



## **Numerical Analysis of Combined Well and Open-Closed Loops Geothermal (CWG) Systems**

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Open-loop geothermal heat pump (GHP) system and closed-loop heat pump systems have been used in Korea to reduce emission of greenhouse gases such as carbon dioxide (CO<sub>2</sub>). The GHP systems have the pros and cons, for example, the open-loop GHP system is good energy-efficient and the closed-loop GHP system requires minimum maintenance costs. The open-loop GHP system can be used practically only with large amount of groundwater supply. The closed-loop GHP system can be used with high costs of initial installation. The performance and efficiency of the GHP system depend on the characteristics of the GHP system itself in addition to the geologic conditions. To overcome the cons of open-loop or closed-loop GHP system, the combined well and open-closed loops geothermal (CWG) system was designed. The open-loop GHP system is surrounded with closed-loop GHP systems in the CWG system. The geothermal energy in closed-loop GHP systems is supplied by the groundwater pumped by the open-loop GHP system. In this study, 2 different types of the CWG systems (small aperture hybrid CWG system and large aperture CWG system) are estimated using numerical simulation models in the aspect of energy efficiency. This work was supported by the New & Renewable Energy Core Technology Program of the Korea Institute of Energy Technology Evaluation and Planning (KETEP), granted financial resource from the Ministry of Trade, Industry & Energy, Republic of Korea. (No.20153030111120).