



## **CO<sub>2</sub> emission mitigation by geothermal development – especially with geothermal heat pumps**

L. Rybach (1)

(1) Geowatt AG Zurich, (2) Institute of Geophysics, ETH Zurich

Geothermal technologies for power generation or direct use operate with little or no greenhouse gas emissions. Since no burning processes are involved they are low in CO<sub>2</sub> emissions. Geothermal energy development has thus great CO<sub>2</sub> emission reduction potential when substituting fossil sources of energy.

Geothermal heat pumps (GHP) represent the fastest growing branch of geothermal technology; they use the ubiquitous shallow geothermal resource. GHPs are electricity consumers, nevertheless they can contribute to the fight against climatic warming. Such systems are now increasingly used for space heating, cooling, and to provide domestic hot water. With heat pump systems the use of fossil primary energy sources can be avoided, thus GHPs contribute to energy security: many countries must rely in their space heating systems on imported fossil fuels. The degree of dependence on these can be reduced.

Since heat pumps are usually driven by electric components the origin of the electricity and the corresponding CO<sub>2</sub> emission must be considered. A compilation shows that there are great differences in this respect from country to country. The same (=electricity need with CO<sub>2</sub> emission consequences) applies to GHPs too. This means that by new geothermal heat pumps only additional CO<sub>2</sub> emission can be avoided (“saving”), not a reduction of actual emissions. When GHPs are installed in refurbishment (to replace fossil-fueled systems) actual emission reduction can be achieved. Emission reduction is also evident when electric heater/cooler installations, driven by fossil-based electricity, are replaced by GHP systems. Numerical examples are presented about saving and reduction.