Geothermal Energy Advancement Association

Geothermal Energy Briefing Note

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A commercially driven case for the investment in, and development of, a zero-emission sustainable energy source will attract capital and accelerate the transition to net-zero. Geothermal energy is a high reliability clean baseload energy source which is available globally. The use of tax and regulatory policy will advantage the uptake of geothermal energy while providing opportunities for quality jobs.

Making use of stored carbon: CO_2-plume geothermal

Significance

Renewable energy uptake must increase to reduce carbon emissions and curb today's unprecedented rate of global warming. CO_2-based geothermal energy extraction could be used to produce near zero-carbon power from the heat stored in sedimentary basins across the globe.

Technical aspects

CO_2-plume geothermal (CPG) is a conceptual technology designed to produce power by circulating CO_2 through permeable and porous formations sealed by low-permeability cap rocks, ultimately storing industrial quantities in the subsurface. Examples of such formations include saline aquifers and hydrocarbon reservoirs. Cooled CO_2 is injected into the subsurface via an injection well where it displaces in situ fluid and becomes heated. A portion of the CO_2 is returned to the surface via a production well at an increased pressure and temperature which can be used to generate power in a surface plant.

Commercial applications

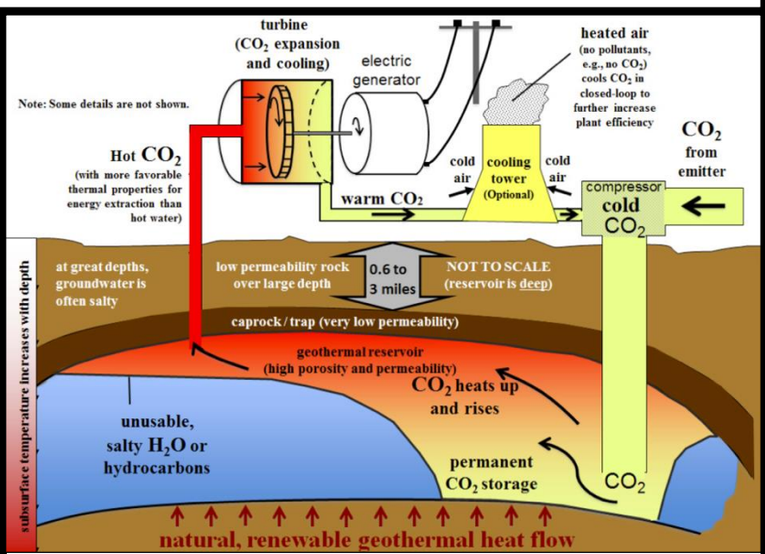
CPG could be used to extend the useful lifespan of ageing natural gas fields in the Southern North Sea (SNS), making for a smooth transition away from hydrocarbons. Several factors make SNS fields promising CPG prospects; geothermal gradients are higher on average than those found onshore in the UK, extensive infrastructure is already in place, excellent data are available, and seawater could be used to cool CO_2 at the surface - thus increasing efficiency when compared with equivalent onshore CPG systems.

Current feasibility

CPG is currently under development as a technically viable for a geothermal energy source analogous to offshore gas fields. The technology required to implement this approach is readily available from the geothermal, CCUS, oil and gas, and power industries. Funding has been granted for pilot projects in the USA to test this approach, aiming to de-risk CPG and advance commercialisation. Research has demonstrated the theoretical potential of CPG – power could be produced in the order of MWe from reservoirs at moderate depths (3-4 km) characterised by common geothermal gradients. The next step is full-scale field size testing and validation.

Way forward & solutions

Market prices along with regulatory, legal, contractual, and environmental conditions must be considered for currently established promising CPG locations. Scalability and infrastructure are crucial to ensure economic competitivity at utility-scale CCS developments.



Graphic source – Martin Saar (ETH Zurich)

Going supercritical

CO_2 becomes a supercritical fluid after surpassing the temperature and pressure thresholds of 31°C and 7.4 MPa. sCO_2 has a high thermal expansivity which causes large density differences between the injection and production wells of a CPG system. Consequently, a buoyancy driven thermosiphon (plume) forms, self-circulating fluid around the system and potentially eliminating parasitic pumping requirements. The low kinematic viscosity of sCO_2 brings about high mass flow rates. These properties equate to an increased heat extraction performance across a range of reservoir and operating conditions when compared with hydrothermal systems.

Key takeaways

- *The combination of geothermal energy and carbon utilization/storage offers an effective pathway to the valorization of CO_2 and providing sustainable baseload power.*
- *Untapped geothermal reservoirs characterized by common geothermal gradients could be accessed by implementing CPG, so resources that were previously considered to be unrecoverable could be targeted for efficient and economical energy extraction.*
- *Extended life of existing wells and infrastructure.*

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