornost treba posvetiti razumijevanju gospodarskih koristi ulaganja u geotermalnu energiju te olakšavanju pristupa dostupnim mogućnostima financiranja.

Mjera javne politike 10: Jačanje uloge posredničkih organizacija

Potrebno je dodatno ojačati ulogu energetske agencije, klastera, gospodarskih komora, razvojnih agencija, geotermalnih udruženja i organizacija za potporu inovacijama kako bi mogle poticati suradnju među dionicima, unaprijediti razmjenu informacija i pružati potporu razvoju projekata. Te organizacije mogu imati ključnu ulogu u povezivanju malih i srednjih poduzeća sa stručnjacima te izvorima financiranja i uslugama potpore inovacijama. Trebale bi djelovati i kao posrednici između nositelja projekata, jedinica lokalne samouprave, financijskih institucija i tijela javne vlasti te olakšavati povezivanje projektnih partnera, komunikacijske aktivnosti, prijenos znanja i umrežavanje u području javnih politika. Posredničke organizacije mogu pridonijeti i međuregionalnoj suradnji, razmjeni dobre prakse te provedbi aktivnosti u okviru partnerstava za pametnu specijalizaciju.

Mjera javne politike 11: Olakšavanje pristupa financiranju za mala i srednja poduzeća

Tijela regionalne (područne) samouprave trebala bi poticati snažnije povezivanje malih i srednjih poduzeća s financijskim institucijama, uključujući poslovne banke, javne razvojne banke i specijalizirane investicijske fondove. Lakši pristup financiranju ključan je za veće sudjelovanje malih i srednjih poduzeća na tržištu geotermalne energije te za razvoj financijski održivih poslovnih slučajeva. Namjenski financijski instrumenti mogu obuhvaćati kreditne proizvode za geotermalne projekte, programe zelenih kredita, jamstvene mehanizme, modele leasinga, modele financiranja putem pružatelja energetske usluga (ESCO) te instrumente kombiniranog financiranja prilagođene investicijskim ciklusima i potrebama malih i srednjih poduzeća.

Mjera javne politike 12: Razvoj regionalnih programa obrazovanja i osposobljavanja u području geotermalne energije

Potrebno je uspostaviti ciljne programe obrazovanja, stručnog osposobljavanja i certificiranja kako bi se ublažio nedostatak kvalificirane radne snage te ojačali kapaciteti inženjera, instalatera, nositelja

projekata i zaposlenika u javnoj upravi za provedbu geotermalnih projekata. Programi bi trebali obuhvaćati certificiranje instalatera, strukovno obrazovanje, razvoj stručnih kompetencija inženjera te specijalizirano osposobljavanje službenika jedinica lokalne i područne (regionalne) samouprave, zaposlenika nadležnih tijela uključenih u postupke ishođenja dozvola i stručnjaka koji sudjeluju u ocjenjivanju geotermalnih projekata. Posebnu pozornost treba posvetiti jačanju stručnih kapaciteta tijela javne vlasti odgovornih za ocjenjivanje projekata i provedbu postupaka ishođenja dozvola.

Mjera javne politike 13: Podizanje javne svijesti i društvene prihvaćenosti

Komunikacijske aktivnosti i aktivnosti podizanja javne svijesti trebale bi biti usmjerene ne samo na geotermalne tehnologije nego i na praktične koristi njihove primjene. One uključuju smanjenje troškova energije, povećanje konkurentnosti, jačanje energetske sigurnosti i otpornosti te doprinos dekarbonizaciji. Transparentno pružanje informacija, demonstracijski projekti, objavljivanje podataka o praćenju, studije izvodljivosti, studije slučaja prilagođene pojedinim sektorima te pravodobno uključivanje dionika mogu znatno pridonijeti većoj prihvaćenosti geotermalne energije u javnosti i njezinoj široj tržišnoj primjeni. Komunikacijske aktivnosti trebalo bi prilagoditi različitim ciljnim skupinama, uključujući građane, mala i srednja poduzeća, jedinice lokalne samouprave, ulagače i donositelje politika.

Mjera javne politike 14: Jačanje europskog partnerstva pametne specijalizacije (S3) u području geotermalne energije

Tijela regionalne (područne) samouprave trebala bi aktivno podupirati daljnji razvoj europskih partnerstava za pametnu specijalizaciju u području geotermalne energije, koja su još u nastajanju, i to međuregionalnom suradnjom, razmjenom znanja i provedbom zajedničkih inovacijskih aktivnosti. Posebnu pozornost treba posvetiti izradi i provedbi planova razvoja geotermalne energije utemeljenih na strategijama pametne specijalizacije (S3). Takvi bi planovi trebali jasno utvrditi korake potrebne za provedbu te poduprijeti dugoročnu suradnju, planiranje ulaganja i međuregionalnu razmjenu iskustava u oblikovanju javnih politika. Time bi se ujedno ojačali temelji za budući razvoj europskih partnerstava pametne specijalizacije (S3) u području geotermalne energije.

Mjera javne politike 15: Uspostava regionalnih platformi za podatke i znanje o geotermalnoj energiji

Tijela regionalne (područne) samouprave trebala bi poduprijeti uspostavu zajedničkih baza geotermalnih podataka i platformi znanja koje bi obuhvaćale geološke podatke, tržišne analize, tehničke smjernice, informacije o regulatornom okviru, studije slučaja i primjere dobre prakse. Lakši pristup pouzdanim informacijama može smanjiti neizvjesnost u razvoju projekata, pridonijeti donošenju kvalitetnijih odluka i ubrzati razvoj geotermalnih projekata. Gdje god je to moguće, takve bi platforme trebale omogućiti međuregionalnu razmjenu podataka, olakšati pristup podacima o podzemlju te poduprijeti dugoročnu razmjenu znanja i međuregionalnu suradnju. Ujedno bi trebale pridonijeti oblikovanju javnih politika utemeljenih na pouzdanim podacima i stručnim spoznajama.

Annex IV. Misure Politiche Greet GEO (IT)

Le seguenti misure politiche sono state identificate e proposte nell'ambito del progetto Greet GEO sulla base dell'analisi delle politiche regionali, del benchmarking della catena del valore, delle consultazioni con i portatori di interesse e delle valutazioni degli ecosistemi dell'innovazione condotte nelle regioni partecipanti. Esse sono finalizzate a sostenere la diffusione dell'energia geotermica profonda e superficiale affrontando le barriere finanziarie, normative, tecniche, di mercato e di

governance, rafforzando al contempo gli ecosistemi regionali dell'innovazione e la cooperazione interregionale.

Misura politica 1: Istituire strutture regionali di supporto agli investimenti geotermici

Le autorità regionali dovrebbero istituire meccanismi di supporto dedicati per aiutare gli sviluppatori di progetti geotermici a preparare interventi pronti per l'investimento e ad accedere alle opportunità di finanziamento disponibili. Tali meccanismi di supporto potrebbero essere gestiti da strutture specializzate (nuove o già esistenti, come poli tecnologici, cluster o agenzia di sviluppo e assistenza) in grado di fornire assistenza tecnica, studi di fattibilità, sviluppo di business case, modellazione finanziaria e orientamento sugli strumenti di finanziamento regionali, nazionali ed europei. Particolare attenzione dovrebbe essere rivolta alle esigenze delle PMI e dei comuni, che spesso non dispongono delle risorse necessarie per sviluppare progetti geotermici bancabili. Queste strutture dovrebbero, inoltre, sostenere lo sviluppo di pipeline regionali di progetti geotermici e incoraggiare l'aggregazione dei progetti ove opportuno, contribuendo a migliorare la maturità per l'investimento, a ridurre i costi di transazione e ad attrarre finanziamenti privati. Rafforzando la preparazione dei progetti e collegando gli sviluppatori con le istituzioni finanziarie e gli esperti tecnici, questi meccanismi possono aumentare il numero di progetti geotermici che raggiungono la fase di realizzazione.

Misura politica 2: Sviluppare meccanismi di condivisione del rischio geotermico

Le autorità pubbliche dovrebbero promuovere strumenti finanziari in grado di ridurre i rischi geologici, esplorativi e di investimento associati ai progetti geotermici. Sistemi di condivisione del rischio, meccanismi di garanzia, fondi per l'esplorazione, programmi di sostegno alla perforazione e strumenti di finanziamento pubblico-privato dovrebbero contribuire a coprire l'incertezza geologica, i rischi di perforazione e i costi di sviluppo dei progetti nelle fasi iniziali. Le autorità regionali e nazionali dovrebbero, inoltre, valutare l'istituzione di strutture dedicate di condivisione del rischio geotermico, strumenti di finanza mista e sistemi di garanzia pubblica in grado di migliorare la bancabilità dei progetti e la fiducia degli investitori. Il miglioramento dell'accesso ai meccanismi di condivisione del rischio dovrebbe rappresentare una priorità per le PMI e per i progetti geotermici di dimensioni minori.

Misura politica 3: Creare servizi regionali di sportello unico per il geotermico

Dovrebbero essere istituiti servizi dedicati di sportello unico per il geotermico, in grado di fornire un supporto coordinato per la preparazione dei progetti, il rilascio delle autorizzazioni, il finanziamento, i requisiti tecnici e le procedure regolamentari. Tali strutture dovrebbero facilitare il coordinamento tra le autorità competenti in materia di acque, ambiente, attività minerarie, pianificazione ed energia, fornendo al contempo indicazioni chiare a sviluppatori di progetti, comuni, PMI e investitori. I servizi di sportello unico dovrebbero, inoltre, sostenere lo sviluppo di business case, il matchmaking tra promotori di progetti e istituzioni finanziarie, nonché l'accesso a competenze tecniche. Le consultazioni regionali hanno costantemente individuato tali strutture di supporto integrato come uno dei meccanismi più efficaci per ridurre la complessità amministrativa e accelerare l'attuazione dei progetti.

Misura politica 4: Semplificare le procedure autorizzative

Le autorità regionali e nazionali dovrebbero riesaminare i quadri autorizzativi esistenti e individuare opportunità per semplificare le procedure, migliorare la trasparenza e rafforzare il coordinamento tra le autorità coinvolte nell'approvazione dei progetti geotermici. Dovrebbero essere sviluppate procedure standardizzate e percorsi autorizzativi più chiari sia per le applicazioni geotermiche profonde sia per quelle superficiali, con particolare attenzione al coordinamento tra le autorità competenti in materia di energia, ambiente, gestione delle acque, attività minerarie e pianificazione territoriale. I responsabili politici dovrebbero, inoltre, esplorare opportunità di cooperazione regolamentare transfrontaliera, incluso il riconoscimento reciproco di qualifiche tecniche,

certificazioni e licenze di perforazione geotermica laddove esistano standard equivalenti. Nelle regioni con condizioni geologiche condivise e obiettivi comuni di sviluppo geotermico, tali accordi potrebbero facilitare la partecipazione di appaltatori di perforazione qualificati attraverso le diverse giurisdizioni, ampliare l'accesso a competenze specialistiche, aumentare la concorrenza e ridurre i costi dei progetti. Le linee guida di settore esistenti, come le linee guida per la perforazione dei pozzi sviluppate dall'International Association of Drilling Contractors (IADC), possono rappresentare utili punti di riferimento per l'armonizzazione dei requisiti tecnici, di sicurezza e operativi.

Misura politica 5: Integrare l'energia geotermica nella pianificazione regionale

L'energia geotermica dovrebbe essere sistematicamente integrata nelle strategie regionali in materia di clima, energia, innovazione e sviluppo economico. Occorre prestare attenzione alla pianificazione energetica regionale, alla pianificazione territoriale, alle strategie di riscaldamento e raffrescamento, alle politiche di sviluppo industriale e alle priorità della Smart Specialisation, al fine di garantire una maggiore coerenza politica e visibilità dei progetti. L'integrazione delle considerazioni geotermiche nella pianificazione regionale può inoltre sostenere la certezza degli investimenti nel lungo periodo e facilitare lo sviluppo di progetti di teleriscaldamento, calore industriale e decarbonizzazione degli edifici.

Misura politica 6: Sostenere progetti dimostrativi e pilota

Il sostegno pubblico dovrebbe dare priorità ai progetti dimostrativi in grado di validare tecnologie geotermiche innovative, ridurre i rischi percepiti e aumentare la fiducia tra investitori, autorità pubbliche e utenti finali. Le attività dimostrative dovrebbero includere progetti pilota, living lab, edifici dimostrativi, visite sul campo e attività di presentazione dei progetti in grado di comunicare i benefici pratici delle soluzioni geotermiche. Settori come il teleriscaldamento, il turismo, l'agricoltura, l'industria e la ristrutturazione edilizia meritano un'attenzione particolare, considerati i significativi benefici economici e ambientali che le tecnologie geotermiche possono generare in tali ambiti.

Misura politica 7: Rafforzare la collaborazione tra ricerca e industria

Le politiche regionali per l'innovazione dovrebbero incoraggiare una cooperazione più stretta tra organizzazioni di ricerca, università, attori industriali e autorità pubbliche. Progetti di ricerca congiunti, partenariati per l'innovazione, iniziative di trasferimento tecnologico e piattaforme collaborative per l'innovazione possono accelerare la commercializzazione e la diffusione sul mercato. Una collaborazione più solida può inoltre migliorare l'accesso ai dati geologici, alle competenze tecniche e ai modelli di business innovativi, sostenendo al contempo lo sviluppo di soluzioni geotermiche specifiche per ciascuna regione.

Misura politica 8: Promuovere sistemi geotermici integrati

Le autorità regionali dovrebbero incoraggiare soluzioni geotermiche integrate in grado di massimizzare l'utilizzo delle risorse e migliorare l'efficienza del sistema. Occorre prestare maggiore attenzione ai concetti di uso a cascata, alle applicazioni di accumulo termico e alle opportunità di integrazione intersettoriale che collegano l'energia geotermica con il teleriscaldamento, il teleraffrescamento, gli edifici, l'agricoltura e i processi industriali.

Misura politica 9: Rafforzare i servizi di supporto alle PMI

Le PMI svolgono un ruolo importante lungo l'intera catena del valore geotermica, ma spesso incontrano ostacoli legati al finanziamento, alle competenze e all'accesso al mercato. I programmi regionali di supporto dovrebbero fornire servizi di consulenza mirati, mentoring, assistenza allo sviluppo dei progetti e supporto imprenditoriale calibrato sulle esigenze delle PMI. I servizi di supporto dovrebbero includere audit energetici, modelli standardizzati di business case, calcolatori del ROI, assistenza nella preparazione dei progetti, servizi di consulenza e supporto per lo sviluppo di soluzioni

geotermiche chiavi in mano. Aiutare le PMI a comprendere i benefici economici degli investimenti geotermici e a orientarsi tra le opportunità di finanziamento disponibili dovrebbe costituire un obiettivo prioritario.

Misura politica 10: Rafforzare il ruolo delle organizzazioni intermedie

Le agenzie per l'energia, le organizzazioni di cluster, le camere di commercio, le agenzie di sviluppo, le associazioni geotermiche e le organizzazioni di supporto all'innovazione dovrebbero essere ulteriormente rafforzate al fine di facilitare la cooperazione tra i portatori di interesse, migliorare lo scambio di informazioni e sostenere le attività di sviluppo dei progetti. Tali organizzazioni possono svolgere un ruolo chiave nel collegare le PMI con le competenze, le opportunità di finanziamento e i servizi di supporto all'innovazione. Dovrebbero inoltre fungere da facilitatori tra sviluppatori di progetti, comuni, istituzioni finanziarie e autorità pubbliche, sostenendo il matchmaking dei progetti, le attività di comunicazione, il trasferimento di conoscenze e il networking politico. Possono, inoltre, contribuire alla cooperazione interregionale, allo scambio di buone pratiche e all'attuazione delle attività di partenariato nell'ambito della Smart Specialisation.

Misura politica 11: Migliorare l'accesso al credito per le PMI

Le autorità regionali dovrebbero facilitare collegamenti più solidi tra le PMI e le istituzioni finanziarie, comprese le banche commerciali, le banche pubbliche di sviluppo e i fondi di investimento specializzati. Un migliore accesso al finanziamento è essenziale per aumentare la partecipazione delle PMI ai mercati geotermici e per sostenere lo sviluppo di business case sostenibili. Gli strumenti specifici possono includere prodotti di prestito dedicati al geotermico, schemi di prestito verde, meccanismi di garanzia, modelli di leasing, approcci ESCO e soluzioni di finanza mista calibrate sui cicli di investimento e sulle esigenze di finanziamento delle PMI.

Misura politica 12: Sviluppare programmi regionali di competenze geotermiche

Dovrebbero essere istituiti programmi mirati di istruzione, formazione e certificazione per affrontare la carenza di manodopera qualificata e rafforzare la capacità di attuazione tra ingegneri, installatori, sviluppatori di progetti e personale della pubblica amministrazione. I programmi di formazione dovrebbero includere sistemi di certificazione integrati nell'ambito del quadro europeo delle qualifiche (EQF) e dei cataloghi formativi riconosciuti a scala nazionale e regionale per gli installatori, istruzione professionale, sviluppo delle capacità ingegneristiche e formazione specialistica per i funzionari comunali, le autorità autorizzative e i valutatori dei progetti coinvolti nello sviluppo geotermico. Occorre rafforzare le competenze all'interno delle autorità pubbliche responsabili della valutazione dei progetti e delle procedure autorizzative.

Misura politica 13: Aumentare la consapevolezza pubblica e l'accettazione sociale

Le attività di comunicazione e sensibilizzazione dovrebbero concentrarsi non solo sulle tecnologie geotermiche in sé, ma anche sui loro benefici pratici, inclusi il risparmio sui costi energetici, la competitività, la sicurezza energetica, la resilienza e i risultati in termini di decarbonizzazione. La condivisione trasparente delle informazioni, i progetti dimostrativi, i dati di monitoraggio, gli studi di fattibilità, gli studi di caso settoriali e il coinvolgimento precoce dei portatori di interesse possono contribuire in modo significativo a migliorare l'accettazione pubblica e la diffusione sul mercato. Le attività di comunicazione dovrebbero essere calibrate sui diversi gruppi target, tra cui cittadini, PMI, comuni, investitori e responsabili politici. È, inoltre, auspicabile che le attività di comunicazione e coinvolgimento delle comunità locali sia attivato fin dalle prime fasi di concezione e sviluppo del progetto geotermico.

Misura politica 14: Rafforzare il partenariato europeo S3 sul geotermico

Le autorità regionali dovrebbero sostenere attivamente l'ulteriore sviluppo dei partenariati europei emergenti di Smart Specialisation (S3) nel settore geotermico, attraverso la cooperazione interregionale, lo scambio di conoscenze e attività congiunte di innovazione. Ciò dovrebbe concentrarsi in particolare sulla creazione e sull'attuazione di roadmap geotermiche basate sulla S3, in grado di fornire percorsi di attuazione concreti e di sostenere la cooperazione di lungo periodo, la pianificazione degli investimenti e l'apprendimento politico tra le regioni europee, rafforzando al contempo le basi dei futuri partenariati europei S3 sul geotermico.

Misura politica 15: Istituire piattaforme regionali di dati e conoscenza sul geotermico

Le autorità regionali dovrebbero sostenere la creazione di repository condivisi di dati geotermici e piattaforme di conoscenza in grado di fornire informazioni geologiche, intelligence di mercato, orientamenti tecnici, informazioni regolamentari, studi di caso e buone pratiche. Un migliore accesso a informazioni affidabili può ridurre l'incertezza dei progetti, rafforzare i processi decisionali e accelerare lo sviluppo dei progetti. Ove possibile, tali piattaforme dovrebbero facilitare la condivisione interregionale dei dati, migliorare l'accesso alle informazioni sul sottosuolo e sostenere lo scambio di conoscenze nel lungo periodo, la cooperazione interregionale e lo sviluppo di politiche basate sull'evidenza.

Annex V. Greet GEO szakpolitikai intézkedések (HU)

Az alábbi szakpolitikai intézkedések a Greet GEO projekt keretében készültek a részt vevő régiókban végzett regionális szakpolitikai elemzések, értéklánc-elemzések (benchmarking), érdekelt felekkel folytatott konzultációk és innovációs ökoszisztéma-értékelések alapján. Céljuk a mélységi és sekély geotermikus energia hasznosításának támogatása a pénzügyi, szabályozási, technikai, piaci és irányítási akadályok kezelésével, egyúttal a regionális innovációs ökoszisztémák és a régióközi együttműködés megerősítésével.

1. szakpolitikai intézkedés: Regionális geotermikus beruházástámogatási központok létrehozása

A regionális hatóságoknak dedikált támogatási mechanizmusokat kell létrehozniuk, amelyek segítik a geotermikus projektfejlesztőket befektetésre kész projektek kidolgozásában és a rendelkezésre álló finanszírozási lehetőségekhez való hozzáférésben. Ezeknek a központoknak technikai segítségnyújtást, megvalósíthatósági tanulmányokat, üzleti modellek kidolgozását, pénzügyi modellezést, valamint a regionális, nemzeti és európai finanszírozási eszközökkel kapcsolatos útmutatást kell biztosítaniuk. Kiemelt figyelmet kell fordítani a kkv-k és önkormányzatok igényeire, amelyek gyakran nem rendelkeznek a bankképes geotermikus projektek kidolgozásához szükséges erőforrásokkal. Ezeknek a központoknak támogatniuk kell továbbá a regionális geotermikus projektportfóliók kialakítását, és adott esetben ösztönözniük kell a projektek összevonását, hozzájárulva a befektetési készség javításához, a tranzakciós költségek csökkentéséhez és a magántőke bevonásához. A projektelőkészítés megerősítésével és a projektfejlesztők pénzügyi intézményekkel és technikai szakértőkkel való összekapcsolásával ezek a mechanizmusok növelhetik a megvalósításig eljutó geotermikus projektek számát.

2. szakpolitikai intézkedés: Geotermikus kockázatmegosztási mechanizmusok kidolgozása

A hatóságoknak elő kell mozdítaniuk azokat a pénzügyi eszközöket, amelyek csökkentik a geotermikus projektekhez kapcsolódó geológiai, feltárási és befektetési kockázatokat. A kockázatmegosztási konstrukcióknak, garanciamechanizmusoknak, feltárási alapoknak, fúrástámogatási programoknak és állami-magán finanszírozási eszközöknek hozzá kell járulniuk a geológiai bizonytalanság, a fúrési kockázatok és a korai fázisú projektfejlesztési költségek fedezéséhez. A regionális hatóságoknak meg kell vizsgálniuk dedikált geotermikus kockázatmegosztási központok, vegyes finanszírozási (blended finance) eszközök és állami garanciakonstrukciók létrehozásának lehetőségét, amelyek javíthatják a projektek bankképességét és a befektetői bizalmat. A kockázatmegosztási mechanizmusokhoz való hozzáférés javítása kiemelt prioritást kell, hogy élvezzen a kkv-k és a kisebb léptékű geotermikus projektek esetében.

3. szakpolitikai intézkedés: Regionális geotermikus egyablakos ügyfélszolgálatok kialakítása

Dedikált geotermikus egyablakos ügyfélszolgálatokat kell létrehozni, amelyek összehangolt támogatást nyújtanak a projektelőkészítéshez, engedélyeztetéshez, finanszírozáshoz, technikai követelményekhez és szabályozási eljárásokhoz. Ezeknek a struktúráknak elő kell segíteniük a vízügyi, környezetvédelmi, bányászati, tervezési és energiaügyi hatóságok közötti koordinációt, egyúttal egyértelmű iránymutatást kell nyújtaniuk a projektfejlesztők, önkormányzatok, kkv-k és befektetők számára. Az egyablakos ügyfélszolgálatoknak támogatniuk kell továbbá az üzleti modellek kidolgozását, a projektgazdák és finanszírozó intézmények közötti párosítást (matchmaking), valamint a technikai szakértelemhez való hozzáférést. A regionális konzultációk az ilyen integrált támogatási struktúrákat azonosították az adminisztratív terhek csökkentésének és a projektmegvalósítás felgyorsításának egyik leghatékonyabb eszközeként.

4. szakpolitikai intézkedés: Az engedélyezési eljárások egyszerűsítése

A regionális és nemzeti hatóságoknak felül kell vizsgálniuk a meglévő engedélyezési kereteket, és azonosítaniuk kell az eljárások egyszerűsítésének, az átláthatóság javításának és a geotermikus projektek jóváhagyásában érintett hatóságok közötti koordináció megerősítésének lehetőségeit. Szabványosított eljárásokat és egyértelműbb engedélyezési útvonalakat, átlátható és nyomon követhető döntési struktúrákat kell kidolgozni mind a mélységi, mind a sekély geotermikus alkalmazásokhoz, különös hangsúlyt fektetve az energiaügyi, környezetvédelmi, vízgazdálkodási, bányászati és területrendezési hatóságok közötti koordinációra. A döntéshozóknak meg kell vizsgálniuk a határon átnyúló szabályozási együttműködés lehetőségeit is, beleértve a technikai képesítések, tanúsítványok és geotermikus fúrési engedélyek kölcsönös elismerését azokban az esetekben, ahol egyenértékű szabványok érvényesülnek. Az azonos geológiai adottságokkal és közös geotermikus fejlesztési célokkal rendelkező régiókban az ilyen megállapodások elősegíthetik a képzett fúróvállalkozók joghatóságok közötti részvételét, kiszélesíthetik a szakértelemhez való hozzáférést, fokozhatják a versenyt és csökkenthetik a projektköltségeket. A meglévő ágazati iránymutatások, például a Nemzetközi Fúróvállalkozói Szövetség (IADC) által kidolgozott kútfúrési irányelvek, hasznos referenciapontként szolgálhatnak a technikai, biztonsági és üzemeltetési követelmények harmonizálásához.

5. szakpolitikai intézkedés: A geotermikus energia beépítése a regionális tervezésbe

A geotermikus energiát rendszerszerűen be kell építeni a regionális klíma-, energia-, innovációs és gazdaságfejlesztési stratégiákba. Figyelmet kell fordítani a regionális energiatervezésre, a területrendezésre, a fűtési és hűtési stratégiákra, az iparfejlesztési politikákra, valamint az intelligens szakosodási (S3) prioritásokra a nagyobb szakpolitikai koherencia és projektláthatóság biztosítása érdekében. A geotermikus szempontok regionális tervezésbe történő integrálása hozzájárulhat a hosszú távú befektetési biztonsághoz, és elősegítheti a távfűtési, ipari hő- és épület-dekarbonizációs projektek fejlesztését.

6. szakpolitikai intézkedés: Demonstrációs és kísérleti projektek támogatása

Az állami támogatásnak elsőbbséget kell biztosítania az innovatív geotermikus technológiák érvényesítésére alkalmas demonstrációs projekteknek, amelyek csökkentik az érzékelt kockázatokat, és növelik a befektetők, hatóságok és végfelhasználók bizalmát. A demonstrációs tevékenységeknek magukban kell foglalniuk kísérleti projekteket, élő laboratóriumokat (living lab), bemutató épületeket, helyszíni látogatásokat és projektbemutató tevékenységeket, amelyek képesek közvetíteni a geotermikus megoldások gyakorlati előnyeit. Külön figyelmet érdemelnek az olyan ágazatok, mint a távfűtés, a turizmus, a mezőgazdaság, az ipar és az épületfelújítás, tekintettel azokra a jelentős gazdasági és környezeti előnyökre, amelyeket a geotermikus technológiák ezekben a szektorokban generálhatnak.

7. szakpolitikai intézkedés: A kutatás–ipar közötti együttműködés megerősítése

A regionális innovációs politikáknak ösztönözniük kell a kutatási szervezetek, egyetemek, ipari szereplők és hatóságok közötti szorosabb együttműködést. A közös kutatási projektek, innovációs partnerségek, technológiaátadási kezdeményezések és együttműködési innovációs platformok felgyorsíthatják a kereskedelmi hasznosítást és a piaci elterjedést. A szorosabb együttműködés javíthatja a geológiai adatokhoz, a technikai szakértelemhez és az innovatív üzleti modellekhez való hozzáférést is, egyúttal támogatva a régióspecifikus geotermikus megoldások kidolgozását.

8. szakpolitikai intézkedés: Integrált geotermikus energiarendszerek előmozdítása

A regionális hatóságoknak ösztönözniük kell azokat az integrált geotermikus megoldásokat, amelyek maximalizálják az erőforrás-kihasználást és javítják a rendszerhatékonyságot. Nagyobb figyelmet kell fordítani a kaszkád felhasználási koncepciókra, a hőtárolási alkalmazásokra, valamint azokra az ágazatközi integrációs lehetőségekre, amelyek összekapcsolják a geotermikus energiát a távfűtéssel, -hűtéssel, az épületekkel, a mezőgazdasággal és az ipari folyamatokkal.

9. szakpolitikai intézkedés: A kkv-támogató szolgáltatások megerősítése

A kkv-k fontos szerepet töltenek be a geotermikus értékláncok egészében, ugyanakkor gyakran szembesülnek finanszírozási, szakértelembeli és piacra jutási akadályokkal. A regionális támogatási programoknak célzott tanácsadói szolgáltatásokat, mentorálást, projektfejlesztési segítségnyújtást és a kkv-k igényeihez igazított üzleti támogatást kell nyújtaniuk. A támogató szolgáltatásoknak ki kell terjedniük az energetikai auditokra, szabványosított üzleti modell-sablonokra, megtérülésszámító (ROI) eszközökre, projekt-előkészítési segítségnyújtásra, tanácsadói szolgáltatásokra, valamint a kulcsrakész geotermikus megoldások kidolgozásának támogatására. Kiemelt hangsúlyt kell fektetni annak elősegítésére, hogy a kkv-k megértsék a geotermikus beruházások gazdasági előnyeit, és eligazodjanak a rendelkezésre álló finanszírozási lehetőségek között.

10. szakpolitikai intézkedés: A közvetítő szervezetek szerepének megerősítése

Az energiaügynökségeket, klaszterszervezeteket, kereskedelmi kamarákat, fejlesztési ügynökségeket, geotermikus egyesületeket és innovációtámogató szervezeteket tovább kell erősíteni annak érdekében, hogy elősegítsék az érdekelt felek közötti együttműködést, javítsák az információcserét, és támogassák a projektfejlesztési tevékenységeket. Ezek a szervezetek kulcsszerepet játszhatnak abban, hogy összekapcsolják a kkv-kat a szakértelemmel, finanszírozási lehetőségekkel és innovációtámogató szolgáltatásokkal. Emellett közvetítőként kell fellépniük a projektfejlesztők, önkormányzatok, pénzügyi intézmények és hatóságok között, támogatva a projektpárosítást, a kommunikációs tevékenységeket, a tudásátadást és a szakpolitikai hálózatépítést. Továbbá hozzájárulhatnak a régióközi együttműködéshez, a jó gyakorlatok cseréjéhez és az intelligens szakosodási (S3) partnerségi tevékenységek megvalósításához.

11. szakpolitikai intézkedés: A kkv-k finanszírozáshoz jutásának javítása

A regionális hatóságoknak elő kell segíteniük a kkv-k és a pénzügyi intézmények – köztük a kereskedelmi bankok, állami fejlesztési bankok és szakosított befektetési alapok – közötti szorosabb kapcsolat kialakítását. A finanszírozáshoz való jobb hozzáférés elengedhetetlen a kkv-k geotermikus piaci részvételének növeléséhez és az életképes üzleti modellek kidolgozásának támogatásához. A konkrét eszközök között szerepelhetnek dedikált geotermikus hiteltermékek, zöldhitel-konstrukciók, garanciamechanizmusok, lízingmodellek, ESCO-megközelítések és a kkv-k beruházási ciklusaihoz és finanszírozási igényeihez igazított vegyes finanszírozási (blended finance) megoldások.

12. szakpolitikai intézkedés: Regionális geotermikus készségfejlesztési programok kidolgozása

Célzott oktatási, képzési és tanúsítási programokat kell létrehozni a munkaerőhiány kezelésére, valamint a mérnökök, kivitelezők, projektfejlesztők és a közigazgatási dolgozók végrehajtási kapacitásának megerősítésére. A képzési programoknak ki kell terjedniük a kivitelezői tanúsítási rendszerekre, a szakképzésre, a mérnöki kapacitásépítésre, valamint az önkormányzati tisztviselőkre, engedélyező hatóságokra és a geotermikus fejlesztésben részt vevő projektértékelőkre számára kialakított speciális képzésekre. Erősíteni kell a szakértelmet a projektértékelésért és az engedélyezési eljárásokért felelős hatóságokon belül.

13. szakpolitikai intézkedés: A közvélemény tudatosságának és a társadalmi elfogadottságnak a növelése

A kommunikációs és tudatosságnövelő tevékenységeknek nem csupán magukra a geotermikus technológiákra kell összpontosítaniuk, hanem azok gyakorlati előnyeire is, beleértve az energiaköltség-megtakarítást, a versenyképességet, az energiabiztonságot, a rezilienciát és a dekarbonizációs eredményeket. Az átlátható információmegosztás, a demonstrációs projektek, a monitoringadatok, a megvalósíthatósági tanulmányok, az ágazatspecifikus esettanulmányok és az érdekelt felek korai bevonása jelentős mértékben hozzájárulhat a közvélemény elfogadottságának és a piaci elterjedésnek a javításához. A kommunikációs tevékenységeket a különböző célcsoportokhoz – köztük a polgárokhoz, kkv-khoz, önkormányzatokhoz, befektetőkhez és döntéshozókhoz – kell igazítani.

14. szakpolitikai intézkedés: Az európai geotermikus S3-partnerség megerősítése

A regionális hatóságoknak aktívan támogatniuk kell a kialakulóban lévő európai geotermikus intelligens szakosodási (S3) partnerségek további fejlesztését régióközi együttműködés, tudáscsere és közös innovációs tevékenységek révén. Ennek különösen az S3-alapú geotermikus ütemtervek létrehozására és megvalósítására kell összpontosítani, amelyek gyakorlati végrehajtási utakat kínálnak, és amelyek támogathatják a hosszú távú együttműködést, a befektetéstervezést és a szakpolitikai tanulást az európai régiók között, egyúttal megerősítve a jövőbeli európai geotermikus S3-partnerségek alapjait.

15. szakpolitikai intézkedés: Regionális geotermikus adat- és tudásplatformok létrehozása

A regionális hatóságoknak támogatniuk kell a megosztott geotermikus adattárak és tudásplatformok létrehozását, amelyek geológiai információkat, piaci ismereteket, technikai útmutatást, szabályozási információkat, esettanulmányokat és jó gyakorlatokat biztosítanak. A megbízható információkhoz való jobb hozzáférés csökkentheti a projektbizonytalanságot, megerősítheti a döntéshozatalt és felgyorsíthatja a projektfejlesztést. E platformoknak – amennyiben lehetséges – elő kell segíteniük a régióközi adatmegosztást, javítaniuk kell a felszín alatti információkhoz való hozzáférést, valamint támogatniuk kell a hosszú távú tudásmegosztást, a régióközi együttműködést és a bizonyítékokon alapuló szakpolitika-alkotást.

Annex VI. Ukrepi politike Greet GEO (SL)

Naslednji ukrepi politike so bili razviti v okviru projekta Greet GEO na podlagi analize regionalnih politik, primerjalne analize verige vrednosti, posvetovanj z deležniki in ocen inovacijskih ekosistemov, izvedenih v sodelujočih regijah. Namenjeni so podpori uvajanju globoke in plitve geotermalne energije z obravnavo finančnih, regulativnih, tehničnih, tržnih in upravljavskih ovir, hkrati pa krepijo regionalne inovacijske ekosisteme in medregionalno sodelovanje.

Ukrep politike 1: Vzpostavitev regionalnih struktur za podporo naložbam v geotermalno energijo

Regionalni nabori geotermalnih projektov naj vključujejo projekte na različnih stopnjah zrelosti, od ocenjevanja geotermalnega potenciala in priprave študij izvedljivosti do pridobivanja dovoljenj, zagotavljanja financiranja in doseganja investicijske pripravljenosti. Kjer je to smiselno, naj regionalni organi podprejo prednostno obravnavo projektov z velikim potencialom za nadaljnjo uporabo in ponovljivost ter njihov razvoj v smeri finančno in investicijsko zrelih projektov. Na ta način je mogoče vzpostaviti kontinuiran nabor geotermalnih naložb namesto razvoja posameznih, med seboj nepovezanih projektov. Posebno pozornost je treba nameniti potrebam MSP-jev in občin, ki pogosto nimajo sredstev, potrebnih za razvoj bančno sprejemljivih geotermalnih projektov. Te strukture naj podpirajo tudi razvoj regionalnih naborov geotermalnih projektov in, kjer je to smiselno, spodbujajo združevanje projektov, kar pripomore k večji naložbeni pripravljenosti, nižjim transakcijskim stroškom in privabljanju zasebnega kapitala. S krepitvijo priprave projektov ter povezovanjem razvijalcev s finančnimi institucijami in tehničnimi strokovnjaki lahko ti mehanizmi povečajo število geotermalnih projektov, ki dosežejo fazo izvedbe.

Ukrep politike 2: Razvoj mehanizmov za delitev tveganja pri geotermalnih projektih

Posebno pozornost je treba nameniti instrumentom za zmanjševanje tveganj, povezanih z geološkim tveganjem v fazi raziskovanja in izvedbe prvih raziskovalnih vrtin, ko sta negotovost projekta in izpostavljenost kapitala največji. Takšni mehanizmi bi lahko ob ustreznih tehničnih in drugih merilih upravičenosti zagotavljali delno kritje stroškov neuspešnih ali podpovprečno uspešnih raziskovalnih vrtin. Z zmanjšanjem finančnih posledic neuspešnega raziskovanja lahko takšni instrumenti spodbudijo zasebne naložbe in omogočijo večjemu številu geotermalnih projektov prehod iz faze raziskovanja virov v komercialni razvoj. Regionalni organi naj proučijo tudi vzpostavitev namenskih struktur za delitev tveganja na področju geotermalne energije, mešanih (blended) finančnih instrumentov ter javnih garancijskih shem, ki lahko izboljšajo bančno sprejemljivost projektov in zaupanje vlagateljev. Izboljšan dostop do mehanizmov za delitev tveganja naj bo prednostna naloga za MSP-je in manjše geotermalne projekte.

Ukrep politike 3: Vzpostavitev regionalnih storitev "vse na enem mestu" za geotermalno energijo

Kjer je mogoče, naj storitve »vse na enem mestu« razvijalcem projektov zagotovijo jasno opredeljeno pot razvoja projekta, ki vključuje potrebna dovoljenja, pristojne organe, razpoložljive podporne instrumente, ključne tehnične zahteve ter posamezne postopkovne korake od začetne projektne ideje do izvedbe. Takšna funkcija usmerjanja skozi celoten razvojni proces je lahko še posebej pomembna za občine in MSP-je, ki imajo omejene izkušnje z razvojem geotermalnih projektov. Storitve "vse na enem mestu" naj podpirajo tudi razvoj poslovnih modelov, povezovanje nosilcev projektov s finančnimi institucijami ter dostop do tehničnega strokovnega znanja. Regionalna posvetovanja so dosledno pokazala, da so tovrstne celovite podporne strukture eden najučinkovitejših mehanizmov za zmanjševanje upravne zapletenosti in pospešitev izvajanja projektov.

Ukrep politike 4: Poenostavitev postopkov pridobivanja dovoljenj

Kjer institucionalni okvir to omogoča, naj se prouči možnost določitve vodilnega oziroma koordinacijskega organa, ki bi razvijalca geotermalnega projekta usmerjal skozi postopek pridobivanja dovoljenj ter omogočal učinkovitejše usklajevanje med pristojnimi organi. Spodbujati je treba tudi večjo uporabo digitaliziranih postopkov, standardiziranih zahtev glede dokumentacije ter preglednih postopkovnih navodil. Jasni in, kjer je mogoče, okvirno določeni časovni roki za posamezne faze postopkov lahko povečajo predvidljivost za razvijalce projektov in vlagatelje ter zmanjšajo administrativno negotovost, ne da bi se pri tem znižale okoljske, tehnične ali varnostne zahteve. Razviti je treba standardizirane postopke in jasnejše poti za pridobivanje dovoljenj tako za globoko kot za plitvo geotermalno energijo, s posebnim poudarkom na usklajevanju med energetske, okoljske, vodnogospodarske, rudarske in organi za prostorsko načrtovanje. Oblikovalci politik naj proučijo tudi možnosti čezmejnega regulativnega sodelovanja, vključno z vzajemnim priznavanjem tehničnih kvalifikacij, certifikatov in dovoljenj za geotermalno vrtanje, kjer obstajajo enakovredni standardi. V regijah s skupnimi geološkimi razmerami in skupnimi cilji razvoja geotermalne energije bi taki dogovori lahko olajšali sodelovanje usposobljenih izvajalcev vrtalnih del med jurisdikcijami, razširili dostop do specializiranega strokovnega znanja, povečali konkurenco in znižali stroške projektov. Obstoječe panožne smernice, kot so smernice za vrtanje vrtin, ki jih je razvilo Mednarodno združenje vrtalnih izvajalcev (International Association of Drilling Contractors, IADC), lahko predstavljajo koristno izhodišče za harmonizacijo tehničnih, varnostnih in operativnih zahtev.

Ukrep politike 5: Vključitev geotermalne energije v regionalno načrtovanje

Kjer je to primerno, naj se vključevanje geotermalne energije v regionalno načrtovanje podpre s pripravo regionalnih načrtov oziroma časovnih načrtov razvoja geotermalne energije (*geothermal development roadmaps*), ki opredeljujejo potencial geotermalnih virov, potrebe po ogrevanju in hlajenju, prednostna področja uporabe, obstoječo energetske infrastrukturo, potencialne lokacije projektov in naložbene priložnosti. Takšni načrti naj pomagajo prenesti strateške cilje v konkretne nabore projektov, infrastrukturne prioritete in okvirne poti izvajanja ter tako vzpostavijo močnejšo povezavo med regionalnimi politikami, prostorskim načrtovanjem in investicijskimi odločitvami. Pozornost je treba nameniti regionalnemu energetskega načrtovanju, prostorskemu načrtovanju, strategijam ogrevanja in hlajenja, politikam industrijskega razvoja ter prioritetam pametne specializacije (S3), da se zagotovita večja skladnost politik in prepoznavnost projektov. Vključevanje vidikov geotermalne energije v regionalno načrtovanje lahko prispeva tudi k dolgoročni naložbeni gotovosti ter olajša razvoj projektov daljinskega ogrevanja, industrijske toplote in razogljičenja stavb.

Ukrep politike 6: Podpora demonstracijskim in pilotnim projektom

Podpora demonstracijskim projektom naj posebno pozornost namenja projektom z jasnim potencialom za povečanje obsega, komercialno uporabo in ponovitev v drugih regijah. Sodelujoče regije naj se spodbuja k opredelitvi vodilnih oziroma referenčnih geotermalnih projektov, ki lahko prikažejo celotno verigo vrednosti, od razvoja geotermalnega vira do končne rabe energije. Pridobljene izkušnje, tehnične rezultate, ekonomske kazalnike in ugotovljene ovire pri izvedbi takšnih projektov je treba sistematično dokumentirati in izmenjevati med regijami ter tako olajšati prenos in ponovitev uspešnih rešitev. Posebno pozornost si zaslužijo sektorji, kot so daljinsko ogrevanje, turizem, kmetijstvo, industrija in prenova stavb, glede na pomembne gospodarske in okoljske koristi, ki jih lahko geotermalne tehnologije prinesejo na teh področjih.

Ukrep politike 7: Krepitev sodelovanja med raziskovalno sfero in industrijo

Regionalne inovacijske politike naj spodbujajo tesnejše sodelovanje med raziskovalnimi organizacijami, univerzami, akterji iz industrije in javnimi organi. Skupni raziskovalni projekti, inovacijska partnerstva, pobude za prenos tehnologij in platforme za sodelovalno inoviranje lahko

pospešijo komercializacijo in prodor na trg. Tesnejše sodelovanje lahko izboljša tudi dostop do geoloških podatkov, tehničnega strokovnega znanja in inovativnih poslovnih modelov, hkrati pa podpira razvoj regijsko specifičnih geotermalnih rešitev.

Ukrep politike 8: Spodbujanje integriranih geotermalnih energetskega sistemov

Integrirani geotermalni sistemi naj vključujejo tudi možnosti povezovanja geotermalne energije s toplotnimi črpalkami, hranilniki toplote, električno energijo iz obnovljivih virov, izrabo odvečne toplote in pametnimi sistemi upravljanja z energijo, kadar takšne kombinacije povečujejo skupno učinkovitost in prilagodljivost energetskega sistema. Posebno pozornost je treba nameniti vključevanju geotermalne energije v obstoječe in nove sisteme daljinskega ogrevanja in hlajenja, pri čemer lahko geotermalni viri zagotavljajo stabilno osnovno oskrbo z energijo, dopolnilne tehnologije pa pokrivajo konične potrebe in zagotavljajo obratovalno prilagodljivost.

Regije naj ocenijo tudi možnosti ponovne uporabe oziroma spremembe namembnosti obstoječih vrtin in energetske infrastrukture, vključno z nekdanjimi naftnimi in plinskimi vrtinami, obstoječimi geotermalnimi vrtinami ter infrastrukturo daljinskega ogrevanja, kadar je takšna uporaba tehnično, ekonomsko, okoljsko in pravno izvedljiva. Takšni pristopi lahko zmanjšajo investicijske stroške, skrajšajo čas razvoja projektov ter podprejo prehod regij z obstoječim znanjem in infrastrukturo na področju izkoriščanja podzemnih energetskega virov v smeri geotermalne energije.

Ukrep politike 9: Krepitev podpornih storitev za MSP-je

MSP-ji imajo pomembno vlogo v celotni verigi vrednosti geotermalne energije, vendar se pogosto srečujejo z ovirami na področju financiranja, strokovnega znanja in dostopa do trga. Regionalni podporni programi naj zagotavljajo ciljno usmerjene svetovalne storitve, mentorstvo, pomoč pri razvoju projektov ter poslovno podporo, prilagojeno potrebam MSP-jev. Podporne storitve naj vključujejo energetske preglede, standardizirane predloge poslovnih modelov, kalkulatorje donosnosti naložb (ROI), pomoč pri pripravi projektov, svetovalne storitve ter podporo pri razvoju t. i. "ključ v roke" geotermalnih rešitev. Ključni poudarek naj bo na pomoči MSP-jem pri razumevanju gospodarskih koristi naložb v geotermalno energijo in pri usmerjanju med razpoložljivimi možnostmi financiranja.

Ukrep politike 10: Krepitev vloge posredniških organizacij

Energetske agencije, grozdovske organizacije, gospodarske zbornice, razvojne agencije, geotermalna združenja in organizacije za podporo inovacijam je treba dodatno okrepiti, da bodo lahko olajševale sodelovanje med deležniki, izboljševale izmenjavo informacij in podpirale dejavnosti razvoja projektov. Te organizacije lahko igrajo ključno vlogo pri povezovanju MSP-jev s strokovnim znanjem, možnostmi financiranja in storitvami za podporo inovacijam. Prav tako naj delujejo kot posredniki med razvijalci projektov, občinami, finančnimi institucijami in javnimi organi ter podpirajo povezovanje projektov, komunikacijske dejavnosti, prenos znanja in politično mreženje. Poleg tega lahko prispevajo k medregionalnemu sodelovanju, izmenjavi dobrih praks in izvajanju partnerskih dejavnosti v okviru pametne specializacije.

Ukrep politike 11: Izboljšanje dostopa MSP-jev do financiranja

Finančni podporni instrumenti naj, kjer je to mogoče, upoštevajo različne investicijske značilnosti plitve in globoke geotermalne energije ter specifične potrebe po financiranju ponudnikov tehnologij, izvajalcev vrtnih del, monterjev, ESCO podjetij in razvijalcev projektov, ki delujejo v geotermalni verigi vrednosti. Izboljšanje dostopa do financiranja je bistven za povečanje udeležbe MSP-jev na trgih geotermalne energije in za podporo razvoju izvedljivih poslovnih modelov. Specifični instrumenti lahko vključujejo namenske posojilne produkte za geotermalno energijo, sheme zelenih posojil, garancijske

mehanizme, modele lizinga, pristope ESCO in rešitve mešanega (blended) financiranja, prilagojene naložbenim ciklom in potrebam po financiranju MSP-jev.

Ukrep politike 12: Razvoj regionalnih programov usposabljanja na področju geotermalne energije

Posebno pozornost je treba nameniti krepitvi strokovnega znanja znotraj javnih organov, pristojnih za ocenjevanje projektov, postopke pridobivanja dovoljenj in izvajanje politik na področju geotermalne energije. Programi usposabljanja naj se odzivajo na dejanske potrebe regionalnega trga dela ter naj, kjer je to primerno, vključujejo univerze, institucije poklicnega izobraževanja, panožna združenja in geotermalna podjetja v pripravo izobraževalnih vsebin in izvajanje praktičnega usposabljanja. Medregionalno usposabljanje in izmenjava znanja lahko dodatno prispevata k odpravljanju pomanjkanja specializiranega strokovnega znanja na področju geotermalne energije. Programi usposabljanja naj vključujejo sheme certificiranja monterjev, poklicno izobraževanje, krepitev inženirskih zmogljivosti ter specializirano usposabljanje za občinske uradnike, organe za izdajo dovoljenj in ocenjevalce projektov, vključene v razvoj geotermalne energije. Krepiti je treba strokovno znanje znotraj javnih organov, pristojnih za ocenjevanje projektov in postopke izdaje dovoljenj.

Ukrep politike 13: Povečanje javne ozaveščenosti in družbene sprejemljivosti

Komunikacijske strategije naj jasno predstavijo tudi lokalne in regionalne koristi geotermalnih projektov. Te lahko vključujejo stabilnejše stroške energije, večjo energetske varnost, ustvarjanje lokalnih delovnih mest, nove poslovne priložnosti, zmanjšanje odvisnosti od uvoženih energentov ter podporo regionalnemu gospodarskemu razvoju. Pri večjih projektih naj bo zgodnje in kontinuirano sodelovanje z lokalnimi skupnostmi sestavni del razvoja projekta in naj ne bo omejeno zgolj na formalne postopke pridobivanja dovoljenj. Pregledno deljenje informacij, demonstracijski projekti, podatki spremljanja, študije izvedljivosti, sektorsko specifične študije primerov ter zgodnje vključevanje deležnikov lahko bistveno prispevajo k izboljšanju javne sprejemljivosti in prodora na trg. Komunikacijske dejavnosti naj bodo prilagojene različnim ciljnim skupinam, vključno z državljani, MSP-ji, občinami, vlagatelji in oblikovalci politik.

Ukrep politike 14: Krepitev evropskega partnerstva S3 za geotermalno energijo

Partnerstvo naj postopoma okrepi podporo razvoju skupnih medregionalnih investicijskih pobud, demonstracijskih projektov in naborov geotermalnih projektov, ki lahko pritegnejo evropska sredstva in zasebne naložbe v sodelujočih regijah. Regionalni organi naj dejavno podpirajo nadaljnji razvoj nastajajočih evropskih partnerstev pametne specializacije (S3) na področju geotermalne energije prek medregionalnega sodelovanja, izmenjave znanja in skupnih inovacijskih dejavnosti. Poseben poudarek naj bo na oblikovanju in izvajanju geotermalnih načrtov na osnovi S3, ki zagotavljajo praktične poti izvajanja ter lahko podpirajo dolgoročno sodelovanje, načrtovanje naložb in politično učenje med evropskimi regijami, hkrati pa krepijo temelje prihodnjih evropskih partnerstev S3 na področju geotermalne energije.

Ukrep politike 15: Vzpostavitev regionalnih platform za geotermalne podatke in znanje

Kjer je to pravno in tehnično mogoče, naj bodo geotermalni podatki, pridobljeni v okviru javno financiranih raziskav, vrtanja, testiranja in raziskovalnih dejavnosti, dostopni za nadaljnji razvoj projektov. Ti lahko vključujejo podatke o vrtnah, geološke in geofizikalne podatke, meritve temperatur, rezultate testiranja rezervoarjev in proizvodnih testov ter druge relevantne podatke o podzemlju. Spodbujati je treba uporabo skupnih podatkovnih standardov in interoperabilnih formatov, ki omogočajo primerjavo in ponovno uporabo informacij med posameznimi regijami.

Regionalne podatkovne platforme naj se dolgoročno razvijajo iz zbirk podatkov in znanja v celovita orodja za podporo geotermalnim naložbam. To je mogoče doseči s povezovanjem podatkov o podzemlju s kartiranjem potreb po toploti in hlajenju, obstoječo energetske infrastrukturo,

potencialnimi končnimi uporabniki, naborom načrtovanih projektov ter razpoložljivimi možnostmi financiranja. Takšne platforme lahko razvijalcem projektov in vlagateljem pomagajo prepoznati najperspektivnejše naložbene priložnosti ter zmanjšati negotovost v zgodnjih fazah razvoja projektov.

Annex VII. Medidas de Política Greet GEO (PT)

As seguintes medidas de política foram desenvolvidas no âmbito do projeto Greet GEO com base na análise de políticas regionais, na comparação da cadeia de valor (*benchmarking*), em consultas a partes interessadas (*stakeholders*) e em avaliações dos ecossistemas de inovação realizadas nas regiões participantes. Destinam-se a apoiar a implantação da energia geotérmica profunda e superficial, abordando barreiras financeiras, regulamentares, técnicas, de mercado e de governação, ao mesmo tempo que reforçam os ecossistemas de inovação regionais e a cooperação inter-regional.

Medida de Política 1: Criar Mecanismos Regionais de Apoio ao Investimento em Geotermia

As autoridades regionais devem estabelecer mecanismos de apoio dedicados para ajudar os promotores de projetos geotérmicos a preparar projetos bancáveis (*investment-ready*) e a aceder às oportunidades de financiamento disponíveis. Estes mecanismos devem prestar assistência técnica, estudos de viabilidade, desenvolvimento de modelos de negócio (*business cases*), modelação financeira e orientação sobre instrumentos de financiamento regionais, nacionais e europeus. Deve ser prestada especial atenção às necessidades das PME e dos municípios, que frequentemente carecem dos recursos necessários para desenvolver projetos geotérmicos financeiramente viáveis. Estes mecanismos devem igualmente apoiar o desenvolvimento de uma carteira (*pipeline*) de projetos geotérmicos regionais e incentivar a agregação de projetos, quando apropriado, ajudando a melhorar a aptidão ao investimento, a reduzir os custos de transação e a atrair financiamento privado. Ao reforçar a preparação de projetos e ao ligar os promotores a instituições financeiras e peritos técnicos, estes mecanismos podem aumentar o número de projetos geotérmicos que atingem a fase de implementação.

Medida de Política 2: Desenvolver Mecanismos de Partilha de Risco em Geotermia

As autoridades públicas devem promover instrumentos financeiros que reduzam os riscos geológicos, de exploração e de investimento associados aos projetos geotérmicos. Os regimes de partilha de risco, os mecanismos de garantia, os fundos de exploração, os programas de apoio à perfuração e os instrumentos de financiamento público-privado devem ajudar a cobrir a incerteza geológica, os riscos de perfuração e os custos de desenvolvimento de projetos em fase inicial. As autoridades regionais devem também explorar a criação de mecanismos dedicados à partilha de risco geotérmico, instrumentos de financiamento misto (*blended finance*) e esquemas de garantia pública capazes de melhorar a viabilidade financeira (*bankability*) dos projetos e a confiança dos investidores. A melhoria do acesso a mecanismos de partilha de risco deve ser uma prioridade para as PME e para os projetos geotérmicos de menor escala.

Medida de Política 3: Criar Serviços Regionais de Balcão Único (One-Stop-Shop) para a Geotermia

Devem ser estabelecidos serviços dedicados de balcão único para a energia geotérmica, com o intuito de prestar um apoio coordenado na preparação de projetos, licenciamento, financiamento, requisitos técnicos e procedimentos regulamentares. Estas estruturas devem facilitar a coordenação entre as autoridades responsáveis pela água, ambiente, minas, ordenamento do território e energia, fornecendo em simultâneo orientações claras aos promotores de projetos, municípios, PME e

investidores. Os serviços de balcão único devem igualmente apoiar o desenvolvimento de modelos de negócio (*business cases*), a aproximação (*matchmaking*) entre promotores de projetos e instituições financeiras, bem como o acesso a conhecimentos técnicos especializados. As consultas regionais identificaram consistentemente estas estruturas de apoio integrado como um dos mecanismos mais eficazes para reduzir a complexidade administrativa e acelerar a implementação dos projetos.

Medida de Política 4: Simplificar os Procedimentos de Licenciamento

As autoridades regionais e nacionais devem rever os quadros de licenciamento existentes e identificar oportunidades para simplificar procedimentos, aumentar a transparência e reforçar a coordenação entre as entidades envolvidas na aprovação de projetos geotérmicos. Devem ser desenvolvidos procedimentos padronizados e percursos de licenciamento mais claros, tanto para aplicações geotérmicas profundas como de superfície, com particular incidência na articulação entre as autoridades da energia, ambiente, gestão de recursos hídricos, minas e ordenamento do território. Os decisores políticos devem também explorar oportunidades de cooperação regulamentar transfronteiriça, incluindo o reconhecimento mútuo de qualificações técnicas, certificações e licenças de perfuração geotérmica sempre que existam normas equivalentes. Em regiões que partilhem condições geológicas e objetivos comuns de desenvolvimento geotérmico, estes acordos poderiam facilitar a participação de empresas de perfuração qualificadas entre diferentes jurisdições, alargar o acesso a conhecimento especializado, aumentar a concorrência e reduzir os custos dos projetos. As orientações setoriais existentes, tais como as diretrizes de perfuração de poços desenvolvidas pela Associação Internacional de Empreiteiros de Perfuração (IADC), podem constituir pontos de referência úteis para a harmonização dos requisitos técnicos, operacionais e de segurança.

Medida de Política 5: Integrar a Energia Geotérmica no Planeamento Regional

A energia geotérmica deve ser sistematicamente incorporada nas estratégias regionais de clima, energia, inovação e desenvolvimento económico. Deve ser dada atenção ao planeamento energético regional, ordenamento do território, estratégias de aquecimento e arrefecimento, políticas de desenvolvimento industrial e prioridades de Especialização Inteligente (S3), garantindo assim uma maior coerência nas políticas e visibilidade dos projetos. A integração da componente geotérmica no planeamento regional pode também apoiar a previsibilidade do investimento a longo prazo e facilitar o desenvolvimento de redes de calor urbano (*district heating*), calor industrial e projetos de descarbonização de edifícios.

Medida de Política 6: Apoiar Projetos de Demonstração e Projetos-Piloto

O apoio público deve priorizar projetos de demonstração capazes de validar tecnologias geotérmicas inovadoras, reduzir os riscos percecionados e aumentar a confiança entre investidores, autoridades públicas e utilizadores finais. As atividades de demonstração devem incluir projetos piloto, laboratórios vivos (*living labs*), edifícios de demonstração, visitas técnicas e ações de divulgação de projetos que comuniquem de forma prática os benefícios das soluções geotérmicas. Setores como as redes de calor urbano, turismo, agricultura, indústria e renovação de edifícios merecem especial atenção, dados os significativos benefícios económicos e ambientais que as tecnologias geotérmicas neles podem gerar.

Medida de Política 7: Reforçar a Cooperação entre Investigação e Indústria

As políticas regionais de inovação devem incentivar uma cooperação mais próxima entre organizações de investigação, universidades, atores industriais e autoridades públicas. Projetos de investigação conjunta, parcerias de inovação, iniciativas de transferência de tecnologia e plataformas colaborativas de inovação podem acelerar a comercialização e a adoção pelo mercado. Uma colaboração mais forte pode também melhorar o acesso a dados geológicos, conhecimento técnico e modelos de negócio

inovadores, apoiando simultaneamente o desenvolvimento de soluções geotérmicas específicas para a realidade de cada região.

Medida de Política 8: Promover Sistemas Integrados de Energia Geotérmica

As autoridades regionais devem incentivar soluções geotérmicas integradas que maximizem a utilização dos recursos e melhorem a eficiência dos sistemas. Deve ser dada maior atenção aos conceitos de uso em cascata, aplicações de armazenamento térmico e oportunidades de integração intersetorial que liguem a energia geotérmica a redes de aquecimento urbano, climatização de edifícios, agricultura e processos industriais.

Medida de Política 9: Reforçar os Serviços de Apoio às PME

As PME desempenham um papel fundamental ao longo de toda a cadeia de valor da geotermia, mas enfrentam frequentemente barreiras relacionadas com financiamento, conhecimento especializado e acesso ao mercado. Os programas de apoio regional devem disponibilizar serviços de consultoria direcionados, mentoria, assistência ao desenvolvimento de projetos e apoio empresarial adaptado às necessidades das PME. Os serviços de apoio devem incluir auditorias energéticas, modelos padronizados de planos de negócio, calculadoras de retorno do investimento (ROI), assistência na preparação de projetos, serviços de aconselhamento e apoio ao desenvolvimento de soluções geotérmicas "chave na mão". Ajudar as PME a compreender os benefícios económicos dos investimentos em geotermia e a navegar pelas oportunidades de financiamento disponíveis deve constituir uma prioridade fundamental.

Medida de Política 10: Reforçar o Papel das Organizações Intermediárias

As agências de energia, as organizações de *clusters*, as câmaras de comércio, as agências de desenvolvimento, as associações de geotérmicas e as organizações de apoio à inovação devem capacitar-se ainda mais para facilitar a cooperação entre partes interessadas, melhorar a troca de informação e apoiar as atividades de desenvolvimento de projetos. Estas organizações podem desempenhar um papel determinante na ligação das PME a conhecimento técnico especializado, oportunidades de financiamento e serviços de apoio à inovação. Devem igualmente atuar como facilitadores entre promotores de projetos, municípios, instituições financeiras e autoridades públicas, promovendo o contacto entre parceiros (*matchmaking*), atividades de comunicação, transferência de conhecimento e redes de trabalho em políticas públicas (*policy networking*). Podem ainda contribuir para a cooperação inter-regional, a troca de boas práticas e a implementação de atividades em parceria no âmbito da Especialização Inteligente (S3).

Medida de Política 11: Melhorar o Acesso ao Financiamento para as PME

As autoridades regionais devem facilitar ligações mais fortes entre as PME e as instituições financeiras, incluindo bancos comerciais, bancos públicos de desenvolvimento e fundos de investimento especializados. A melhoria do acesso ao financiamento é essencial para aumentar a participação das PME nos mercados da geotermia e apoiar o desenvolvimento de modelos de negócio viáveis. Os instrumentos específicos podem incluir linhas de crédito dedicadas à geotermia, esquemas de financiamento verde, mecanismos de garantia, modelos de *leasing*, abordagens através de empresas de serviços energéticos (ESCO) e soluções de financiamento misto (*blended finance*) adaptadas aos ciclos de investimento e necessidades de financiamento das PME.

Medida de Política 12: Desenvolver Programas Regionais de Capacitação em Geotermia

Devem ser criados programas específicos de educação, formação e certificação para responder à escassez de mão de obra qualificada e reforçar a capacidade de implementação entre de engenheiros, instaladores, promotores de projetos e técnicos da administração pública. Os programas de formação devem incluir esquemas de certificação de instaladores, ensino profissional, capacitação em

engenharia e formação especializada para técnicos municipais, autoridades licenciadoras e avaliadores de projetos envolvidos no desenvolvimento geotérmico, desenvolvendo também as competências internas das autoridades públicas responsáveis pelas avaliações de projetos e procedimentos de licenciamento.

Medida de Política 13: Aumentar a Consciencialização Pública e a Aceitação Social

As atividades de comunicação e de sensibilização devem focar-se não apenas nas tecnologias geotérmicas em si, mas também nos seus benefícios práticos, incluindo a poupança nos custos com energia, competitividade, segurança energética, resiliência e resultados ao nível da descarbonização. A partilha transparente de informação, os projetos de demonstração, os dados de monitorização, os estudos de viabilidade, os casos de estudo setoriais e o envolvimento precoce dos intervenientes podem contribuir significativamente para melhorar a aceitação pública e a adesão do mercado. As atividades de comunicação devem ser adaptadas aos diferentes grupos-alvo, incluindo cidadãos, PME, municípios, investidores e decisores políticos.

Medida de Política 14: Reforçar a Parceria Europeia de Especialização Inteligente (S3) em Geotermia

As autoridades regionais devem apoiar ativamente o desenvolvimento contínuo da parceria europeia emergente de Especialização Inteligente (S3) em energia geotérmica, através de cooperação inter-regional, troca de conhecimento e atividades de inovação conjunta. Esta ação deve centrar-se especialmente na criação e implementação de roteiros geotérmicos baseados na S3, que forneçam percursos práticos de execução e apoiem a cooperação a longo prazo, o planeamento de investimentos e a aprendizagem de políticas públicas entre as regiões europeias, reforçando simultaneamente os alicerces de futuras parcerias europeias de S3 em geotermia.

Medida de Política 15: Criar Plataformas Regionais de Dados e Conhecimento em Geotermia

As autoridades regionais devem apoiar a criação de repositórios partilhados de dados e plataformas de conhecimento geotérmico que disponibilizem informação geológica, inteligência de mercado, orientação técnica, informação regulamentar, casos de estudo e boas práticas. O acesso facilitado a informação fiável reduz a incerteza dos projetos, reforça a tomada de decisões e acelera o desenvolvimento de novas iniciativas. Sempre que possível, estas plataformas devem viabilizar a partilha inter-regional de dados, melhorar o acesso a informação do subsolo e promover a partilha de conhecimento a longo prazo, a cooperação inter-regional e o desenvolvimento de políticas baseadas em evidências.

Annex VIII. Recomendaciones para medidas políticas de Greet GEO (ES)

Las siguientes recomendaciones se desarrollaron en el marco del proyecto Greet GEO partiendo del análisis de políticas regionales, la evaluación comparativa de la cadena de valor, las consultas con las partes interesadas y las evaluaciones del ecosistema de innovación en las regiones participantes. Su objetivo es apoyar el despliegue de la energía geotérmica profunda y somera abordando las barreras financieras, regulatorias, técnicas, de mercado y de gobernanza, reforzando a su vez los ecosistemas regionales de innovación y la cooperación interregional.

Medida Política 1: Establecer Servicios Regionales de Apoyo a la Inversión Geotérmica

Las autoridades regionales deberían establecer mecanismos de apoyo específicos para asistir a los promotores de proyectos geotérmicos en la preparación de proyectos listos para inversión y facilitar

el acceso a las oportunidades de financiación disponibles. Estos servicios deberían proporcionar asistencia técnica, estudios de viabilidad, desarrollo de casos de negocio (business cases), modelos financieros y orientación sobre instrumentos de financiación regionales, nacionales y europeos, prestando especial atención a las necesidades de las PYMEs y los municipios, los cuales a menudo carecen de los recursos necesarios para desarrollar proyectos geotérmicos financiados. Estos servicios deberían apoyar también el desarrollo de carteras regionales de proyectos geotérmicos y fomentar la agregación de proyectos cuando proceda, contribuyendo a mejorar la preparación para la inversión, reducir los costes de transacción y atraer financiación privada. Al reforzar la preparación de proyectos y conectar a los promotores con instituciones financieras y expertos técnicos, estos mecanismos pueden aumentar el número de proyectos geotérmicos que alcancen la fase de implementación.

Medida Política 2: Desarrollar Mecanismos de Distribución del Riesgo para los Proyectos Geotérmicos

Las autoridades públicas deberían promover instrumentos financieros que reduzcan los riesgos geológicos, de exploración y de inversión asociados a proyectos geotérmicos. Los sistemas de distribución del riesgo, los mecanismos de garantía, los fondos de exploración, los programas de apoyo a la perforación y los instrumentos de financiación público-privada deberían ayudar a cubrir la incertidumbre geológica, los riesgos de perforación y los costes de desarrollo en las fases iniciales del proyecto. Las autoridades regionales deberían explorar también la creación de servicios específicos de distribución del riesgo geotérmicos, instrumentos de financiación combinada (blended finance) y sistemas de garantía pública capaces de mejorar la financiación de los proyectos y la confianza de los inversores. La mejora del acceso a mecanismos de distribución del riesgo debería ser una prioridad para las PYMEs y los proyectos geotérmicos de menor escala.

Medida Política 3: Crear Servicios Regionales de Ventanilla Única para la Geotermia

Deberían establecerse servicios de ventanilla única específicos para la geotermia que ofrezcan apoyo para la preparación de proyectos, la tramitación de permisos, la financiación, los requisitos técnicos y los procedimientos regulatorios. Estos servicios deberían facilitar la coordinación entre las autoridades de aguas, medio ambiente, minería, planificación y energía, ofreciendo al mismo tiempo una clara directriz a los promotores de proyectos, municipios, PYMEs e inversores. Los servicios de ventanilla única deberían apoyar también el desarrollo de casos de negocio, el contacto entre promotores de proyectos e instituciones financieras, y el acceso a experiencia técnica. Los procesos de consultas regionales llevados a cabo por el proyecto identificaron de manera constante este tipo de estructuras de apoyo integradas como uno de los mecanismos más eficaces para reducir la complejidad administrativa y acelerar la implementación de los proyectos.

Medida Política 4: Agilizar los Procedimientos de Tramitación de Permisos

Las autoridades regionales y nacionales deberían revisar sus marcos de tramitación de permisos actuales e identificar posibles simplificaciones para los procedimientos, para la mejora de la transparencia, y el refuerzo de la coordinación entre las autoridades implicadas en la aprobación de proyectos geotérmicos. Deberían desarrollarse procedimientos estandarizados e itinerarios de tramitación más claros tanto para las solicitudes de proyectos geotérmicos tanto profundos como someros, con especial atención a la coordinación entre las autoridades de energía, medio ambiente, gestión del agua, minería y ordenación del territorio. Los responsables políticos deberían también explorar oportunidades de cooperación regulatoria transfronteriza, incluido el reconocimiento mutuo de cualificaciones técnicas, certificaciones y licencias de perforación geotérmica cuando existan normas equivalentes. En regiones con condiciones geológicas compartidas y objetivos comunes de desarrollo geotérmico, este tipo de acuerdos podría facilitar la participación de contratistas de perforación cualificados en distintas jurisdicciones, ampliar el acceso a experiencia especializada, aumentar la competencia y reducir los costes de los proyectos. Las orientaciones sectoriales

existentes, como son las directrices de perforación de pozos elaboradas por la Asociación Internacional de Contratistas de Perforación (IADC, por sus siglas en inglés), pueden constituir referencias útiles para la armonización de los requisitos técnicos, de seguridad y operativos.

Medida Política 5: Integrar la Energía Geotérmica en la Planificación Regional

La energía geotérmica debería incorporarse de manera sistemática en las estrategias regionales de clima, energía, innovación y desarrollo económico. Debe prestarse atención a la planificación energética regional, la ordenación del territorio, las estrategias de climatización, las políticas de desarrollo industrial y las prioridades de especialización inteligente (S3), con el fin de garantizar una mayor coherencia política y visibilidad de los proyectos. La integración de las consideraciones geotérmicas en la planificación regional puede también aportar seguridad a la inversión a largo plazo y facilitar el desarrollo de proyectos de climatización urbana, calor industrial y descarbonización de edificios.

Medida Política 6: Apoyar Proyectos de Demostración y Proyectos Piloto

El apoyo público debería priorizar los proyectos de demostración capaces de validar tecnologías geotérmicas innovadoras, reducir los riesgos percibidos y aumentar la confianza entre inversores, autoridades públicas y usuarios finales. Las actividades de demostración deberían incluir proyectos piloto, living labs, espacios de demostración, visitas a instalaciones y actividades de divulgación de proyectos capaces de comunicar los beneficios prácticos de las soluciones geotérmicas. Sectores como la climatización urbana, el turismo, la agricultura, la industria y la rehabilitación de edificios merecen una atención especial, dados los importantes beneficios económicos y medioambientales que las tecnologías geotérmicas pueden aportar a estos sectores.

Medida Política 7: Reforzar la Colaboración entre Investigación e Industria

Las políticas regionales de innovación deberían fomentar una cooperación más estrecha entre organismos de investigación, universidades, actores industriales y autoridades públicas. Los proyectos de investigación conjunta, los actores de innovación, las iniciativas de transferencia tecnológica y las plataformas de innovación colaborativa pueden acelerar la comercialización y la adopción en el mercado. Una colaboración más sólida puede también mejorar el acceso a datos geológicos, experiencia técnica y modelos de negocio innovadores, al tiempo que apoya el desarrollo de soluciones geotérmicas adaptadas a cada región.

Medida Política 8: Promover Sistemas Integrados de Energía Geotérmica

Las autoridades regionales deberían fomentar soluciones geotérmicas integradas que maximicen el aprovechamiento de recursos y mejoren la eficiencia del sistema. Debe prestarse mayor atención a los conceptos de uso en cascada, las aplicaciones de almacenamiento térmico y las oportunidades de integración intersectorial que vinculen la energía geotérmica con la climatización urbana, la construcción, la agricultura y los procesos industriales.

Medida Política 9: Reforzar los Servicios de Apoyo a las PYMEs

Las PYMEs desempeñan un papel importante a lo largo de las cadenas de valor geotérmicas, pero a menudo se enfrentan a barreras relacionadas con la financiación, la falta de experiencia y el acceso a mercados. Los programas regionales de apoyo deberían ofrecer servicios de asesoramiento específicos, mentoría, asistencia para el desarrollo de proyectos y apoyo empresarial adaptado a las necesidades de las PYMEs. Los servicios de apoyo deberían incluir auditorías energéticas, plantillas estandarizadas de casos de negocio, calculadoras de retorno de la inversión (ROI), asistencia en la preparación de proyectos, servicios de asesoramiento y apoyo para el desarrollo de soluciones geotérmicas. Ayudar a las PYMEs a comprender los beneficios económicos de las inversiones

geotérmicas y a orientarse entre las oportunidades de financiación disponibles debería ser un objetivo prioritario.

Medida Política 10: Reforzar el Papel de las Organizaciones Intermediarias

Las agencias de energía, las organizaciones de clústeres, las cámaras de comercio, las agencias de desarrollo, las asociaciones geotérmicas y las organizaciones de apoyo a la innovación deberían recibir un mayor respaldo para facilitar la cooperación entre las partes interesadas, mejorar el intercambio de información y apoyar las actividades de desarrollo de proyectos. Estas organizaciones pueden desempeñar un papel clave a la hora de conectar a las PYMEs con experiencia técnica, oportunidades de financiación y servicios de apoyo a la innovación. Deberían actuar también como facilitadoras entre los promotores de proyectos, los municipios, las instituciones financieras y las autoridades públicas, apoyando la colaboración entre proyectos, las actividades de comunicación comunes, la transferencia de conocimiento y la creación de redes de política. Pueden contribuir además a la cooperación interregional, al intercambio de buenas prácticas y a la implementación de actividades de asociación en el marco de la especialización inteligente (S3).

Medida Política 11: Mejorar el Acceso a la Financiación para las PYMEs

Las autoridades regionales deberían facilitar conexiones más sólidas entre las PYMEs y las instituciones financieras, incluyendo bancos comerciales, bancos públicos de desarrollo y fondos de inversión especializados, ya que la mejora del acceso a la financiación es esencial para aumentar la participación de las PYMEs en los mercados geotérmicos y apoyar el desarrollo de casos de negocio viables. Entre los instrumentos específicos pueden figurar productos de préstamo geotérmico específicos, líneas de préstamo verde, mecanismos de garantía, modelos de arrendamiento (leasing), enfoques de tipo ESCO y soluciones de financiación combinada (blended finance) adaptadas a los ciclos de inversión y las necesidades de financiación de las PYMEs.

Medida Política 12: Desarrollar Programas Regionales de Capacitación en Geotermia

Deberían establecerse programas específicos de educación, formación y certificación para hacer frente a la escasez de mano de obra cualificada y reforzar la capacidad de especialización de ingenieros, instaladores, promotores de proyectos y personal de la administración pública. Los programas de formación deberían incluir sistemas de certificación de instaladores, formación profesional, desarrollo de capacidades de ingeniería y formación especializada para funcionarios municipales, autoridades competentes en la tramitación de permisos y evaluadores de proyectos implicados en el desarrollo geotérmico, reforzando la experiencia dentro de las autoridades públicas responsables de la evaluación de proyectos y los procedimientos de tramitación de permisos.

Medida Política 13: Aumentar la Concienciación Pública y la Aceptación Social

Las actividades de difusión y sensibilización deberían centrarse no solo en las tecnologías geotérmicas en sí mismas, sino también en sus beneficios prácticos, incluidos el ahorro en costes energéticos, la competitividad, la seguridad energética, la resiliencia y los resultados en materia de descarbonización. El intercambio transparente de información, los proyectos de demostración, los datos de seguimiento, los estudios de viabilidad, los casos prácticos sectoriales y la implicación temprana de las partes interesadas pueden contribuir de manera significativa a mejorar la aceptación pública y la adopción en el mercado. Las actividades de difusión deberían adaptarse a distintos grupos destinatarios, incluyendo a la ciudadanía, las PYMEs, los municipios, los inversores y los responsables políticos.

Medida Política 14: Reforzar la Asociación Europea de Especialización Inteligente (S3) en Geotermia

Las autoridades regionales deberían apoyar activamente el desarrollo de las incipientes asociaciones europeas de especialización inteligente (S3) en geotermia, mediante la cooperación interregional, el intercambio de conocimiento y las actividades conjuntas de innovación. Esto debería centrarse

especialmente en la creación e implementación de hojas de ruta geotérmicas basadas en la estrategia S3 que ofrezcan guías prácticas de implementación y puedan apoyar la cooperación a largo plazo, la planificación de inversiones y el aprendizaje político entre las regiones europeas, al tiempo que refuerzan las bases de las futuras asociaciones europeas de especialización inteligente (S3) en geotermia.

Medida Política 15: Establecer Plataformas Regionales de Datos y Conocimiento Geotérmico

Las autoridades regionales deberían apoyar la creación de repositorios de datos y plataformas de conocimiento geotérmico compartidos que proporcionen información geológica, inteligencia de mercado, orientación técnica, información regulatoria, casos prácticos y buenas prácticas. Un mejor acceso a información fiable puede reducir la incertidumbre de los proyectos, reforzar la toma de decisiones y acelerar el desarrollo de los proyectos. Siempre que sea posible, estas plataformas deberían facilitar el intercambio interregional de datos, mejorar el acceso a la información del subsuelo y apoyar el intercambio de conocimiento a largo plazo, la cooperación interregional y el desarrollo de políticas basadas en evidencia.