# Topics and Considerations for Developing State Geothermal Regulations

Aaron Levine, Faith Martinez Smith, and Heather Buchanan

*National Renewable Energy Laboratory*

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*Photos (clockwise) by Dennis Schroeder, NREL 36653; Alaska Center for Energy and Power, NREL 32760; Dennis Schroeder, NREL 48223 and 48223; John W. Lund, NREL 13101; Robb Williamson, NREL 13033*

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# List of Acronyms

| | |
|---|---|
| BLM | Bureau of Land Management |
| CEQA | California Environmental Quality Act |
| EGS | enhanced geothermal systems |
| EPA | U.S. Environmental Protection Agency |
| GDP | Bureau of Land Management Geothermal Drilling Permit |
| GSA | Geothermal Steam Act of 1970 |
| GSHP | ground-source heat pump |
| MOA | memorandum of agreement |
| MOU | memorandum of understanding |
| NDEP | Nevada Division of Environmental Protection |
| NDOM | Nevada Division of Minerals |
| NEPA | National Environmental Policy Act |
| NOI | Bureau of Land Management Notice of Intent |
| NREL | National Renewable Energy Laboratory |
| SDWA | Safe Drinking Water Act |
| SLB | Texas School Lands Board |
| SWG | Geothermal Regulatory Stakeholder Working Group |
| UIC | underground injection control |

# Executive Summary

In 2019, the U.S. Department of Energy's Geothermal Technologies Office with support from the National Renewable Energy Laboratory (NREL) released the *GeoVision* report and associated Non-Technical Barriers Task Force report.[1] The Non-Technical Barriers Task Force report identified states in the eastern and southern United States that do not currently have geothermal regulations for power production or direct-use applications. In addition, other discussions have indicated interest from states in updating existing geothermal regulations that have been in place for decades. Based on these findings, the intent of this document is to provide information that states might find valuable when developing geothermal regulations that would be inclusive of all geothermal power and heating technologies (e.g., conventional and nonconventional power production and direct-use applications) with applicability in all states. Furthermore, this report does not focus on ground source heat pumps (GSHPs, also known as geothermal heat pumps) or use of the subsurface as a thermal sink.

As part of this project, the NREL project team reviewed and catalogued existing state and Federal geothermal regulations, compiled best practices from geothermal and other extractive industries, and established a Geothermal Regulatory Stakeholder Working Group (SWG) to advise and review the geothermal regulatory synthesis. The SWG was comprised of volunteers and met approximately monthly over the course of one year to review and discuss specific topics relevant to this set of geothermal regulatory considerations.

This report is divided into five main sections, which were identified in coordination with the SWG as the main topics for inclusion. Within these sections, a list of considerations within each category are identified and, in some cases, relevant examples from existing state and Federal geothermal regulations are included to further illustrate the proposed considerations. This report includes the following sections:

- Geothermal resource ownership and definition
- Leasing process
- Exploration approval process
- Drilling/wellfield development approval process
- Underground injection control (UIC) process.

In addition, a list of key considerations summarized from this report are included below. This list is not meant to be exhaustive, as each state's regulatory landscape is unique; rather, these are meant to be concepts that can be considered when developing and/or updating existing geothermal regulations.

The key considerations highlighted below were identified based on:

- A comprehensive review and analysis of existing geothermal regulations for all 50 states.

[1] *GeoVision* report available at https://www.energy.gov/eere/geothermal/geovision, and Non-Technical Barriers report available at https://www.nrel.gov/docs/fy19osti/71641.pdf.

- SWG discussions, which included monthly meetings and multiple reviews of the material presented in this report.

### *Considerations Regarding the Geothermal Resource Definition*

#### *The use of a specific temperature threshold could lead to multiple regulatory regimes, as well as the potential need for additional water rights, and/or permitting requirements.*

In many existing state geothermal resource definitions, temperature thresholds are included to define a minimum temperature for what constitutes a geothermal resource. Typically, lower temperature thresholds are used to distinguish between water resources or the use of GSHPs, both of which may require distinct permits. Higher temperature thresholds generally indicate utilization of a geothermal resource for electricity generation, which may inadvertently create different regulatory regimes for electricity generation and direct-use applications. As such, the inclusion of a temperature threshold may result in different regulatory structures, the need to acquire additional water rights, and/or additional permitting based on the specific geothermal technology. If considering the use of a temperature threshold within the geothermal resource definition, the following should be taken into account:

- The inclusion of a higher temperature threshold may categorize different geothermal technologies under different regulatory regimes.
- The inclusion of a lower temperature threshold may help distinguish GSHPs from other geothermal applications that require a more rigorous approval process.

#### *States should consider how the definition of the geothermal resource relates to water resources/water rights within the state.*

When considering the geothermal resource definition, the existing water resource and/or water rights regulatory structure may impact how a geothermal resource may be utilized. For example, Idaho's inclusion of a specific temperature threshold results in a geothermal right if the resource is 212°F or above, while below this threshold, the resource is considered a water right even though it could be utilized in multiple types of geothermal applications. The following should be considered if the state has any interplay between the geothermal resource definition and water rights:

- Based on the geothermal resource definition, the resource in question may require a water right in addition to a geothermal resource lease.
    - Note: This may also depend on whether there is a consumptive use of the water.
- Generally, the use of water for geothermal development has been deemed a beneficial use of the water.

#### *States may want to consider specifying what is encompassed within the geothermal right.*

Geothermal resource definitions may be very specific or may broadly define what is included within the right to extract the geothermal resource, including heat, brine, fluid, steam, and/or byproducts. States should consider the use of specific terminology of what is and can be extracted from the subsurface as it has the potential to include or exclude specific technologies, such as enhanced geothermal systems (EGS) or closed-loop geothermal systems. To ensure

longevity of the geothermal resource definition as technology continues to advance, the following should be considered:

- The geothermal resource definition should expressly include what is encompassed within the geothermal right.
    - The definition should be clear and concise to ensure that it is easy to comprehend and not subject to multiple interpretations.
- The geothermal resource definition should remain consistent with other existing mineral extraction laws and/or water rights (e.g., exclusion of hydrocarbons, interplay with water rights).

#### *States may want to consider use of the term "heat" in addition to "fluids."*

When considering geothermal technology inclusivity in addition to creating forward-facing regulations as technology continues to rapidly change, the geothermal resource definition should consider using "heat" in addition to "fluids," which may more accurately encompass nonconventional geothermal technologies (e.g., EGS and closed-loop systems).

### *Considerations Within the Geothermal Resource Leasing and Acquisition Processes*

#### *States may consider employing either a competitive or noncompetitive leasing process for geothermal resources on state-managed lands/mineral estates.*

States that manage large state or school trust lands may consider creating and/or updating their existing leasing process to have a clear process in place. For example, the Federal government (i.e., Bureau of Land Management [BLM]) and some states use a default competitive leasing process when utilizing geothermal resources for electricity generation, whereas these jurisdictions may use a noncompetitive process for direct-use applications.

#### *States may consider exceptions to the competitive and noncompetitive processes described above.*

In some instances, states may need to make exceptions to the leasing process(es) they have employed. The following could be considered as exceptions to a competitive or noncompetitive leasing process in place:

- Default noncompetitive leasing processes for geothermal resources at existing oil and gas wells, within mining operations, and for direct-use applications solely used on-site due to proximity to the resource.
- Allowing a noncompetitive leasing process to become competitive if multiple parties express interest in a particular parcel for geothermal resources (including for direct-use applications).

#### *States may consider geothermal lease terms without a fixed end date for a viable, producing resource.*

Currently there are a wide range of differences within geothermal resource leasing term lengths and extensions. Federal geothermal leases have a primary term of 10 years, with an initial extension of the primary term up to 5 years and an additional extension of the primary term for up to 5 years. There can also be a drilling extension of 5 years, a production extension up to 35

years, and a renewal period of up to 55 years **(43 CFR § 3207)**. In most cases, states have deployed specific time limitations on geothermal leases ranging from initial leasing periods of 10 years to terms up to 49 years. Oregon is a unique example where all leases are without limitation with discretion held by the Department of State Lands. When determining lease terms and extensions, states may consider lease terms that do not have a fixed end date for a viable, producing resource (i.e., discouraging/declining to extend a lease for a commercially viable resource).

### *Considerations Within the Exploration and Drilling Approval Processes*

#### *States may consider whether exploration will be limited to leased or unleased lands/rights in the geothermal resource.*

A Notice of Intent (NOI) to Conduct Geothermal Resource Exploration Operations is required prior to conducting exploration on Federally managed public land administered by the BLM, regardless of whether the land is currently leased for geothermal resources or on Federally managed lands where the surface is managed by a separate Federal agency (e.g., the U.S. Forest Service) but BLM has leased the subsurface resources (**43 CFR §3250.10**). However, BLM approval is not required under the following situations:

- Unleased geothermal resources whose surface is managed by another Federal agency.
- Casual use activities.[2]

On state-managed lands, exploration approval processes greatly vary, including:

- Exploration may be approved within a geothermal resource lease.
- Geologic or geophysical permits may restrict how a developer may operate in the exploration process.
- A state may require specific exploration or prospecting permits with varying requirements.
- Exploration may be included within a unified drilling permit.
- A temperature threshold may determine the type of permit and/or regulatory structure at play.

If a state is interested in creating an environment to encourage exploration for geothermal resources, it could consider whether to include an option to explore unleased lands, and if so, potentially have a process to noncompetitively lease those lands or otherwise provide an incentive to explore on unleased lands.

#### *States should be specific with what is permitted under an exploration permit versus a drilling permit.*

If a state requires separate permits for exploration and drilling processes, the state should be specific with what is permitted under an exploration permit versus a drilling permit. This

[2] Federal geothermal resource exploration operations do not include casual use activities. This means casual use activities do not technically require a permit. Casual use means activities that ordinarily lead to no significant disturbance of Federal lands, resources, or improvements (**43 CFR §3200.1**).

includes clearly defining what is encompassed within the scope of "exploration." A prime example of this is the Federal "geothermal exploration permit," which constitutes BLM's written permission to conduct only geothermal exploration operations and associated surface disturbance activities under an approved NOI to Conduct Geothermal Resource Exploration Operations and includes any necessary conditions BLM imposes as defined in **43 CFR §3200.1**.[3]

### *States may wish to offer a more inclusive drilling permit that does not distinguish between exploration and drilling for production.*

At the Federal level, there is a clear delineation between exploration and drilling processes with separate approval processes. In some states, regulations do not distinguish between drilling for exploration and production. In these cases, the developer must apply using the same process, regardless if drilling for exploratory or resource utilization purposes. New Mexico is an example of this process, where the state uses the same process for approving exploration, production, and observation wells.

## *Considerations Within the Underground Injection Control Approval Process*

### *States without existing UIC Class V wells primacy may need to determine whether they should seek primacy for Class V wells.*

If a state has not obtained UIC Class V primacy from the U.S. Environmental Protection Agency (EPA), then applications are provided and processed by the EPA. This also means that the EPA is the agency responsible for compliance of a UIC permit or applicable requirements. If a state has primacy for the well class, applications and compliance are typically authorized by a Primary Enforcement Agency, a state-level regulatory agency (see Table 1 for examples of Primary Enforcement Agencies).

- If a state anticipates a high volume of geothermal utilization, it may need to determine whether to seek primacy for Class V wells.
- A potential alternative to seeking primacy could include a Memorandum of Understanding (MOU)/Memorandum of Agreement (MOA) with the EPA for a state to specifically regulate geothermal wells (e.g., MOA between California Geologic Energy Management Division and EPA).

### *States may consider having a mechanism for state interagency coordination.*

If a state has primacy for Class V wells and has multiple agencies regulating geothermal drilling and UIC injection permits, it may consider having a formal mechanism for state interagency coordination. This could include an MOU between the agency authorizing the drilling and the agency authorizing the UIC injection permits (assuming these are separate agencies).

### *States may consider the use of temporary injection permits as structured by the Nevada Division of Environmental Protection and Nevada Division of Minerals (NDOM) MOU.*

If a state has primacy for Class V wells, it may be useful to consider a temporary injection permit for exploration of the geothermal resource. For example, in Nevada, NDOM can authorize a

[3] A BLM-approved geothermal exploration permit does not give a developer exclusive rights (**43 CFR §3250.11**).

seven-day temporary injection permit within the exploration process, which should be sufficient in duration to adequately capture the necessary data needed to apply for a UIC permit. This allows a developer to determine whether a well can later be utilized as an injection well. As part of this process, the developer typically monitors flow to better model the resource.

### *Environmental Considerations for Geothermal Development*

#### *States may consider the impacts of their existing environmental review process and how frequently a geothermal project would be subject to review.*

State-level environmental review processes vary drastically. In California, any project requiring a permit from a state agency will trigger the California Environmental Quality Act (CEQA), including those on Federal land. In other states, there may be limitations based on project size or other factors. Regardless of the state's processes, it should be aware of how many times a geothermal project may need to go through an environmental review process (e.g., leasing, exploration, drilling).

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# 1 Introduction

In 2019, the Department of Energy's Geothermal Technologies Office with support from the National Renewable Energy Laboratory (NREL) released the *GeoVision* report and associated Non-Technical Barriers Task Force report.[4] The Non-Technical Barriers Task Force report identified states in the eastern and southern United States that do not have geothermal regulations for power production or direct-use applications. In addition, other discussions have indicated interest from other states in updating existing geothermal regulations that have been in place for decades. Based on these findings, the intent of this document is to provide information that states might find valuable when developing geothermal regulations that would be inclusive of all geothermal technologies (e.g., conventional and nonconventional power production and direct-use applications)[5] with applicability in all states. Furthermore, this report does not focus on ground source heat pumps (GSHPs, also known as geothermal heat pumps) or use of the subsurface as a thermal sink.

As part of this project, the NREL project team reviewed and catalogued existing state geothermal regulations, compiled best practices from geothermal and other extractive industries, and established a Geothermal Regulatory Stakeholder Working Group (SWG) comprised of volunteers to advise and review the draft geothermal regulatory synthesis. The SWG was composed of representatives from the following organization types:

- Industry/developer representatives from hydrothermal, enhanced geothermal systems (EGS), and closed-loop geothermal companies
- Regulatory representatives from states with existing geothermal activity and states with interest in geothermal energy
- Oil and gas representatives from companies interested in pursuing geothermal energy
- State Energy Office representatives
- Academic researchers
- Consultants
- Attorneys with experience in extractive industries and geothermal energy.

The SWG met approximately monthly for one year to review and discuss specific topics relevant to geothermal regulation. Meeting agendas were divided based on the following topics discussed below. In addition, separate meetings were held with industry and/or developer interests and regulatory representatives. This document is the compilation of the geothermal regulatory considerations.

This report is broken into five main sections, which were identified in coordination with the SWG as the main topics for inclusion. Within these sections, a list of considerations within each category are identified and, in some cases, relevant examples from existing regulations are

[4] *GeoVision* report available at https://www.energy.gov/eere/geothermal/geovision, and Non-Technical Barriers report available at https://www.nrel.gov/docs/fy19osti/71641.pdf.
[5] For more information on geothermal technologies, see the U.S. Department of Energy's Geothermal Technologies Office website, at: https://www.energy.gov/eere/geothermal/geothermal-technologies-office.

included to further illustrate the proposed considerations. This report includes the following topics separated into individual sections:

- Geothermal resource ownership and definition
- Leasing process
- Exploration approval process
- Drilling/wellfield development approval process
- Underground injection control (UIC) process.

In addition, the report culminates with a section of "key considerations" that may be helpful to decision-makers when drafting new and/or updated state geothermal regulations.

# 2 Geothermal Resource Ownership and Definition

This section provides an example of geothermal resource ownership and themes to consider when developing or updating an existing state geothermal resource definition. This includes an overview of Federal ownership, followed by a few state examples broken down by themes, as illustrated in Subsection 2.2.

## 2.1 Geothermal Resource Ownership

### *2.1.1 Federal Geothermal Resource Ownership*

At the Federal level, geothermal resources are treated as mineral resources. Ownership of geothermal resources on Federally managed public lands typically falls within the Federal mineral reservation, and such resources are leased and regulated by the Bureau of Land Management (BLM).

### *2.1.2 State Examples of Geothermal Resource Ownership*

Geothermal resource ownership varies by state and typically includes resources owned by the surface owner or by the mineral owner, commonly referred to as a severed or split-estate. How the resource is classified can also determine its ownership; examples of this include running with the surface estate, water, mineral or sui generis. Prior to creating a regulatory structure to utilize geothermal resources, ownership of the resource should be clearly defined.

West Virginia's geothermal resource ownership definition is included below as an example of a state where the resource is tied to the surface estate.

> Ownership of any geothermal resource is vested in the owner of the surface property overlying the geothermal resource unless severance of the geothermal resource is clear and unambiguous in an instrument conveying or reserving ownership of the geothermal resource (**W. Va. Code R § 22-33-4**).

Idaho's geothermal resource definition illustrates how the resource itself is sui generis—it is neither a water resource nor a mineral resource:

> "Geothermal resource" means the natural heat energy of the earth, the energy, in whatever form, which may be found in any position and at any depth below the surface of the earth present in, resulting from, or created by, or which may be extracted from such natural heat, and all minerals in solution or other products obtained from the material medium of any geothermal resource. Ground water having a temperature of two hundred twelve (212) degrees Fahrenheit or more in the bottom of a well shall be classified as a geothermal resource. Geothermal resources are found and hereby declared to be sui generis, being neither a mineral resource nor a water resource, but they are also found and hereby declared to be closely related to and possibly affecting and affected by water and mineral resources in many instances (**Idaho Code § 42-4002(c)**).

## 2.2 Geothermal Resource Definition

The following subsection includes four themes to consider when developing or updating an existing state geothermal resource definition. The Federal definition is discussed in Subsection 2.2.2.

- Temperature thresholds
- Specificity of what is encompassed within the geothermal right
- Clear and concise definitions
- Regionally applicable "geopressured" language.

Each theme below includes suggested considerations and the rationale behind those considerations. Existing state geothermal resource definitions are included to illustrate the considerations within each theme.

### *2.2.1 Temperature Thresholds*

Many existing state geothermal resource definitions include temperature thresholds to define a minimum temperature for what constitutes a geothermal resource. Minimum temperature thresholds set at a lower value (around 30°-40°C) can be used to distinguish a water resource or GSHP, which may require distinct permits, from a geothermal resource used for electricity generation or larger direct-use applications. Minimum temperature thresholds set a higher value (100°C or higher), which typically indicate the utilization of a resource for electricity generation, may create different regulatory regimes for electricity generation and direct-use applications.

When including a temperature threshold in the definition of geothermal resources, the following aspects should be considered:

- If using a higher temperature threshold, there is the potential to classify geothermal electricity generation and direct-use applications under distinct regulatory schemes.
- The inclusion of a higher minimum temperature threshold may create limitations as technology advances and geothermal electricity generation becomes feasible at lower temperatures.
- The inclusion of a lower minimum temperature threshold can be helpful to distinguish between larger direct-use applications and GSHPs.
- Generally, the lowest geothermal fluid temperature useful for direct-use applications without the need for a heat pump is around 30°–40°C. Example applications at these low temperatures include fish farming, de-icing, and balneology (i.e., recreational hot springs).
- The efficiency of generating electricity from geothermal heat strongly depends on the difference between the geothermal fluid temperature and the surface temperature. Minimum required fluid temperature to make electricity cost-competitively is approximately 100°C. Electricity has been generated from geothermal fluids at lower temperatures (the record low is 74°C at a geothermal plant in Alaska), but these are

exceptions.[6] The vast majority of geothermal fluid temperatures used for electricity production at power plants around the world fall in the range 100° to 300°C.[7]

**South Carolina's** geothermal resource definition is included below as an example to illustrate the use of a lower minimum temperature threshold. The use of a lower minimum temperature threshold (i.e., 40°C) would theoretically include all geothermal technologies, but not include GSHPs.

> "Geothermal resources" means "the natural heat of the earth at *temperatures greater than forty degrees Celsius. . .*" **S.C. Code Ann. §§ 10-9-310; 48-43-10.**

However, **Alaska's** geothermal resource definition illustrates a definition that has a specific minimum temperature threshold (120°C), which has the potential to create distinct regulatory schemes for electricity generation and direct-use applications as well as potentially lower-temperature electricity generation as geothermal technologies evolve.

> "Geothermal resources" (A) means "the natural heat of the earth at *temperatures greater than 120 degrees Celsius. . .*" **Alaska Stat. §41.06.060(5).**

#### 2.2.1.1 Interplay With Water Rights

A temperature threshold may determine whether the geothermal resource in question is considered a geothermal resource or water resource. For example, **Idaho's** inclusion of a specific temperature threshold results in a geothermal right 212°F or above, while below this threshold, the resource is considered a water right (even though it could be utilized in multiple types of geothermal applications).

> ". . .Ground water having a temperature of two hundred twelve (212) degrees Fahrenheit or more in the bottom of a well shall be classified as a geothermal resource." **Idaho Code § 42-230(2)**.

In some instances, this delineation may require additional authorization for use of the water within the reservoir in order to develop the geothermal resource.

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[6] For instance, northern states such as Alaska and North Dakota can generate electrical power between 70° and 100°C because of below-freezing temperatures at the surface all winter. However, in southern states such as Texas, Louisiana, and Mississippi, the summer temperatures are near 100°F (37.8°C), and for these hot surface temperatures, the geothermal fluids are suggested to be over 225°F (108°C).

[7] The ambient air temperature has an impact on power plant efficiency when air is used for providing cooling in the power plant cycle (as is typically the case with the most popular geothermal power plant technology used today). The colder the ambient air, the more efficient the power plant is. If using water or cooling loop fluids, the cooling cycle of a geothermal power plant may also fluctuate between day and night temperature differences, which may impact total generation. The reservoir temperature is assumed to be consistent over the time frame of the plant, which is used to calculate the base output. The type of equipment used for the power plant will determine the required temperature differences between the geothermal resource and the cooling source.

### 2.2.2 Specificity of What Is Encompassed Within the Geothermal Right

Geothermal resource definitions may be very specific or may broadly define what is encompassed within the right to extract the geothermal resource, including heat, brine, fluid, steam, and/or byproducts. The definition should specify what is encompassed within the geothermal right granted for extracting the resource. In addition, the definition should remain consistent with other mineral extraction laws (e.g., oil and gas, locatable minerals). Geothermal resource definitions generally exclude hydrocarbons, including oil and gas resources. However, geothermal resource definitions may include locatable minerals found within the brine, but this should remain consistent with other mineral laws. The interplay between geothermal resources and locatable minerals found within the brine can be captured within the definition of "byproducts" as included in the Federal geothermal resource definition.

The Federal definition of a geothermal resource is as follows:

> "Geothermal steam and associated geothermal resources means:
> 1) All products of geothermal processes, including indigenous steam, hot water, and hot brines;
> 2) Steam and other gases, hot water, and hot brines resulting from water, gas, or other fluids artificially introduced into geothermal formations;
> 3) Heat or other associated energy found in geothermal formations; and
> 4) Any byproducts[8]" (**43 CFR § 3200.1**).

Decision-makers should consider the implications of using specific terminology of what is permitted to be extracted from the subsurface as it may include or exclude specific technologies such as EGS or closed-loop. To encompass all geothermal technologies, including language such as harnessing or extracting the resource's "heat" would be beneficial to ensure the broadest scope of technologies are included. For example, using terminology such as the "heat of the earth" or "geothermal heat," rather than "geothermal reservoir" will encompass all geothermal technologies.

**California's** definition of a geothermal resource includes these considerations. The California geothermal resource definition illustrates clear boundaries regarding what is and what is not encompassed within the right to extract geothermal resources.

> "Geothermal resources" means "the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, such natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, but excluding oil, hydrocarbon gas or other hydrocarbon substances" (**Cal. Pub. Res. Code § 6903**).

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[8] "Byproducts are minerals (exclusive of oil, hydrocarbon gas, and helium), found in solution or in association with geothermal steam, that no person would extract and produce by themselves because they are worth less than 75 percent of the value of the geothermal steam or because extraction and production would be too difficult" (**43 CFR § 3200.1**).

#### 2.2.2.1 Interplay With Water Rights

In some cases, geothermal resource definitions include distinct water rights, while in other definitions such rights are not clearly delineated. Depending on how the definition is written, geothermal resource extraction may require obtaining a water right or completing a separate permitting process.

Some states require both a geothermal right and a water right to develop the geothermal resource. For example, **Utah's** geothermal resource definition does not include geothermal fluids, rather just the energy extracted from the resource. To harness the resource via a production well, an "Appropriation of Water" is required.

> "Any person, owner, or operator, who proposes to drill a well for the production of geothermal resources or to drill an injection well *shall first apply to the Division (Division of Water Rights, Department of Natural Resources, State of Utah)* in accordance with Title 73, Chapter 3. . ."
> **Utah Admin. Code r. R655-1-2.**

#### 2.2.2.2 Use of the Term "Heat" Instead of "Fluids"

Some geothermal technologies utilize geothermal "heat" instead of geothermal "fluids." When creating a definition to ensure technology inclusivity, the definition should consider use of the term "heat," which may more accurately encompass EGS and closed-loop technologies because they extract the heat from the subsurface instead of a fluid.

**Nevada's** definition illustrates the previously discussed considerations and focuses on the use of the geothermal resource or natural heat of the earth rather than a fluid or reservoir.

> "Geothermal resource" means "the *natural heat of the earth* and the energy associated with that natural heat, pressure and all dissolved or entrained minerals that may be obtained from the medium used to transfer that heat, but excluding hydrocarbons and helium." **Nev. Rev. Stat. § 534A.010**

### 2.2.3 Clear and Concise Definitions

Geothermal resource definitions should be clear and concise so that they are easy to comprehend and not subject to multiple interpretations. The addition of "clarifying phrases" may not be as helpful as intended. Instead, the definition may confuse or require further information and/or additional definitions to define terms used. For example, the geothermal resources definition in **Hawaii** includes a long definition as well as confusing clarifying language, which may be subject to multiple interpretations.

> "Geothermal resources" means "the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, such natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, but excluding oil, hydrocarbon gas, other hydrocarbon substances, and any water, mineral in solution, or other product obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, and not used for electrical power generation."

In contrast, **Oregon's** definition of geothermal resource is clear and easier to understand.

> "Geothermal resources" means "the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or that may be extracted from, the natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, exclusive of helium or of oil, hydrocarbon gas or other hydrocarbon substances, but including, specifically:
>
> (a) All products of geothermal processes, including indigenous steam, hot water and hot brines;
>
> (b) Steam and other gases, hot water and hot brines resulting from water, gas, or other fluids artificially introduced into geothermal formations;
>
> (c) Heat or other associated energy found in geothermal formations; and
>
> (d) Any by-product derived from them." **Ore. Rev. Stat. § 522.005(11).**

### 2.2.4 Regional Considerations for the Gulf Coast

The terms geopressured or hydropressured have been added to geothermal resource definitions in states along the Gulf Coast. The addition of these terms may impact the development of geothermal resources. When determining if the addition of these terms is necessary to distinguish the geothermal resource due to specific geology, remaining clear and concise in doing so is highly recommended. For example, **Texas** incorporates the use of geopressured water within their definition of geothermal energy.

> "Geothermal energy and associated resources" means:
> "(A) products of geothermal processes, embracing indigenous steam, hot water and hot brines, and *geopressured water*. . ." **Tex. Nat. Res. Code Ann. § 141.003(4).**

# 3 Geothermal Resource Leasing and Acquisition Process

This section provides a high-level overview of geothermal resource leasing at the Federal level, as well as four approaches currently used for geothermal resource leasing at the state level. The state approaches include competitive leasing, noncompetitive leasing, combination or hybrid leasing, and acquisition of geothermal development rights as water rights. Other considerations include those related to land type(s), end use of the resource, or decisions about the use of the geothermal resource. Each of these approaches are described below and include existing state examples. However, in some states, there is limited state or public land outside of Federal public and/or managed land that could be utilized for geothermal resource leasing. A prime example of this is Nevada, where more than 80% of the state is Federally owned or managed with extremely limited state land available for geothermal resource leasing.[9] In such instances, the state geothermal resource leasing process is unique due to the limited use cases available.

## 3.1 Competitive Leasing

This subsection provides context for the existing Federal geothermal resource leasing process as amended by the Energy Policy Act of 2005, as well as an overview of existing processes for state geothermal resource leasing.

### *3.1.1 Federal Competitive Leasing*

The Geothermal Steam Act of 1970 (GSA) as amended and associated regulations promulgated at 43 CFR § 3200 et seq. require competitive geothermal resource leasing for geothermal resources intended for electricity generation on Federally managed public land. The Federal geothermal resource leases are issued by the BLM. The Federal process involves:

> (a) Nominations
> The Secretary shall accept nominations of land to be leased at any time from qualified companies and individuals under this chapter….
> (2) Competitive lease sales
> The Secretary shall hold a competitive lease sale at least once every 2 years for land in a State that has nominations pending under subsection (a) if the land is otherwise available for leasing (**30 USC Ch. 23 §1003**).

The BLM has promulgated regulations in furtherance of the GSA's competitive leasing requirement.

> (a) The competitive geothermal leasing process consists of the following steps:
> (1) (i) Entities interested in geothermal development nominate lands by submitting to BLM descriptions of lands they seek to be included in a lease sale;
> or (ii) BLM may include land in a competitive lease sale on its own initiative (**43 CFR § 3203.5**).

[9] CRS Report: Federal Land Ownership: Overview and Data (https://sgp.fas.org/crs/misc/R42346.pdf)

Following passage of the Energy Policy Act of 2005, which amended the GSA, all parcels nominated for Federal geothermal resource leasing with the intent to generate electricity require competitive leasing via a public lease auction. If the nominated parcel does not receive a qualifying bid at the lease auction, the parcel is then available for noncompetitive leasing for the following two years from the BLM.

### 3.1.2 State Competitive Leasing

Generally, states with competitive geothermal leasing typically follow one of two processes:

- Initial competitive leasing with lands selected by the relevant regulatory agency organizing the sale or managing the rights of the geothermal resource.
- Competition occurs after initial interest from developers.
    - This may be due to more than one application or simply due to interest in an area with defined resources.

For either of these competitive leasing processes, rules vary with each state; however, in almost all circumstances, the highest qualifying bid typically receives the leasing rights. In some states, if a specific lease is not sold, it may become noncompetitive or may be considered for sale at a future date.

**California** is used as an example below to illustrate the initial competitive leasing process described above.

> a) Lands may be selected for lease by the commission and shall be leased by competitive bid on the basis of a cash bonus, net profit, or other single biddable factor…
>
> (c) Lands so selected for lease by the commission shall be leased to the highest responsible qualified bidder under such rules and regulations as the commission may prescribe for notice to the public of terms and conditions of the sale, receipt of bid, and awarding of the lease (**Cal. Pub. Res. Code § 6911**).

## 3.2 Noncompetitive Leasing

At the Federal level, direct-use leasing typically falls under a noncompetitive lease. This process is described below, as well as three processes states typically follow regarding noncompetitive leasing.

### 3.2.1 Federal Noncompetitive Leasing

The GSA provides for limited exceptions to the default competitive leasing process for electricity-generating resources, which allows for noncompetitive geothermal resource leasing on mining claims with an approved Federal plan of operation, as well as co-production of geothermal resources from existing oil and gas wells on Federally managed public land. Additional information about lands subject to mining claims and oil and gas leases as relevant to the GSA is included below for more context regarding the process in which competitive parcels may become available for noncompetitive leasing.

- Lands subject to mining claims

Lands that are subject to a mining claim for which a plan of operations has been approved by the relevant Federal land management agency may be available for noncompetitive leasing under this section to the mining claim holder.

- Land subject to oil and gas lease

  Land under an oil and gas lease issued pursuant to the Mineral Leasing Act (30 U.S.C. 181 et seq.) or the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351 et seq.) that is subject to an approved application for permit to drill and from which oil and gas production is occurring may be available for noncompetitive leasing under subsection (c) by the holder of the oil and gas lease—

  (A) on a determination that geothermal energy will be produced from a well producing or capable of producing oil and gas; and

  (B) to provide for the coproduction of geothermal energy with oil and gas (**30 USC Ch. 23 §1003**).

The BLM has promulgated associated regulations at **43 CFR § 3203.5**.

> BLM will issue geothermal leases to the highest responsible qualified bidder after a competitive leasing process, except for situations where noncompetitive leasing is allowed under subparts 3204 and 3205, which include:
>
> (1) Lease applications pending on August 8, 2005
>
> (2) Lands for which no bid was received in a competitive lease sale
>
> (3) Direct-use lease applications for which no competitive interest exists
>
> (4) Lands subject to mining claims (**43 CFR § 3203.5**).

In addition, if the Federal lease nomination is specifically for developing a geothermal resource for direct use, the parcel is available for a noncompetitive lease. In this instance, the BLM must post the nomination publicly to determine if competitive interest exists in the parcel. If there is interest in the parcel through another nomination, it is then placed up for competitive leasing for direct-use applications only. This process is described in the GSA:

> Subject to paragraph (2), a geothermal lease for the direct use of geothermal resources shall cover not more than the quantity of acreage determined by the Secretary to be reasonably necessary for the proposed use (**30 USC Ch. 23 §1003**).

### 3.2.2 State Noncompetitive Leasing

Noncompetitive geothermal resource leasing occurs in multiple states and typically follows one of these processes:

- Direct application to lease
- Direct negotiation.

The following examples illustrate these two types of noncompetitive leasing processes.

#### 3.2.2.1 Direct Application to Lease

For states with direct applications for leasing, there may be specific requirements for the developer to meet, or leasing may be contingent on ensuring it is in the best interest of the state.

**New Mexico** is used as an example to illustrate noncompetitive direct application for geothermal resource leasing as determined by the best interest of the state.

> A. Leases may be issued by the commissioner according to such terms and conditions not inconsistent with the provisions of the Geothermal Resources Act which the commissioner determines to be in the best interest of the state…
>
> C. The commissioner shall issue a lease to the first qualified applicant under regulations adopted by the commissioner (**N.M. Stat. Ann. § 19-13-5**).

#### *3.2.2.2 Direct Negotiation*

For states where direct negotiation occurs with the agency managing the geothermal resource leasing rights, the process varies. An example of this can be found in Nevada, where an interested party works directly with the office of the Attorney General.

> Each lease is executed upon a form prepared by the Attorney General, which contains all covenants and agreements usual and necessary to leases for utilization of the resource (**Nev. Rev. Stat. § 322.010 - 332.040**).

## 3.3 Combination or Hybrid Leasing Process

As discussed above, the Federal leasing process typically delineates the process between competitive or noncompetitive leasing. However, there are instances where the process is a hybrid or combination process, as illustrated above with the concept of direct-use leasing.

Likewise, some states take a similar approach whereby a noncompetitive leasing process may become competitive based on specific qualifying factors. The following scenarios illustrate how this may occur:

- Interest from multiple parties in the same parcel
- Two or more lease applications are received simultaneously (generally same-day)
- The regulatory agency decides to have a competitive sale based on known geologic information.

Alternatively, a competitive process may become noncompetitive if interest is lacking or a specific time frame has passed. In some instances, the parcel will automatically be available for a noncompetitive lease, or it may be placed on hold for a specific period or return to the queue for future competitive lease sales.

Colorado is a prime example of a combination or hybrid leasing process, where geothermal resource leasing is a combination of negotiation and/or competitive bidding.

> "(1) Geothermal leases may be awarded by the state board of land commissioners for lands under its jurisdiction through negotiation or by competitive bidding, but no such lease may be awarded prior to a public notice period of thirty-five days" (**Colo. Rev. Stat. § 37-90.5-105**).

## 3.4 Water Rights

States may require a water right or permit to utilize the geothermal resource, either in lieu of or in addition to a geothermal resources lease. This may be based on the type of water resource, the definition of a water resource in a state (e.g., groundwater or surface water), or the end use of the water resource (e.g., a state may only require a water right for a consumptive use). Water rights typically vary based on the location, with some exceptions. Generally, eastern states follow riparian[10] water rights, while western states follow the principle of prior appropriation.[11] In addition, a water right acquisition may be based on a specific temperature threshold. A prime example of a state requiring a water right to harness a geothermal resource under a specific temperature is Idaho, as described above in Section 2.1. The following citations establish the temperatures at which geothermal developers are required to appropriate a water right in the State of Idaho.

> "(1) All ground water having a temperature of greater than eighty-five (85) degrees Fahrenheit and less than two hundred twelve (212) degrees Fahrenheit in the bottom of a well shall be classified and administered as a low temperature geothermal resource pursuant to section 42-233, Idaho Code.
> (2) All ground water having a temperature of two hundred twelve (212) degrees Fahrenheit or more in the bottom of a well shall be classified as a geothermal resource pursuant to section 42-4002, Idaho Code, and shall be administered as a geothermal resource pursuant to chapter 40, title 42, Idaho Code."

As defined above, a ground water resource with a temperature of 212°F or above is considered a geothermal resource and is permitted as such. If the temperature is between 85°F and less than 212°F, the resource is treated as a low temperature geothermal resource. For the latter instance, an application to permit an appropriation for the water right to utilize the resource is required.

> "Low temperature geothermal resource. (1) The right to the use of low temperature geothermal resources of this state shall be acquired by appropriation, except as provided in subsection (2) of this section. The appropriation may be perfected by means of the application, permit and license procedure as provided in this chapter for ground water, provided that low temperature geothermal resources shall be utilized primarily for heat value and secondarily for the value as water. Usage of a low temperature geothermal resource primarily for reasons other than heat value is not a beneficial use of the resource, unless the director of the department of water resources exempts the proposed use" (**Title 42-233, Chapter 2, Idaho Code**).

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[10] Riparian water rights follow the riparian doctrine, where the water right belongs to the landowner bordering the water body. The landowner is entitled to utilize the water for reasonable uses if it does not impact the reasonable use of others (Cornell Law School. Riparian doctrine. Legal Information Institute. Retrieved from https://www.law.cornell.edu/wex/riparian_doctrine).

[11] Prior appropriation water rights are based on the priority of beneficial use. This follows the principle of "first in time, first in right," where the first individual to utilize the resource or divert the resource via an aqueduct/pipe for a beneficial use may acquire the rights to the resource. (Cornell Law School. Prior appropriation doctrine. Legal Information Institute. Retrieved from https://www.law.cornell.edu/wex/prior_appropriation_doctrine).

### 3.4.1 Geothermal Unit Agreements

States may want to understand procedures for creating geothermal unit agreements. Unitization or unit agreements are a mechanism by which multiple geothermal leases within the same geothermal reservoir may, voluntarily or by mandate, adopt a joint operating agreement for the exploration and production of geothermal resources in a single consolidated unit. A unit agreement generally provides for the allocation of costs and benefits, including royalties, as defined in the agreement and can decrease material, economic, and resource waste in the development of geothermal resources.

### 3.4.2 Federal Unit Agreements

The BLM may allow, require, or initiate the formation of a unit via a unit agreement in the following situations:

- If an agreement is necessary or advisable in the public interest for lands or leases under Federal administration (**43 CFR § 3280.3-3280.4**).
- The lessee may be required to commit to a unit agreement and the BLM may prescribe the unit agreement (**43 CFR § 3280.4**).

In addition, with the lessees' consent, the BLM can establish, modify, or revoke rates of operations of other requirements of the leases and add lease conditions in relation to unitization and to protect the public interest (**43 CFR § 3280.5**).

Unitization requires the BLM to designate a unit area and approve the unit agreement (**43 CFR § 3281.1**). Unit area designation requires the unit operator to submit the following information:

- A geologic report supporting unitization
- A map of the proposed unit area
- Details of each lease and any unleased land to be included in the unit area (**43 CFR § 3281.2**).

A model unit agreement can be found in its entirety in **43 CFR § 3286.1**. Unit operators may either submit the model unit agreement as written, with variances noted, or a unit agreement that includes all terms and conditions required by the BLM **(43 CFR §§ 3281.13-15**). Before the unit operator can allocate production and royalties prior to commercial operations under a unit agreement, it must also have a participating area approved by the BLM (**43 CFR § 3282.2**). The participating area includes the portions of the unit area that are reasonably proven to produce geothermal resources or support production in commercial quantities (**43 CFR § 3282.1**). Any portions of a lease outside the participating area are split into a separate lease to be developed by the individual lessee under the original lease's terms and serial number (**43 CFR §§ 3210.10-11**).

### 3.4.3 State Examples of Unit Agreements

The following state examples are meant to illustrate differences within unit agreements among California, Texas, and Federal Unit Agreements.

**California**

Geothermal lessees in California may form a unit agreement if the State Supervisor of Oil and Gas, who leads the California Geologic Energy Management Division and oversees geothermal resource development in the state, finds that forming such an agreement would protect geothermal resources from unreasonable waste and approves such an agreement (**Cal. Pub. Res. Code §§ 3756, 6923**). Lessees may choose to enter into a unit agreement to cooperatively develop and operate all of an area or part or parts of an area, with terms outlining the time, location, and manner of drilling wells to produce geothermal resources (**Cal. Pub. Res. Code § 3756**).

In addition, the State Lands Commission may establish, alter, change, or revoke any drilling or production requirements of the geothermal leases on state-owned lands committed to a unit agreement or allow for the production apportionment with the consent of all the owners of the involved leases (**Cal. Pub. Res. Code § 6923)**.

If a lease is eliminated from the unit, the eliminated lease remains effective for the duration of its original term or for two years after it is eliminated from a unit or the unit agreement is terminated, whichever term is longer, for as long as the lease produces or utilizes geothermal resources in commercial quantities (**Cal. Pub. Res. Code § 6922)**.

**Texas**

Geothermal lessees in Texas may form a unit via a unit agreement for leases on Permanent School Fund land if the School Lands Board (SLB) finds that the agreement is in the best interest of the state (**Tex. Nat. Res. Code Ann. § 141.078; Tex. Admin. Code § 155.45(b)**). The General Land Office, in which the SLB sits, may include a condition in its geothermal leases requiring lessees to unitize if unitization is in the best interest of the Permanent School Fund lands.[12] A proposed unit agreement for geothermal resources must include:

- The unit's total acreage and a breakdown of the number of state- and privately-owned acres in the unit
- A list of the leases within the proposed unit and the recording information for each lease in the public records
- A plat that outlines the whole unit, with any state acreage within the unit outlined in red
- The production allocation for each lease
- For each state lease included in the unit area, the state's royalty interest and any costs or deductions allowed against that interest (**31 Tex. Admin. Code § 155.45(a)**).

Additional considerations may apply depending on the type(s) of land within the proposed unit area. If a proposed unit agreement commits royalty interests in permanent school fund lands or state agency lands, the General Land Office pooling committee must examine, investigate, and present the agreement to the SLB (**31 Tex. Admin. Code § 155.45(b)**). The SLB must approve the proposed unit agreement if it finds that the agreement is in the best interests of the state (**31 Tex. Admin. Code § 155.45(b)**). If the proposed unit agreement covers Relinquishment Act

[12] Colby Eaves, Texas General Land Office – Energy Resources, email. March 2, 2023.

Lands (leased by the surface owner as an agent for the state), the proposed unit agreement must be executed by the surface owner before SLB must review and approve it (**31 Tex. Admin. Code §§ 150.40, 155.45(b)**).

In Texas, unit agreements may contain provisions such as:

- Operations that are incident to drilling a well on any part of the unit are deemed to be the conduct of such operations on each tract in the unit.
- Agreed upon production allocations for each tract, when produced, are deemed to have been produced from such tract.
- The state's royalty interest must be paid only on the portion of the production from the unit that is allocated to the tract according to the agreement.
- Each lease committed to the unit must remain in effect for as long as the agreement is in effect, and after the end of the agreement, each lease must continue in effect under its individual terms and provisions.
- Any other terms, conditions, or provisions the SLB or appropriate board deems necessary to serve the best interests of the state (**31 Tex. Admin. Code § 155.45(c)**).

### 3.4.4 Geothermal Leasing Terms and Extensions

Geothermal leasing terms and extensions vary by state. This section provides a few examples of both the Federal leasing terms and extensions as well as a few state examples for leasing terms and examples.

### 3.4.5 Federal

Federal geothermal leases have a primary term of 10 years, with an initial extension of the primary term up to 5 years and an additional extension of the primary term for up to 5 years. There can also be a drilling extension of 5 years, a production extension up to 35 years and a renewal period of up to 55 years (**43 CFR § 3207**).

### 3.4.6 State Examples

The following state examples are meant to illustrate the wide range of differences within geothermal resource leasing term lengths and extensions.

**Alaska**

If, at the expiration of the 10-year primary term of a geothermal lease, the lessee has begun operations necessary to drill a geothermal well using equipment located at the lease area of sufficient size and capacity to drill to the total depth proposed in the plan of exploration for the well, the commissioner will, in his discretion, extend the geothermal lease for one five-year term. In this subsection, "operations necessary to drill a geothermal well" include drilling, redrilling, sidetracking, or other techniques necessary to reach the bottom hole location proposed in the plan of exploration.

Upon notice to the state that commercial production of geothermal resources from the lease has begun, the commissioner will extend the lease for the duration of commercial production (**Alaska Admin. Code tit. 11, § 84.745**).

**Idaho**

The state board of land commissioners is hereby authorized and empowered to issue geothermal resource leases for terms of up to forty-nine (49) years on any state or school lands which may contain geothermal resources, together with the right to use and occupy so much of the surface of said land as may be required for all purposes reasonably incident to the prospecting for, exploration for, drilling or other well construction for, and production of geothermal resources (**Idaho Code § 47-1601**).

**Oregon**

All leases may be without limitation as to time; but the department may cancel any lease upon failure by the lessee to exercise due diligence in the prosecution of the prospecting, development or continued operation of the mine or well, and shall insert in every such lease appropriate provisions for such cancellation (**Ore. Rev. Stat. § 273.551 (2)**).

# 4 Exploration Approval Process

This section discusses the geothermal exploration approval process at the Federal level, the nexus between environmental review and geothermal exploration at both the Federal and state levels, and an overview of five types of exploration approval processes currently used at the state level.

Each of these approaches are described below and include existing state examples.

## 4.1 Federal Geothermal Resource Exploration Process

An NOI to Conduct Geothermal Resource Exploration Operations is required prior to conducting exploration on Federally managed public land administered by the BLM, regardless of whether the land is currently leased for geothermal resources or on Federally managed lands where the surface is managed by a separate Federal agency (e.g., the U.S. Forest Service) but BLM has leased the subsurface resources (**43 CFR §3250.10**). BLM approval is not required under the following situations:

- Unleased geothermal resources whose surface is managed by another Federal agency.
- Casual use activities.[13]

> *Exploration operations* means any activity relating to the search for evidence of geothermal resources, where you are physically present on the land and your activities may cause damage to those lands. Exploration operations include, but are not limited to, geophysical operations, drilling temperature gradient wells, drilling holes used for explosive charges for seismic exploration, core drilling, or any other drilling method, provided the well is not used for geothermal resource production. They also include related construction of roads and trails, and cross-country transit by vehicles over public land. *Exploration operations do not include the direct testing of geothermal resources or the production or utilization of geothermal resources* (**43 CFR § 3200.1**).

An approved NOI constitutes BLM's written permission to conduct geothermal exploration operations and associated surface disturbance activities and includes any conditions BLM imposes as defined in **43 CFR §3200.1**. However, a BLM-approved geothermal exploration permit does not give a developer exclusive rights to develop the resource (**43 CFR §3250.11**).

For lands managed by the U.S. Forest Service not under a geothermal lease, the developer must receive an exploration permit directly from the Forest Service. If the land is managed by the Forest Service under an existing geothermal lease, developers will apply to the BLM for the NOI.

[13] Federal geothermal resource exploration operations do not include casual use activities. This means casual use activities do not technically require a permit. Casual use means activities that ordinarily lead to no significant disturbance of Federal lands, resources, or improvements (**43 CFR §3200.1**).

### 4.1.1 Federal Environmental Review and Geothermal Exploration

The National Environmental Policy Act (NEPA) of 1969 requires consideration of potential environmental impacts for all major Federal actions. As such, all NOIs require NEPA compliance. The BLM has an existing categorical exclusion applicable for geothermal exploration operations, which is applicable to drilling temperature gradient wells *if there is no new well pad or access road construction*. Drilling beyond temperature gradient wells to confirm the geothermal resource requires an approved Geothermal Drilling Permit (GDP) and is outside the scope of permitted activities under an NOI.

## 4.2 State Processes for Geothermal Exploration

At a high level, states use the following five structures for approving geothermal exploration:

1. Included in the existing geothermal resource lease
2. Geologic or geophysical permits
3. Exploration or prospecting permits
4. Unified drilling permits
5. Temperature thresholds and water nexus/use permits.

In addition, there are limited cases where other considerations exist outside of the scope of the exploration process types listed above. This is illustrated below using **Colorado** as an example.

### 4.2.1 Inclusion in the Geothermal Resource Lease

In a few instances, the geothermal exploration process is included within the geothermal resource lease. **Nebraska** is an example that highlights the inclusion of prospecting within the geothermal resource lease.

> When the subsurface or mineral estate in land has been severed from the overlying surface estate, the owner of the subsurface or mineral estate shall have the right to enter upon the overlying surface estate at reasonable times and in a reasonable manner *to prospect for, produce, and transport geothermal resources.* Fair and equitable compensation shall be paid to the owner of the overlying surface estate for the exercise of such right of entry. The right of entry granted in this section shall not include the right to construct surface facilities for on-site utilization of geothermal energy.
> The Board of Educational Lands and Funds shall have the authority to lease state-owned geothermal resources under the procedures contained in Chapter 72, article 3 (**Neb. Rev. Stat. § 66-1104**).

### 4.2.2 Geologic or Geophysical Permits

States requiring geologic or geophysical permits vary in their permitting processes. In some cases, the developer applies through a state geology department or the agency regulating drilling (e.g., the oil and gas regulatory agency). **Montana** is shown below as an example to illustrate the specificity in the language regarding exploration.

> A person, firm, or corporation operating individually or through agents within the state of Montana for the purpose of seismic exploration in which exploration entry is made upon the surface estate for the acquisition of geophysical data for any purpose whatsoever, and which person, firm, or corporation either through its own employees or by hiring the services of others operates seismograph crews, as the term is generally known, shall comply with the following provisions of this part; provided, however, that compliance with the provisions of this part by a seismograph crew or its employer shall constitute compliance herewith by that person, firm, or corporation who has engaged the services of such crew or its employer as an independent contractor insofar as the geophysical operations of such crew are concerned (**Mont. Code Ann. §82-1-101**).

### 4.2.3 Exploration or Prospecting Permits

States may require specific exploration or prospecting permits with varying requirements. In most cases, following permit receipt, the developer may move forward with geophysical surveying, testing, sampling, or to begin drilling. However, in some cases, there may be limitations associated with drilling based on the permit type. For most exploration or prospecting permits, the resource may not be encountered in the same way as Federal *exploration operations* are defined in **43 CFR § 3200.1**. **Hawaii** provides a clear example of the distinction between exploration drilling and geothermal resources development.

> "Geothermal resources development" means the development or production of electrical energy from geothermal resources and direct use application of geothermal resources. The term does not include "geothermal resources exploration."
> "Geothermal resources exploration" means either of the following:
> (1) Conducting non-invasive geophysical operations, including geochemical operations, remote sensing, and other similar techniques; or
> (2) Drilling exploration wells for purposes including but not limited to the extraction and removal of minerals of types and quantities that are reasonably required for testing and analysis to provide ground truth or determine the economic viability of geothermal resources. The term does not include "geothermal resources development" (**Haw. Rev. Stat. § 182-1**).

### 4.2.4 Unified Drilling Permits

In some states, regulations do not distinguish between drilling for exploration and production. In these cases, the developer must apply using the same process, regardless if drilling for exploratory or resource utilization purposes. **New Mexico** is an example of this process, where the state uses the same process for approving exploration, production, and observation wells.

> Prior to the commencement of operations, the owner or operator of any proposed well to be drilled for geothermal exploration, production, observation, or thermal gradient, or for injection or disposal purposes, shall file division form G-101, application for permit to drill, deepen or plugback-geothermal resources well, and obtain approval thereof from the division. Form G-101 shall be accompanied by form G-102, geothermal resources well location and acreage dedication plat.
>
> No permit shall be approved for the drilling of any well within the corporate limits of any city, town or village of this state unless notice of intention to drill such well has been

> given to the duly constituted governing body of such city, town or village or its duly authorized agent. Evidence of such notification shall accompany the application for a permit to drill (form G-101) (**New Mexico Administrative Code § 19.14.21.8**).

### 4.2.5 Temperature Thresholds and Water Nexus/Use Permits

In circumstances where the geothermal resource is below a defined temperature threshold, the geothermal resource may be classified as a water resource. In these instances, a water permit or a permit to drill may be required through the regulatory agency overseeing water resources. **Idaho** is a prime example of this, as geothermal resources are defined as sui generis—neither a mineral nor a water resource.

In order to drill for the production or exploration of geothermal resources, a permit is required. The definition of an exploratory well is also included below.

> Any person, owner, or operator who proposes to construct a well for the production of or exploration for geothermal resources or to construct an injection well shall first apply to the Director (of the Idaho Department of Water Resources) for permit (**Idaho Admin. Code r. 37.03.04.025(01)**).
>
> An *exploratory well* is defined as "a well drilled for the discovery and/or evaluation of geothermal resources either in an established geothermal field or in unexplored areas (**Idaho Admin. Code r. 37.03.04.010(10)**)."

### 4.2.6 Other Considerations

**Colorado** serves as a unique example, as the geothermal resource is tied to the water appropriation system. The requirement to issue a permit for the use of geothermal resources does not apply to operations that are solely nonconsumptive using allocated geothermal resources[14] (**Colo. Rev. Stat. § 37-90.5-107(3)(b)**). A permit will be issued after a determination that any associated geothermal fluid is nontributary groundwater as defined in **Colo. Rev. Stat. § 37-90-103(10.5).**

> "…that is not associated with an economically useful groundwater resource" (**Colo. Rev. Stat. § 37-90-103 (10.5)**).

This requirement to issue a permit for geothermal resources that are a consumptive use of tributary groundwater still requires a water right.

> Notwithstanding any provision of this subsection (3) to the contrary, a water right to use a distributed geothermal resource associated with tributary groundwater may be obtained only in water court and is subject to Article 92 of this Title 37. The beneficial use of energy extracted from geothermal fluid associated with a distributed geothermal resource is the basis, measure, and limit of the water right, and efficient application methods must

[14] Colorado defines "allocated geothermal resource" as any geothermal resources that is associated with nontributary groundwater, but it does not include groundwater in the Denver Basin Aquifers. C.R.S. § 37-90.5-103(1).

be used for the use of energy to qualify as a beneficial use (**Colo. Rev. Stat. § 37-90-107(3)(e)**).

### 4.2.7 State Environmental Review and Geothermal Exploration

Environmental review for geothermal exploration varies by state. California is included below as an example where the state (or local agency) must comply with the California Environmental Quality Act (CEQA) prior to approving an exploration permit.

A state or local entity is required to comply with CEQA for activities defined as a "project." A project means an activity that may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment (**Cal. Pub. Res. Code §21065**). CEQA typically follows a four-step process:

1. Determine if the project falls under an exemption.
2. There are two types of CEQA exemptions—statutory exemptions or categorical exclusions. If the project falls under these, a Notice of Exemption is filed.
3. If the project is not exempt, then an initial study is completed to see if the project could result in significant environmental impacts.
4. The initial study is prepared by the lead agency to determine if an environmental impact report, negative declaration, or mitigated negative declaration is prepared.

# 5 Drilling and Wellfield Approval Process

This section discusses the geothermal drilling and wellfield development approval process at the Federal level, an overview of four types of drilling and wellfield development processes at the state level, and environmental review procedures that may apply at the Federal and/or state levels. The four state-level drilling and wellfield development approaches are categorized as:

- Unified drilling permit
- Drilling approval inclusion within the geothermal resource lease
- Separate drilling permit
- Nexus to water/use permits.

Each of these approaches are described below and include existing state examples.

## 5.1 Federal Geothermal Drilling and Wellfield Development Process

To conduct drilling operations (beyond temperature gradient wells) on Federally managed public lands, an applicant must obtain a GDP and typically an approved Plan of Operations from the BLM. GDP and Plan of Operations approval include "conducting related activities for the purposes of performing flow tests, producing geothermal fluids, or injecting fluids into a geothermal reservoir" (**43 CFR § 3260.10 (a)**). Further information describing the GDP and Plan of Operations is provided below, beginning with requirements for all Federal drilling operations to receive a GDP, followed by a high-level overview of what should be included in a Plan of Operations.

A **GDP** means BLM written permission to drill for and test geothermal resources. This is required for any well that comes into direct contact with the geothermal resource (**43 CFR § 3200.1**).

Additionally, all Federal drilling operations must:

(a) Meet all environmental and operational standards

(b) Prevent unnecessary impacts on surface and subsurface resources

(c) Conserve geothermal resources and minimize waste

(d) Protect public health, safety, and property

(e) Comply with the requirements of § 3200.4 (**43 CFR § 3260.11**).

To receive a GDP, BLM approval is required to begin drilling operations and well pad construction. This includes:

- A completed and signed drilling permit application (form 3260-2)
- A complete operations plan
- A complete drilling program
- An acceptable bond
- Compliance with NEPA.

A Plan of Operations fully describes the location of proposed drill pad, access roads, and other facilities related to the drilling and testing of Federal geothermal resources, and includes measures for environmental and other resource protection and mitigation (**43 CFR § 3200.1**).

A Plan of Operations describes how an applicant will drill for and test the geothermal resources covered by a geothermal lease. The plan must tell BLM enough about the proposal to assess the environmental impacts of the proposed operations. This information should generally include:

(a) Well pad layout and design

(b) Description of existing and planned access roads

(c) Description of any ancillary facilities

(d) Source of drill pad and road building material

(e) Water source

(f) Statement describing surface ownership

(g) Description of procedures to protect the environment and other resources

(h) Plans for surface reclamation

(i) Any other information that BLM may require (**43 CFR § 3260.12**).

### *5.1.1 Federal Environmental Review for Drilling and Wellfield Development*

NEPA requires consideration of potential environmental impacts for all major Federal actions, including BLM issuance of a GDP and Plan of Operations. Currently, a GDP is not eligible for a categorical exclusion, and GDP applications would be subject to an environmental assessment, environmental impact statement, or a determination of NEPA adequacy. A determination of NEPA adequacy is commonly used for activities that are addressed or very similar (in location and impact) to those covered under an existing environmental assessment/environmental impact statement.

## 5.2 State Processes for Geothermal Drilling and Wellfield Development

At a high level, there are four main categories states use to approve geothermal resource drilling and wellfield development regulation:

1. Inclusion within the geothermal resource lease
2. Unified drilling permits
3. Separate drilling permit
4. Nexus to water/use permits.

### *5.2.1 Unified Drilling Permits*

As previously discussed in section 4.2.4, in some states, regulations do not distinguish between drilling for exploration and production. In these cases, the developer must apply using the same process, regardless if drilling for exploratory or resource utilization purposes. **New Mexico** is an

example of this process, where the state uses the same process for approving exploration, production, and observation wells.

### 5.2.2 Separate Drilling Permit

Many states with existing geothermal resource drilling and wellfield development regulations require a separate drilling permit for wellfield development. A prime example of this is **Nevada**, which requires a Permit to Drill or a Geothermal Project Area Permit from the Nevada Division of Minerals (NDOM) for wellfield development. Developers must also file a Sundry Notice with NDOM for any major changes in well operation, to conduct a temperature or pressure survey, to conduct flow tests, or to perform routine maintenance of a well. Nevada also provides a unique example, as the state requires a separate drilling permit for projects on Federally managed land following approval of the GDP by the BLM.

> A person may not drill or operate a geothermal well or drill an exploratory well without obtaining a permit from the Administrator of the Division of Minerals of the Commission on Mineral Resources and complying with the conditions of the permit.
>
> An application must set forth such information as the Administrator requires by regulation (**Nev. Rev. Stats. § 534A.060**).

### 5.2.3 Nexus to Water/Use Permits

As previously discussed, in some cases, a water permit/right or a permit to drill from the regulatory agency overseeing water resources may be required. **Idaho** is a prime example of this.

> *Permit to Drill for Geothermal Resources.*
> Any person, owner, or operator who proposes to construct a well for the production of or exploration for geothermal resources or to construct an injection well shall first apply to the Director (of the Idaho Department of Water Resources) for permit (**Idaho Admin. Code r. 37.03.04.025(01)**).
>
> Geothermal resources are found and hereby declared to be sui generis, being neither a mineral resource nor a water resource, but they are also found and hereby declared to be closely related to and possibly affecting and affected by water resources in many instances (**Idaho Code § 47-1602**).

In other instances, the geothermal resource is tied to the water appropriation system, as illustrated in **Nevada**. In Nevada, a consumptive use of water requires an appropriative right (for beneficial uses) unless developers remove and reinject water into the same aquifer or reservoir. Closed-loop systems circulate water through a closed network of underground pipes and do not extract water from the subsurface where the project is being developed (i.e., hydrothermal reservoirs). Section 6 will describe states with regulations directly related to water rights.

# 6 Underground Injection Control Process

This section discusses the Federal UIC program, provides an overview of states with existing UIC primacy, and includes an overview of Nevada's UIC program as an illustration of a state UIC process.

## 6.1 Federal Underground Injection Control Program

The Safe Drinking Water Act (SDWA) is the Federal statute (**42 U.S.C. §300f et seq.**) created to protect the national public drinking water supply and its sources. The SDWA became law in 1974 and has been amended three times—in 1986, 1996, and 2005. The SDWA gives the U.S. Environmental Protection Agency (EPA) the authority to protect against both naturally occurring and human-made contaminants via minimum groundwater quality standards—specifically, the prohibition of the movement of fluids into underground sources of drinking water if the fluid contains any contaminant that may cause the violation of any primary drinking regulation or may otherwise adversely affect the health of persons (**40 CFR 144.12**). As such, owners or operators of public water systems are required to comply with the standards. The SDWA also required the EPA to develop the UIC program to protect groundwater by controlling the injection of fluids into groundwater (**SDWA Section 1421**). UIC programs can be implemented by either the EPA or by states, territories, or tribes with EPA approved primacy, that is, primary permitting and enforcement responsibility. Regulations for the EPA UIC program are promulgated in Title 40 of the CFR (part 124 and parts 144–148). Primacy programs are established within Sections 1422 and 1425 of the SDWA.

The Federal UIC program includes six well classes; however, for the purpose of this paper, only Class V wells will be discussed. Class V wells are for the disposal of nonhazardous fluids into or above underground sources of drinking water. Most Class V wells are shallow disposal systems, including but not limited to stormwater drainage wells, septic system leach fields, and agricultural drainage wells. Additionally, there are more complex Class V wells that do not fit into any other well class—these are deep injection processes associated with commercial and industrial facilities. Examples of these types of Class V wells include but are not limited to aquifer storage and recovery wells, geothermal electric power or direct-use wells, and deep injection wells for saline control.

If a state does not have primacy for a well class, then applications are provided and processed by the EPA. This also means that the EPA is the agency responsible for compliance of a UIC permit or applicable requirements. States may apply for primacy for all well classes, Classes I–V, or only Class VI. EPA may grant primacy for all or part of the UIC program, which means some jurisdiction for well classes can be shared with the EPA or divided between state, territory, or Tribal authorities.

## 6.2 States With Existing Underground Injection Control Program Primacy

Figure 1 shows a map[15] of the current states, territories, and tribes with UIC primacy.

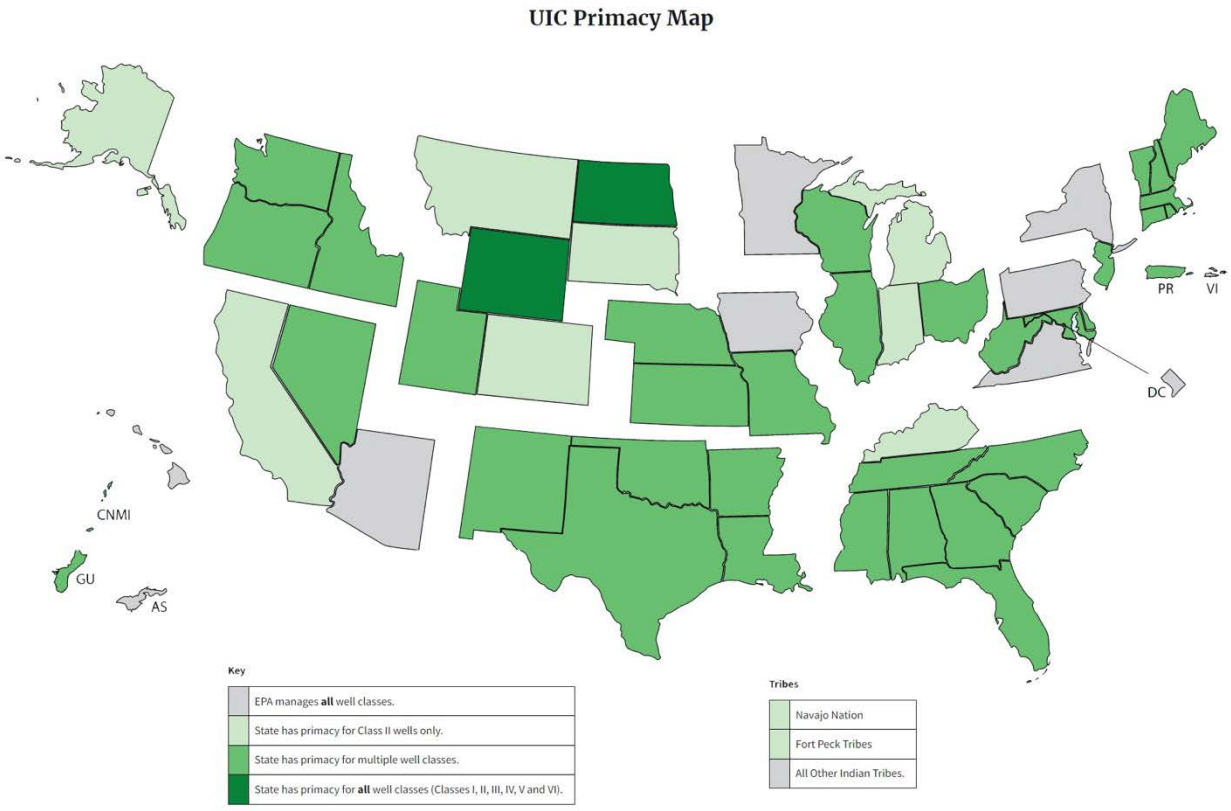


**Figure 1. Underground injection control primacy map**

Figure credit: U.S. EPA.

Currently, there are 35 states with UIC primacy for Class V wells. Of those states, there are 5 states with existing geothermal development—these states are listed below along with the primary enforcement agency for each state. In addition, although California does not have Class V primacy, it does have a Memorandum of Agreement (MOA)[16] that acts as pseudo-primacy specifically for geothermal wells. Nevada is illustrated as an example of primacy below.

[15] At the time of this publication, this map may not be inclusive of all states, territories, and tribes with UIC primacy, as there are currently primacy applications and program revision applications in process with the EPA.
[16] https://www.conservation.ca.gov/calgem/for_operators/Documents/MOU-MOA/MOA_EPA_Geo UIC_1991.pdf

**Table 1. States with Existing Geothermal Development and UIC Primacy for Class V Wells**

| State | Primary Enforcement Agency |
|---|---|
| **Idaho** | Idaho Department of Water Resources |
| **Nevada** | Nevada Division of Environmental Protection |
| **New Mexico** | New Mexico Environment Department |
| **Oregon** | Oregon Department of Environmental Quality |
| **Utah** | Utah Department of Environmental Quality |

### 6.2.1 Nevada Underground Injection Control Class V Wells Overview

Nevada received primacy for Class I–V wells in 1988. In Nevada, a permit is required for all injection activities. Class V wells are permitted and regulated by the Nevada Division of Environmental Protection (NDEP), NDOM, Nevada Division of Water Resources, and the BLM. Of these agencies, NDEP is the lead agency administering the state UIC program under **NRS § 445A**. While NDEP has memorandums of understanding (MOUs) with NDOM and the BLM, a UIC permit from NDEP is required even if an injection well permit has been approved by NDOM or the BLM. In Nevada, regulation of an injection well is distinct from the regulation of a geothermal production well.

An NDEP UIC permit covers injection wells/activity, whereas a separate groundwater discharge water pollution control permit is required for discharges to surface basins. In some cases, a permit to discharge groundwater may also be required. NDEP has the authority to issue individual, area (i.e., multi-well), and general UIC permits for a five-year duration or less. Individual permits are for one injection well, whereas area permits can include more than one well with a similar design and construction in the same area, controlled and operated by the same owner and/or operator. Injection into geothermal Class V wells may be authorized under a general permit. If a facility does not meet requirements under a General Permit, an individual permit is required.

### 6.2.2 Nevada Underground Injection Control Class V Individual Permitting Process

To "propose to construct, modify, and/or operate an injection well in Nevada, an application to the NDEP for a permit is required" (NDEP, UIC program description). The application must be signed by the owner or operator and must contain sufficient information to allow a determination of whether migration of the injection fluid outside of the injection zone will occur. As part of this application, the applicant must include the following information:

- Injection fluid (injectate) source, composition, and characteristics
- Nature of the receiving formation and composition/characteristics of the receiving water
- Construction design of the injection well
- Injection pressures (calculated maximum and proposed average)
- Rate of the injection fluid

- Information on uncased boreholes, wells, mines, quarries, etc., and identification of those that penetrate the receiving formation within an Area of Review as established by Nevada regulations
- A corrective action plan for poorly constructed, or abandoned and unplugged (or improperly plugged) wells within the Area of Review.

Following receipt of a complete application, permit drafting takes place following technical review of the application. Following review of the permit draft, NDEP issues public notice to announce receipt of the permit application, provide a description of the injection facility, the action proposed to be taken on the application, and the final permit draft. Publication of the notice commences a 30-day public comment period, and a public hearing may be held if public interest is warranted. Following these requirements, and after public comments have been considered and addressed, NDEP will issue a new permit, reissue a modified permit, or deny the permit application.

If NDEP grants a UIC permit, it will include conditions to ensure well integrity and protection of groundwater. The permit is typically issued for a period of five years and may be reissued prior to expiration upon application by the Permittee. If an application is in process and the original permit date has expired, the Permittee may continue to operate on the expired permit—provided that the application was received at least 180 days prior to expiration and the permittee is in full compliance with the permit—if temporarily approved by NDEP to do so. NDEP has the authority to change the terms of any permit at any time if there are concerns.

A permit can be transferred to a new owner if the new owner has submitted a transfer of ownership notification with signature accepting responsibility for the permit conditions and if they can provide evidence of financial responsibility, specifically funds necessary to properly plug a well upon abandonment. A transferred permit can be revoked, terminated, or modified for non-performance, failing to comply with permit conditions, falsifying information, being a hazard to public and/or environmental health, or by a good cause as determined by NDEP at any time.

# 7 Key Considerations and Discussion

This section provides an overview of key considerations summarized from this report. This list is not meant to be exhaustive, as each state and project are unique; rather, these are meant to be concepts that could be considered when developing and/or updating existing geothermal regulations.

## 7.1 Discussion of Key Considerations

The key considerations highlighted below were identified based on:

- Comprehensive review and analysis of existing geothermal regulations for all 50 states.
- SWG discussions, which included monthly meetings and multiple reviews of the material presented in this report.

### *7.1.1 Considerations Regarding the Geothermal Resource Definition*

*The use of a specific temperature threshold could lead to multiple regulatory regimes, as well as the potential need for additional water rights and/or permitting requirements.*

In many existing state geothermal resource definitions, temperature thresholds are included to define a minimum temperature for what constitutes a geothermal resource. Typically, lower temperature thresholds are used to distinguish between water resources or the use of GSHPs, both of which may require distinct permits. Higher temperature thresholds generally indicate utilization of a resource for electricity generation, which may inadvertently create different regulatory regimes for electricity generation and direct-use applications. As such, the inclusion of a temperature threshold may result in different regulatory structures, the need to acquire additional water rights, and/or additional permitting based on the specific geothermal technology. If considering the use of a temperature threshold within the geothermal resource definition, the following should be taken into account:

- The inclusion of a higher temperature threshold may categorize different geothermal technologies under different regulatory regimes.
- The inclusion of a lower temperature threshold may help distinguish GSHPs from other geothermal applications that require a more rigorous approval process.

*States should consider how the definition of the geothermal resource relates to water resources/water rights within the state.*

When considering the geothermal resource definition, the existing water resource and/or water rights regulatory structure may impact how a geothermal resource may be utilized. For example, Idaho's inclusion of a specific temperature threshold results in a geothermal right if the resource is 212°F or above, while below this threshold, the resource is considered a water right even though it could be utilized in multiple types of geothermal applications. The following should be considered if the state has any interplay between the geothermal resource definition and water rights:

- Based on the geothermal resource definition, the resource in question may require a water right in addition to a geothermal resource lease.
    - Note: This may also depend on whether there is a consumptive use of the water.

- Generally, the use of water for geothermal development has been deemed a beneficial use of the water.

*States may want to consider specifying what is encompassed within the geothermal right.*

Geothermal resource definitions may be very specific, or may broadly define what is included within the right to extract the geothermal resource, including heat, brine, fluid, steam, and/or byproducts. States should consider the use of specific terminology of what is and can be extracted from the subsurface, as it has the potential to include or exclude specific technologies, such as EGS or closed-loop geothermal systems. To ensure longevity of the geothermal resource definition as technology continues to advance, the following should be considered:

- The geothermal resource definition should expressly include what is encompassed within the geothermal right.
    - The definition should be clear and concise to ensure it is easy to comprehend and not subject to multiple interpretations.
- The geothermal resource definition should remain consistent with other existing mineral extraction laws and/or water rights (e.g., exclusion of hydrocarbons, interplay with water rights).

*States may want to consider use of the term "heat" in addition to "fluids."*

When considering geothermal technology inclusivity in addition to creating forward-facing regulations as technology continues to rapidly change, the geothermal resource definition should consider using "heat" in addition to "fluids," which may more accurately encompass nonconventional geothermal technologies (e.g., EGS and closed-loop systems).

### 7.1.2 Considerations Within the Geothermal Resource Leasing and Acquisition Processes

*States may consider employing either a competitive or noncompetitive leasing process for geothermal resources on state-managed lands/mineral estates.*

States that manage large state or school trust lands may consider creating and/or updating their existing leasing process to have a clear process in place. For example, the Federal government (i.e., the BLM) and some states use a default competitive leasing process when utilizing geothermal resources for electricity generation, whereas these jurisdictions may use a noncompetitive process for direct-use applications.

*States may consider exceptions to the competitive and noncompetitive processes described above.*

In some instances, states may need to make exceptions to the leasing process(es) they have employed. The following could be considered as exceptions to a competitive or noncompetitive leasing process in place:

- Default noncompetitive leasing processes for geothermal resources at existing oil and gas wells, within mining operations, and for direct-use applications solely used on-site due to proximity to the resource.

- Allowing a noncompetitive leasing process to become competitive if multiple parties express interest in a particular parcel for geothermal resources (including for direct-use applications).

*States may consider geothermal lease terms without a fixed end date for a viable, producing resource.*

Currently, there are a wide range of differences within geothermal resource leasing term lengths and extensions. Federal geothermal leases have a primary term of 10 years, with an initial extension of the primary term up to 5 years and an additional extension of the primary term for up to 5 years. There can also be a drilling extension of 5 years, a production extension up to 35 years and a renewal period of up to 55 years **(43 CFR § 3207).** In most cases, states have deployed specific time limitations on geothermal leases ranging from initial leasing periods of 10 years to terms up to 49 years. Oregon is a unique example where all leases are without limitation with discretion held by the Department of State Lands. When determining lease terms and extensions, states may consider lease terms that do not have a fixed end date for a viable, producing resource (i.e., discouraging/declining to extend a lease for a commercially viable resource).

### 7.1.3 Considerations Within the Exploration and Drilling Approval Processes

*States may consider whether exploration will be limited to leased or unleased lands/rights in the geothermal resource.*

An NOI to Conduct Geothermal Resource Exploration Operations is required prior to conducting exploration on Federally managed public land administered by the BLM, regardless of whether the land is currently leased for geothermal resources or on Federally managed lands where the surface is managed by a separate Federal agency (e.g., the U.S. Forest Service) but BLM has leased the subsurface resources (**43 CFR §3250.10**). However, BLM approval is not required under the following situations:

- Unleased geothermal resources whose surface is managed by another Federal agency.
- Casual use activities.[17]

On state-managed lands, exploration approval processes vary greatly, including:

- Exploration may be approved within the geothermal resource lease
- Geologic or geophysical permits may restrict how a developer may operate in the exploration process.
- A state may require specific exploration or prospecting permits with varying requirements.
- Exploration may be included within a unified drilling permit.
- A temperature threshold may determine the type of permit and/or regulatory structure at play.

[17] Federal geothermal resource exploration operations do not include casual use activities. This means casual use activities do not technically require a permit. Casual use means activities that ordinarily lead to no significant disturbance of Federal lands, resources, or improvements (**43 CFR §3200.1**).

If a state is interested in creating an environment to encourage exploration for geothermal resources, it could consider whether to include an option to explore unleased lands, and if so, potentially have a process to noncompetitively lease those lands or otherwise provide an incentive to explore on unleased lands.

*States should be specific with what is permitted under an exploration permit versus a drilling permit.*

If a state requires separate permits for exploration and drilling processes, the state should be specific with what is permitted under an exploration permit versus a drilling permit. This includes clearly defining what is encompassed within the scope of "exploration." A prime example of this is the Federal "geothermal exploration permit," which constitutes BLM's written permission to conduct only geothermal exploration operations and associated surface disturbance activities under an approved NOI and includes any necessary conditions BLM imposes as defined in **43 CFR §3200.1**.[18]

*States may wish to offer a more inclusive drilling permit that does not distinguish between exploration and drilling for production.*

At the Federal level, there is a clear delineation between exploration and drilling processes with separate approval processes. In some states, regulations do not distinguish between drilling for exploration and production. In these cases, the developer must apply using the same process, regardless if drilling for exploratory or resource utilization purposes. New Mexico is an example of this process, where the state uses the same process for approving exploration, production, and observation wells.

### 7.1.4 Considerations Within the Underground Injection Control Approval Process

*States without existing UIC Class V wells primacy may need to determine whether they should seek primacy for Class V wells.*

If a state has not obtained UIC Class V primacy from the EPA, then applications are provided and processed by the EPA. This also means that the EPA is the agency responsible for compliance of a UIC permit or applicable requirements. If a state has primacy for the well class, applications and compliance are typically authorized by a Primary Enforcement Agency, a state-level regulatory agency (See Table 1 for examples of Primary Enforcement Agencies).

- If a state anticipates a high volume of geothermal utilization, it may need to determine whether to seek primacy for Class V wells.
- A potential alternative to seeking primacy could include an MOU/MOA with the EPA for a state to specifically regulate geothermal wells (e.g., MOA between the California Geologic Energy Management Division and EPA).

[18] A BLM-approved geothermal exploration permit does not give a developer exclusive rights (**43 CFR §3250.11**).

*States may consider having a mechanism for state interagency coordination.*

If a state has primacy for Class V wells and has multiple agencies regulating geothermal drilling and UIC injection permits, it may consider having a formal mechanism for state interagency coordination. This could include an MOU between the agency authorizing the drilling and the agency authorizing the UIC injection permits (assuming these are separate agencies).

*States may consider the use of a temporary injection permits as structured by the NDEP – NDOM MOU.*

If a state has primacy for Class V wells, it may be useful to consider a temporary injection permit for exploration of the geothermal resource. For example, in Nevada, NDOM can authorize a seven-day temporary injection permit within the exploration process, which should be sufficient in duration to adequately capture the necessary data needed to apply for a UIC permit. This allows a developer to determine whether a well can later be utilized as an injection well. As part of this process, the developer typically monitors flow to better model the resource.

### 7.1.5 Environmental Considerations for Geothermal Development

*States may consider the impacts of their existing environmental review process and how frequently a geothermal project would be subject to review.*

State-level environmental review processes vary drastically. In California, any project requiring a permit from a state agency will trigger CEQA, including those on Federal land. In other states, there are limitations based on project size or other factors. Regardless of the state's processes, a state should be aware of how many times a geothermal project may need to go through an environmental review process (e.g., leasing, exploration, drilling).