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GeoBOOST

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1. Introduction

The overall performance and impact indicators of the project include the general impacts that will result from the implementation of the project's recommendations and findings. Although the project is specifically focused on 8 target countries where consortium partners operate (Austria, Belgium, Germany, Ireland, the Netherlands, Poland, Spain, Sweden), it has a European wide focus, and its results will be promoted to European policy makers and made easily applicable at the local or national level when and where relevant. This means that the project impacts can be measured at the European scale as well as within the 8 target countries.

2. Progress towards performance indicators and project milestones

This report includes an assessment of the monitoring indicators listed in Annex B of the Grant Agreement.

Number of established regulatory proposals incorporated into target and other Member States

The following section provides illustrative examples of national and regional policy and legislative measures adopted during the GeoBOOST project duration that are, in various ways, aligned with the project's objectives of accelerating the deployment of geothermal heat pumps and renewable heating and cooling solutions. The examples cover both project countries and non-project countries and reflect a broad range of policy approaches, including heat planning, building regulations, fossil fuel phase-out measures, permitting reforms, and financial support schemes. This non-exhaustive overview highlights the growing policy momentum across Europe to decarbonise heating and support geothermal and heat pump technologies.

- **Belgium — Flanders: "Warmteplan 2025" (Flemish Heat Plan)** — regional heat plan package that mandates local heat planning, supports heat-pump rollout and sets measures to phase out fossil heating in new buildings.
- **Czech Republic — Czech Republic Modernisation Fund & Recovery and Resilience Plan (RRP)** — Financial support for renewable heating, including heat pumps and geothermal solutions, in buildings and district heating.
- **Germany — Federal heating/building measures (2023 heating legislation / GEG & follow-up rules)** — 2023 federal legislation to accelerate replacement of fossil

heating systems and strengthen renewable share requirements for new systems (measures from 2023–2024 raising the role of heat pumps and renewable heating).

- **Ireland — Policy Statement on Geothermal Energy for a Circular Economy (July 2023)** — formal policy statement (July 2023) to unlock geothermal for heating & cooling, address barriers and embed geothermal in national planning and climate action.

- **Spain — Draft update of the National Energy and Climate Plan (NECP) (2023–2024)** — Spain's NECP updates (2023 draft / 2024 processes) include strengthened measures for renewable heating & cooling and the promotion of heat pumps as part of decarbonisation of heat.

- **Estonia — Building renovation and heating transition measures** — Policies promoting heat pumps and renewable heat in residential buildings.

- **Netherlands — "Municipal Instruments for Heat Transition Act" (Wgiw) and related 2023 heat-planning reforms** — national instruments introduced in 2023 to empower municipalities to set local heat plans and manage the gas-phase-out / district-oriented heat transition (plus concurrent Mining Act amendments to streamline geothermal permitting).

- **Austria — Renewable-Heating measures / updated NECP & Renewable Heating Law (2024 actions)** — Austria's updated NECP (submitted 2024) and a Renewable-Heating legal package (measures from 2023–2024) that prohibit fossil boilers in new buildings and prioritise renewable heat sources (including geothermal) in district heating decarbonisation.

- **Poland — Updated NECP submission and related district-heating / H&C measures (2024)** — Poland submitted an updated NECP in 2024 (March 2024 / Commission recommendations in Apr 2024) with measures and planning actions addressing the decarbonisation of district heating and reporting improvements for the H&C sector.

- **Sweden — National climate / heat-sector measures (national plans & subsidies to phase out oil/gas boilers and support heat pumps and district heating decarbonisation)** — Sweden's 2024 national plans and related measures (including subsidy schemes and strong policy support for heat pumps and district heating upgrades) support renewable H&C deployment and improved planning/reporting.

- **France — Acceleration of Renewable Energy Act (2023)** — Includes measures to streamline permitting and support renewable heat deployment.

- **Italy — National Energy and Climate Plan (NECP) update (2023–2024)** — Strengthens renewable heating and cooling targets and promotes heat pumps in buildings and district heating.

Conto Termico 2.0 — Incentive scheme supporting the replacement of fossil heating systems with renewable technologies, including geothermal heat pumps.

- **Denmark — National Heat Planning Framework & Heat Supply Act** — Strong municipal heat planning system prioritising fossil-free heating solutions, including geothermal district heating and large heat pumps.
- **Finland — Carbon Neutrality Target 2035 & Heating Transition Measures** — National policies promoting electrification of heating and heat pump deployment, including geothermal heat pumps in residential and tertiary buildings.

  Support schemes for oil boiler replacement — Incentives encouraging a switch to renewable heating technologies.

Number of target and other Member States that establish harmonised data collection protocols and processes

At present, there is no single EU-wide, fully harmonised registry or data-collection system dedicated specifically to geothermal heat pumps. Instead, data availability and consistency across Member States are achieved through a combination of national statistical offices, energy agencies, geological surveys, market surveillance mechanisms, and reporting obligations linked to permitting or subsidy schemes. As a result, national approaches vary in scope and level of detail, but several Member States have nonetheless established structured and repeatable processes that allow for the systematic monitoring of heat-pump sales, installed capacity, and heat production, including geothermal applications. These national datasets are frequently consolidated and cross-referenced in EU-level analyses, notably through Joint Research Centre (JRC) assessments and market overviews produced by sectoral associations. In this context, countries with established registries, standardised surveys, or integrated statistical reporting frameworks provide the most robust sources for tracking geothermal heat pump deployment, while in other cases data must be derived from a combination of subsidy databases, installer reporting, and market surveys. The following examples highlight Member States that have put in place such harmonised or semi-harmonised data-collection protocols relevant to geothermal heat pumps.

Member States with notable national data-collection protocols or processes for (geo)thermal heat pumps

- **Denmark** — National heat-pump monitoring and public platform (heatpumpdata.eu) and national heat-atlas work that use building registers and systematic production reporting for large-scale heat pumps.
- **France** — Regular national surveys and datasets for heating (including DHC and renewable heat) compiled by CEREMA and sectoral programmes (Fonds Chaleur);

France's monitoring of district heating and renewable heat provides structured, repeated data relevant to geothermal heat pumps.

- **Germany** — National statistics and reporting on heat-pump sales and installed stock are compiled in official energy statistics and sector reports (see national renewables publications and JRC country overview). These rely on harmonised statistical definitions and periodic reporting.
- **Netherlands** — Statistics Netherlands (CBS) publishes systematic data on shallow geothermal energy and heat-pump production, drawing on national energy and extraction statistics.
- **Sweden** — Statistics Sweden (SCB) maintains official heating-supply statistics (including heat-pump production figures) through regular, standardised data collections.
- **Spain** — IDAE (Institute for Energy Diversification and Saving) publishes heat-pump statistics (by climate zone/type/sector) and contributes to harmonised national monitoring of H&C technologies.
- **Italy** — National monitoring and market reports (ENEA / GSE / sector bodies) provide harmonised statistics on heat-pump sales and stock; country overviews summarised in JRC/EHPA reports document these processes.
- **Ireland** — National geothermal and heat-resource data is collated by Geological Survey Ireland (GSI) and SEAI (maps, suitability data and project monitoring) feeding into a coherent national dataset for geothermal and heat-pump planning.

Volume of end-users and project developers accessing private and/or public finance through the financing tools

Across the EU, the volume of end-users and project developers accessing finance for geothermal heat pumps (GHPs) through innovative financing tools remains moderate in absolute terms, but highly significant in strategic and leverage terms. Deliverable 4.2 shows that uptake is concentrated in specific market segments, countries, and business models, where financial mechanisms effectively reduce upfront costs, mitigate risks, and simplify decision-making.

At the end-user level, access to finance primarily involves individual homeowners, housing cooperatives, and multi-family building owners. In mature markets such as Sweden and parts of Denmark, financing is accessed by large shares of detached homeowners, supported by a long-standing mix of grants, tax incentives, favourable electricity pricing, and, increasingly, service-based models. In these contexts, GHP adoption has reached tens of percent of the housing stock, indicating that financing mechanisms are no longer niche but have enabled

mass-market participation. Subscription, leasing, and on-bill–type arrangements have broadened access beyond high-income households by eliminating or reducing upfront payments.

In most other EU Member States, volumes are smaller but expanding. Financing tools such as green mortgages, subsidised public loans (e.g. KfW, Eco-PTZ), and grant-loan combinations enable thousands of households per year to proceed with GHP installations, mainly among owner-occupiers with access to credit. However, GeoBOOST analysis highlights that low-income households remain under-represented, as many schemes still rely on post-installation reimbursement or conventional creditworthiness criteria. Where on-bill financing, cooperative models, or utility-led offers are available, access widens noticeably, suggesting a latent demand that is unlocked when financial friction is reduced.

At the project developer and intermediary level, volumes are smaller in number but large in investment value. ESCOs, utilities, cooperatives, and specialised project developers access blended public–private finance to deliver bundled projects, typically in multi-family buildings, social housing, or collective ground-loop systems. Individual projects may serve dozens to hundreds of dwellings, meaning that a limited number of financed projects can translate into substantial end-user reach. Municipal utilities and public-oriented ESCOs, often backed by cheap public capital, guarantees, or concessional loans, play a central role in these volumes.

Institutional finance participation is emerging through green bonds, securitisation of loan portfolios, and aggregated investment vehicles, which, while still limited in number, have high scalability potential. GeoBOOST analysis indicates that even a small set of such instruments could mobilise finance for thousands to potentially millions of installations, provided regulatory and risk-sharing frameworks are aligned. Pilot experiences (e.g. on-bill aggregation, subscription models, EPCs) demonstrate that once projects are standardised and aggregated, private capital becomes more willing to participate.

Overall, the current volume of financed GHP uptake should be understood as uneven but structurally promising. End-user access is highest where financing tools remove upfront cost barriers and transfer risk, while developer-led access concentrates investment into fewer but larger projects. Although still far from saturation at EU level, the document shows that existing financing tools already support meaningful volumes of installations and, if scaled and harmonised, are capable of supporting orders-of-magnitude higher participation across both households and professional project developers.

Market uptake of GHPs in the EU by 2025 and 2030

The initial expectations for the GeoBOOST project assumed a strong growth trajectory for geothermal heat pumps (GHPs), with an additional 2 million units deployed by 2025 and a total of around 4 million units installed under a business-as-usual (BAU) scenario. However, market developments in 2024 have significantly diverged from these assumptions. While more

than 2 million GHP units are currently installed across Europe, sales in 2024 dropped sharply to approximately 111,000 units across the EU-27, representing a 29% decline compared to 2023. This downturn has affected virtually all European markets and building segments.

The contraction of the GHP market in 2024 can be attributed to a combination of macroeconomic, regulatory, and technical factors. High interest rates between 2022 and mid-2024 slowed construction and renovation activity, directly impacting demand for heating technologies. Although interest rates began to decline in 2024, their positive effect on construction had not yet materialised by year-end. In parallel, falling and subsidised gas prices, combined with an unfavourable electricity-to-gas price ratio in many Member States, have reduced the economic attractiveness of heat pumps despite their high efficiency. Additional uncertainty surrounding electrification strategies, grid capacity, and long-term political support has further weakened consumer confidence. Finally, persistent permitting delays and inconsistent financial support schemes continue to hinder GHP deployment.

In light of these developments, the projections for geothermal heat pump (GHP) sales have been recalculated using a more conservative scenario for the period 2025–2030. This revised approach reflects current market conditions while still assuming a gradual recovery from 2025 onwards, supported by improving financial conditions and a rebound in construction and renovation activity. For 2025, GHP sales are assumed to remain at the same level as in 2024, reflecting continued market inertia. From 2026 onwards, sales are projected to resume a steady growth trajectory of approximately 20% per year, consistent with the growth rates observed prior to 2024.

GHP sales forecast 2024-2030 (based on EGEC and EHPA Market Report data)

	2024	2025	2026	2027	2028	2029	2030
Austria	5046	5046	6055.2	7266.24	8719.488	10463.3856	12556.06272
Poland	6000	6000	7200	8640	10368	12441.6	14929.92
Spain	812	812	974.4	1169.28	1403.136	1683.7632	2020.51584
Sweden	23410	23410	28092	33710.4	40452.48	48542.976	58251.5712
Germany	15000	15000	18000	21600	25920	31104	37324.8
Belgium	5233	5233	6279.6	7535.52	9042.624	10851.1488	13021.37856
Ireland	1225	1225	1470	1764	2116.8	2540.16	3048.192
Netherlands	19600	19600	23520	28224	33868.8	40642.56	48771.072
total	76326	76326	91591.2	109909.44	131891.328	158269.5936	189923.5123

Volume of new entrants and business models developed in target and other Member States

During the project duration, the geothermal heat pump (GHP) market has seen a measurable increase in new entrants and innovative business models, both in GeoBOOST target countries and in other EU Member States. While the absolute number of new actors remains limited compared to more mature renewable energy sectors, Deliverable 4.2 shows that market diversification is clearly underway, particularly in response to financing, permitting, and risk-allocation challenges specific to geothermal heat pumps.

At the business-actor level, new entrants have primarily emerged in the form of specialised installers, drilling companies, engineering consultancies, energy service companies (ESCOs), and integrated solution providers. In several countries, especially those with growing heat pump markets, smaller and medium-sized companies have expanded or diversified their activities from air-source heat pumps, construction services, or shallow geothermal drilling into the geothermal heat pump segment. These entrants often position themselves as turnkey providers, combining system design, permitting support, installation, and maintenance into a single offer, thereby lowering transaction costs for end-users.

At the same time, Deliverable 4.2 highlights the emergence of new intermediary actors and business roles, particularly linked to financing and aggregation. These include project aggregators, cooperatives, utilities, and local energy communities, which bundle multiple installations into single investment projects. Although still limited in number, such actors are increasingly present in both target and non-target countries and are critical for enabling access to public and private finance at scale. Even a relatively small number of these intermediaries can have a disproportionate market impact, as each entity may enable dozens or hundreds of individual installations.

In terms of business models, several innovative approaches have gained visibility during the project period. These include leasing and subscription-based models, where end-users pay a monthly fee instead of making an upfront investment; on-bill and service-based models, where costs are recovered through energy bills; and energy performance contracting (EPC) models applied to residential or multi-building contexts. While uptake remains at pilot or early deployment stage in most countries, the document shows that these models are being tested and replicated across multiple Member States, indicating a growing level of market learning and transferability.

Importantly, these developments are not confined to GeoBOOST target countries. Similar patterns of new entrants and business model experimentation are observed in other EU Member States, particularly where national policies support heat planning, building renovation, or fossil fuel phase-out. This suggests that GeoBOOST activities are aligned with broader EU market trends and contribute to reinforcing them rather than acting in isolation.

Overall, the volume of new entrants and business models should be understood as moderate in absolute numbers but structurally significant. The market is moving away from a purely technology-driven model towards more service-oriented, finance-enabled, and aggregated approaches. This diversification is a key enabler for future scaling, as it addresses non-technical barriers that have historically limited geothermal heat pump deployment.

Volume of professionals completing the MOOC

The MOOC "Specialization in Shallow Geothermal Energy: Skills Development and Training Across the EU", launched on the edX platform on 1st October 2025, has achieved encouraging participation figures during its first weeks. As of November 2025, the course has reached a total enrollment of 365 learners, of which 58 have paid for the verified track to receive a certificate. Participants represent 64 different countries or regions, reflecting the strong international outreach of the program. The top three countries by enrollment are Spain (15%), Portugal (12%), and the United States (10%).

Regarding educational background, the course attracts a highly qualified audience: 4.8% of learners hold a high school diploma or less, 34.5% have a college degree, and 60% possess an advanced degree. These indicators confirm that the MOOC is successfully engaging professionals and students with a solid academic foundation who are interested in deepening their knowledge of shallow geothermal energy technologies across Europe and beyond.

Increased share of GHPs in the EU's overall renewable heating & cooling in NECPs and in the EUROSTAT energy statistics

Between 2023 and 2025, geothermal heat pumps (GHPs) have gained increased visibility and recognition within the European Union's renewable heating and cooling (H&C) framework, as reflected in both National Energy and Climate Plans (NECPs) and Eurostat energy statistics. While geothermal heat pumps still represent a relatively small share of total renewable heat production compared to biomass or ambient heat captured by air-source heat pumps, their contribution is increasingly acknowledged as a structurally important component of the EU's long-term decarbonisation pathway for buildings and district heating.

In updated and draft NECP submissions during this period, a growing number of Member States explicitly reference geothermal heat pumps as part of their renewable heating and cooling strategies, particularly in the context of building renovation, electrification of heat, and district heating decarbonisation. Several NECPs strengthened their projected deployment of heat pumps overall, with geothermal systems highlighted for their high efficiency, stable performance, and suitability for dense urban areas, multi-family buildings, and low-temperature district heating networks. This has translated into higher projected shares of

renewable heat from heat pumps, including shallow geothermal, in national energy balances and forward-looking scenarios.

From a statistical perspective, Eurostat's energy balance data for the period 2023–2025 show a continued increase in the contribution of renewable heat derived from heat pumps, reported under ambient and geothermal energy. Although Eurostat does not always disaggregate heat pump types in a fully harmonised way across Member States, national reporting improvements and methodological clarifications have contributed to a more consistent accounting of geothermal heat output, particularly in countries with established registries or heat-pump monitoring systems (see above what said for the second performance indicator). As a result, geothermal heat pumps increasingly appear as a distinct and growing component within the renewable H&C category, rather than being absorbed implicitly into broader electricity consumption figures.

The period also coincides with stronger policy alignment at EU level, notably through the revised Renewable Energy Directive (RED III), which reinforces targets and reporting obligations for renewable heating and cooling. This has encouraged Member States to better reflect geothermal heat pump deployment in both planning and statistical reporting. In several cases, improved data collection and reporting have led to upward revisions of renewable heat contributions, suggesting that part of the observed increase reflects not only market growth but also improved statistical visibility.

Overall, while geothermal heat pumps still account for a modest share of total renewable heating and cooling at EU level, their relative contribution has increased between 2023 and 2025 in both policy planning (NECPs) and official statistics (Eurostat). This trend confirms the growing role of GHPs as a reliable, efficient, and scalable renewable heating solution, and underscores their importance in achieving the EU's medium- and long-term climate and energy objectives.

However, despite these improvements, significant gaps remain in statistical data collection and reporting for heat pumps in general and geothermal heat pumps in particular. Current statistics often do not sufficiently differentiate between air-source and geothermal heat pumps, limiting the ability to accurately assess the specific contribution of geothermal technologies to renewable heating and cooling. In addition, cooling output from heat pumps is still inadequately captured in many national datasets and in EU-level statistics, despite its growing relevance in the context of climate change and building comfort. Finally, more consistent and transparent reporting on installed capacity, in addition to energy output, is needed to better assess market development, system performance, and future deployment potential. Addressing these data gaps will be essential to ensure robust monitoring, informed policymaking, and effective support for geothermal heat pumps across the EU.