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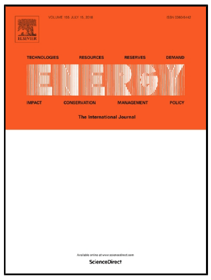

Assessment of Deep Geothermal Energy Exploitation Methods: the Need for Novel Single-Well Solutions

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Assessment of Deep Geothermal Energy Exploitation Methods: the Need for Novel Single-Well Solutions

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Abstract

Geothermal energy is a constant and independent form of renewable energy and plays a key role towards the world's future energy balance. In particular, deep geothermal resources are largely available across continents and can help countries become less dependent on energy imports and build a broader base in their future energy mix.

However, despite its significant potential, the total contribution of the geothermal sector to global power generation remains relatively small. The International Energy Agency has recommended devising plans to address technology-specific challenges to achieve faster growth and improving policies tackling pre-development risks for geothermal energy. Reaching considerable depths is a requirement to exploit deep geothermal resources, but experience gained to date from the implementation of complex, engineered deep geothermal projects has unveiled technical and economic challenges, lower-than-expected performance and poor public image. There is therefore an urgent need for alternative, more sustainable well designs.

This paper critically assesses conventional and unconventional deep geothermal well concepts, focusing on the basic Borehole Heat Exchanger (BHE) concept. The discussions are supported by numerical simulations of a BHE design that includes heat conductive fillers to enhance the heat exchange with the surrounding formation, while avoiding direct fluid interaction with the latter.

Keywords: Deep Geothermal Energy; Geothermal Potential; Deep Borehole Heat Exchangers.

1. Introduction

One of the most abundant energy sources exists in renewables is geothermal energy, which is considered by many to be a constant and independent supply. Geothermal energy already plays a vital role in some countries, such as Iceland (27% of power) and El Salvador (26% of power) [1,2]. Deep geothermal resources are largely available across continents and can help countries become less dependent on energy imports and build a broader base in their future energy mix. Generally, however, the total contribution of the geothermal sector to global power generation remains relatively small (0.3%) [1,2]. According to the International Energy Agency (IEA) [3], geothermal electricity production has not experienced significant growth between 1990 and 2016, with an average annual rate of 2.3%, from 28.6 TWh to 51.8 TWh. It is believed that continued low fossil fuel prices, together with high drilling costs and high project development risk, have created unfavourable conditions for geothermal power development [4] [5]. Based on the IEA's 2°C Scenario (2DS), which lays out an energy system deployment pathway and an emissions trajectory consistent with at least a 50% chance of limiting the average global temperature increase to 2°C (reducing CO_2 emissions by almost 60% by 2050, compared with 2013), geothermal is not on track (see **Fig.1**) [5]. Hence, for 2017, the IEA recommended devising plans to address technology-specific challenges to achieve faster growth and improving policies tackling pre-development risks for geothermal energy.

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