Ground Source Heat Pumps in Europe: An analysis of the Geothermal Heat Pumps market for 2025

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Abbreviations

BEG EM = Federal funding for efficient buildings—individual measures

BHE = Borehole

BWP = German Heat Pump Association

BWP/BDH = joint market statistics for heat pump technologies by German Heat Pump Association and German Heating Industry Association

C&I = Commercial & Industrial

CAPEX = Capital Expenditure(s) — investment costs (e.g., drilling, BHE field, heat pump plant,...

DHW = Domestic Hot Water

double-U = U-bend probe with two U-loops in the same borehole

DTH = Down-The-Hole (Hammer) drilling — a percussive drilling method often used in hard rock

DVGW W 120 = German technical rule series for qualification/quality requirements in drilling & well construction and shallow geothermal drilling/installation (

EGEC = European Geothermal Energy Council

EPC = Engineering, Procurement & Construction

GEG = Germany's Building Energy Act

GHP = Geothermal Heat Pump

GSHP = Ground-Source Heat Pump

KPI = Key Performance Indicator

O&M = Operations & Maintenance

PE100-RC (HDPE) = Most common Polyethylene used for geothermal loops

PV = Photovoltaic

RITE = Spanish regulation for thermal installations in buildings

single-U = U-bend borehole heat exchanger probe

SPF = Seasonal Performance Factor — the seasonal/annual efficiency of a heat pump system

VDI 4640 = German guideline " Thermal use of the underground"

WHG = German Water Resources Act

EU Ground-Source Heat Pump (GSHP) Market Summary — 2025

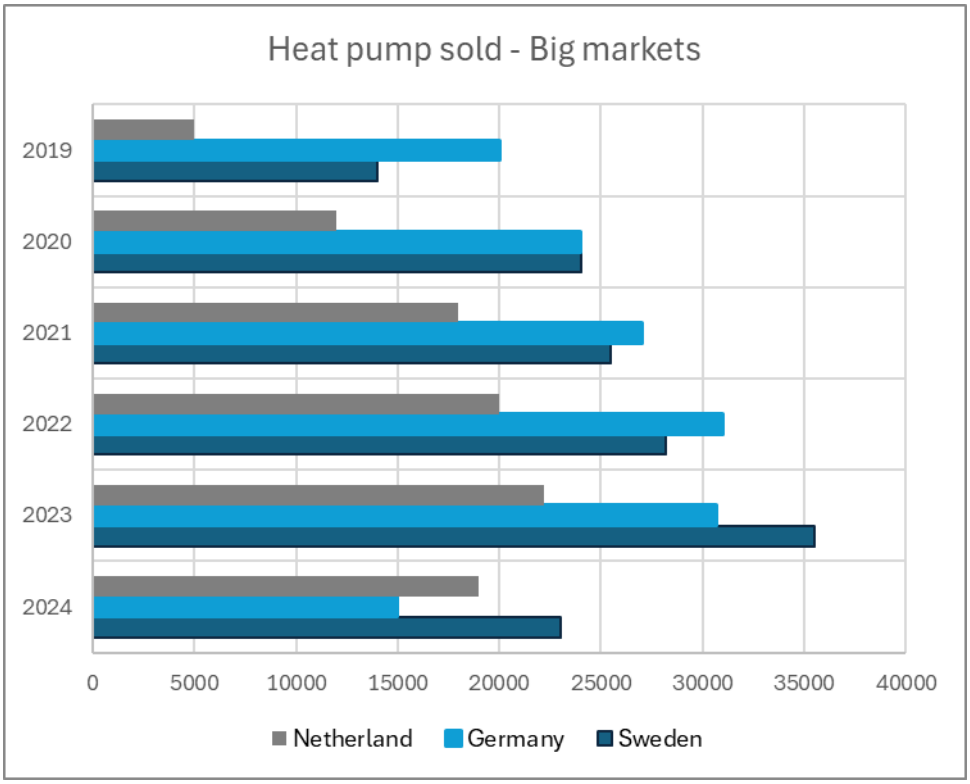
This 2025 update of Deliverable D2.1 reviews the GSHP market across seven European countries (Sweden, Spain, Austria, Germany, Ireland, Poland and the Netherlands). Overall, GSHP technology remains mature and standardized, with stable design parameters, but new residential installations weakened after their recent peaks (typically 2022–2023), meaning electrification and decarbonisation targets may be reached later than planned. Similar situation were during 2008 world financial crisis, when the sales in Europe fell after strong exponential grow (Sanner 2023 [1]). Market maturity varies sharply: Sweden leads the European market share, with very high household penetration and a large installed base now driven mainly by replacements, optimisation, PV coupling and smart controls. Austria and Germany contribute the strongest new-build momentum within regulated, professionalised supply chains. Ireland remain emerging and project-driven, constrained by fragmented statistics and permitting complexity—especially for open-loop—which makes turn-key delivery models (EPC+O&M) and strong regional partnerships decisive.

Across the different countries, typical borehole diameters of ~152 mm are most common, with smaller diameters common in crystalline rock and cost-sensitive markets and larger diameters used in unconsolidated sediments; drilling costs span from low-cost, highly competitive markets (e.g., Poland and the Netherlands) to higher-cost contexts (notably Germany and parts of Spain). Data availability remains a defining issue: the Netherlands and Austria benefit from stronger registration regimes, Germany and Ireland still show fragmented reporting, and Poland's archive captures only a small share of installations, limiting performance benchmarking. Strategic opportunities for 2025–2027 center on retrofits and replacements, larger commercial and municipal projects (often cooling-led), expansion of shared bore fields and low-temperature networks, and growth in monitoring, optimisation and service contracts that convert stable technology into recurring revenue.

Comparison between countries

The newest installations are in Austria and Germany, steady expansion in the mature Swedish market is driven mainly by replacements of the old systems, often connected not only with a higher efficiency heat pump, but also with deeper ground heat exchangers or more borehole.

The number of new GHP installations in Germany and Poland increased up to 2022, after which it started to fall. In Sweden, the Netherlands and Austria, the number of new GSHPs increased up to 2023, after which it decreased. However, in emerging markets such as Spain and Ireland, growth was evident until 2023, after which time it remained at a steady level.



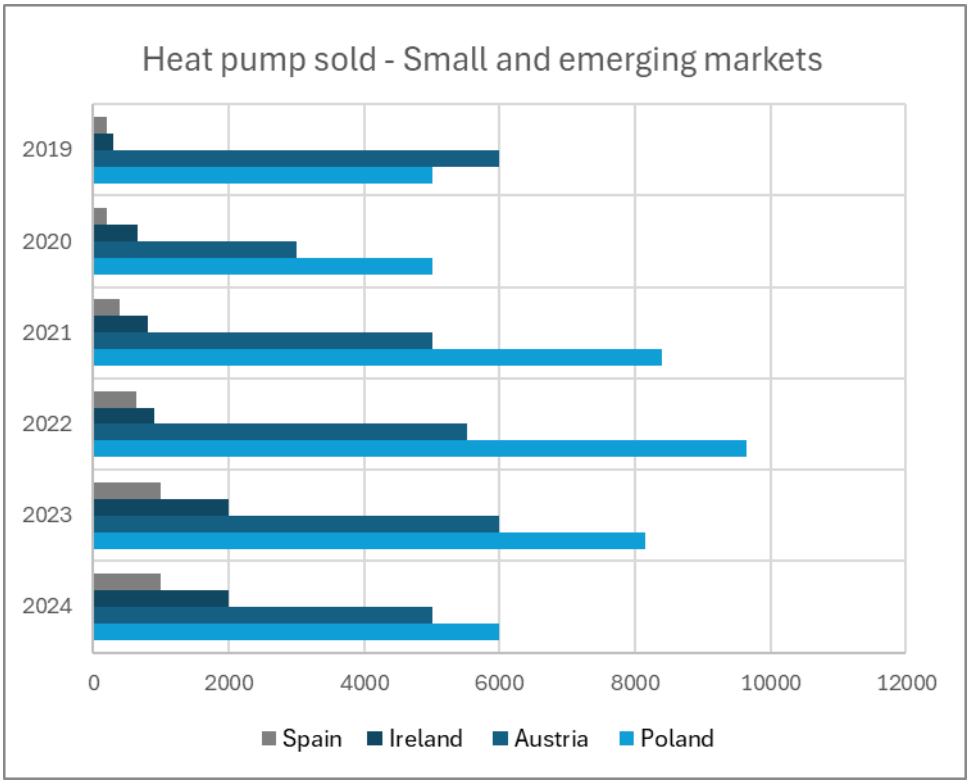
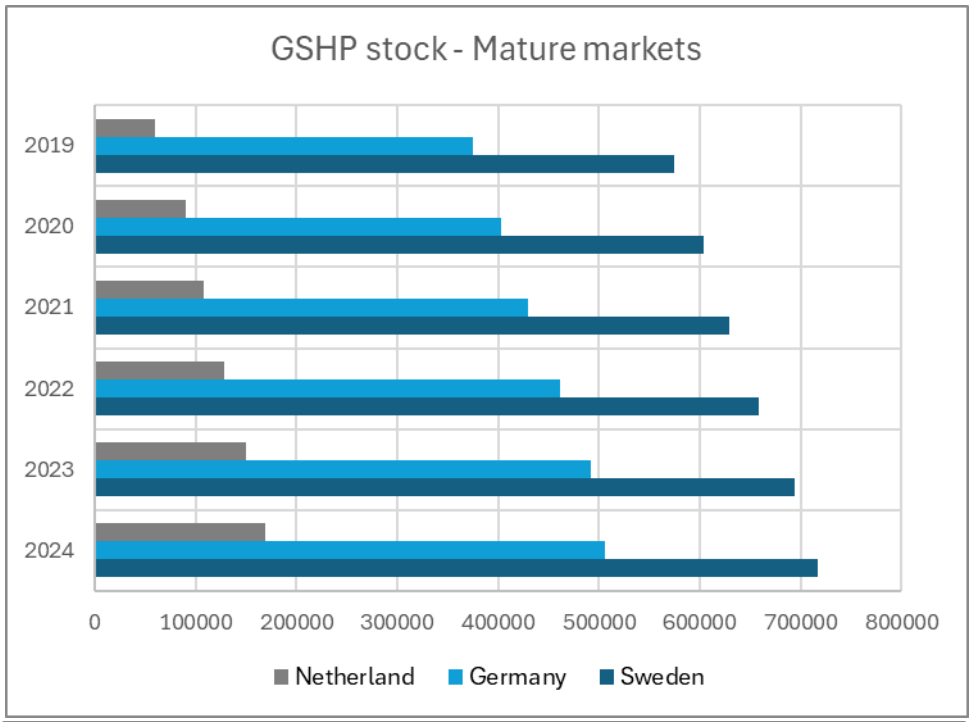


Figure 1: GSHP sold in GeoBOOST partner countries (Source: EGEC)

Data from all installations shows steady growth. The fall in new installations is not easily visible in the overall graphs. As you can see in the graphs, the decarbonisation targets will probably be reached, however it might take a little longer, than originally planned, because, the number of new installations fell down in respect the predictions from the years around 2022.



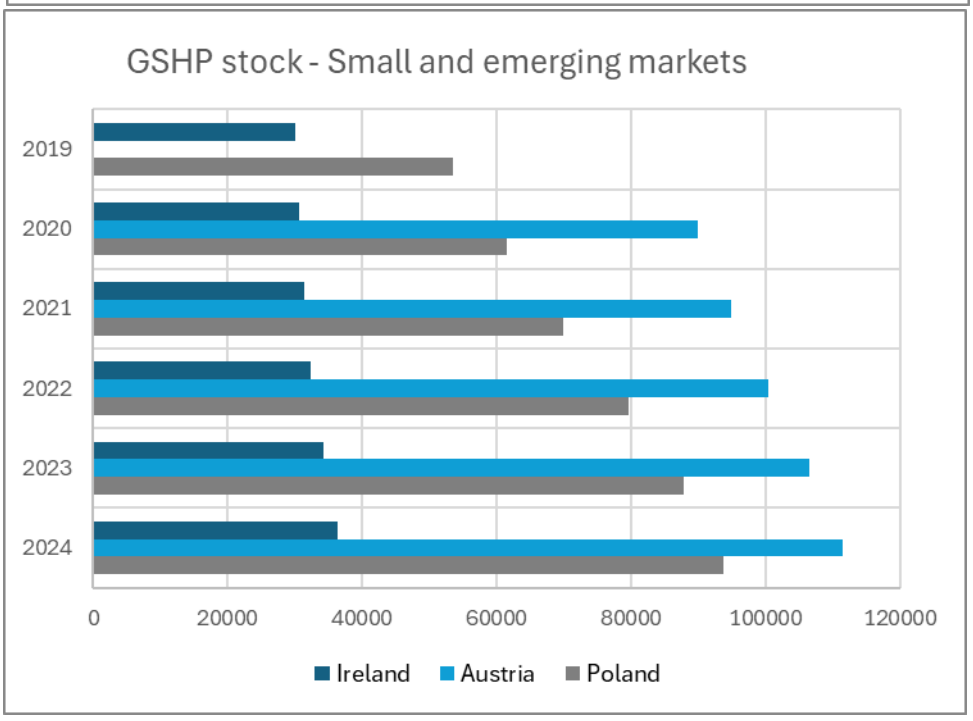


Figure 2: The stock of GSHP systems in GeoBOOST partner countries (Source: EGEC)

The following graph shows the number of ground source heat pumps (GSHPs) per 1,000 households in different countries. Sweden has the highest number, with 118 GSHPs per 1,000 households, followed by Austria with 31 GSHPs per 1,000 households. At the other end of the spectrum are Ireland and Spain, with 3.3 and 0.2 GSHPs per 1,000 households, respectively. To achieve the same number of installations per 1000 household in Ireland as that observed in mature markets, Ireland would have to increase its number of installed GHPs by 50 times compared to the current numbers. And Spain has even longer way to achieve these numbers.

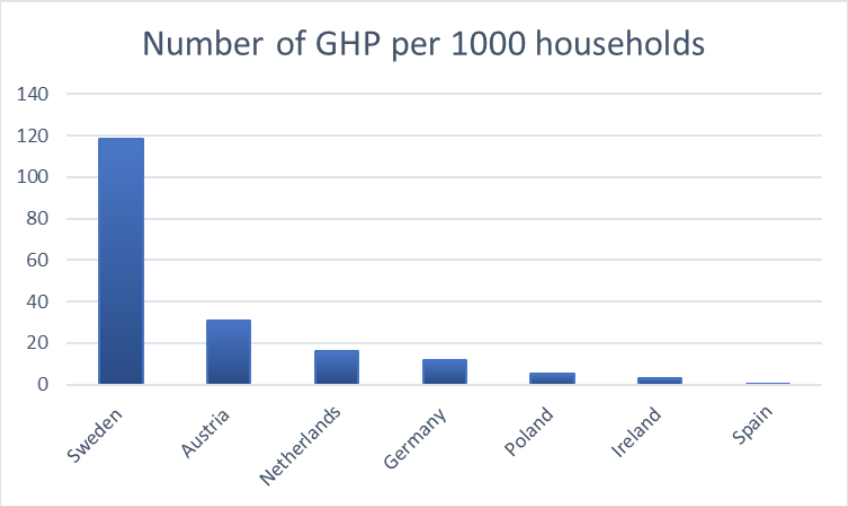


Figure 3: Number of GSHP systems per 1000 households in GeoBOOST countries (Source: EGEC)

The most common borehole diameter is 152 mm. The minimum diameter is 110 mm, which most commonly used in Sweden in mainly crystalline rocks.. This is also the case in Spain and Poland, where the price is important. Boreholes with a diameter above 180 mm are typically used in unconsolidated sediments of glacial origin in Germany and Poland.

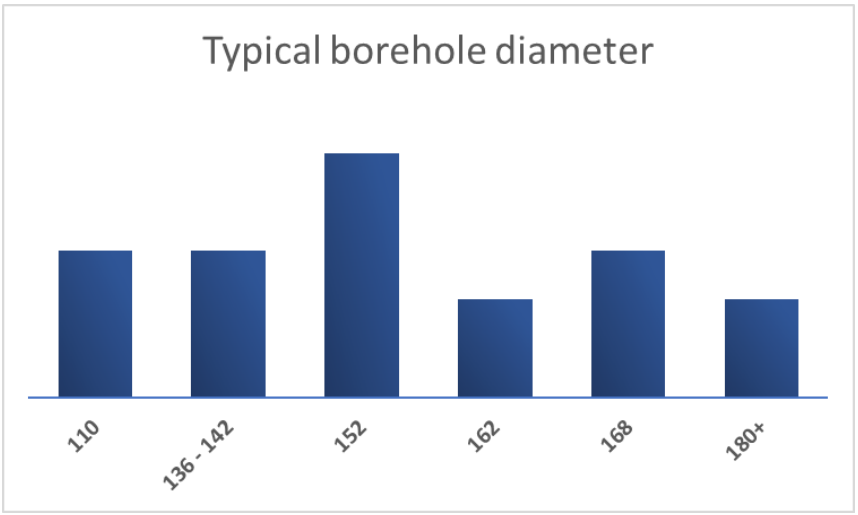


Figure 4: Typical borehole diameter based on GeoBOOST countries

The costs shown in the graph are for boreholes equipped with PE100-RC (HDPE) heat exchangers and grouting. However, grouting is usually unnecessary in Sweden, whereas it is necessary in most other markets, which increases the total cost. Market size and economies of scale also influence costs, as do labour and fuel costs. Finally, geological conditions differ significantly between countries. For instance, hard-rock drilling in Sweden, Ireland often requires different methods to drilling in unconsolidated sediments, as in the Netherlands, Poland and northern Belgium. The latter requires special borehole casing, which increases the price.

Germany has the most expensive borehole installations (between 90 and 130 EUR/m), due to the prevalence of unconsolidated sediments and the high cost of labour. The average number of drillers operating a drilling machine is three, which is excessive compared to other countries. Expensive installations can also be found in Spain (80 EUR/m), where the market is small and competition between drilling companies is therefore limited. Austria and Ireland have moderate prices (€70–80/m and €56–62/m, respectively).

Drilling is relatively cheap in Sweden (40–47 EUR/m) due to strong competition, automation, and excellent geological conditions. Granitic rocks are resistant to cave-ins in these conditions, so grouting is unnecessary, which makes the final price much lower. The cheapest installations are in Poland (€35/m), where labour and energy costs are much lower than in other countries. The second cheapest prices are in the Netherlands, where they range from 25 to 35 EUR/m. This is due to excellent automation and competition.

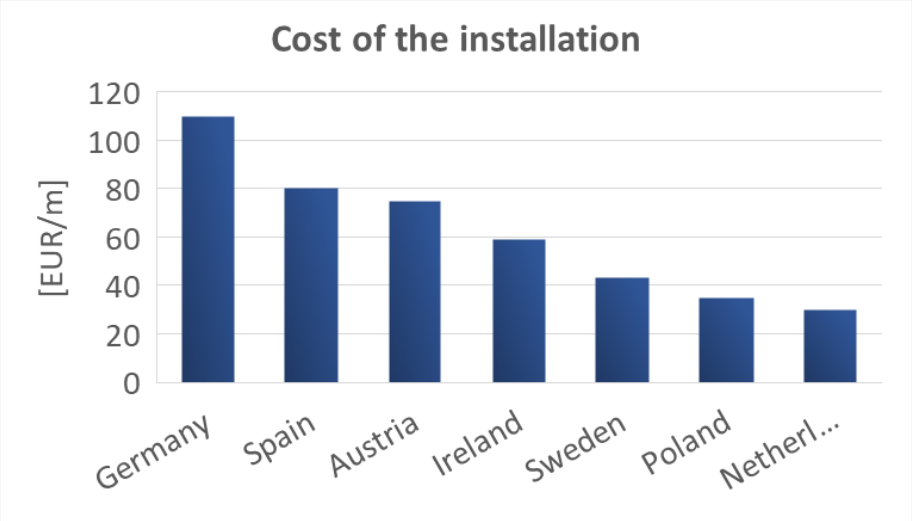


Figure 5: Cost of the installation of the borehole and the heat exchanger

District heating and cooling is one of the fastest-growing markets for geothermal energy. Although there are still only a few systems in place, the size of the borehole fields helps to decarbonise heating systems. Germany and Sweden are leading the way with this method.

Sweden

Sweden remains one of the most mature ground source heat pump (GSHP) markets in Europe, with an estimated 670,000 units installed by 2025 (an increase of 22% from 550,000 in 2022). Annual additions are stable (~27,000 in 2024 vs 28,000 in 2022). The market now focuses on replacements, optimization, and integration with PV and smart controls rather than rapid expansion. Growth reflects steady replacements and improved data accuracy. Detached homes remain dominant; multi-family and commercial fields grow gradually.

The typical borehole design is 200-320 m deep and 114 mm in diameter (some are 139 mm). Probes are mostly 'simple-U', mainly 40–50 mm in diameter, with 45-50 mm gaining share in deeper systems. Most collector working fluids are a solution of 28–30% bioethanol and water.

GSHPs are increasingly integrated with building management systems and seasonal optimisation. Stable technology enables predictable costs, while aftermarket services such as monitoring and tuning drive new margins.

Mature supply chains keep CAPEX stable; smart retrofits and PV coupling enhance payback and resilience. Typical home replacements remain financially attractive even with modest electricity price swings.

Stable standards and clear permitting (depth, diameter, fluids). The 2025 dataset now links to official SKVP (Sweden's industry association for the refrigeration and heat pump sector) statistics, improving transparency and planning confidence. GSHPs remain central to Sweden's building-sector decarbonization targets.

Strategic opportunities for GSHPs in Sweden include upgrading the large installed base of pre-2010 systems with modern compressors and variable-speed pumps, bundling GSHPs with PV and storage to enable smart self-consumption, and scaling commercial and multi-family borefields (typically 200–320 m deep with 114/139 mm diameters). Providers can also grow recurring revenue through tiered monitoring and optimization contracts, while leveraging improved datasets to build local case studies and robust CO_2 benchmarks.

Spain

Spain's GSHP market segment remains emerging compared to Northern Europe, with patchy national statistics and strong regional variation. In 2025, data scarcity persists and installation costs vary between regions and cities, which still have their own specific approval procedures. [2]

GSHP growth is shaped less by the technology than by soft costs and permitting: the legal framework for shallow geothermal is complex and varies widely by Autonomous Community, and the lack of a clear, specific framework can make licensing a practical barrier. Permitting procedures vary significantly between Autonomous Communities. For instance, Catalonia

maintains an accessible public shallow-geothermal registry (OGSCat), which contrasts with regions where groundwater concessions must be obtained via case-by-case submissions to water authorities (archive databases such as ADEPAS) [3], [4]. With Spain's cooling-dominated energy demand in the building sector, well-engineered designs (including reinjection temperature considerations for groundwater) matter, and the most scalable opportunities sit in larger non-domestic projects (commercial and public sector). This makes turn-key C&I/municipal delivery and bundled EPC+O&M attractive, because one provider can manage drilling, compliance under RITE (including regional add-ons), monitoring and long-term optimisation—reducing hydrogeology/permitting risk amid ongoing data and monitoring gaps.

Spain's GSHP market is best approached as a project-driven business where growth depends on regional relationships, permitting expertise, and anchor reference projects, rather than mass retail. Typical 2025 segment archetypes range from single-/small multi-family systems with between 2 and up to 6 boreholes, to medium buildings with 8–30, and large or district-scale schemes with 20–200+ boreholes, with 2025 providing clearer sizing bands than earlier *in the past*. Based on measured data from Catalonia (OGSCat), many residential GSHP installations are below 30 kWth, while a minority exceed 500 kWth; this helps validate the sizing bands proposed [3].

Ground source heat pump (GSHP) boreholes are typically designed to a depth of around 100 m with a diameter of 110 to150 mm. The most common probe is the 32 mm Single-U, although wider diameter Single-U probes are also used for deeper installations (around 125–200 m). Recent IGME-CSIC research shows that adoption of improved geothermal techniques (enhanced grouts, optimized probe designs) is growing in Spain; worth mentioning to reflect current best practices [5]. As ground temperatures are relatively warm, antifreeze is often not required, but becomes necessary when underground temperatures drop below 15 °C.

Open-loop GSHPs are typically concentrated in cities where aquifers are favorable (e.g., Zaragoza), but projects still face significant hydrogeology and permitting constraints. Because open-loop GSHPs rely on groundwater concessions, developers often must consult historic hydrogeological records (e.g., via ADEPAS) and navigate complex water-authority procedures; a non-trivial barrier in many basins. Where available, use publicly accessible geothermal-potential maps or regional registers to support site-selection arguments [2],[6]. Cost ranges are wide—about €200–600 per metre for drilling and roughly €1,000–3,000+ per kWth for the full system—driven by geology, access, casing/grout needs, diameter, and logistics. Spain's longer cooling seasons also improve the value proposition for reversible systems and seasonal balancing, lifting annual performance in mixed heating-and-cooling buildings. EU-supported renovation programmes keep municipal and public buildings an important channel.

Horizontal GSHPs in Spain for single-family homes typically use 200–600 m of buried pipe (often ~300–400 m across 2–4 circuits) and need about 25–50 m^2 per kWth, so an 8–12 kW home commonly requires ~200–500 m^2 of land. Collectors are usually installed in one layer, with two layers used occasionally when space is tight, and typical installed cost is €30–€50/m^2 (often quoted as €200–€400 per kWth for the horizontal collector).

Spain's technical guidance indicates horizontal GSHP collectors are typically installed with at least ~1.2 m of cover (sometimes up to ~1.5 m) and around 0.3 m minimum pipe spacing. The surface above the collector should not be paved or concreted to avoid reducing heat exchange. More broadly, horizontal collectors are generally placed when, are particularly suitable or where drilling isn't permitted and sufficient land is available, and deliver an indicative ~10–40 W/m^2 of heat transfer.

GSHPs in general compete mainly against air-source heat pumps and rooftop PV-led strategies for project budgets, but can be especially attractive for larger assets where stable heating/cooling performance, low operating cost, and noise-sensitive sites matter. To support the market-opportunity argument, reference funding instruments such as GEOTERMIA PROFUNDA (current) or historical programmes such as GEOTCASA, which have helped subsidise geothermal installations in buildings.

The biggest GSHP opportunities are project-led C&I and public-sector retrofits where cooling demand and performance stability matter, delivered through design–build–operate packages with metered KPIs and service tiers.

Austria

Austria's ground-source heat pump (GSHP) market is primarily documented through the Water Registries ("Wasserbücher") of the Federal States. These registries capture most licensed installations, but data completeness varies by system type and by state. For closed-loop borehole heat exchangers (BHEs), some states also record projects even where licensing is not required, while at least one state does not collect such data at all and another only partially (e.g., in water-protection areas). As a result, closed-loop lists are not fully complete, and performance indicators (efficiency, space-heating/cooling, DHW, SPF) are generally not collected systematically. Reported closed-loop totals increased from 23,293 installations (2022) to 27,078 (2024), with 895 new installations recorded for 2024 (vs. 704 in the earlier dataset). Typical closed-loop designs show an average BHE depth of 107 ± 36 m (based on 69% of installations with valid data) and 2.8 ± 7.6 probes per installation (71% valid data). Where specified, circulation media are typically ethylene or propylene glycol. Borehole diameters are reported around 152 mm (for U32 probes) and 168 mm (for U40 probes). Common probe configurations are double-U 32 mm (2.9 mm wall) for deeper BHEs, and double-U 40 mm (3.7 mm wall), with double-U 50 mm used for depths down to ~400 m. Indicative installation costs for single-family homes are ~€70–80 per meter, with lower unit costs for larger projects. (A note in the dataset states that the reported numbers do not include energy piles.)

For open-loop (groundwater) systems, Austria has stronger reporting coverage because a license is mandatory nationwide; therefore, the registry-based datasets are considered complete for open-loop installations. The total number of open-loop installations rose from 20,583 (2022) to 21,824 (2024), with 717 new installations recorded for 2024 (vs. 790 in the earlier dataset). Typical layouts use one abstraction well and one injection well, reported as 1 Inlet and 1 Outlet (based

on 74% of installations with valid data). However, even for open-loop systems, detailed operational data (efficiency, delivered heating/cooling, DHW, monitoring time series) are generally not stored by the authorities; permitted values exist in licenses but would need to be checked on a case-by-case basis.

For horizontal ground collectors, the data are more limited and not consistently reported across all Federal States, so the dataset is far from complete. Where documented, the most common collector type is the slinky loop, used more commonly than classic trenched horizontal collectors; geothermal baskets are also common. Typical installations are described as <100 m of pipework and <100 m^2 of area, with indicative costs of ~€30–40 per m^2. The recorded inventory is small and slightly declining, from 497 installations (2022) to 487 in (2024).

In Austria, the biggest GSHP opportunities are in fossil-heating replacement where national and regional support schemes are pushing households and building owners toward heat pumps, in large multi-building borefields and low-temperature networks for new districts and major retrofits (e.g., Vienna developments using shared fields for heating + summer tempering), and in public/portfolio projects where cities are planning long-term decarbonisation of building heat. Groundwater/open-loop can also be attractive where local conditions fit, but it's best sold as a turnkey, permit-and-risk-managed package because permitting requirements and procedures can be critical.

Germany

Close loop system in Germany has very large potential geoethermal heat pump market, it is supported by strong regulatory integration (VDI 4640, WHG, DVGW W120) and a broad installer base. Between 2023–2025, design standards stayed largely stable, but market volume and segment definitions became clearer; while the dataset doesn't state total/new system counts, broader trends indicate strong growth driven by electrification and incentives (GEG and BEG EM). Typical systems use ~102–110 m boreholes with 152–168 mm diameters in igneous rock (≥178 mm in sedimentary), mainly 32 mm double-U probes (sometimes larger or coaxial), ~25% mono-ethylene glycol, and drilling costs around €90–130 per metre (incl. grouting, excl. heat pump), alongside a shift toward more standardized designs and sector-wide reporting.

In Germany, open-loop (groundwater) heat pump systems are used mainly in single-family houses and—more importantly for market impact—in large commercial buildings and industry, where they are often cooling-led. Permitting and reporting are driven by local water authorities under the Water Resources Act (WHG), so visibility is fragmented: total and annual installation counts are generally not available, and databases typically exist only locally, are not published, and are incomplete. The typical configuration is one extraction ("inlet") and one reinjection ("outlet") well, while large systems may be built as wellfields with 2–5 extraction and 2–5 reinjection wells to meet higher loads. Where systems exceed roughly 100,000 m^3/year, annual monitoring data are more likely to exist (mostly for cooling-focused projects), and some detailed performance and energy-balance datasets exist for selected installations but are not generally

freely accessible; cost data are often tracked per installed thermal capacity rather than per drilled metre, and broader cost analysis is still being compiled.

Horizontal collectors are mainly used where sufficient land is available, typically requiring a ground area of **<~210 m²** and, as a rule of thumb, about **1.5–3× the heated floor area**, depending on load and soil conditions. Typical pipework lengths are **often below ~100 m**, scaled to the building's thermal demand and the soil's thermal properties. The most common layouts are **straight horizontal trenches** and **slinky (coil) loops**, and installed costs are commonly reported around **€50–80 per m²** for the ground collector works.

BWP/BDH graph show that Germany's heat-pump market peaked in 2023 but cooled sharply in 2024; ground-coupled heat pumps accounted for about 15,000 units in 2024 (roughly 13,000 closed-loop and 2,000 groundwater). The latest BWP estimate places the installed ground-coupled stock at ~310,000 systems around the 2024/25 year change, indicating a sizable but still niche segment compared with air-source

In Germany, geothermal heat pump economics and growth are increasingly driven by policy and professional execution: the regulatory backdrop is shaped by the 65% renewable-heating pathway linked to municipal heat planning and supported by investment subsidies for heat-pump systems, with geothermal often receiving an efficiency bonus and additional bonuses possible up to a cap. Well-designed ground-coupled systems commonly reach seasonal performance around 4+ and can deliver strong whole-life value, especially where buildings benefit from both heating and cooling. Compliance and quality assurance remain decisive—VDI 4640 and DVGW W120 underpin design, testing and drilling qualification—while open-loop projects face the highest permitting friction under water law. The largest 2025–2027 opportunities therefore lie in municipal rollout programmes, retrofit packages with smart controls, and cooling-led commercial projects bundled with monitoring-based O&M and performance guarantees, with the main risks being fragmented permitting, data gaps, and installer capacity bottlenecks.

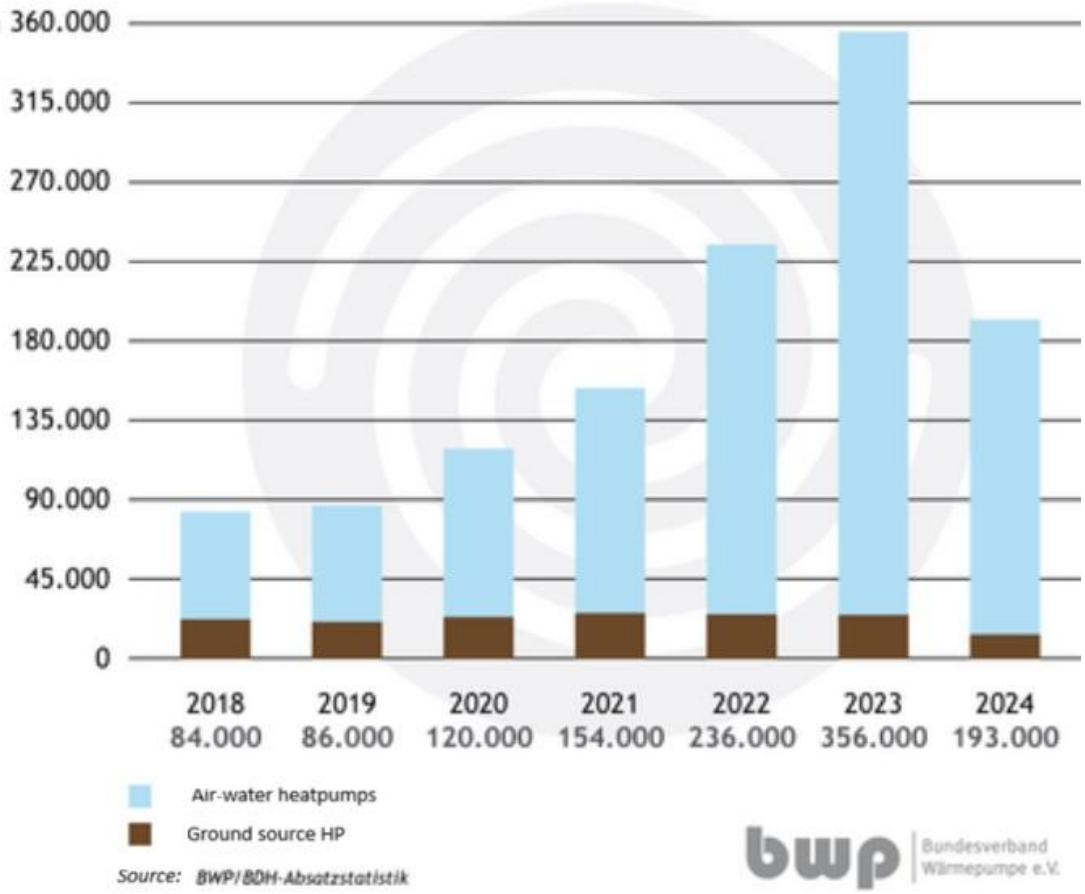


Figure 6: New installations of air-water and ground source HPs in Germany (Source: BWP [9]*)*

Ireland

In 2025, Ireland's GSHP market is still small and project-driven, with incomplete national reporting; however, Pasquali et al. 2022 [10] already recorded 18653 households and 88 larger installations using ground-source heat pumps,. Typical reference design/economic parameters cited for Ireland include ~150 m average borehole depth, ~152 mm borehole diameter, common single-U heat exchangers (often around 40 mm pipe), glycol-based heat-carrier fluids, and indicative installed borehole costs ~€56–62 per metre—so the strongest opportunities tend to be turnkey, performance-backed C&I/public projects that package design, delivery, and monitoring/O&M to reduce delivery risk.

In Ireland, open-loop GSHP systems are used mainly in large commercial buildings and industrial/process applications, while residential uptake is less common and poorly documented. The number of extraction and reinjection wells is site- and flow-rate dependent, so there is no single "typical" well-pair count. Market transparency is limited: there is no dedicated national open-loop GHP database. Information about the systems is only partial, coming from (i) an industry registers of some larger systems with estimated values and (ii) licensing records for large groundwater abstractions (>25m^3/day) recorded by Enironmental Protection Agency,

however the industry records are incomplete. Costs are therefore not reliably quoted per metre because they depend strongly on well design and the required primary-side flow rates.

In Ireland, residential horizontal GSHP systems are typically designed with around 100 m of pipework and use roughly 200 m^2 of collector area, most commonly installed as standard horizontal trenches or slinky loops. Market tracking is limited: there is no dedicated national database or register for horizontal systems, and installation volumes are not reported separately from overall GSHP figures. Reported costs are only indicative, with a stated range of approximately €2,200–€2,500 per m^2 of collector area, and performance/monitoring data are not available from public datasets.

Poland

In Poland, closed-loop GSHPs typically use boreholes around 120 m deep (most near 100 m, with larger projects at 150 m and occasional 200–250 m) and average about 5 BHEs per installation. The market is sizeable at roughly 94,000 installed systems, with about 6,000 new installations in 2024, and longer-term annual data are available. Typical probes are single-U 40 mm (mainly PE-RC), with 45 mm single-U used for deeper holes and double-U 40 mm appearing around 200 m; borehole diameters range from ~110 mm (DTH) through ~136–142 mm (sediment drilling) up to ~162–186 mm for double-U configurations. Heat-carrier fluid is mainly propylene glycol (≈80%) or ethylene glycol (≈20%), and drilling plus grouting, probe and glycol is cited at about €35/m (excluding horizontal connections). Monitoring is limited, and only about ~7% of installations are captured in the National Geological Archive.

Open-loop groundwater GSHPs remain a niche segment: systems are typically designed as a 1 abstraction (inlet) + 1 reinjection (outlet) well pair, scaled to multiple wells only when higher flow rates are needed. Public market visibility is limited because there is no single complete national installation register, and some groundwater projects are reported under brine/water statistics due to use of an intermediate heat exchanger; published market analysis puts the water/water stock in the low-thousands range.

Horizontal GSHP systems typically use about 1,000 m of pipework installed over roughly 200 m^2 of ground area, most commonly as a single-layer collector. The dominant design is the standard horizontal collector (~90% of installations), with slinky loops used less often (~10%). There is currently no dedicated database tracking horizontal loop installations.

Netherlands

In the Netherlands, closed-loop GSHP systems (including energy piles) typically use boreholes averaging ~200 m deep (range 80–350 m), with 1–2 BHEs common for single-family houses. The installed base reached about 161095 systems (2024), for family houses total 151932, with around 12,494 new installations. Typical designs use ~150 mm boreholes and mostly single-U PE probes (usually 32 mm, increasing to 40 mm for deeper ~200 m boreholes), with heat-carrier fluids such as propylene glycol, ethylene glycol, or water. Reported drilling/installation costs are about €25–

35 per metre (highly variable), and while there is limited operational monitoring, an overall SPF ~4 is reported from the national registration database. All closed loop systems require a registration, but a permit is only required if the municipality requires it. Monitoring of systems is also mandatory (exception single family houses with individual BHE) but < 70 kW you doe not need to report but keep the data on site for 10 years. A ground source energy plan gives special rules for implementation, drilling depth can be limited on a regional scale (not in a ground source energy plan) and there are of course other exclusion zones (e.g. drinking water production areas).

and key system parameters (capacity, depth, borehole count, heating/cooling, efficiency) are recorded in a public database.

Open-loop (groundwater) GSHP systems are used mainly in large commercial buildings and industry, typically with about 2–3 production/reinjection wells per system. Market statistics do not currently separate open- and closed-loop installations, so total and annual installation counts are not updated at national level. documentation exist in databases, but they are generally not public and must be requested per system. In Netherlands all open loop systems are permitted, registered and monitored by law with exception of very small systems < 10 m3/hour in some regions. Documentation exist in databases, but they are generally not public and must be specially requested. Cost varies strongly by site and design, and is therefore not reliably stated per metre; indicative investment is roughly €50k–€150k per well.

Very few horizontal systems have been implemented, and no relevant data is available. Similarly to other countries the Horizontal collectors are installed very shallow and require a large surface area, so they tend to fit rural plots much better than compact urban developments, and they are also more influenced by seasonal temperature swings than vertical boreholes. While closed systems can be registered (including horizontal loops), national reporting generally doesn't isolate "horizontal" as a separate category, so there's little aggregated, practical market evidence specific to horizontal systems.

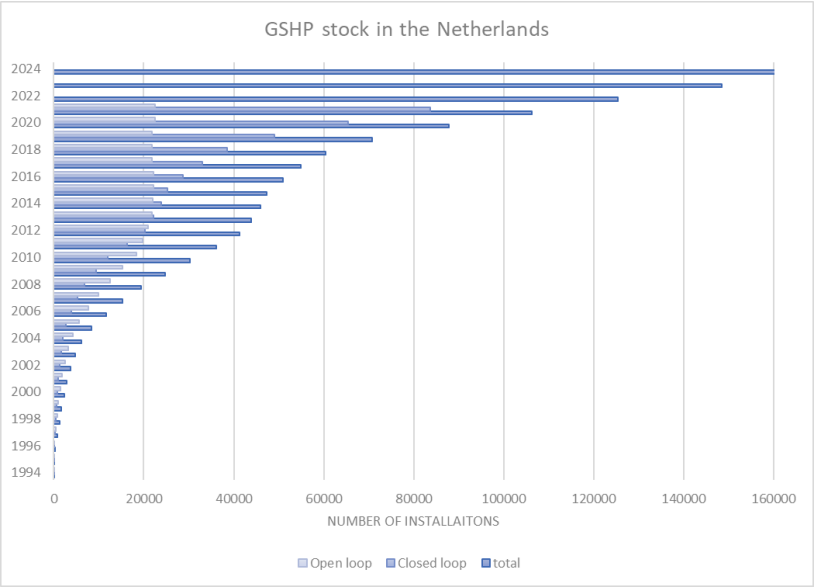


Figure 7: Ground source HP stock of open loop, close loop and total number of GSHPs in the Netherlands

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