



# North Dakota Legislative Council

Prepared for the Energy Development and Transmission Committee  
LC# 27.9118.01000  
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## GEOTHERMAL ENERGY STUDY - BACKGROUND MEMORANDUM

Section 1 of Senate Bill No. 2360 (2025) ([appendix](#)) directs the Legislative Management to study the feasibility of developing geothermal energy in the state. The study must include an evaluation of:

- The state's geology and the feasibility of resource exploration and production of geothermal energy in the state.
- Support opportunities for startup geothermal companies, including fostering innovation and promoting economic growth within the state's energy sector.
- The application of geothermal energy to nonproductive oil and gas wells to extend the life of the well through the use of a complementary energy extraction method.
- Other opportunities to advance geothermal energy opportunities in the state.

### BACKGROUND

Testimony provided in support of Senate Bill No. 2360 emphasized the importance of exploring the potential of geothermal energy in the state. Testimony indicated geothermal heat is being emitted from current oil and gas wells; however, the energy is not being harnessed. Testimony noted the potential to produce geothermal energy using nonproducing oil and gas wells. Repurposing nonproducing oil and gas wells could provide a second life for dry wells and turn otherwise unproductive wells into productive energy and revenue sources. Testimony also indicated repurposing wells would prevent the wells from becoming abandoned and reduce the environmental impact of abandoned wells.

In regard to availability, testimony indicated the quantity of heat being produced in nonproducing oil and gas wells is sufficient to generate electricity from geothermal energy and at least one company is deploying geothermal technology in oil and gas fields in the state. Testimony indicated the amount of thermal energy stored in the Williston Basin is estimated to be 10,000 times larger than the amount of energy in oil and gas reserves in the basin. No testimony in opposition to the study was received.

### OVERVIEW

Geothermal energy is derived from heat stored beneath the earth's surface. Geothermal energy from shallow underground sources may be used to heat or cool residential or commercial buildings, while geothermal energy from deeper underground sources may be used to generate steam to produce electricity.

#### Types of Geothermal Energy Systems

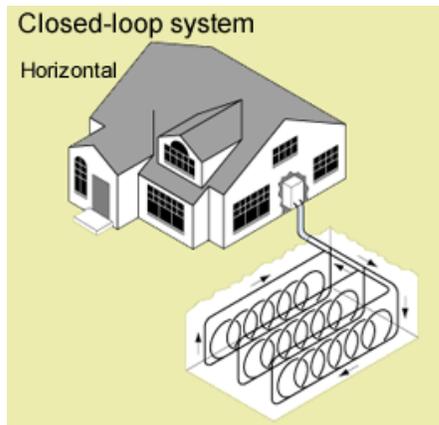
##### Geothermal Heat Pumps

Heat pumps are a common way to harness geothermal energy from shallow underground sources. Heat pumps heat or cool buildings using underground pipes. In North Dakota, the shallow ground temperature is roughly 45 degrees year round, which is generally much cooler than the air temperature in the summer and much warmer than the air temperature in the winter.<sup>1</sup> The pumps rely on the relatively consistent temperature of the ground to transfer heat to a building in the winter or cool a building in the summer. The pumps heat or cool by sending water underground into looped pipes in which heat either

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<sup>1</sup> Ned Kruger, *Geothermal Heat Pumps*, Geo News, 12, (July 2024).

is collected or dissipated. The heated or cooled water is recirculated back into the building's heating and cooling system.<sup>2</sup>

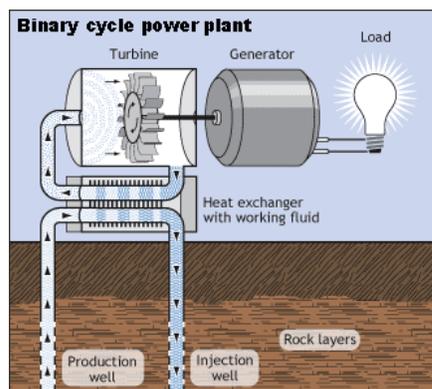


Source: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (public domain)

### Geothermal Power Plants

Geothermal energy also may be harnessed to produce electricity from heat in deep geothermal wells. A potential source of deep geothermal wells is previously drilled oilfield wells. Many oil wells are drilled deep enough for the heat energy to be collected and used for electrical generation.<sup>3</sup>

Three common types of geothermal power plants are dry steam plants, flash steam plants, and binary cycle power plants. A dry steam plant brings underground steam to the surface to power turbines to generate electricity. A flash steam plant, which is the most prevalent type of plant, pulls fluids exceeding 360 degrees Fahrenheit from deep underground. When the fluids transfer from a high-pressure underground source to an aboveground holding tank, the dramatic change in pressure causes the fluid to flash into a vapor which is used to power a turbine to generate electricity. A binary cycle power plant uses lower-temperature underground fluids, which do not exceed 360 degrees Fahrenheit, to heat a secondary fluid with a lower boiling point to produce steam to power a turbine to generate electricity. A binary cycle power plant would be needed to harness geothermal energy in the Bakken Formation due to the formation's lower underground temperatures, which generally range from 210 to 250 degrees Fahrenheit.<sup>4</sup>



Source: U.S. Department of Energy, Geothermal Technologies Office (public domain)

<sup>2</sup> Energy Information Administration, *Geothermal explained*, (December 27, 2022).

<sup>3</sup> United States Department of Energy, *Geothermal Basics*.

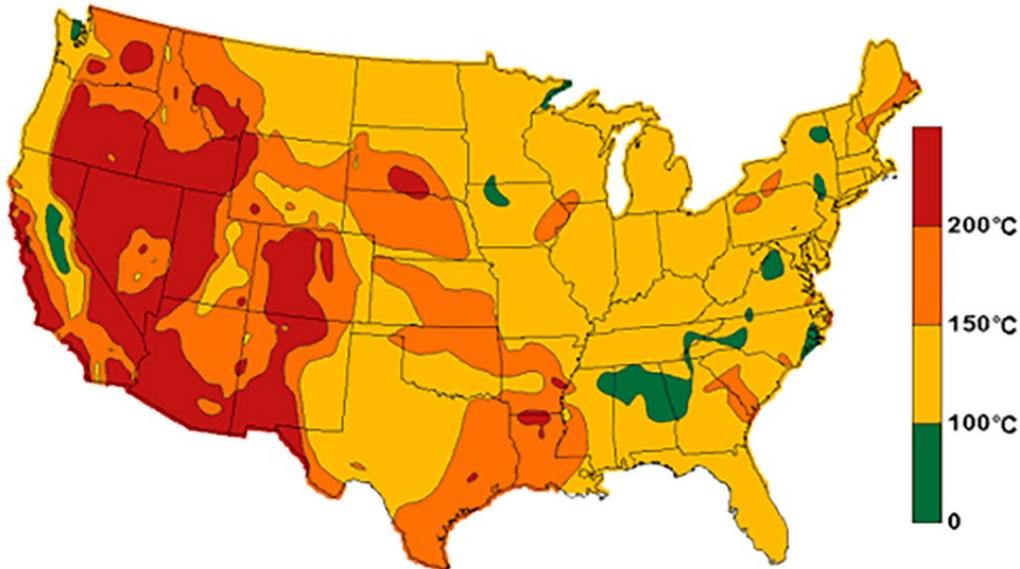
<sup>4</sup> Sidike Abudureyimu, *Geothermal Energy from Repurposed Oil and Gas Wells in Western North Dakota*, 11, (May 2020) (Ph.D. dissertation, University of North Dakota).

## Geothermal Resources

### National Geothermal Resources

Because geothermal resources are naturally occurring, these heat sources are not evenly distributed across the country. The following graphic depicts the areas in which geothermal resources are the most concentrated, which generally are in the western portion of the United States.

### Geothermal resources of the United States



Source: U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy (public domain)

As of 2023, California leads the United States in geothermal electricity production, accounting for 66.6 percent of the geothermal electricity production in the nation. Nevada ranks second in geothermal electricity production, producing 26.1 percent of the nation's geothermal electricity, and Utah ranks third, producing 3.2 percent of the nation's geothermal electricity.<sup>5</sup>

### State Geothermal Resources

With the number of nonproducing oil wells in the state increasing, more than 7,000 wells may have the potential to be repurposed for geothermal use. If geothermal energy is produced from oil wells in the state, there is the potential to generate 1.3 to 7.5 megawatt-hours of electricity.<sup>6</sup> From 2007 to 2023, the North Dakota Industrial Commission issued 1,843 permits for the installation of residential and commercial heat pumps, with the largest number of heat pump permits being issued in 2010 and 2011.<sup>7</sup>

## STATE REGULATIONS AND INCENTIVES

### North Dakota Century Code

North Dakota Century Code (NDCC) Chapter 38-19 provides the Industrial Commission the authority to regulate geothermal resource development, adopt rules, and issue orders to enforce the chapter. The chapter requires a person to receive a permit from the director of the Department of Mineral Resources before constructing a geothermal energy extraction facility or engaging in any drilling, boring, or excavating in relation to the facility. Within 30 days after the completion of a geothermal energy extraction facility, the geothermal energy extraction facility installer must prepare and provide a report to the State Geologist which must include the name of the facility owner and location of the facility, environmental

<sup>5</sup> Energy Information Administration, *Geothermal explained*, (April 3, 2024).

<sup>6</sup> Sidike Abudureyimu, *Geothermal Energy from Repurposed Oil and Gas Wells in Western North Dakota*, 12, 26-27, (May 2020) (Ph.D. dissertation, University of North Dakota).

<sup>7</sup> Ned Kruger, *Geothermal Heat Pumps*, Geo News, 12, (July 2024).

safety information relating to the facility, a log of formations penetrated or total depth, system specifications and design, and fluids used in the facility.

### **North Dakota Administrative Code**

#### **Geothermal Energy Production Regulations**

North Dakota Administrative Code (NDAC) Chapter 43-02-07 regulates geothermal energy production and provides the State Geologist the authority to enforce the chapter. The chapter requires a person installing a geothermal energy extraction facility to obtain a permit from the State Geologist. An applicant may appeal a decision of the State Geologist to the Industrial Commission. The chapter prohibits a producer from operating a facility in a way that contaminates drinking water. The chapter requires the permit holder to file an intention to abandon a geothermal extraction facility before commencing plugging operations and to plug wells in a manner which permanently seals the facility before abandoning the facility. The permit holder must maintain financial responsibility for closing and plugging an abandoned geothermal well.

#### **Deep Geothermal Energy Production Regulations**

NDAC Chapter 43-02-07 regulates deep geothermal energy production and requires a person to obtain an exploration permit from the Industrial Commission before a person may begin well-site preparations for drilling a deep geothermal well. A person also must receive a separate facilities permit from the Industrial Commission before commencing construction on a deep-well geothermal facility. The operator of a deep-well geothermal facility is required to collect and deliver to the State Geologist sample cuts, cores, radioactivity logs, and other pertinent information. The operator also must remit an annual operating fee, which is based on the cost to monitor and inspect the facility. The chapter requires an operator to comply with all plugging and reclamation rules applicable to oil wells when abandoning a deep-well geothermal facility.

### **State Income Tax Incentive**

NDCC Section 57-38-01.8 provides an income tax credit for the installation of geothermal, solar, wind, or biomass energy devices. The credit is available for devices installed after December 31, 2008, and before January 1, 2015, and is equal to 3 percent per year for 5 years of the actual cost of acquiring and installing a geothermal energy device. The credit has expired for purposes of installing future geothermal energy devices.

## **FEDERAL REGULATIONS AND INCENTIVES**

### **National Environmental Policy Act**

Geothermal energy was first regulated under the federal Geothermal Steam Act of 1970 (30 U.S.C. 1001), which authorized the Secretary of the Interior to lease lands managed by the Department of the Interior or the United States Forest Service for the development of geothermal resources. The Act was amended by the federal Energy Policy Act of 2005 (Public Law No. 109-58), which sought to reduce delays in the federal leasing process and reduce royalty charges to encourage the development of geothermal energy. The federal Energy Policy Act of 2005 also extended certain categorical exclusions to the oil and gas industry. The National Environmental Policy Act (42 U.S.C. 4321-4347) requires a federal agency to consider the environmental impacts of an activity before the federal agency determines how or whether the activity may proceed. This consideration is exercised through the preparation of an environmental assessment or environmental impact statement.

A categorical exclusion is an activity for which a specific federal agency has determined the environmental assessment or environmental impact statement normally required to be prepared to comply with the National Environmental Policy Act is not required due to a history of the activity not significantly affecting the quality of the environment. In April 2024, the Department of the Interior published a rule to categorically exclude geothermal exploration operations under the National Environmental Policy Act. Specifically, the Department of the Interior adopted the United States Forest Service exclusion related to short-term mineral, energy, or geophysical investigations and the Department of the Navy exclusion related to prelease upland exploration activities for oil, gas, or geothermal reserves for the Bureau of Land Management to use when approving geothermal exploration

operations.<sup>8</sup> Geothermal activities not subject to a categorical exclusion are subject to the requirements under the National Environmental Policy Act.

### **Residential Clean Energy Credit**

A taxpayer who installs geothermal heat pumps is eligible for the Residential Clean Energy Credit, which provides a tax credit against federal income tax equal to 30 percent of the cost of qualified clean energy property.<sup>9</sup> The "One Big Beautiful Bill Act" limited the Residential Clean Energy Credit to apply only to expenditures made before December 31, 2025.

## **OTHER STATES**

### **California**

In 2025, California passed Assembly Bill No. 527 to exempt geothermal exploration projects from the California Environmental Quality Act. Geothermal exploration is exempted under the bill when it includes six or fewer wells and has the purpose of evaluating geothermal resources before developing a geothermal field. The California Environmental Quality Act requires an agency to create an environmental impact report for a project that may have a significant effect on the environment.

### **New Mexico**

In 2024, New Mexico passed House Bill No. 91, which created the Geothermal Projects Development Fund and Geothermal Projects Revolving Loan Fund. Money from the funds is used to provide grants for the study of costs and benefits associated with a proposed geothermal project, financing of a geothermal development project, financing of a political subdivision or a state university geothermal project, and development of geothermal energy in Indian nations.

### **Washington**

In 2024, Washington passed Senate Bill No. 6039, which created a comprehensive database of publicly available subsurface geologic information related to geothermal energy. The statute requires that rates on geothermal leases issued by the state must be competitive with geothermal lease rates adopted by the federal government and the lease rates adopted by other western states. The state provides a grant program that incentivizes deep exploration drilling to identify locations suitable for development of geothermal energy.

### **Maryland**

In 2024, Maryland passed House Bill No. 397, which requires gas companies serving more than 75,000 customers to develop a pilot program for a geothermal energy network or system. Each gas company serving more than 75,000 customers must submit the plan to the Maryland Public Service Commission for approval. As part of the plan, 80 percent of the pilot project's customers must be from low- or moderate-income housing. The plan also must demonstrate the gas company is eligible for federal funding.

### **Virginia**

In 2024, Virginia passed Senate Bill No. 508, which designated geothermal systems as eligible energy sources under the state's renewable energy portfolio standard. The Virginia renewable energy portfolio requires certain utilities to generate 100 percent of electricity from renewable sources by 2045 and others by 2050. The other sources of electricity allowed under the profile are biomass, falling water, landfill-gas-fired, solar, and wind.

### **Minnesota**

Minnesota created a geothermal planning grant program to provide grants to examine the feasibility of installing geothermal energy systems in counties, cities, towns, tribal governments, and the

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<sup>8</sup> *Adoption of Categorical Exclusions Under Section 109 of the National Environmental Policy Act*, 89 FR 28797, Interior Department, (April 19, 2024).

<sup>9</sup> 26 U.S.C. § 25D.

Metropolitan Council.<sup>10</sup> A recipient of a grant under the program may be awarded up to \$150,000. Grant recipients may use the funds for analysis of the heating and cooling demands of buildings, evaluations of equipment that could be used with a geothermal energy system, and analysis of the geologic conditions for the geothermal system. The state provided \$1.08 million to the program for the current round of grant funding.

### **Colorado**

In 2022, Colorado passed House Bill No. 1381 to provide a grant program for energy produced from geothermal resources installed in a single structure as the primary heating or cooling system, a community heating system that serves multiple buildings, or a facility that generates electricity from geothermal energy.

In 2023, Colorado passed Senate Bill 23-285, which established that the property right to a geothermal resource from groundwater is part of the ownership of the surface estate. The state splits the authority to issue permits for geothermal energy between the State Engineer and the Energy and Carbon Management Commission. The state grants the authority to regulate deep geothermal operations to the Energy and Carbon Management Commission and the authority to regulate other geothermal operations to the State Engineer.

### **UNIVERSITY OF NORTH DAKOTA STUDY**

The University of North Dakota (UND) conducted two projects assessing the feasibility of generating electricity using geothermal resources in North Dakota and published the paper *Co-Produced and Low-Temperature Geothermal Resources in the Williston Basin* in 2015, which discussed the methods and results of the projects.<sup>11</sup> Researchers used a field of 12 oil and gas wells during the project and aimed to generate 250 kilowatts of electricity using two 125 kilowatt Organic Rankine Cycle (ORC) engines. The ORC engine used in the project required water temperatures of at least 95.6 degrees Celsius to operate; however, the engine was designed to operate at maximum efficiency when it reached a water temperature of 135 degrees Celsius.

The study determined geothermal energy from water in the Williston Basin is adequate for power generation, but it is difficult to generate economic amounts of power from single wells. The study recommended that to reach economical amounts of electrical power it would be best to use multi-well pads. The study found there are localized areas in the Bakken and Three Forks Formations that could provide water at 120 degrees Celsius to 130 degrees Celsius and there is the potential to generate several hundred megawatts of electricity from wells in the Bakken Formation.

### **PREVIOUS LEGISLATIVE STUDIES AND REPORTS**

#### **2023-24**

The 2023-24 interim Energy Development and Transmission Committee received a report from the Clean Sustainable Energy Authority that indicated the authority approved grants and loans for 20 projects, including projects to evaluate the potential of using geothermal power generation on oil and gas production sites.

#### **2011-12**

The 2011-12 interim Energy Development and Transmission Committee received testimony for a review of the energy industry in the state including the state's geothermal energy sector. The committee was informed the geothermal laboratory at UND was conducting a geothermal power demonstration project to demonstrate and test the technical and economic feasibility of generating electricity from nonconventional, low-temperature geothermal resources using ORC technology.

<sup>10</sup> Minn. Stat. § 216C.47.

<sup>11</sup> Will Gosnold et. al, *Co-Produced and Low-Temperature Geothermal Resources in the Williston Basin*, GRC Transactions, Vol. 39, 2015.

**2009-10**

The 2009-10 interim Energy Development and Transmission Committee received testimony from the EmPower ND Commission regarding geothermal and hydrogen. The testimony focused on the Energy & Environmental Research Center as to hydrogen technology. The committee was informed that the commission has investigated the industrial potential of using abandoned oil wells as sources of geothermal energy and determined the pressure and heat from deep oil wells can produce energy.

**RECENT LEGISLATION****2015 Legislation**

House Bill No. 1429 (2015) would have extended the tax credit in NDCC Section 57-38-01.8 to include geothermal devices installed before January 1, 2017. The bill faced opposition in committee based on the desire to avoid influencing market forces with a tax credit supporting a particular type of energy. The bill received a do not pass recommendation out of committee and failed in the House of Representatives by a vote of 33 to 60.

**2011 Legislation**

House Bill No. 1124 (2011) provided the current language for a state tax credit for geothermal energy. The bill amended NDCC Section 57-38-01.8 to allow an individual taxpayer to claim an income tax credit for the cost of a geothermal energy device installed after December 31, 2008, and before January 1, 2015. The credit is equal to 3 percent per year for 5 years of the actual cost of acquisition and installation of the geothermal device.

**2009 Legislation**

Senate Bill No. 2075 (2009) appropriated \$3,039,414 to the Department of Veterans' Affairs. The appropriated funds were designated to first come from federal funds appropriated to the state by the Federal American Recovery and Reinvestment Act of 2009, or if federal funds were not available, the General Fund. The funds were appropriated to install a geothermal heating system in the new Veterans' Home facility. Federal funds were not available for the project and the Veterans' Home used money from the General Fund for the project. The entire appropriation was expended during the biennium.

**STUDY APPROACH**

In conducting the study of geothermal energy, the committee may wish to receive testimony from:

- Geothermal energy companies;
- Researchers at UND and other institutions who have researched geothermal energy;
- The Department of Mineral Resources; and
- Oil and gas industry members.

ATTACH:1