West Virginia University
Bridge Initiative for Science and Technology Policy, Leadership, and Communications
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Science and Technology Note

Geothermal Energy on Abandoned Mine Lands

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Geothermal energy is a type of renewable energy that is generated from the natural heat of the Earth's interior. This heat can be harnessed to produce electricity and heat buildings. The process is both environmentally friendly and sustainable, as it relies on the Earth's constant internal heat. This Science and Technology Note highlights the opportunities and challenges associated with harnessing geothermal energy from former coal mine lands in West Virginia.

What are Minewater Geothermal Energy Systems?

Minewater geothermal systems are renewable energy sources that utilize heat from flooded mines. When a mine is abandoned, it fills with water that is warmed by subsurface heat. This water can be channeled through a heat exchanger within a heat pump.

Geothermal heat pumps can provide heating or cooling at 3-5 times the efficiency of natural gas and electric, but they are not often utilized due to high upfront costs.

AMLs in West Virginia with Geothermal Heat Pump Potential

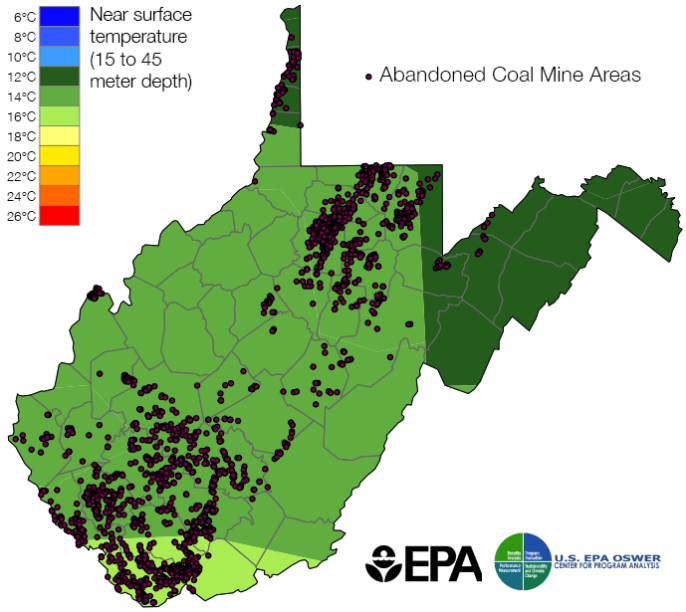


Image adapted from Environmental Protection Agency (2009)

Research Highlights

- Every geothermal facility surveyed in the North American study reported a payback period of five years or less for each investment.
- Heat pumps using mine water can reduce heating costs by 67% annually and cooling by 50% compared to other conventional methods.
- Mine owners and operators can receive renewable energy credits as well as carbon credits for geothermal development on an abandoned mine site.

A major upfront cost is the capital cost of excavation and drilling, which can be reduced or eliminated by re-using existing flooded mineshafts on abandoned mine lands (AMLs).

According to the EPA, a majority of AMLs have never been considered for any type of re-use and remain idle. The Pittsburgh coal seam, situated in northern WV, encompasses an estimated 1.36 trillion gallons of mine water stored underneath 5,000 square miles of land—a rich resource with the capacity for diverse and impactful applications.

Mines located near or below existing facilities are great options for developing a geothermal system. Facilities of interest include schools, universities, and data centers.

Possible West Virginia Case Scenario

West Virginia AMLs provide an opportunity to capitalize on this geothermal source for cooling applications. For example, Project Oasis, a campaign in southwest Virginia, proposes the use of geothermal energy on AML for data center cooling. This method could save data centers more than $1 million annually. Most new renewable energy projects for data centers in the current market utilize solar energy, which requires a large land area (6-10 acres per MW). Minewater geothermal provides a more efficient land use for this application.

Illustrative Minewater Geothermal Systems

DATE	COUNTRY/STATE	WATER TEMP (°C)	DEPTH (m)	SYSTEM CAPACITY	UPFRONT COST
1980	Nova Scotia, Canada	18	1350	45 kW	$110,000
1995	Park Hills, Missouri	14	120	1 municiple building	$132,000
2007	Shachsen, Germany	12	144	690 kW	N/A
2009	Heerleen, Netherlands	16-19	700	700 kW	N/A
1981	Kingston, Pennsylvania	N/A	N/A	12,000 ft^2 rec center	N/A
2009	Scranton, Pennsylvania	N/A	132	N/A	$530,000
N/A	Southwest Virginia	11-21	N/A	20,000 kW thermal load	N/A

Source: Michigan Tech (2021)

Geothermal Opportunities on West Virginia Abandoned Mine Lands

Geothermal exploration within West Virginia's AMLs offers a range of opportunities. These include potentials for land rehabilitation, enhanced land use, increased site values, and energy-efficient heating and cooling solutions.

- *Land Rehabilitation*: Harnessing geothermal energy can offset land cleanup costs, potentially enhancing environmental remediation.
- *Economic Revitalization*: There is potential to revive coal mining communities through geothermal utilization in abandoned mines.
- *AML Site Value*: Geothermal energy can enhance the long-term appeal of these sites for potential investors and policymakers, thus promoting sustainable development.

Geothermal Energy Challenges on West Virginia Abandoned Mind Lands

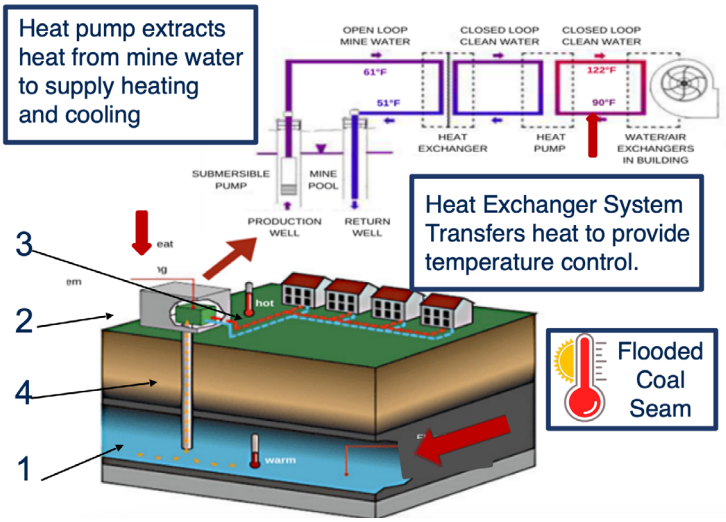
Geothermal development requires careful consideration to ensure sustainable practices. For instance, AMLs are located in regions that are remote from energy sources and infrastructures. The distance from the mine to the location where the energy is needed presents difficulties.

There are also liability concerns on these sites since AMLs can be contaminated with Acid Mine Drainage (AMD). Such concerns could deter investors in renewable development. Other potential environmental impacts are related to surface disturbances and discharge of chemicals that can affect local communities.

Policy Options

For development to occur, it is important establish clear legal standards for the leasing and ownership of the water. A mineral rights lease is a short-term option, but a long-term solution might involve the establishment of a geothermal utility in the state of West Virginia.

Minewater Geothermal System Steps



1. The warmed water from the flooded coal seam is pumped to the surface.
2. The water is directed to a heat exchanger, where its heat is efficiently extracted and harnessed.
3. The heat pump system transfers this heat to warm or cool the building's air.
4. The heat pump returns the minewater back to the mine seam to be warmed again for future use, completing the cycle.

Source: adapted from Pennsylvania Department of Environmental Protection

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