Scientists have reviewed the potential for worldwide development of geothermal energy systems in old, unused mines. The technology is proven in many sites and could therefore help increase the share of renewable energy sources in the energy mix, offering sustainability and job creation, which may make mining operations more appealing to investors, communities and policymakers.

The mineral industry is energy intensive and is therefore focusing on developing energy efficiency and cleaner production technologies. It is also expensive to open, operate and close mines, but few are ever considered as being useful once they have been closed. They are often located on marginal, unproductive land in remote, harsh environments and nearby communities may only live in the area as a direct result of the mine. Being often highly dependent on the mine and on imports of (fossil) fuel, such communities are highly unsustainable.

The researchers argue that mines could be used post-closure for energy generation (heating and cooling) using the natural heat contained in the mine water. Geothermal energy systems could be implemented to extract this heat using heat pumps, from both closed and potentially working mines. This would offer local employment and energy resilience to the surrounding communities. Other uses of the energy may include melting snow on icy roads (instead of using salt) or supplying heat for fish farms and greenhouses.

Several other technologies can extract energy from abandoned mines, including compressed air storage or the direct use of warm mine water to regulate the temperature of microalgal raceway ponds, allowing a longer growing season for cultivation; key products that can be obtained from the microalgae include nutraceuticals and biofuels. If biodiesel is used to fuel the energy extraction operations, there could be further CO₂ and air pollution reduction, with particular health benefits for workers if used in working mines. Competition with other fuels may limit geothermal development in less remote locations, but rising prices and CO₂ reduction incentives could see this barrier decline over time.

Without ongoing dewatering, mines may fill with water permeating from surrounding rocks, possibly leading to contaminated floodwater escaping into local land or water bodies. Measures which contribute to on-going economic viability of mines will increase the motivation to continue water monitoring and pumping operations, preventing such events and offering energy resources from the controlled flows.

The type, size and flexibility of the geothermal energy system depends on the water quality, volume and temperature and must be designed to avoid degrading the energy reserve by extracting too much heat. However, detailed site and water balance models can provide heat maps of geothermal resources and identify opportunities and customers for heat recovery. Additional efficiency measures to maximise benefit include, design to minimise water loss in the distribution system and upgrading of customer buildings insulation.

Worldwide there may be over 1 million abandoned mines. The study lists several feasibility studies for potential geothermal projects across North America and Europe, plus many examples of operational systems worldwide, including:

- a district heating system at Heerlen, Netherlands, with multiple heat pumps, built as part of regeneration scheme for an area devastated by the closure of coal mines;
- a Norwegian copper/zinc mine closed in 1941, providing heat since 1998 to an underground cavern used for concerts and banquets;
- small coal mines heating a few tens of houses in Scotland, UK.


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