

A Comparative Environmental Impact Study of Ground Source Heat Pump Systems

Lazaros Aresti, Faculty of Engineering and Technology, Cyprus University of Technology, Limassol, Cyprus

Email: lg.aresti@edu.cut.ac.cy

Paul Christodoulides, Faculty of Engineering and Technology, Cyprus University of Technology, Limassol, Cyprus

Email: paul.christodoulides@cut.ac.cy

Christos Makarounas, Faculty of Engineering and Technology, Cyprus University of Technology, Limassol, Cyprus

Email: christos.makarounas@cut.ac.cy

Lazaros Lazaris, Faculty of Engineering and Technology, Cyprus University of Technology, Limassol, Cyprus

Email: lazaros.lazaris@cut.ac.cy

Georgios Florides, Faculty of Engineering and Technology, Cyprus University of Technology, Limassol, Cyprus

Email: georgios.florides@cut.ac.cy

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Ground Source Heat Pump (GSHP) systems are the main application of Shallow Geothermal Energy (SGE) systems, which are categorized as a RES. The GSHP systems consist of ground heat exchangers (GHEs) and HPs and they are used for space heating and cooling, exploiting Geothermal Energy. An important feature of RES is whether they are also "green" or ecological. Hence, this study focuses on the ecological aspect of GSHP systems, examining case studies in Cyprus and other European countries for residential buildings with high and low heating and cooling loads. The ground thermal characteristics and the peak heating and cooling loads of specific residential buildings of constant area are first used to determine the GHE length and the GSHP Coefficient of Performance (COP) by the GLD software. Next, a Life Cycle Analysis (LCA) of the systems is employed to estimate the environmental impact of all cases. The yearly heating and cooling load of the building is set as a functional unit, with the system boundaries containing the GHEs manufacturing and the operation of the system. An Air Source Heat Pump (ASHP) system is set as the baseline. The GSHP systems are compared to the baseline in percentage deviation, as, although the GSHP system is of higher COP than ASHP systems, it is not necessarily a more environmental-friendly solution in all cases. The LCA comparative results indicate that the location of the installed GSHP system play an important role in the magnitude of its environmental impact.