REGEOCITIES

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Analysis of Market for Shallow Geothermal Energy

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Table of Contents

1. Introduction

We stand on a frequently untapped source of renewable energy: geothermal energy, energy in the form of heat beneath the surface of the earth. By using borehole heat exchangers, SGS (0-400 m depth) can extract thermal energy to be used in the heating and cooling systems of buildings and for domestic hot water. The average energy savings, if the technology is used properly, are as much as 50% in winter and 40% in summer. The resource is both valuable and under-exploited. In some municipalities, the technology is simply not used and there is no regulatory system. In other countries, where geothermal is widely adopted, we sometimes see over regulation.

The ReGeoCities project has been developed with the overarching objective to facilitate the 2020 target for shallow geothermal energy, notably through the implementation of Article 13 of Directive 2009/28/EC concerning the simplification and streamlining of administrative and regulatory procedures.

The project covers the following eleven EU countries:

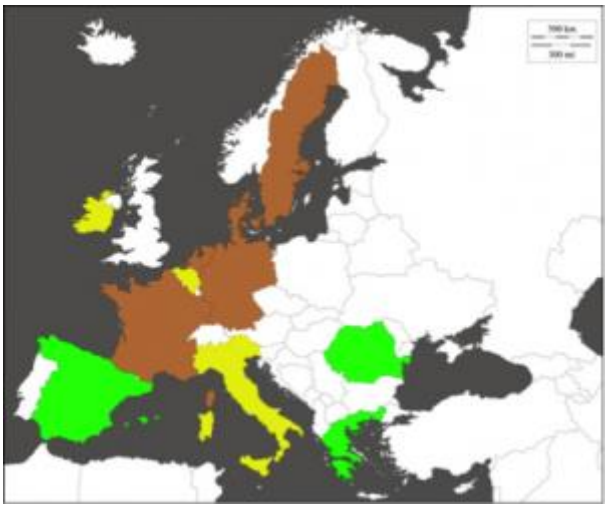

Fig. 1 ReGeoCities project countries

Green - Juvenile GSHP market: Spain, Romania, Greece
Yellow - Consolidated GSHP market: Ireland, Belgium, Italy
Brown - Mature GSHP market: Germany, France, Denmark, The Netherlands, Sweden

The intention of this third and final edition of the annual monitoring report within project Regeocities is to assess the initial impact of the project and to update the available statistical data since the first report in 2013 and the second in 2014.

2. Evolution of renewable heat from shallow geothermal in project countries

As can be seen from figure 2, there was a steady increase of heat production from geothermal heat pumps in the Regeocities partner countries from 2011 to 2013, with about 9-10 % per year. The total production in the Regeocities partner countries amounted to 1270 ktoe in 2013, of an EU total of 1706 ktoe.

Figure 3 gives a more detailed view of the countries with large and small markets, where a substantial increase can be seen in most countries with smaller markets. In several countries, the markets had experienced a severe setback in sales after the financial crisis of 2008, as can be shown by the example of Ireland in figure 4; meanwhile most are recovering, and market effects currently are felt from various other sources.

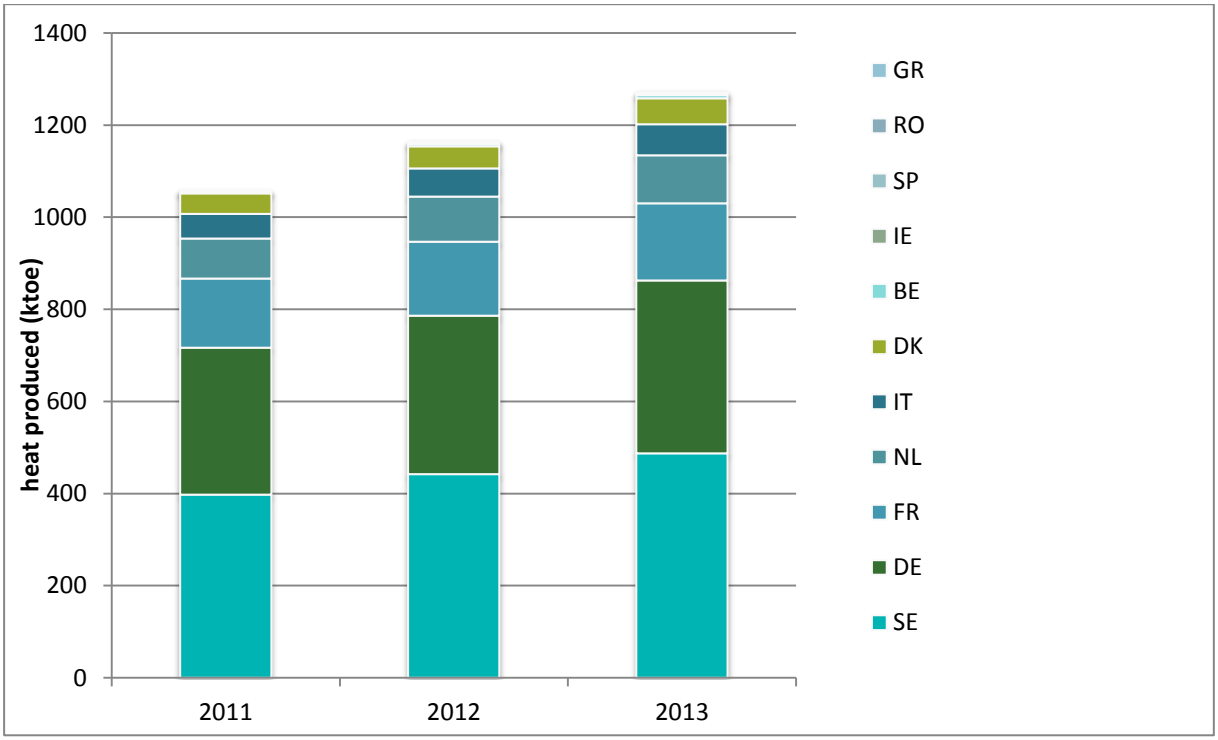

Fig. 2: Heat produced by the existing geothermal heat pumps in the Regeocities project countries for the years 2011-2012, after EurObserv'ER Heat Pump Barometer and EurObserv'ER Report #14 (values for 2013 calculated by EGEC, assuming the same production per unit as in 2012)

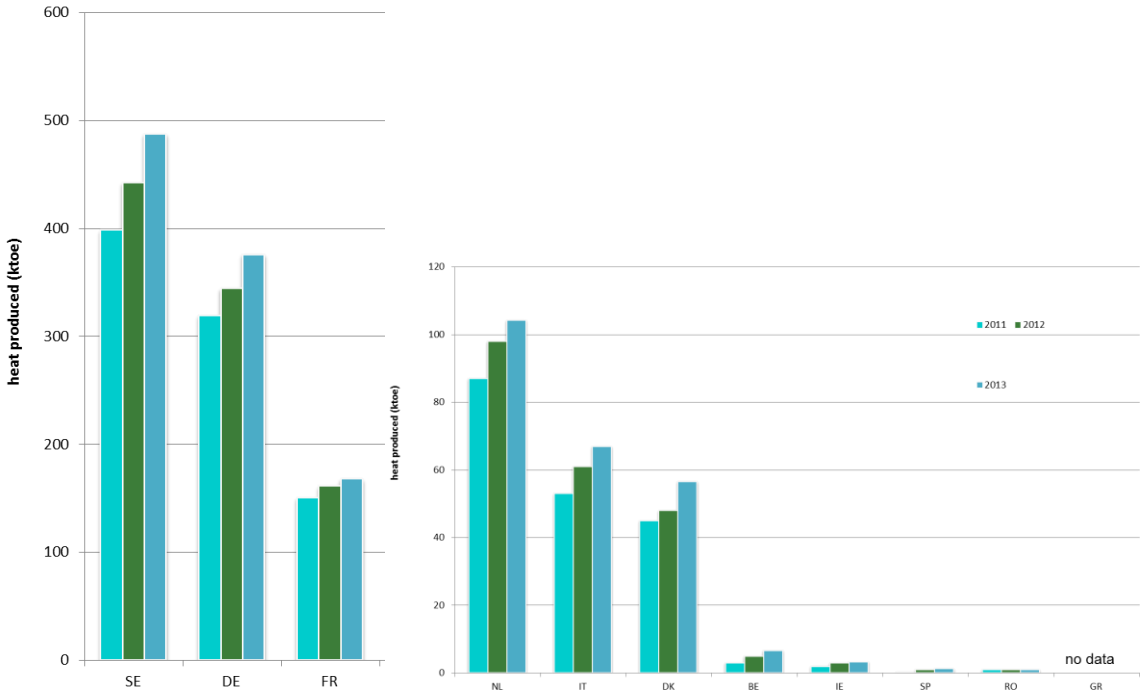

Fig. 3: Heat produced by the existing geothermal heat pumps in the Regeocities project countries with larger (left) and smaller (right) markets for the years 2011-2012, after EurObserv'ER Heat Pump Barometer and EurObserv'ER Report #14 (values for 2013 calculated by EGEC, assuming the same production per unit as in 2012)

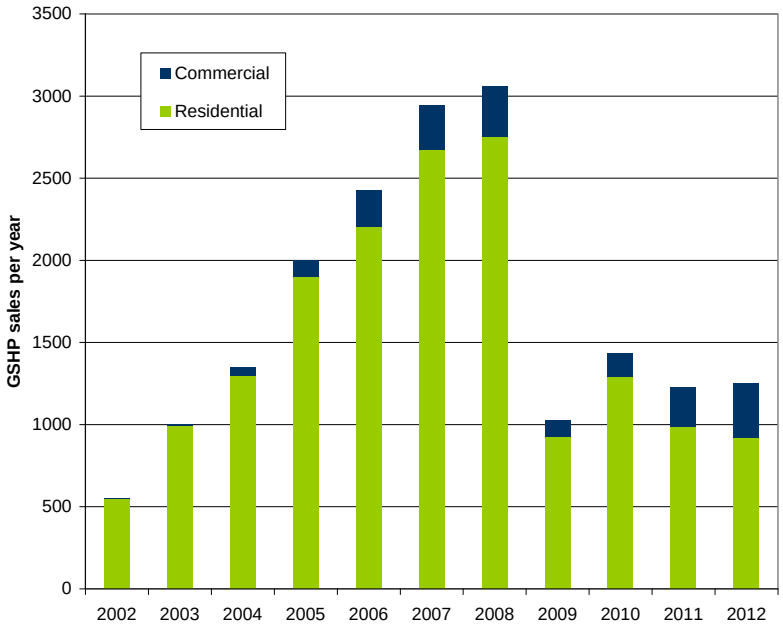

Fig. 4: Number of geothermal heat pump sales in Ireland, 2002-2012 (from data in Pasquali et al., 2015)

3. Methodology and statistical assessment

The quality of the statistical data is still not consistent. There is a period of transition to adjust to the methodology stipulated in Directive 2009/28/EC (the "Renewable Energy Directive") and in the subsequent Decision 2013/114/EU, and this is visible in the EurObserv´ER data and some of the national and Eurostat data. A different approach is taken in the Country Update Reports from the World Geothermal Congresses (latest WGC 2015), with national geothermal experts collecting and reporting the development, and not all follow yet the path the statistical agencies are heading on. This can be elucidated when comparing the values for Sweden and Germany, as shown in figure 5. While the country update reports from Germany, the respective EGEC compilation and the values from EurObserv´ER are close and converging, the values for Sweden are diverging substantially as from 2011 on. The country update reports from Sweden infer a much higher increase than the other sources show.

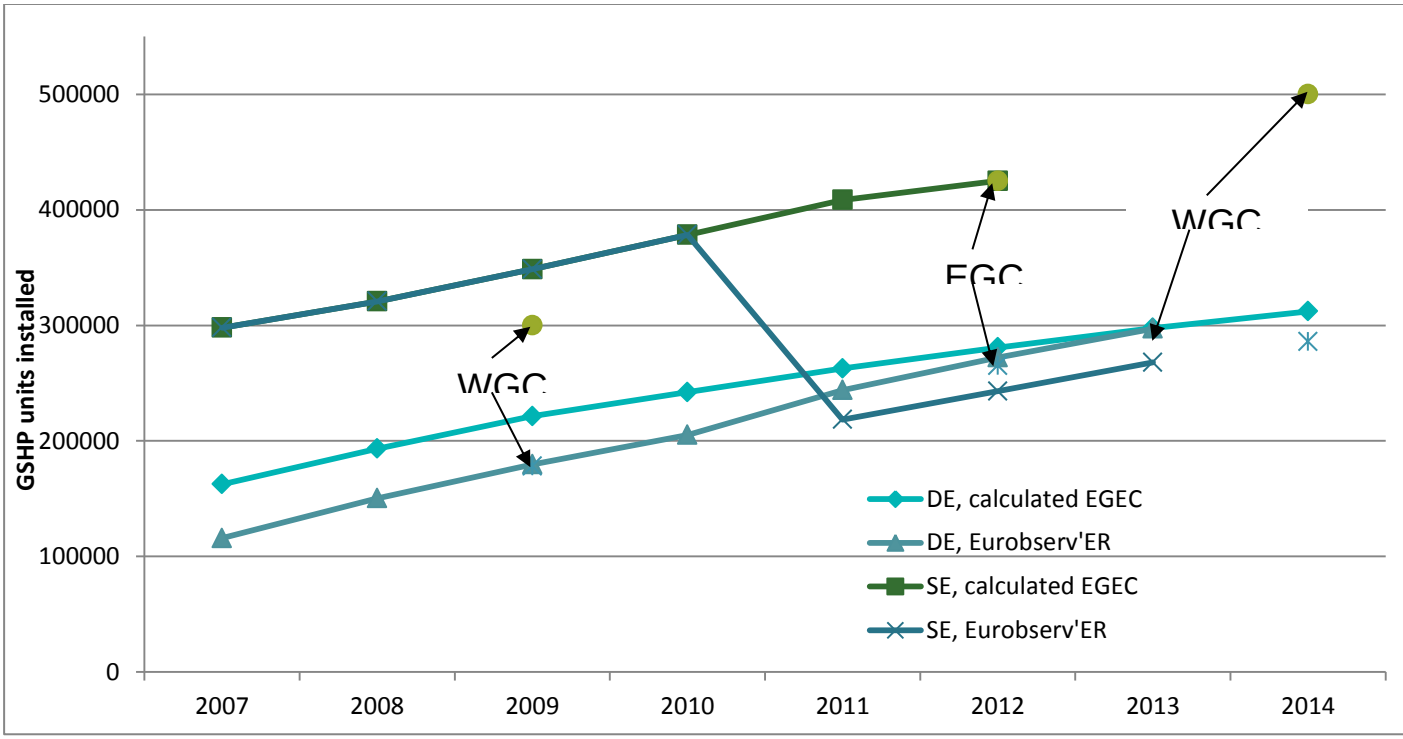

Fig. 5: Total installed geothermal heat pumps in Germany and Sweden, for the years 2007-2013, after own calculations (see Monitoring Report 2013), and from different issues of the EurObserv'ER Heat Pump Barometer and EurObserv'ER Report #14; values from WGC 2010, EGC 2013 and WGC 2015 for comparison

While figure 5 is comparing the relatively simple matter of numbers of units, the RES Directive calls for reporting of the produced renewable energy (in this case heat, and only

the renewable part as to the provision in Annex 7 of the RES Directive). Here Eurostat provides data compiled from the national statistics; alas, only a fraction of member states report numbers separately for the different heat sources. Concerning Regeocities, there are only 4 partner countries for which Eurostat provides data for the geothermal heat pumps: Italy, , Germany, France, and Sweden. Figure 6 now repeats the comparison for Germany and Sweden, this time showing the data for heat produced (in ktoe), and including Eurostat. The variety of values is much higher than with the numbers only, and can be attributed to the various assumptions to be made when "deeming" the average heat pump size, annual hours of operation, average efficiency, etc.; also confusion between heat produced and just the geothermal (renewable) part as to the RES Directive may occur. While the default values given in Decision 2013/114/EU might seem rather simplistic, this can be nevertheless considered the only practical approach to achieve a valid comparison among the member states, and a fair accounting of the renewable energy contribution. In figure 7, the values from Eurostat and EurObserv'ER are compared for the four Regeocities partner countries where Eurostat data exist, and beside from Sweden, they are not too far from each other.

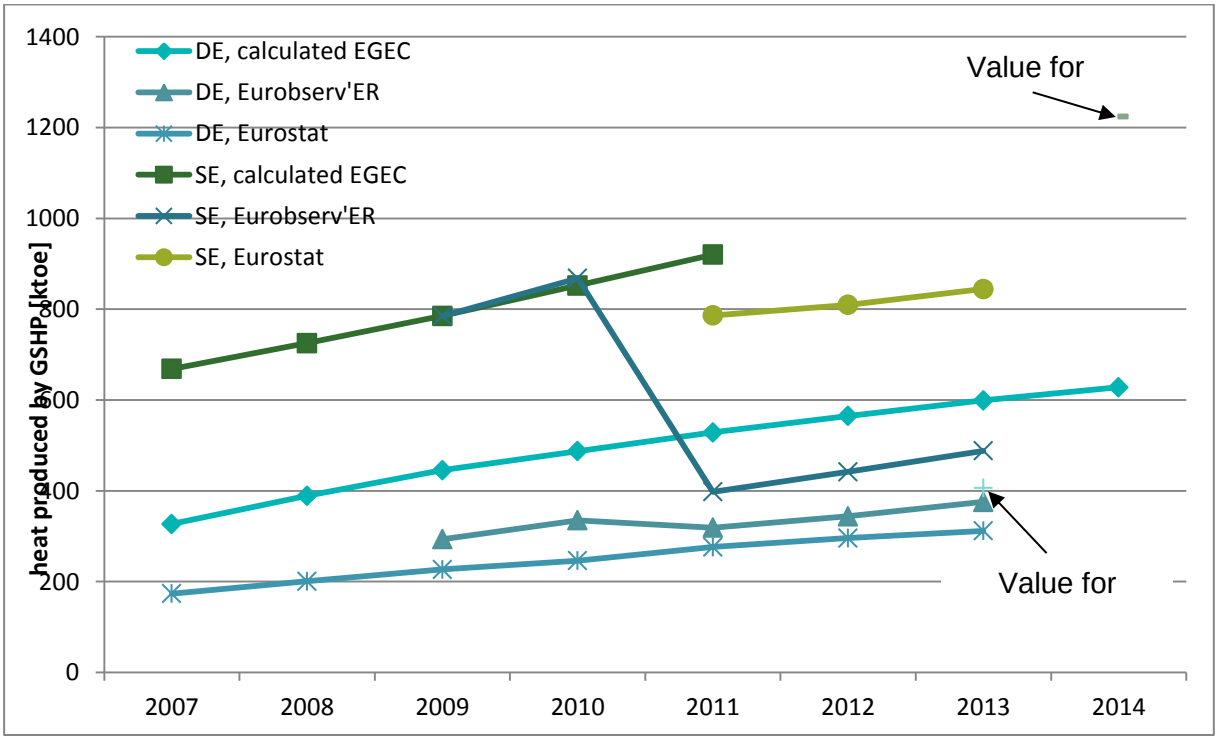

Fig. 6: Heat produced by the existing geothermal heat pumps in Germany and Sweden, for the years 2007-2013, after own calculations (see Monitoring Report 2013) and from different issues of the EurObserv'ER Heat Pump Barometer and EurObserv'ER Report #14, and from Eurostat; values from WGC 2015 for comparison

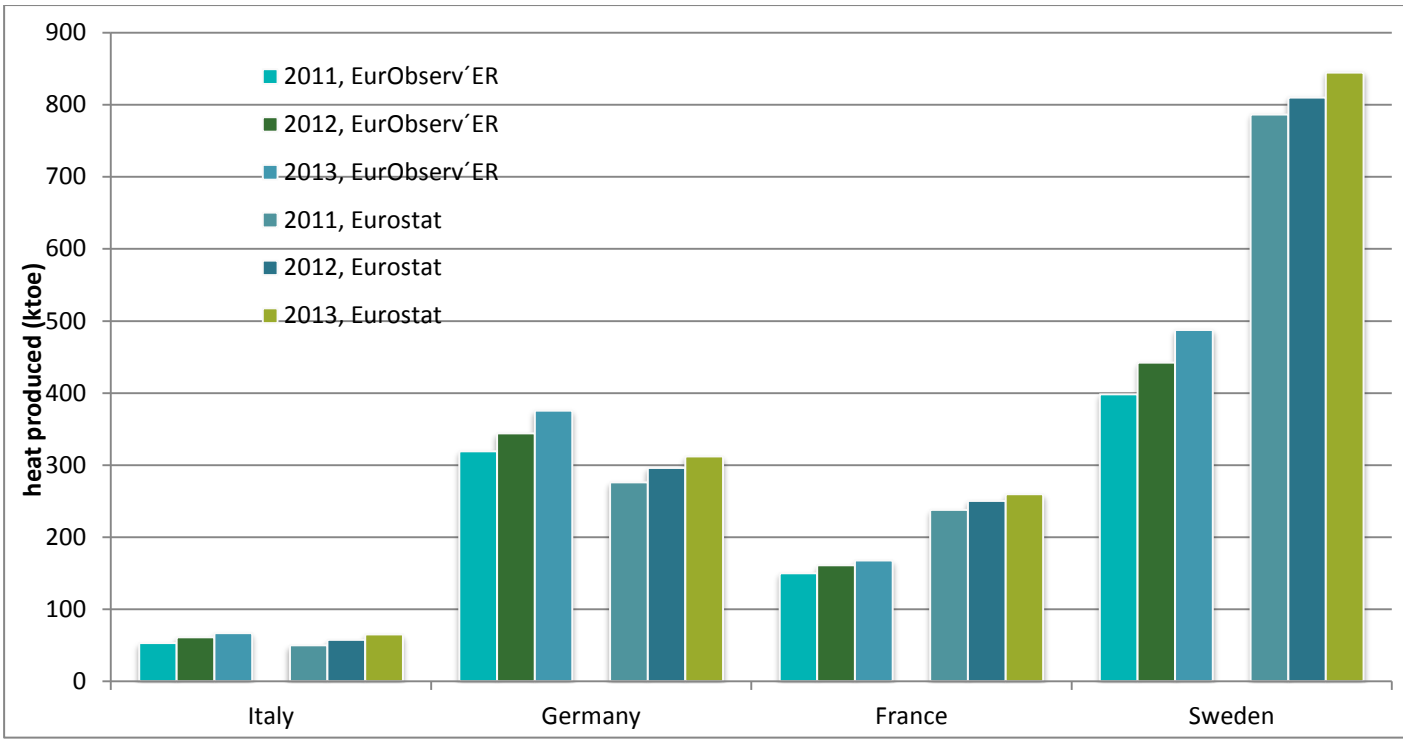

Fig. 7: Heat produced by the existing geothermal heat pumps in 4 Regeocities partner countries, for the years 2011-2013, after different issues of the EurObserv'ER Heat Pump Barometer and EurObserv'ER Report #14, and from Eurostat

This divergence between EurObserv´ER and WGC 2015 data can be seen in most of the Regeocities partner countries, as shown in figure 8. The extreme case again is Sweden, where WGC 2015 claims more than double the heat production than EurObserv´ER. In other countries, the values diverge in both directions, or are close to each other, as for Germany. Looking back at the development as reported since 2007 by EurObserv´ER, it becomes obvious that substantial adjustments took place around 2011 – in line with the timing of the RES Directive (figure 9). Several national statistical agencies (alas, far from all) meanwhile use the methodology and breakdown according to the RES Directive in their national statistics, allowing for Eurostat to improve the accuracy and comparability of the EU statistics step by step. As this process is all but finished, we expect to see adjustments in the annual data on geothermal heat pumps continuing for the foreseeable future – and improved and consistent data to report eventually.

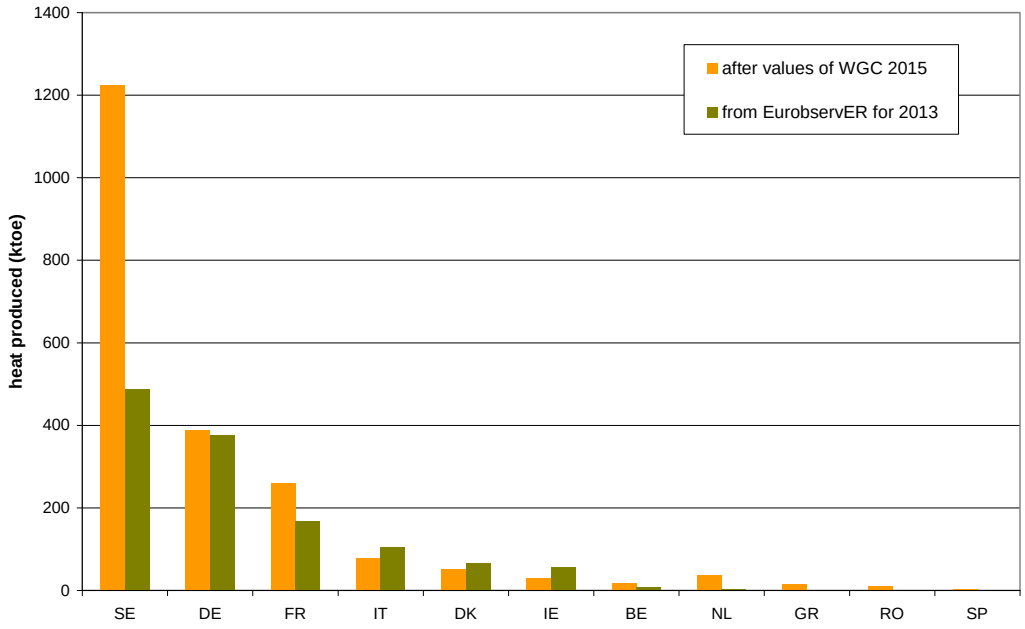

Fig. 8: Heat produced by the existing geothermal heat pumps in the Regeocities project countries after the WGC 2015 county update reports (for 2014, in some countries for 2013), and after EurObser'ER Heat Pump Barometer and EurObser'ER Report #14 (values for 2013 calculated by EGEC, assuming the same production per unit as in 2012)

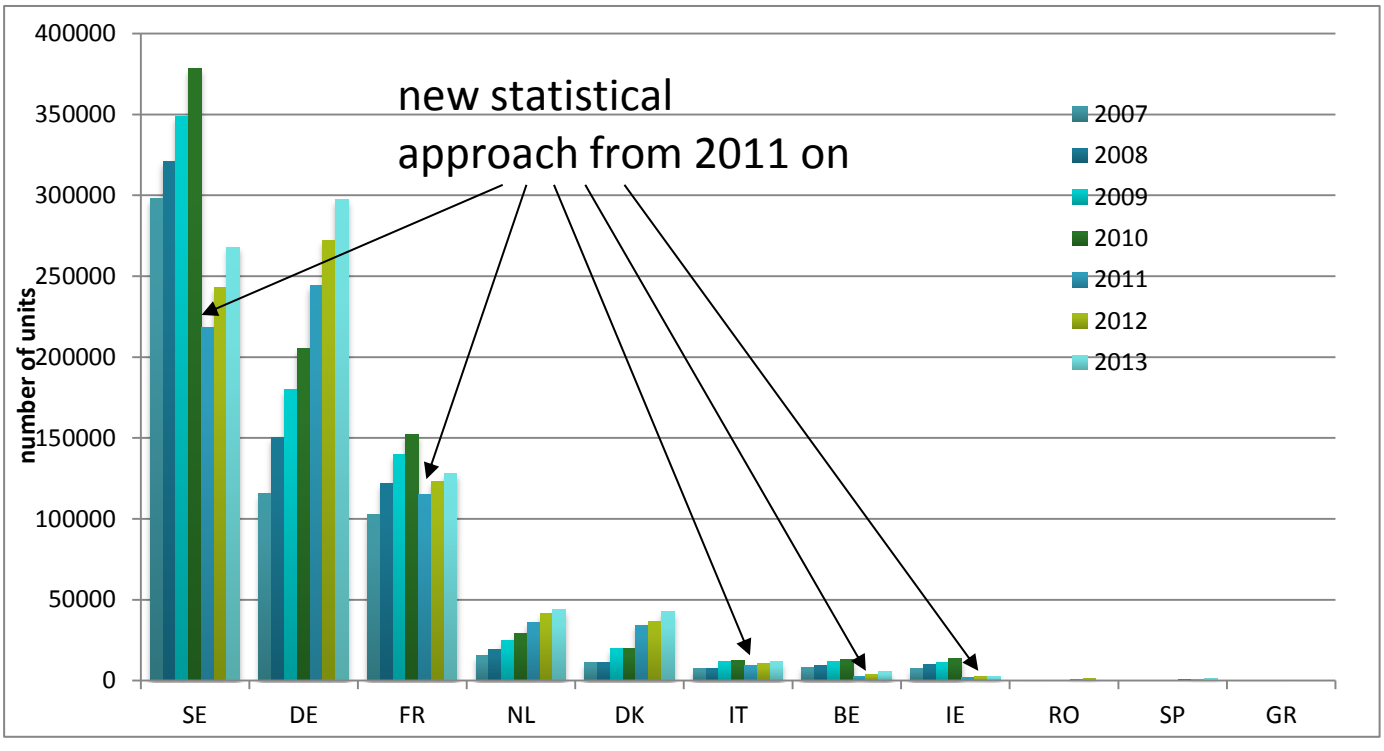

Fig. 9: Number of existing geothermal heat pumps in the Regeocities project countries for the years 2007-2013, after different issues of the EurObser'ER Heat Pump Barometer and EurObser'ER Report #14

In the 2014 issue of the Regeocities report on geothermal heat pump market, we concluded: "For the purpose of monitoring the common performance indicators for the Regeocities

project, for the moment only the bare number of new ground source heat pump installations can be used, as for all other data the rules and boundary conditions are in a period of change, and the published data might not be comparable with the years before or after." This statement is still valid, and thus the final part of the 2015 issue is focussing on the number of installations only.

4. Market development in project countries

Figure 10 shows the development of the total number of existing geothermal heat pump plants for 2011-2013, and figure 11 depicts the annual sales numbers for the same period. While the total number is rising steadily (see also figure 2), the annual sales numbers are continuing to decrease slightly in most countries. Generally, this decrease is much lower from 2012 to 2013 than for the previous year, with the notable exceptions of the Netherlands, with a stronger decrease in 2013.

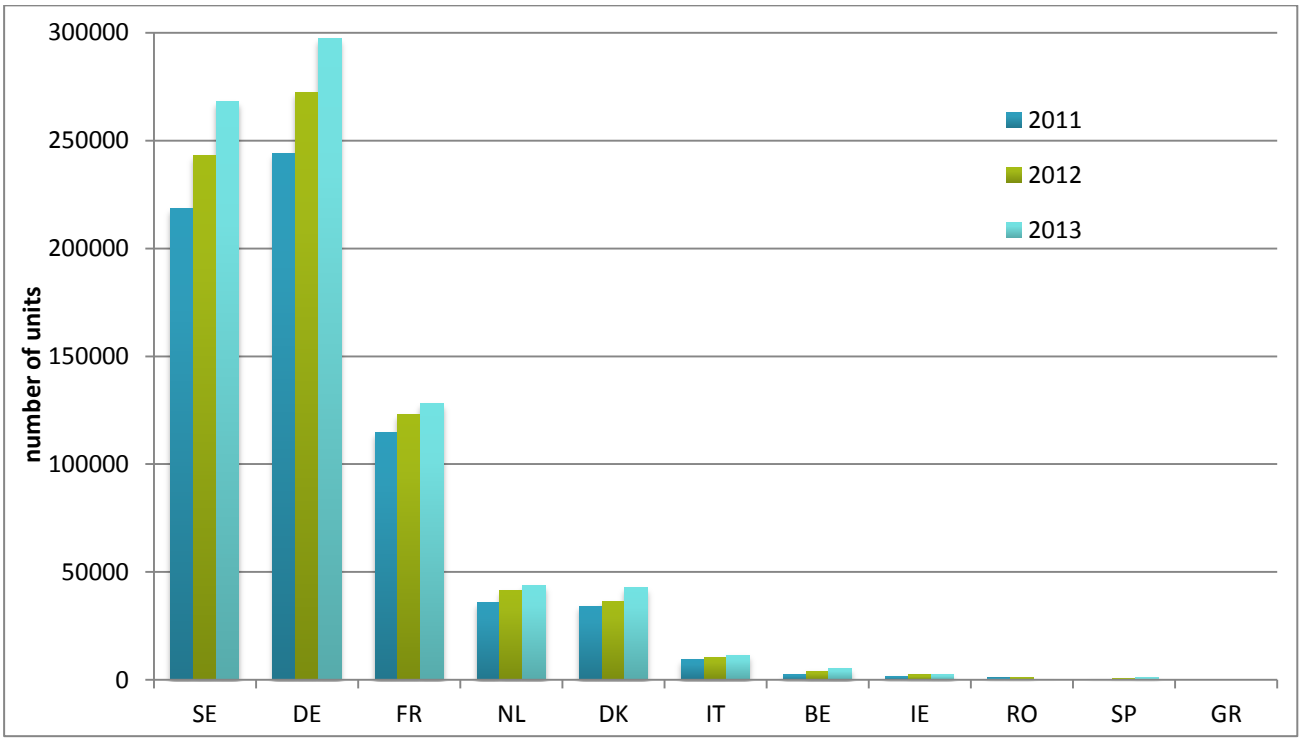

Fig. 10: Number of existing geothermal heat pumps in the Regeocities project countries for the years 2011-2013, after EurObser'ER Heat Pump Barometer and EurObser'ER Report #14

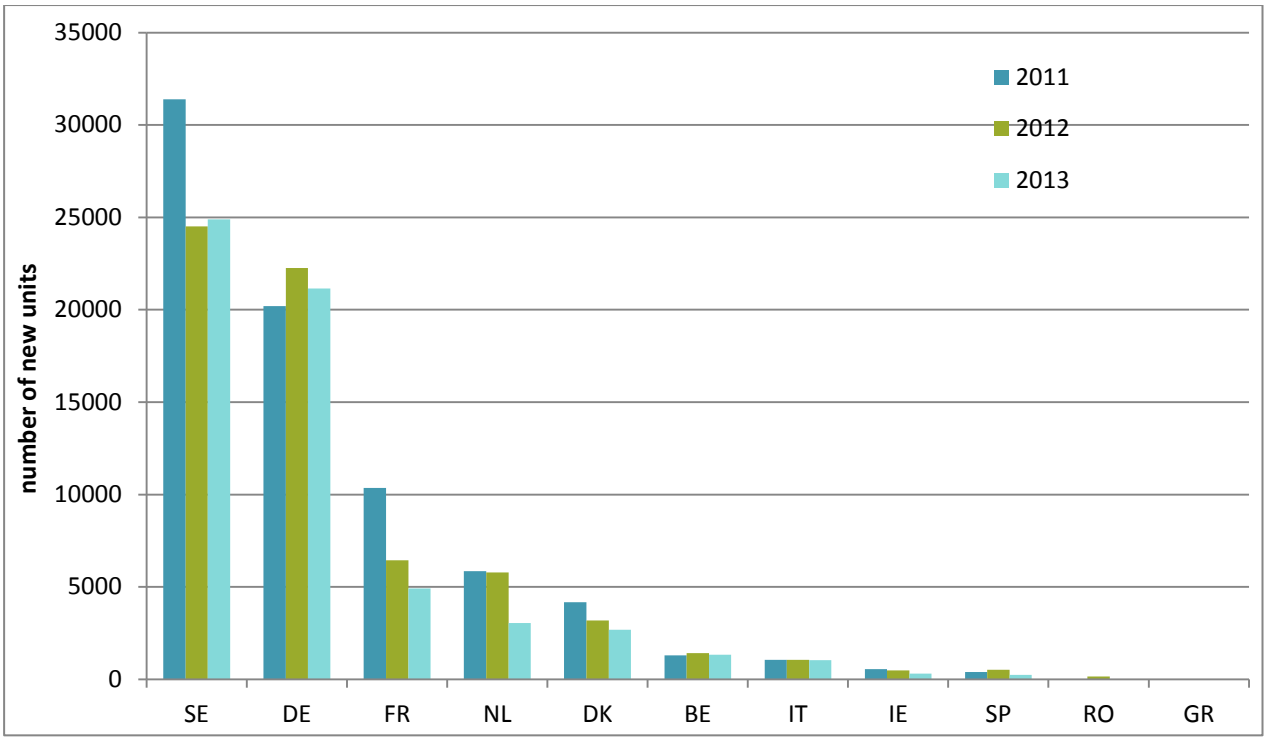

Fig. 11: New installations of geothermal heat pumps in the Regeocities project countries for the years 2011-2013, after EurObser'ER Heat Pump Barometer and EurObser'ER Report #14

Searching for sources for the continuing downturn is difficult. Obvious reasons in some countries comprise the lack of awareness with possible investors, insufficient knowledge of designers and installers, and deficient regulations – all the topics Regeocities has addressed. In Germany, a certain over-regulation on environmental issues in some regions hampers the market. And a major threat to the use of the ground as heat source and sink for heat pumps is the continuing improvement of air-source heat pumps. Still showing lower overall efficiency, usually requiring back-up heaters for colder days, and struggling with noise issues in residential areas, their installation is much easier, hassle-free and cheaper than drilling or digging for a geothermal installation. In combination with the continuing reduction of heat load in buildings, the economic case often is in favour of air-source systems, albeit the energy efficiency and emission reduction with geothermal systems would be higher. As an example, figure 12 shows the development in Germany for the years 1996-2014, with an increasing share of air-source heat pumps since the early 2000s. However, the effect geothermal heat pumps have on the environment is quite positive, with savings of CO_2-emissions increasing steadily (figure 13).

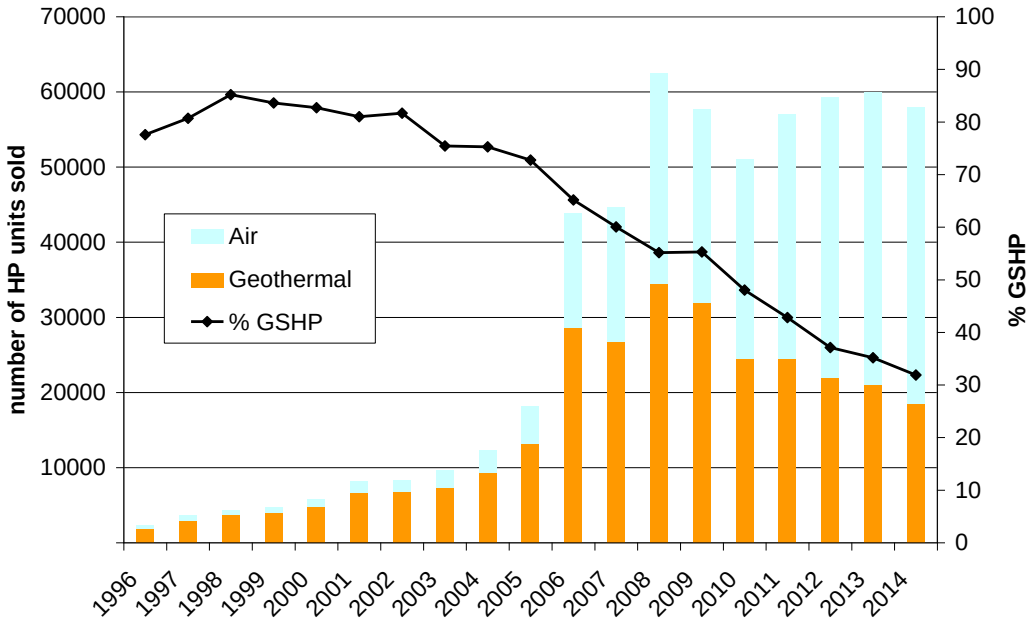

Fig. 12: Number of annual heat pump sales in Germany for all heat pump types, showing the share of GSHP in the total sales, after data from BWP

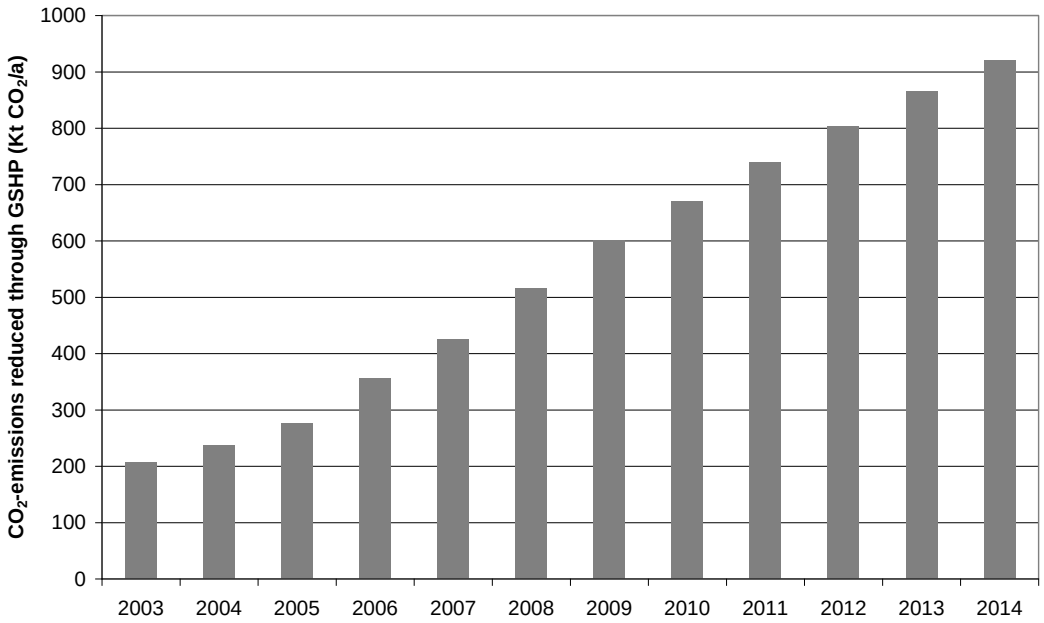

Fig. 13: CO_2-emissions saved by use of GSHP in Germany, calculated after data from BWP

At this time, a consistent distinction between residential and commercial applications cannot be made in statistics. However, observations and also data from some countries (cf. figure 4 for Ireland) suggest that the share of commercial installations is growing. This can be attributed to the superb efficiency of geothermal installations in cooling mode, and to the

fact that the savings in a larger installation can more easily return the higher investment cost. Thus the future is bright for geothermal heat pumps in the commercial sector. The business case is given, and the deficiencies in investor awareness and installer skills can be overcome by respective campaigns.

A response to the development towards air-source heat pumps in the residential sector is more difficult. Beside information and training activities, further R&D is required to adapt the geothermal installation to lower heat loads (near-zero-energy buildings), to simplify installation and to provide standard, of-the-shelf solutions with reduced cost. Two related projects to be funded within Horizon 2020 are expected to start soon, but more effort and development work by industry is required.

Also in 2013 the eleven Regeocities partner countries did cover a major part of the geothermal heat pump market in the EU, and thus are a valid representation of the overall market, as can be seen in figure 14. Alas, the decrease of the market since the high in 2008 can also be seen in that graph. As a consequence, the main goal of Regeocities might have to be readjusted, from a substantial increase of the market, to stopping the decrease and turning it into a growth again.

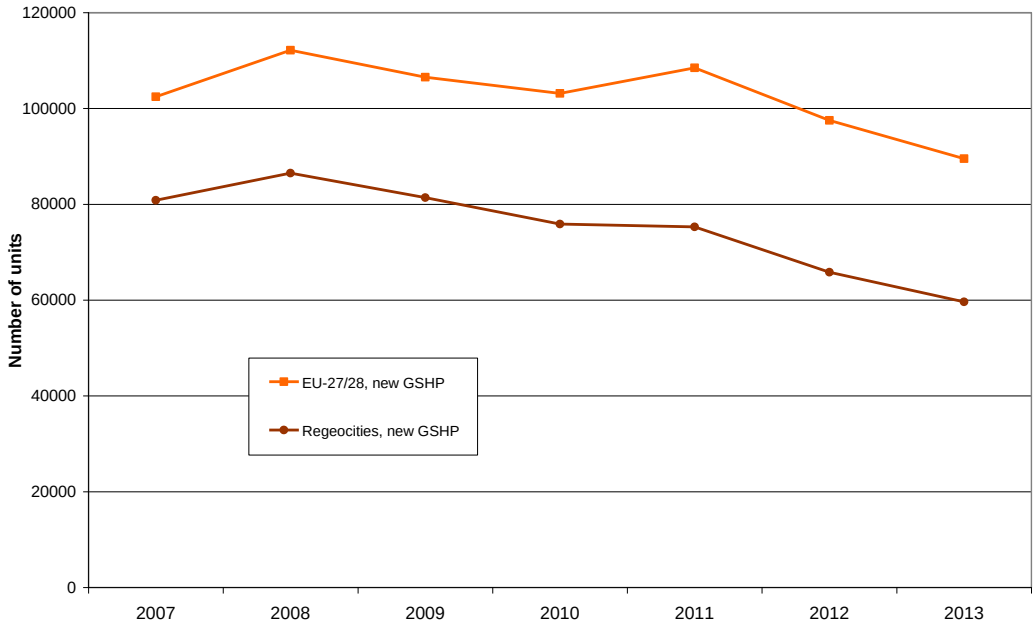

Fig. 14: Development of total number of new geothermal heat pumps in EU-27 and in the Regeocities project countries for the years 2007-2013, after different issues of the EurObser'ER Heat Pump Barometer and EurObser'ER Report #1

Conclusions

For the purpose of monitoring the common performance indicators for the Regeocities project, at the time of writing (June 2015) the number of new units installed was available only until end of 2013. **Therefore, an impact of the project (started in 2012) in terms of triggered investments, renewable energy production, primary energy savings, and greenhouse gas emissions reduction cannot yet be seen in the statistics.** As stated above, a stopping of the market decrease could be considered a success already under the current circumstances.

Literature:

Country Update Reports from WGC 2015 (selected papers for Europe) – Proc. WGC 2015 Melbourne

EurObserv´ER Heat Pump Barometer, 20 p, October 2009

EurObserv´ER Ground-Source Heat Pump Barometer, 20 p, September 2011

EurObserv´ER Heat Pumps Barometer, 9 p, October 2013

Eurostat, values from SHARES 2013

Pasquali, R., Allen, A., Burgess, J., Jones, G.L. & Hunter Williams, T. (2015): Geothermal Energy Utilisation - Ireland Country Update – Proc. WGC 2015 Melbourne, 10 p, paper # 01043

The state of Renewable Energies in Europe – edition 2014, 14th EurObserv´ER report, pp 39-43