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## Ground source heat pump system for buildings heating and cooling

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Geothermal heat pumps (GSHPs), or direct expansion (DX) ground source heat pumps, are a highly efficient renewable energy technology, which uses the earth, groundwater or surface water as a heat source when operating in heating mode or as a heat sink when operating in a cooling mode. It is receiving increasing interest because of its potential to reduce primary energy consumption and thus reduce emissions of the greenhouse gases (GHGs). The main concept of this technology is that it utilizes the lower temperature of the ground (approximately  $<32^{\circ}\text{C}$ ), which remains relatively stable throughout the year, to provide space heating, cooling and domestic hot water inside the building area. The main goal of this study is to stimulate the uptake of the GSHPs. Recent attempts to stimulate alternative energy sources for heating and cooling of buildings has emphasized the utilization of the ambient energy from ground source and other renewable energy sources. The purpose of this study, however, is to examine the means of reduction of energy consumption in buildings, identify GSHPs as an environmentally friendly technology able to provide efficient utilization of energy in the buildings sector, promote using GSHPs applications as an optimum means of heating and cooling, and to present typical applications and recent advances of the DX GSHPs.

The study highlighted the potential energy saving that could be achieved through the use of ground energy sources. It also focuses on the optimization and improvement of the operation conditions of the heat cycle and performance of the DX GSHP. It is concluded that the direct expansion of the GSHP, combined with the ground heat exchanger in foundation piles and the seasonal thermal energy storage from solar thermal collectors, is extendable to more comprehensive applications.

### Recent Publications

1. Performance, Modelling, Measurement and Simulation of Energy Efficiency for Heat Exchanger, Refrigeration and Air Conditioning January 2022, Sustainable Energy Development and Innovation (pp.157-176), DOI:10.1007/978-3-030-76221-6\_23
2. Analytical Studies of Energy Efficiency Development of the Greenhouses, Abdeen Mustafa Omer, ISSN: 2754-477X Sep 2021
3. A prescription for improvement: Health and Safety Measures, Abdeen Mustafa Omer, 2020.

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