Adopting Circular Economy Strategies into Geothermal Power Generation

3rd Symposium on Circular Economy and Sustainability
Chania, Greece 27-29 June, 2022

Adopting Circular Economy Strategies into Geothermal Power Generation

Jingyi Li[1,2], Raphael Ricardo Zepon Tarpani[1], Laurence Stamford[2], Alejandro Gallego-Schmid[1*]

1 Tyndall centre for climate change research, Department of Mechanical, Aerospace, and Civil Engineering, The University of Manchester, Oxford Road, United Kingdom, M13 9PL
2 Sustainable industrial systems, Department of Chemical Engineering, The University of Manchester, Oxford Road, United Kingdom, M13 9PL
** Corresponding author: alejandro.gallegoschmid@manchester.ac.uk*

Abstract

Geothermal energy is a stable and ubiquitous renewable energy source, which has been successfully deployed for heating, cooling, and electricity production in many nations around the world. Therefore, it has been considered a promising technique to mitigate climate change and other impacts. However, few studies have addressed circular economy (CE) strategies for geothermal energy utilisation, leaving an important but underexplored gap in literature. This work evaluates how different CE strategies can aid geothermal energy to become an even more sustainable energy source.

Introduction

Taking advantage of its low pollution potential, geothermal energy has been considered in the pertinent literature as one of the contributors for achieving Net-Zero Emissions targets by 2050[1]. With the prominent growth in geothermal power generation, the sustainability aspects associated with the adoption of this technique have recently emerged in literature. The CE has been identified as a key to support some of the United Nations Sustainable Development Goals (SDGs) like affordable and clean energy (SDG 7), sustainable cities and societies (SDG 11), and climate action (SDG 13)[2]. However, the connection between geothermal energy utilisation and CE strategies has not been systematically reviewed.

CE explores how economic growth can be obtained by minimising wastes and using materials and energy in an efficient and regenerative manner. It is oftentimes conceptualised as the "9R framework" - Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover[3]. Therefore, these strategies can be used for guiding a systematic analysis of geothermal energy utilisation.

Methodology of the literature review

In total, 12 articles have been considered for evaluation after a systematic literature review (search string: "circular economy" AND "geothermal"), following the methodology described in Figure 1.

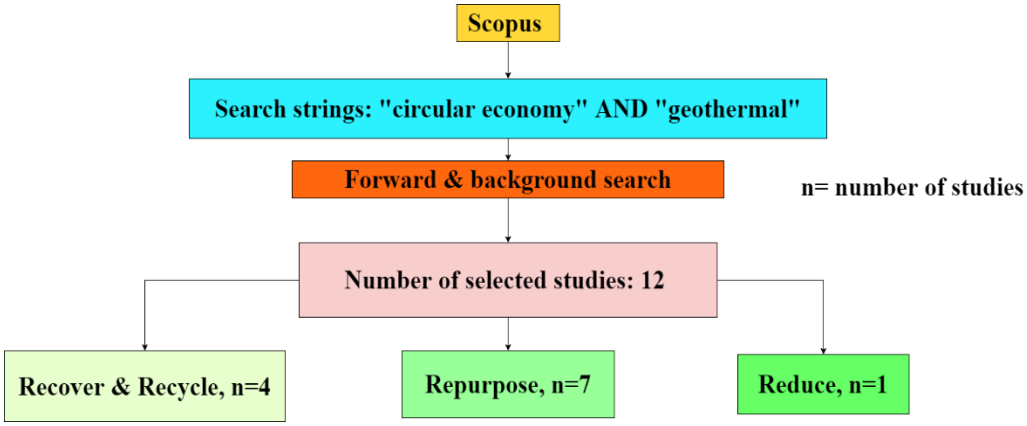

Figure 1. Methodology and literature searching results

Main results and conclusions

The results identified opportunities for geothermal energy to adopt the CE framework at both micro-level (process-focused) and meso-level (e.g. co-operation with the lithium-ion battery industry). For instance, the 'recover' principle can be applied by incinerating non-recycled materials to generate heat and electricity; 'repurpose' provides opportunity to enlarge the scope of geothermal energy exploitation via retrofitting of abandoned oil and gas wells, and closed or flooded coal mines, for electricity and district heating distribution; hybridisation can be used to integrate the locally available renewable energy sources to supply heat and electricity in different weather and seasons, which could effectively reduce the land use and carbon emissions (by around 40%). However, limited CE information for the geothermal industry has been discussed in scientific literature, resulting in a lack of analytical power, contextualisation and awareness of the topic. As a result, future work should focus on qualitative and quantitative evaluations of the sustainability performance of geothermal power within a CE framework.

Key words: climate change, sustainability, geothermal power, renewable energy source

References

[1] Achieving Net-Zero Emissions by 2050. Int Energy Agency 2020. https://www.iea.org/reports/world-energy-outlook-2020/achieving-net-zero-emissions-by-2050 (accessed December 30, 2020).

[2] United Nations General Assembly. "Circular Economy for the SDGs: From Concept to Practice." vol. 73. 2018.

[3] Kirchherr J, Reike D, Hekkert M. Conceptualizing the circular economy: An analysis of 114 definitions. Resour Conserv Recycl 2017;127:221–32. https://doi.org/10.1016/j.resconrec.2017.09.005.