# Interview 8 - Dr. Gehlin, Sweden

**Profile**
Name: Signhild Gehlin
Age: 47
Education: PhD and MSc from Luleå Univeristy of Technology, Sweden
Activity: Technical Expert at the Swedish Geoenergy Center
Lives in Nynäshamn, Sweden
Experience in the thermogeology sector: 22 years
Geographical working area: Sweden

## Thermogeology in Sweden

Dr. Gehlin works for the Swedish Geoenergy Center as technical expert and project manager. The Swedish Geoenergy Centre (SGC) was founded in 2013 with the main task to gather and disseminate information related to geothermal energy. Information on national and global research as well as close contact with contractors and industry are central for SGC. SGC arranges courses in shallow geothermal energy, and the annual event Geoenergidagen and issues geothermal energy related guidelines and supporting material. SGC also publishes the free magazine Svensk Geoenergi (Swedish geoenergy), with two issues per year, informing and promoting geothermal energy in Sweden. Dr. Gehlin is the editor of the magazine. Within SGC, Dr. Gehlin collects and disseminates statistical data and information related to geothermal energy in Sweden and globally. Dr. Gehlin is active within several energy international agencies (such IEA ECES and IEA HPT) annexes.

*Sweden is recognized to be one of the countries where low enthalpy thermogeology is more disseminated. What are the main reasons of such success?*

Geothermal energy in Sweden is dominated by low temperature, shallow geothermal energy systems. By the end of 2015, a total of around 500.000 shallow geothermal systems were in operation in Sweden. The vast majority of these geothermal energy systems are ground source heat pumps (GSHP) for space heating and domestic hot water heating for single-family buildings. About a fifth of the Swedish buildings use GSHP, making Sweden a leading country within this technology. The market for larger shallow geothermal energy systems for residential as well as non-residential buildings has been expanding over the last years. By the end of 2015, shallow geothermal energy systems provide some 23 TWh of heating and cooling in Sweden (including free-cooling and electricity for heat pumps) of which approximately 17.5 TWh is renewable heat from the ground and approximately 1.1 TWh is free-cooling from the ground. The total installed capacity (heating and cooling) by the end of 2015 was 6.8 GW.
Most parts of Sweden lack the geological conditions for deep geothermal exploitation. However, there is one plant in Lund from the mid-1980's that is in operation, providing some 140 GWh of geothermal heat to the Lund district heating system. The boreholes are 700-800 m deep and drilled into a permeable layer of sandstone. The water that is pumped from this resource is around 20ºC and large-scale heat pumps are used to raise the temperature so that it can be used in the local district-heating network.
There are multiple reasons for the Swedish success in geothermal energy, among them the suitable climate with relatively cold winters and relatively warm summers in

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combination with a suitable geology (mainly fairly homogeneous crystalline rock rich in quartz – granites and gneiss – with high thermal conductivity) and high groundwater levels. An early and general environmental awareness and political initiatives from the 1970's and 1980's in making Sweden less reliant on fossil fuels are other important factors in building the success.

*Typical granite outcrop in Sweden*

*When did the boom of geothermal installations start?*

Geothermal energy utilisation started in Sweden in the 1970's and 1980's, triggered by the oil crises, and the following nationwide efforts to achieve an oil-independent energy system. Heat pump technology was promoted, favoured by the national power production strategy based on nuclear and hydropower. Ground source heat pump technology developed rapidly during the 1990's, and is still a strong area of research and development in Sweden. Research related to geothermal energy is carried out at several academic institutions in Sweden, and since the founding of the Swedish Center for Geoenergy in 2013, the platform for communication and promotion of geothermal energy has been significantly enhanced.
While shallow geothermal energy exploitation is continuously thriving in Sweden, deep geothermal energy exploitation remains minimal. Only one deep geothermal plant, taken into operation in the 1980's, is currently in operation. The market for small GSHP systems has stabilised during the last years, but there is a steady market growth for larger systems for residential buildings as well as for larger ATES (Aquifer Thermal Energy Storage) and BTES (Borehole Thermal Energy Storage) systems in the commercial and institutional sector. Systems for BTES tend to be designed with increasing size, deeper boreholes and higher capacities, and new applications are investigated. The extensive use of ground source heat pumps nationwide has made Sweden the third leading country in geothermal energy utilisation in the world, in terms of installed units, installed capacity, and extracted thermal energy.

*Which are the most common geothermal installations?*

The majority of shallow geothermal energy systems in Sweden are pure heat extraction systems. About 75-80% of all geothermal installations in Sweden are vertical GSHP systems for single family houses, drilled in hard rock. The typical borehole is around 150 m deep and fitted with a single u-tube borehole heat exchanger suspended in the

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un-grouted groundwater-filled borehole. The heat pump is typically electrically driven and is used for both space heating and domestic hot water (DHW) heating.

*Are Swedes generally aware and somehow proud of the sustainability of their geo-thermal heating systems?*

Sweden is one of the world's leading countries in shallow geothermal energy utilisation, and geothermal energy has a general goodwill among the public as an environmentally friendly and economically feasible technology. Geothermal energy tends to increase the commercial value of a building. Geothermal energy has played a major part in replacing fossil fuel heating in the Swedish building stock, especially for small residential buildings. As the market for larger geothermal energy systems increases, it helps to regulate the pricing of alternative energy sources such as biofuel and district heating. This has led to strong reactions from the district-heating sector, which has a dominant market share in space heating and domestic hot water heating in larger Swedish buildings.

*Did interference problems ever arise due to the high numbers of geothermal installations? How do you manage them?*

The Swedish guidelines for geothermal boreholes stipulate that boreholes must not be drilled closer to the property border than 10 m, which means that for two independent GSHP systems the distance between them will be at least 20 m. For Swedish geological conditions this means that the boreholes will not interfere significantly. However, this rule is based on two GSHP systems in the area, but if there are more GSHP systems in the vicinity, there will be an added effect. The more boreholes in the neighbourhood, the more significant is the interference. In some areas with densely situated single-family houses, where most or all buildings install individual GSHPs, there have been issues related to borehole thermal interference. In general this has been dealt with according to "first in place – first chance", and the newer installations are bound to compensate for their added load, by either drilling deeper boreholes or lower their annual net energy load to the borehole (e.g. by installing solar thermal panels or heat recovery).

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