Summary of EGC 2022 Country Update Reports on Geothermal Energy in Europe

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ABSTRACT

The European status of geothermal energy use by the year 2021 is presented. 32 countries have reported for EGC 2022, from a total of 40 with known geothermal activities in Europe. The situation varies from country to country according to the geothermal technology that best suits the available natural resource. The opportunities include power generation from high enthalpy resources, binary power production and/or direct use of hydrothermal resources in sedimentary basins, and shallow geothermal applications available everywhere, the latter mostly harnessed by ground source heat pump installations.

Geothermal power generation in Europe currently stands at 3496 MW_e installed capacity. The installed capacity of geothermal heating from medium to low temperature sources exceeds 11'600 MW_{th}, of which about half is used in district heating. Concerning shallow geothermal energy (ground source heat pumps – GSHP and Underground Thermal Energy Storage – UTES), there is still a steady growth, and a capacity of at least 30'300 MW_{th} was achieved by the end of 2021, distributed over more than 2.1 Mio GSHP installations.

1. INTRODUCTION

In most countries in Europa, geothermal energy is firmly established on the heat market, with shallow geothermal energy (GSHP) used in virtually all of Europe. Direct use of deep geothermal resources is more regionally concentrated, due to its dependence upon suitable geological settings, and is mainly used in the East/South-East of Europe, France, Germany, and some more. Recent development in Belgium and the Netherlands is very encouraging for increased direct use of geothermal energy. Geothermal power generation still is centred in few countries, with only Iceland, Italy and Turkey having substantial shares of geothermal power in the national electricity mix.

The growth of geothermal electricity is also reflected in the shares the different sectors have in installed capacity in Europe. As can be seen in Figure 1, the share of power generation capacity increased from 7.3 % to 7.7 % over three years (it was at just 6.0 % at the time of EGC 2016). Shallow geothermal plants make up the largest share of about 2/3 of all capacity installed.

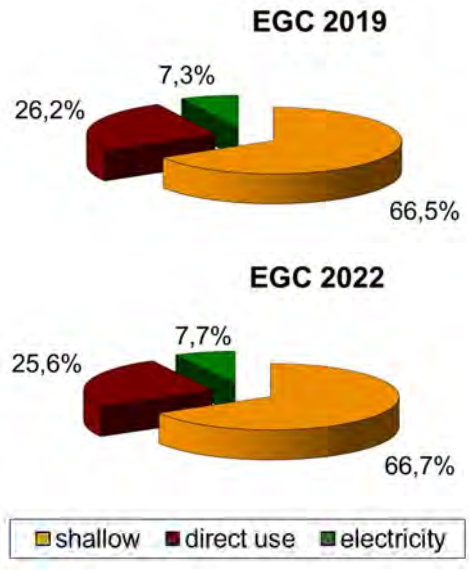

Figure 1: Share of installed capacity in the three geothermal sub-sectors in Europe as reported at EGC 2019 and EGC 2022

The coverage of the European situation by the country update reports is rather complete. 32 countries have reported for EGC 2022, from a total of about 40 with known geothermal activities in Europe (see table 1 at the end of this paper). For missing countries or data,

information was taken from previous WGC and EGC editions, where available. The EGC country update reports complement nicely the annual EGEC Market report (EGEC, 2022), which offers more details on individual installations, but is only available to EGEC members.

2. GEOTHERMAL POWER PRODUCTION

The implementation of geothermal power in Europe at the end of 2021 is listed in table 2, at the end of this paper. Figure 2 shows the development as reported at the various WGC and EGC events since 1995, and the forecast to 2028. In electricity, the minimum target of the Ferrara Declaration (EGEC, 1999) for the year 2020, set to 3000 MW_e, was surpassed in the meantime and reached almost 3500 MW_e in 2021. The average load factor is at ca. 77 % and can be expected to rise further once all new plants are in full, routine operation with start-up problems fixed. Iceland achieved an excellent average load factor of 90.1 %, and some individual plants in Europe can report values close to 100 %.

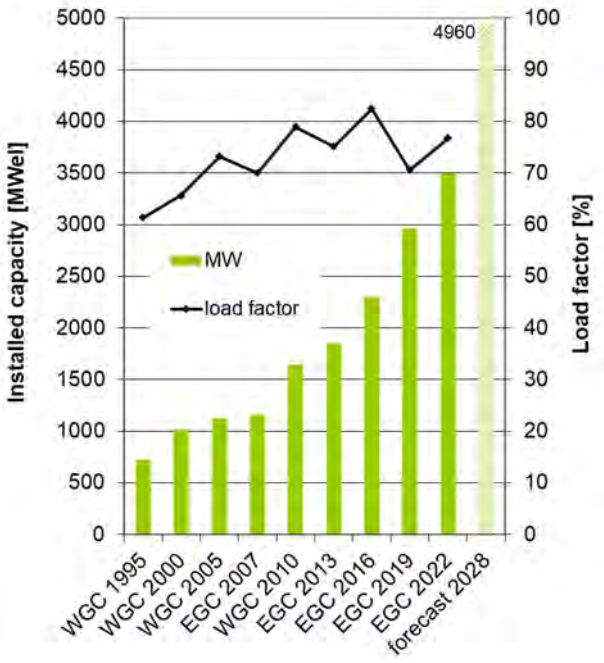

Figure 2: Installed capacity and average load factor for geothermal electricity in Europe as reported at various events, and forecast of installed capacity to 2028.

The number of countries having operational geothermal power plants remained at 10 [1], a number expected to rise to about 20 by 2028, as the data given in the reports suggest. In most of the countries considered, geothermal electricity production is growing slowly, but steadily (Figure 3), with the notable exception of Türkiye, showing a spectacular growth of about 430 MW_e in installed capacity since the last reporting (for EGC 2019, cf. Figure 4, left). Growth can be seen both in the traditional high-enthalpy areas, and in the low-medium temperature resources through the extensive utilization of binary plants technologies (e.g. in Germany).

The development of installed capacity and annual production in the currently producing countries is shown in figure 3 for the time since the reporting of WGC 2005. The extraordinary growth in Türkiye over the last decade is apparent. Installed capacity is steady on a high level in Italy, with efforts focusing on keeping production in known fields sustainable, and to develop new fields. Iceland has almost 100 MW_e of additional capacity on line, after some time without much increase. In Germany, the increase of almost 10 MW is mainly brought by two ORC plants in the Bavarian Molasse basin (Holzkirchen, 2018, and Garching an der Alz, 2021).

The development in Türkiye and Germany is shown separately in figure 4, highlighting the strong increase in geothermal power production in Türkiye, with good average load factor of about 74 %. The growth of installed capacity in Germany is on a similar trend, albeit on a much lower level; the increase in electricity production, however, lags behind. One reason is that some of the ORC-plants also provide district heating, with a higher share of the geothermal heat going into heating in wintertime. Contrary to high-enthalpy power plants, where heat is a kind of residual product, lower-temperature resources often need to divide the geothermal heat for either heating or power production. This is reflected in the relatively modest load factor of about 46 % on average for Germany.

Figure 5 shows the installed capacity for the different countries as reported at EGC 2013, 2016, 2019 and 2022, and the values expected to be reached by 2028. It can be seen from this figure that the huge potential that EGS might offer (cf. Geoelec, 2013) is not reflected in the growth expectations up to 2028. Most reported and expected geothermal power production is based on the currently available high enthalpy resources and low-to-medium-temperature binary power plants. The number of countries with current production and stated expectations is at least 20 (Figure 5). Some additional countries have not reported any expectations for 2028, albeit conducting experiments in geothermal power (e.g. Belgium), or had stated expectations in earlier reports, so the actual number of countries with geothermal power by the end of this decade might be beyond 20.

It seems like all geothermal binary power plants are of the ORC type today. The application of the Kalina technology, met with high expectations in the 2000s, apparently did not survive the harsh conditions of real power plant operation. The two known plants, Husavik in Iceland and Unterhaching in Germany, have been retired in the meantime.

[1] Russia has reported geothermal power production in the national report, however, this is not considered in this European summary, as the respective plants belong to the Circum-Pacific geothermal realm.

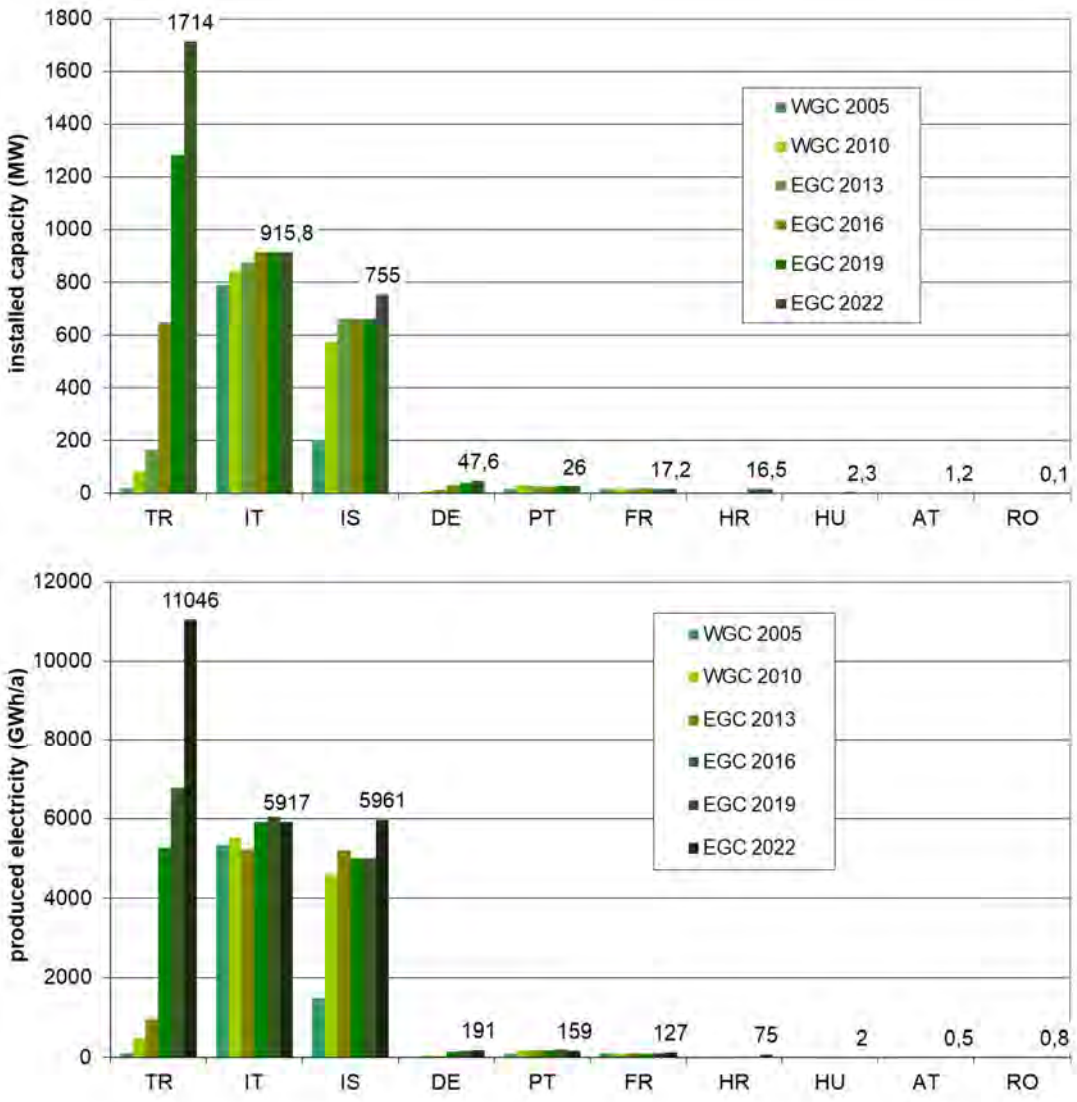

Figure 3: Installed geothermal power (top) and annual production (bottom) in Europe after country update reports since WGC 2005.

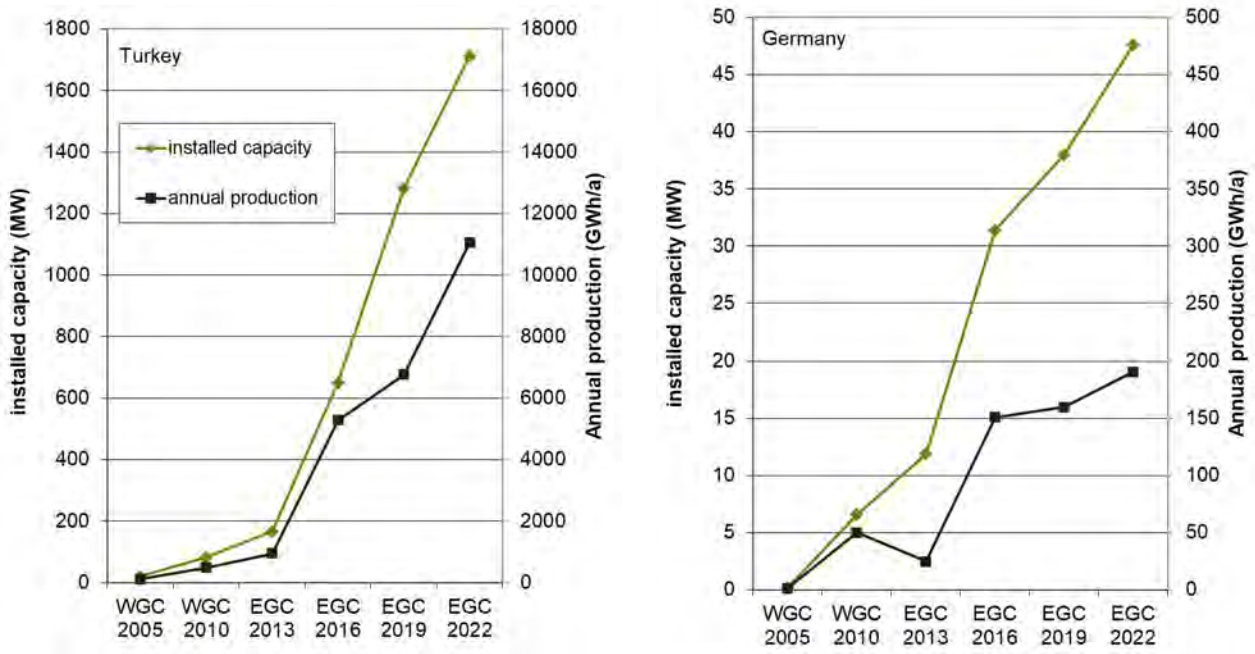

Figure 4: Development of installed geothermal power and annual production in Türkiye (left) and in Germany (right), after country update reports since WGC 2005.

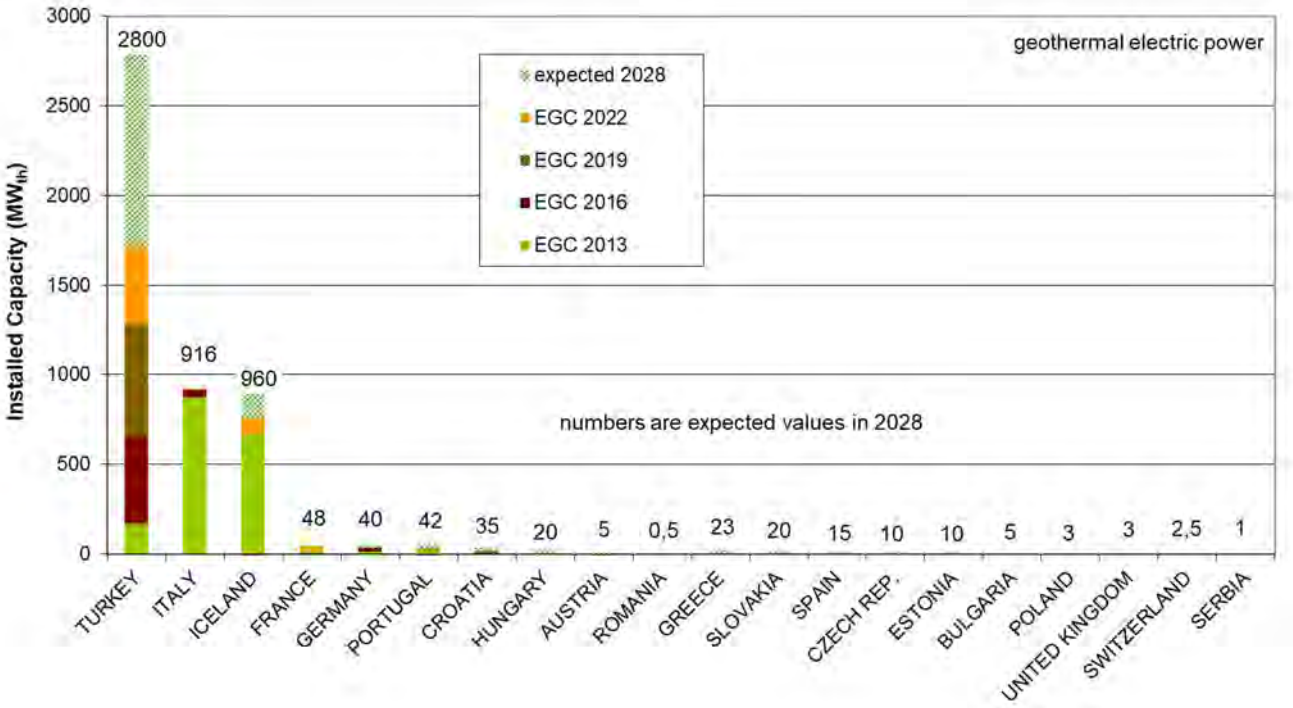

Figure 5: Installed geothermal power in Europe 2012-2021, after EGC 2013, 2016, 2019 and 2022, and reported expectations towards 2028.

3. GEOTHERMAL DIRECT USES

The reporting according to different types of direct use of (deep) geothermal resources as attempted since EGC 2013, and adjusted for EGC 2016, is working well. A meaningful distinction between district heating and other type of direct use could be made. The amount of geothermal heat used in spas and balneology was mostly reported, albeit being difficult to determine. Similar distinction meanwhile is applied for the WGC (world-wide) reports also, making comparisons easier, and allowing to fill some gaps in the EGC 2022 reporting with data from WGC 2020 (cf. Table 3 at the end of this paper).

Figure 6 shows five country-specific examples of the distribution into the different sectors, and the European mean distribution, with pie charts highlighting the big differences that can be found. 72 % of geothermal heat goes into district heating in Germany, and a remarkable 76 % in Iceland. In Hungary, geothermal heat for agriculture etc. has the biggest share with 47 %. In Italy, heat for individual buildings and other applications is in the lead with 46 %, with district heating accounting for only 10 %. More than 30 % of the heat is used for balneology and spas in Hungary, Italy and Türkiye. District heating accounts for 48 % of the heat use in Europe on average.

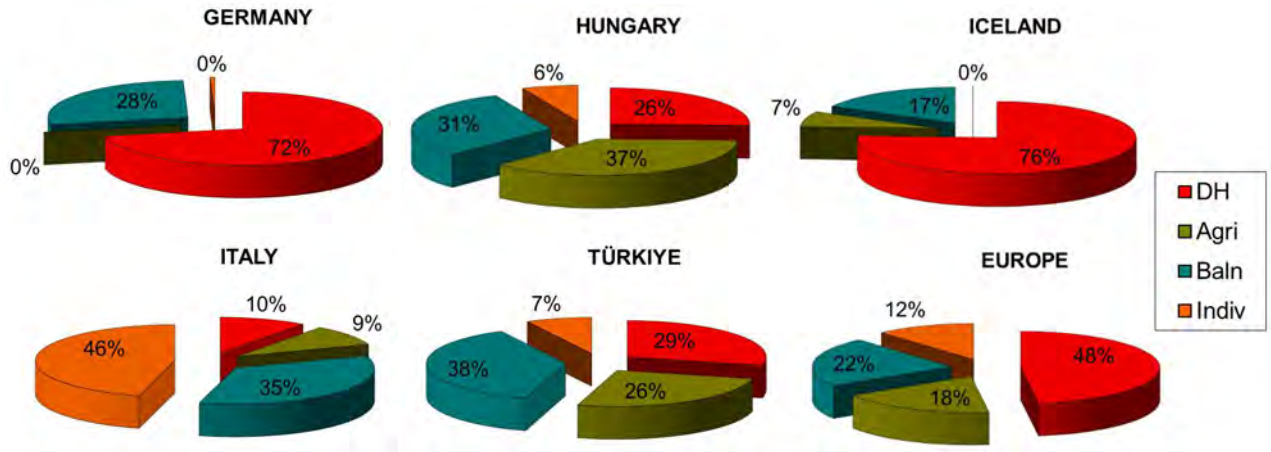

Figure 6: Share of geothermal heat production in district heating, agricultural uses, balneology and individual buildings in deep geothermal direct use in 5 European countries and in Europe on average.

The reported values for 2021 (or 2020) for each country are listed in table 3 at the end of this paper. Figure 7 shows the total values for each country and the share of geothermal district heating thereof. Some countries like Turkey, Italy, Hungary, Slovakia and the Netherlands have a high share of other direct uses and would be much undervalued if only geothermal district heating is considered. In other countries, like Iceland, France,

Germany, Romania and Poland, district heating is the main use of geothermal heat. Figure 8 is a synopsis of the values reported at the EGCs since 2013, and the forecast for 2028. Not many countries state high expectations for the future growth, with the notable exceptions of Türkiye and France. The goal of 20 GW_{th} installed capacity in Türkiye towards the end of this decade is very ambitious indeed.

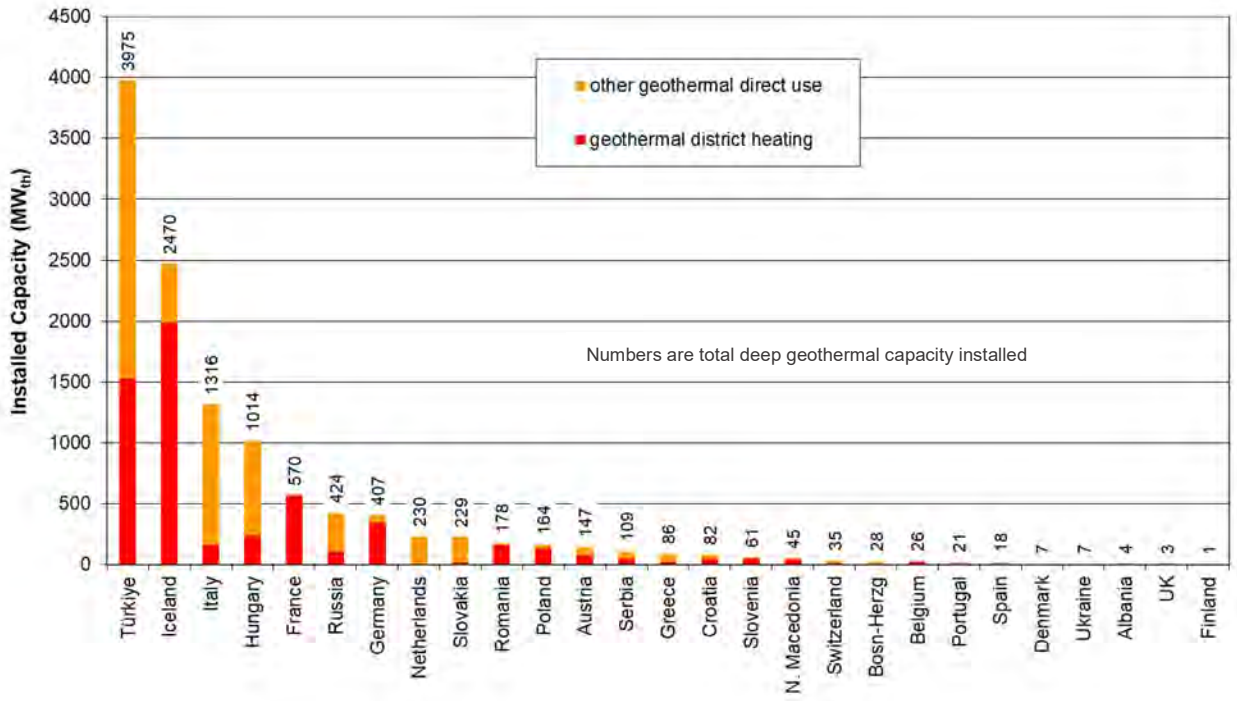

Figure 7: Installed capacity in geothermal direct use in Europe 2021, showing the share of district heating in the total deep geothermal direct use.

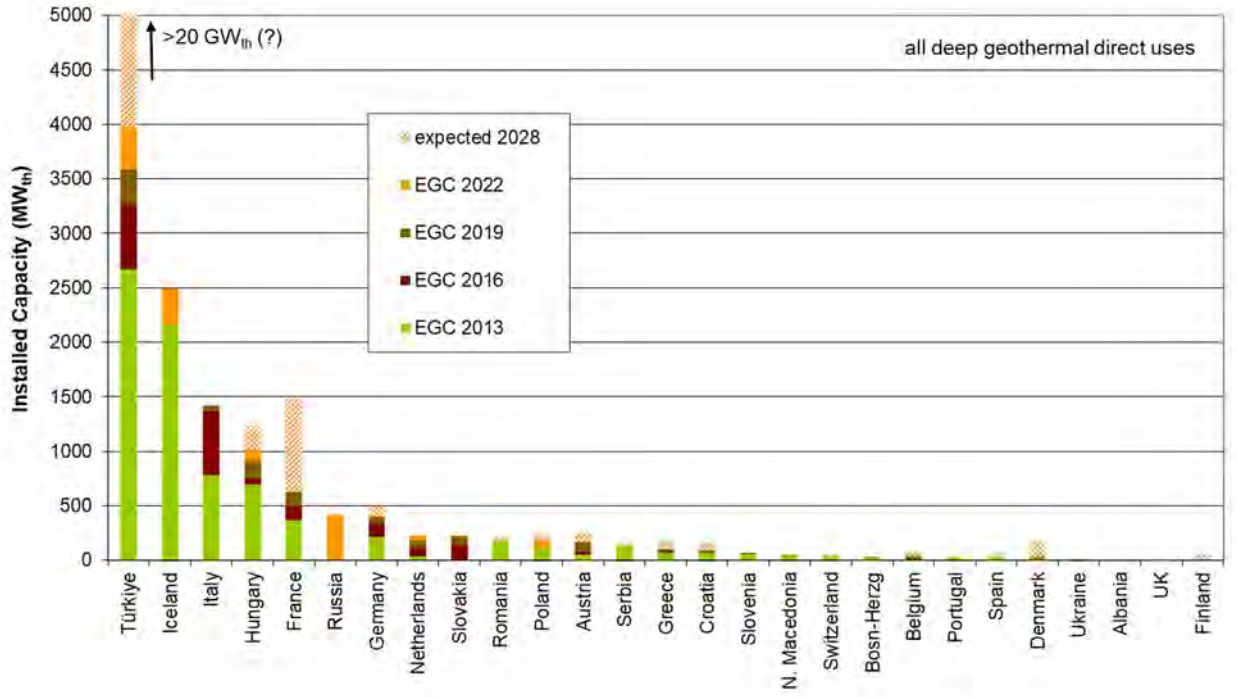

Figure 8: Installed capacity in deep geothermal direct use in Europe 2012-2021, after EGC 2013, 2016, 2019 and 2022, and reported expectations towards 2028.

4. SHALLOW GEOTHERMAL APPLICATIONS

In terms of number of installations, installed capacity and energy produced this is by far the largest sector of geothermal energy use in Europe, with the shallow geothermal share amounting to over 66 % of installed capacity (cf. figure 1). It enjoys the widest deployment among European countries; the data for 2022 from the individual countries are summarised in Table 4 at the end of this paper.

The total number of geothermal heat pumps installed in Europe is more than 2.1 Mio units. The leader by far is Sweden; Germany, with a population more than eight times larger, comes in second, France still is owns the 3rd rank, but due to a relatively low annual number of new installations might lose that soon to Finland. Figure 9 shows the numbers of installed heat pumps per country for countries with at least 1000 existing units reported, compared to the annual sales (not all countries reported the sales number).

For countries with an early market uptake in the 1980s like Sweden, Switzerland and Austria, new installations per year typically amount to ca. 2-3 % of the existing stock, a sign for a well developed market. A noteworthy exception among the "old" countries is Germany with 6.2 %, driven by an economy favourable for heat pumps and supported by policy measures and incentives. Other countries with new installations per year exceeding 6 % of the existing stock are more in the category of emerging markets; they include Denmark, Italy, Poland. Slovenia, Türkiye, the UK and the Baltic countries (cf. Figure 9).

We can see a strong demand for GSHP in many countries under the current energy price explosion in the wake of the Russian invasion of Ukraine in February 2022. A further, intensified increase in installations can be expected throughout Europe, the limiting factor currently being the shortage in supply of material and, in particular, in skilled workforce.

Heat pump unit numbers are a way to understand the markets in the individual countries. The reasons for the differences among the countries are manifold and can be attributed to energy prices, incentives, regulation, awareness, knowledge, but also active salesforce and installers. As the average size of heat pumps differ, the sheer number does not say how much capacity is installed in shallow geothermal energy within a country. The recent development of installed capacity of shallow geothermal in Europe can be seen from figure 10, where data from EGC 2013 to EGC 2022 are shown in comparison. Sweden is again the country leading by installed capacity, followed by Germany, France, Finland and Switzerland. Shallow geothermal energy is used also in some countries that did not report to EGC 2022 (Luxembourg can serve as a small, but interesting example here, with good growth and some large installations), and we can state that there is virtually no country in Europe without some shallow geothermal installation (cf. Table 4 at the end of this paper).

The ranking of countries for GSHP unit numbers or installed capacity as seen in Figures 9 and 10 does not in any way take into account the size of the respective country. Ladislaus Rybach started to show numbers corrected for the country area already in the 1990s, at various presentations and in some publications; the most recent might be Rybach and Sanner (2017), and this approach was also taken world-wide in Lund and Toth (2020). To get a sense of the areal density of GSHP in a country and to assess the limits of sustainable use, the areal approach is helpful. To understand the status and limits of a market in a country, a correction of the GSHP numbers by the number of inhabitants can be used.

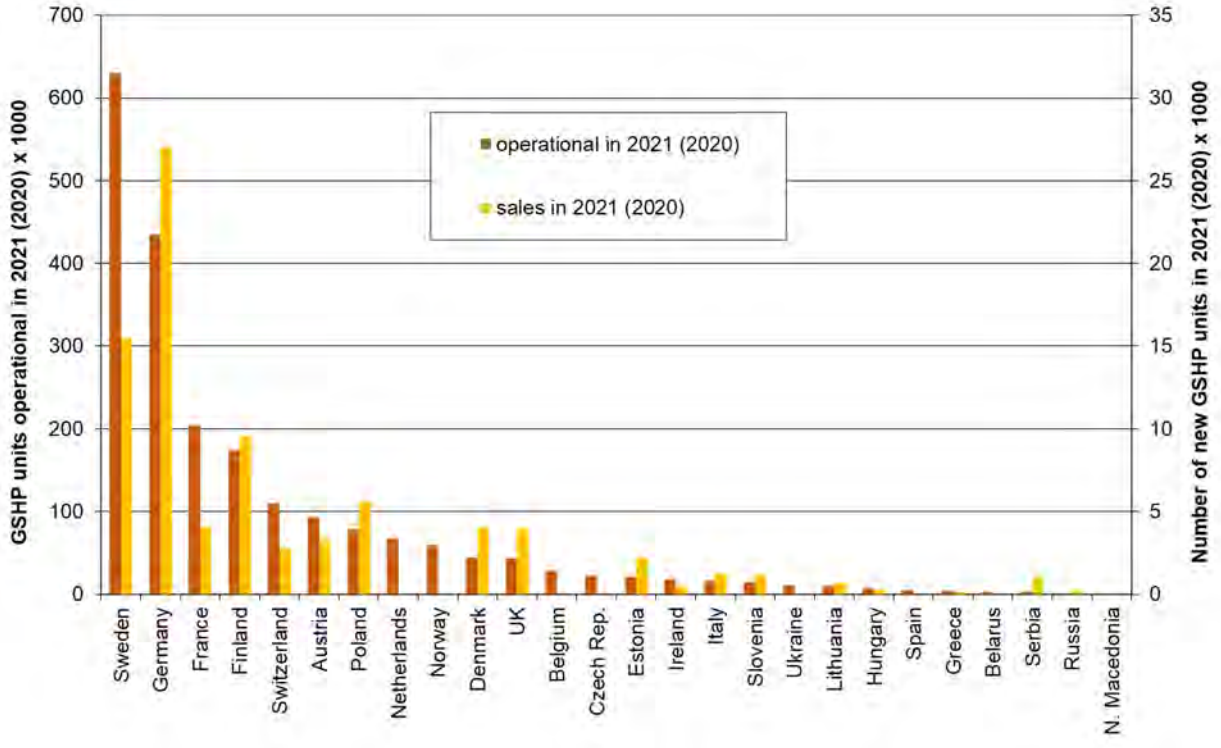

Figure 9: Total number of existing GSHP units and new sales in 2021 (some countries 2020) as stated in EGC 2022 country update reports; only countries reporting at least 1000 existing GSHP units are shown.

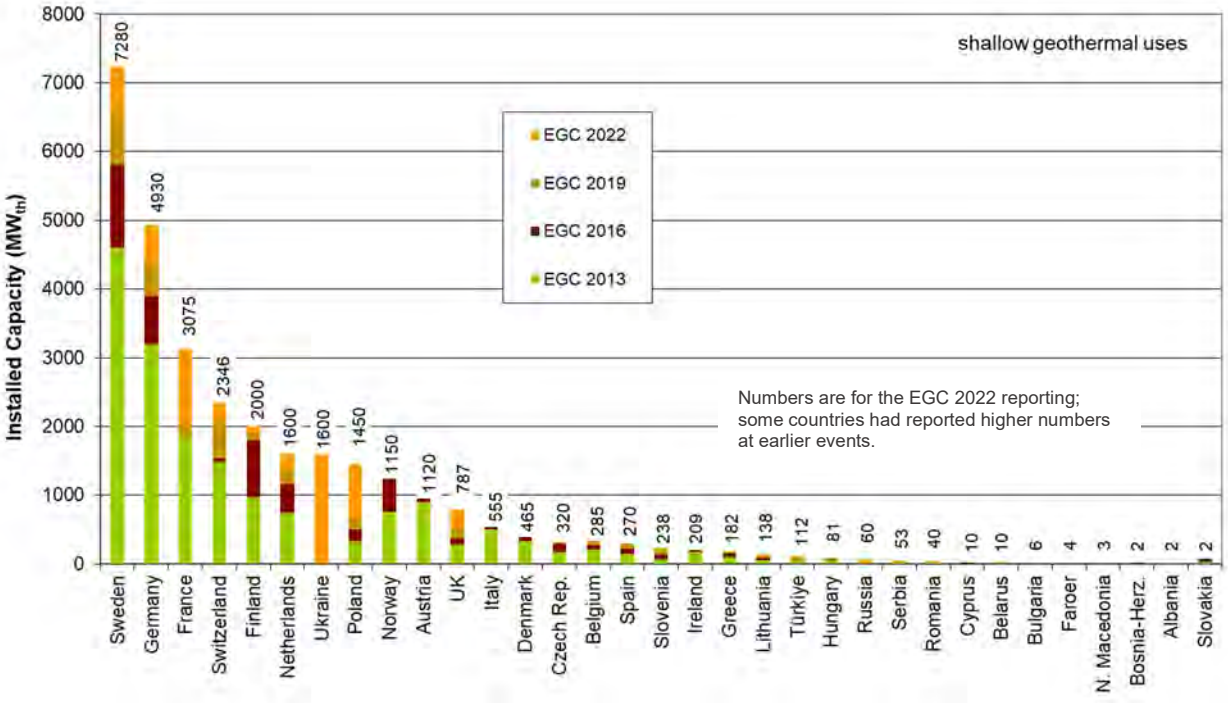

Figure 10: Installed capacity in geothermal heat pumps in Europe after EGC 2013, 2016, 2019 and 2022.

Both corrections have been applied to the EGC 2022 data on GSHP unit numbers (Figures 11 and 12). Concerning the number per area, Switzerland still owns the first rank by a good margin, followed by the Netherlands. Larger countries with a high number of units are on ranks 3 and 4 (Sweden and Germany). The rest of the Top 20 is dominated by smaller countries again (Austria, Denmark, Belgium etc., cf. Figure 11). From these data it is understandable that Switzerland was the first country to work on the sustainable extraction of heat from the shallow underground and to develop methods and regulations for balancing or recharging the thermally influenced underground volumes.

Looking at the GSHP units per inhabitants (Figure 12), the countries with the highest market penetration stand out. The Scandinavian and Baltic countries are high on the list, with Sweden and Finland taking the top places. Switzerland and Austria are on rank 4 and 6, respectively, and Germany with its population of >83 Mio just makes it to rank 10, despite being second in total numbers (Figure 9).

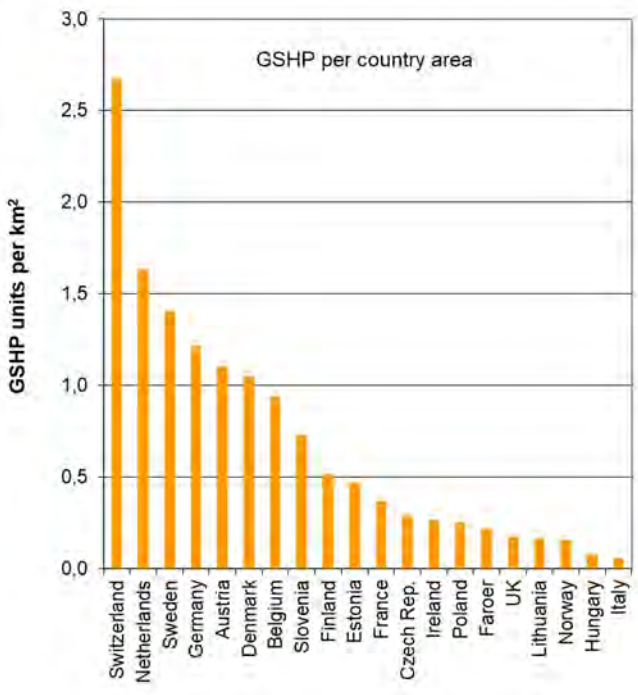

Figure 11: GSHP units per country area in 2020/21, top 20 countries only.

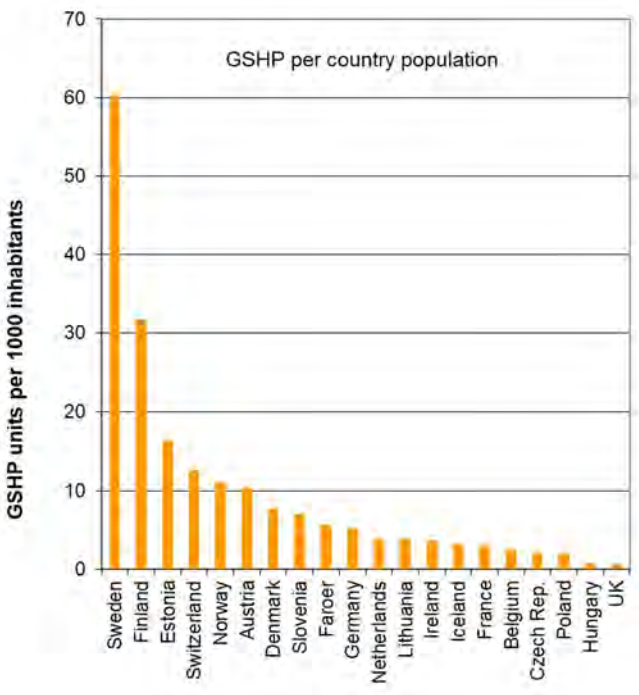

Figure 12: GSHP units per country population in 2020/21, top 20 countries only.

5. MARKET SITUATION

Not all countries reported on the financial aspects and workforce requirement of the geothermal market. Hence the numbers given here should be considered as a minimum only. Investment in geothermal energy was at least 12 billion € in 2021, with the highest share for shallow geothermal energy (Figure 13). The second highest is for electric power, in line with the big increase in installed capacity in Türkiye. However, the investment as reported for EGC 2022 is significantly lower as for EGC 2019, albeit virtually the same countries reported. Türkiye and Sweden are the countries with the highest investment in geothermal energy by far (Figure 15), while values for Germany have not been reported.

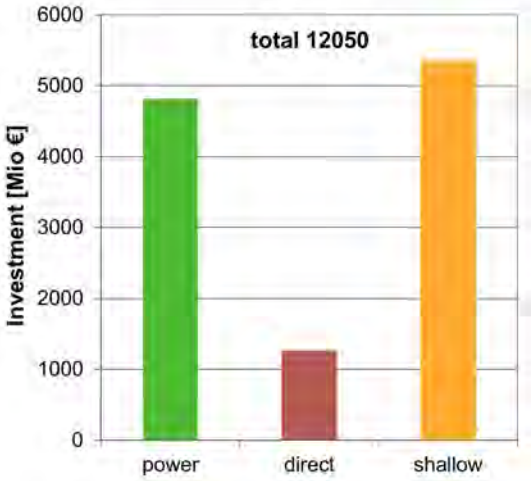

Figure 13: Investment in the different fields of the geothermal sector (only 20 countries reporting, for a further 6 countries values from WGC 2020 were used)

For employment, we can state that at least 27'000 persons work in the geothermal sector, somewhat less than reported for EGC 2019 (34'000 persons); for EGC 2016, an even higher number was reported (36'000 persons). It is not clear if that is a real trend, or if more accuracy in reporting has replaced overestimation. The shallow geothermal sector definitely dominates the workforce (Figure 14), with about 20'000 persons, half of which in Sweden only (Figure 15). The true number of geothermal personnel in Europe will be definitely higher, considering the limited number of countries reporting, and partial sectoral reporting only in some cases.

The breakdown of investment and personnel per country is shown in figure 15 for the larger reporting countries.

6. CONCLUSIONS

In geothermal power, Turkey has strengthened its position further with very dynamic development, while Iceland has a moderate and Italy virtually no growth. Furthermore, the players in particular from Iceland are active elsewhere in the world to develop new geothermal projects and to transfer their experience.

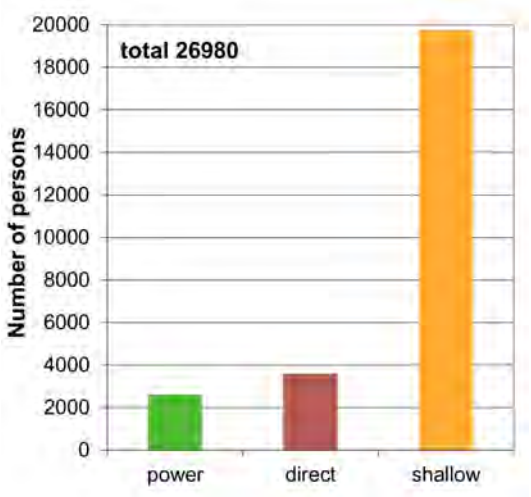

Figure 14: Number of persons working in the different fields of the geothermal sector (only 22 countries reporting, for a further 5 countries values from WGC 2020 were used)

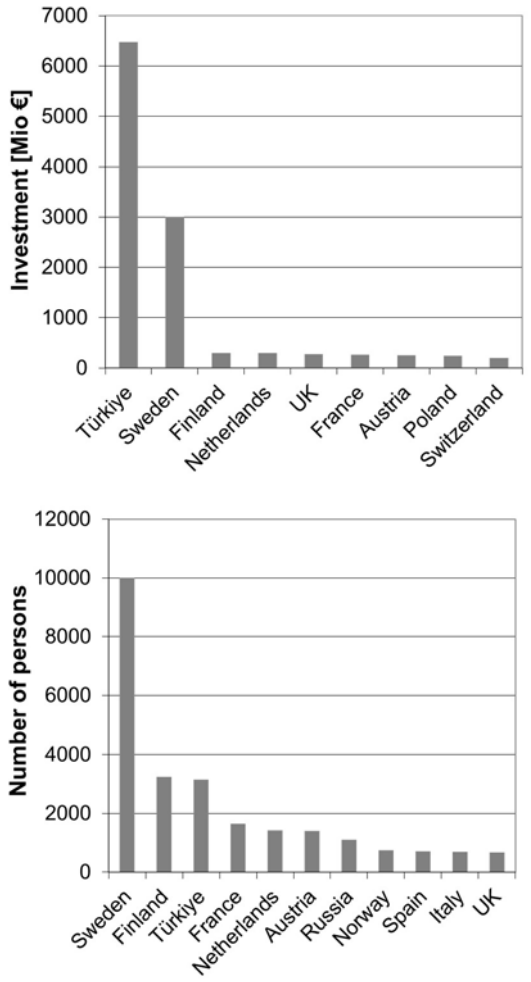

Figure 15: Total geothermal investment for countries with more than 100 Mio €/a (top) and personnel in countries with more than 500 geothermal workers (bottom)

For direct uses, some countries have a good development in the agricultural sector, in particular the Netherlands and Hungary. District heating is growing steadily, however, the share of district heating in all direct uses

of geothermal energy decreased slightly to 46 %. The shallow geothermal sector has a sound development, with poor sales numbers in some countries (France is still an example), and positive markets in others. Germany is an example for a good market development driven by policies and incentives, and some other markets with substantial growth include Denmark, Italy, Poland. Slovenia, Türkiye, the UK and the Baltic countries.

The country update reports for WGC and EGC still serve an important task, as national statistics cannot (yet?) deliver the data and insights requested. Documents like the EGEC Market Report are intended for use in industry (and limited in availability, e.g. for members only). The individual country updates and summary reports are a source open to everybody. For more detail on the resources, technology and policies, readers are encouraged to study the individual country update reports that form a part of the EGC 2022 proceedings.

REFERENCES

Antics, M., Sanner, B.: Status of Geothermal Energy Use and Resources in Europe, *Proc. EGC 2007*, Unterhaching, paper #082, 1-8 (2007).

Antics, M., Bertani, R., Sanner, B.: Summary of EGC 2013 Country Update Reports on Geothermal Energy in Europe, *Proc. EGC 2013*, Pisa, paper keynote-1, 1-18 (2013).

Antics, M., Bertani, R., Sanner, B.: Summary of EGC 2016 Country Update Reports on Geothermal Energy in Europe, *Proc. EGC 2016*, Strasbourg, paper K1, 1-16 (2016).

EGEC: Ferrara Declaration / Dichiarazione di Ferrara. *EGEC Business Seminar Ferrara,* Brussels, 1-2, (1999). [2]

EGEC: 2021 EGEC Geothermal Market Report – Full Report. EGEC, Brussels, restricted to EGEC members. (2022). [3]

Geoelec: A prospective study on the geothermal potential in the EU, *D2.5, Geoelec*, Brussels (2013), 1-97

Lund, J.W., Toth, A.N.: Direct Utilization of Geothermal Energy 2020 Worldwide Review. *Proc. WGC 2020*, Reykjavik, Iceland (2020).

Rybach, L., Sanner, B.: Geothermal Heat Pump Development: Trends and Achievements in Europe. in: Bertani, R. (ed.), Perspectives for Geothermal Energy in Europe, 215-253, World Scientific Publishing, New Jersey (2017)

Sanner, B.: Summary of EGC 2019 Country Update Reports on Geothermal Energy in Europe. *Proc. EGC 2019* Den Haag, paper CUR-00, 1-14 (2019).

Acknowledgements

The authors of this summary like to sincerely thank all contributors to the country update reports for EGC 2022 (see table 1), who devoted considerable time and effort to research, verify and write the individual country papers. These papers, as available in the proceedings of EGC 2022, give a detailed account of geothermal resources, regulatory framework, actual use and potential future development in the individual countries, and enabled the authors of this summary to once again endeavour in painting the overall picture of the development in Europe.

[2] for download e.g. at: https://www.sanner-geo.de/media/a9008fdc446be240ffff800effffffef.pdf
[3] "Key Facts" for download at: https://www.egec.org/wp-content/uploads/2022/06/MR21_KF.pdf

Table 1: EGC 2022 country update reports.

Author(s)	Country
Polo, N., Kodhelaj, N., Bozgo, S., Karamani, E., Aliko, A., Shehaj, E.	Albania
Goldbrunner, J.E., Goetzl, G.	Austria
Dupont, N., Petitclerc, E., Broothaers, M., Kaufmann, O.	Belgium
Samardžić, N., Hrvatović, H., Skopljak. F.	Bosnia and Herzegovina
Deneva, B., Kolev, S., Valchev, S., Toteva, A.	Bulgaria
Živković, S., Kolbah, S., Tumara, D., Škrlec, M., Bilić, T., Vajdić, M.	Croatia
Mathiesen, A., Nielsen, L. H., Vosgerau, H., Erbs Poulsen, S., Andersen, T.R., Tordrup, K.W., Røgen B., Ditlefsen, C., Vang-kilde-Pedersen, Th.	Denmark
Soesoo, A., Bauert, H.	Estonia
Arola, T., Wiberg, M.	Finland
Schmidlé-Bloch, V., Pomart, A., Boissavy, C., Maurel, C., Philippe, M., Cardona-Maestro, A., Genter, A.	France
Weber, J., Born, H., Pester, S., Schifflechner, C., Moeck, I.	Germany
Mendrinos, D., Karytsas, C., Kapiris, M., Papachristou, M., Dalampakis, P., Arvanitis, A., Andritsos, N.	Greece
Nádor, A., Kujbus, A., Tóth, A.	Hungary
Ragnarsson, Á., Steingrímsson, B., Thorhallsson, S.	Iceland
Pasquali, R., Blake, S., Braiden, A.K., McCormack, N.	Ireland
Della Vedova, B., Bottio, I., Cei, M., Conti, P., Giudetti, G., Gola, G., Spadoni, L., Vaccaro, M., Xodo, L.	Italy
Zinevičius, F..	Lithuania
Provoost, M., Agterberg, F.	Netherlands
Popovska-Vasilevska, S., Stavreva, S.	North Macedonia
Kępińska, B., Hajto, M.	Poland
Nunes, J.C., Coelho, L., Martins Carvalho, J., do Rosário Carvalho, M.	Portugal
Gavriliuc, R., Rosca, M., Cucueteanu, D.	Romania
Svalova, V.	Russia
Oudech, S., Djokic, I.	Serbia
Fričovský, B., Marcin, D., Benková, K., Černák, R., Fordinál, K., Pelech, O.	Slovakia
Rajver, D., Lapanje, A., Rman, N., Prestor, J.	Slovenia
Arrizabalaga, I., De Gregorio, M., De Santiago, C., García de la Noceda, C., Pérez, P., Urchueguía, J.F.	Spain
Gehlin, S., Andersson, O., Rosberg, J.-E.	Sweden
Link, K., Minnig, C.	Switzerland
Mertoglu. O., Şimşek, Ş., Başarir, N., Paksoy, H., Cetin, A.	Türkiye
Abesser, C., Curtis, R., Raine, R., Claridge, H.	United Kingdom
Morozov, Y., Barylo, A., Lysak, O.	Ukraine

Further Countries with known geothermal activities in Europe (mainly shallow geothermal)		
Country	Type of activity	Latest reporting
Belarus	Resource exploration, GSHP	EGC 2019, WGC 2020
Cyprus	R&D, GSHP	EGC 2019, WGC 2020
Czech Republic	Resource exploration, R&D, GSHP	EGC 2019, WGC 2020
Faroe Islands	Resource exploration, GSHP	WGC 2020
Latvia	R&D, GSHP	*WGC 2015 (only policies)*
Luxembourg	GSHP	*Personal communications*
Montenegro	Resource exploration, *GSHP ?*	EU-project LEGEND 2012-14
Norway	Resource exploration, R&D, GSHP	EGC 2019, WGC 2020

Table 2: Geothermal Electric Power in Europe in 2020/21.

	2021 installed capacity	2021 electricity produced	2021 load factor	Inst. cap. expected 2028
	[MW_{el}]	[GWh_{el}/yr]	[%]	[MW_{el}]
Austria	1.2	0.5*	4.8*	5
Belgium				*4.5*
Bulgaria				5
Croatia	16.5	74.7	51.6	34.8
Czech Republic				*10*
Estonia				10
France	17.2	127	84.3	42.2
Germany	47.6	190.6	46.7	47.6
Greece				23
Hungary	2.3	2.0	9.9	20
Iceland	755	5961	90.1	960
Italy	916	5917	73.8	916
Poland				*3*
Portugal	26	158.9	69.8	40
Romania	0.1	0.8	91.3	0.1
Serbia				1
Slovakia				20
Spain				15
Switzerland				5
Türkiye	1714	11046	73.6	2800
UK				3
Total	3496	23478	average 76.7	4958

* low load factor due to Altheim plant not operational

Italics: No expectations for 2028 reported to EGC 2022, but to EGC 2019 for the year 2025.

Table 3: Geothermal Direct Use in Europe in 2020/21.

	Geothermal DH Plants		Geothermal heat in agriculture		Geothermal heat in balneology		Geothermal heat in other and indiv. Bldg.	
Country	Capacity [MW_{th}]	Production [GWh_{th}/yr]	Capacity [MW_{th}]	Production [GWh_{th}/yr]	Capacity [MW_{th}]	Production [GWh_{th}/yr]	Capacity [MW_{th}]	Production [GWh_{th}/yr]
Albania	1.9						1.9	9.2
Austria	75.1	223.6	18.8	63.0	43.1	350.0	9.8	24.0
Belgium	25.5	17.7						
Bosnia-Herz.			0,84	0,986	9,55	16,304	17,36	43,64
Bulgaria			*1.7*	*9.2*	*91.1*	*415.6*	*3.3*	*18.0*
Croatia	42.3	21.1	6.8	19.4	18.3	14.0	14.1	11.2
Cyprus			*0.07*	*0.01*				
Denmark	7.0	15.0						
Finland	1.0	1.5						
France	570	1733		236		31		
Germany	345.8	1233.1			56.8	474.6	4.38	10
Greece	17	52	24	76	43	72	2	5
Hungary	235.3	641.4	429.5	925	263	778.5	86.1	163.4
Iceland	1990	7551	145	672	335	1714		
Italy	164	238	147	221	387	813	618	1078
Netherlands			230	1546				
N. Macedonia	42.6	106	2.8	12.5				
Poland	137.5	281.5	4	6	12	35	10	25
Portugal	2.1	12.3			17.1	125	2.0	3.2
Romania	160	305.2	8	50	10	12		
Russia	110	600	200	1000	4	18	110	600
Serbia	47.7	113.9	11.6	61.7	35.5	182.7	14.5	71.1
Slovakia	20.6	64.2	41.2	81.3	134.2	245	33.4	80.2
Slovenia	49.6	99.1	6.4	30.4	3.2	3.9	1.6	1.6
Spain	2.6	14.6	14.9	26.2				
Switzerland	11.7	30.1			22.3	185.3	1.1	2.3
Turkey	1528	4840	821.5	4327.3	1205	6338.4	420	1288.5
UK	1.7	20.1			1	9.4		
Ukraine					7	26.8		
Total	5588.9	18214.4	2114.2	9363.	2698.1	11860.3	1349.5	3434.3

Italics: Values from WGC 2020.

Table 4: Ground Source Heat Pump Use in Europe in 2020/21.

Country	Number of GSHP	Capacity [MW_{th}]	Production [GWh_{th}/year]	kW_{th} per unit	Full-load hours per year
				Calculated from reported data	
Albania		1.9			
Austria	92400	1120	1850	12.1	1652
Belarus	*3000*	*10*	*40.3*	*3.3*	*4031*
Belgium	*28782*	*284.6*	*1027.5*	*9.9*	*3610*
Bosnia-Herzeg.	500				
Bulgaria			1174		
Cyprus	*175*	*10.2*	*18.1*	*58.5*	*1766*
Czech Rep.	*22740*	*320*	*472*	*14.1*	*1477*
Denmark	45000	465	815	10.3	1753
Estonia	21260				
Faroe Islands	*304*	*3.7*	*5.6*	*12.0*	*1519*
Finland	175000	2000		11.4	
France	205000	3075	4770	15.0	1551
Germany	435000	4930	7140	11.3	1448
Greece	3878	182	478	46.9	2626
Hungary	7353	80.9	161.	11.0	1991
Iceland	120	1.2	5	10.0	4167
Ireland	18746	209	269	11.1	1287
Italy	16145	555	946	34.4	1705
Lithuania	10647	138.2	314.3	13.0	2274
Netherlands	68000	1600	1352.8	23.5	845
N. Macedonia	1000	2.5	21	2.5	8400
Norway	*60000*	*1150*	*3502.8*	*19.2*	*3046*
Poland	78400	1450	1850	18.5	1276
Portugal	54	0.7	0.9	12.0	1340
Romania	600	40	100	66.7	2500
Russia	1200	60	270	50.0	4500
Serbia	2850	52.6	116.9	18.5	2223
Slovakia	10	1.6	14.2	160.0	8875
Slovenia	14818	237.8	329.3	16.0	1385
Spain	4889	270.2		55.3	
Sweden	630000	7280	25500	11.6	3503
Switzerland	110247	2345.5	3797.9	21.3	1619
Turkey	161	112	984	695.7	8786
UK	43700	787	1316	18.0	1672
Ukraine	11000	1600	1386	145	866
Total	2112979	30376	58642	average 14.4	average 1931

Italics: Values from WGC 2020.