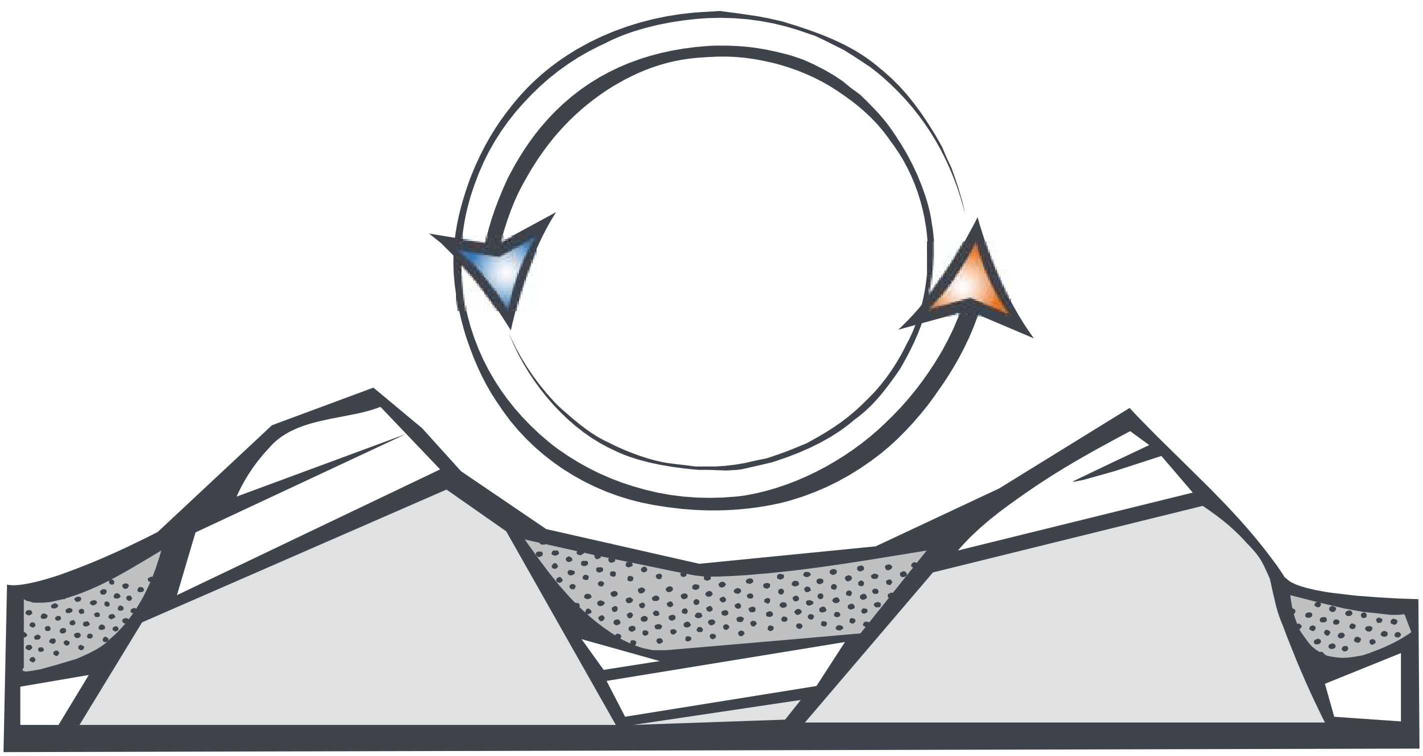

APPENDIX A

STATUS OF US GEOTHERMAL ENERGY AND PERMITTING IN THE WESTERN STATES AND TRIBAL LANDS

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Status of US Geothermal Energy and Permitting in the Western States and Tribal Lands

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Status of US Geothermal Energy and Permitting in the Western States and Tribal Lands

October 2008

prepared
by

Environmental Management and Planning Solutions Inc.

Western States Summary

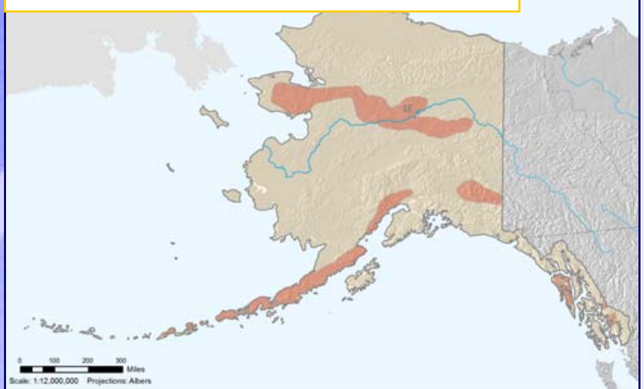
Introduction

This report details the current status of geothermal resources and development for each of the 12 western states covered in this PEIS: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming. The report contains focused information on resource geography, current and proposed geothermal utilization, technical capabilities in the form or public and private research and investment, a look at geothermal resources on tribal lands within each state, and state geothermal regulations and the agencies responsible for the oversight of geothermal resources. Additional requirements and considerations for pursuing geothermal resource development on tribal lands follow the state status section.

The Western States

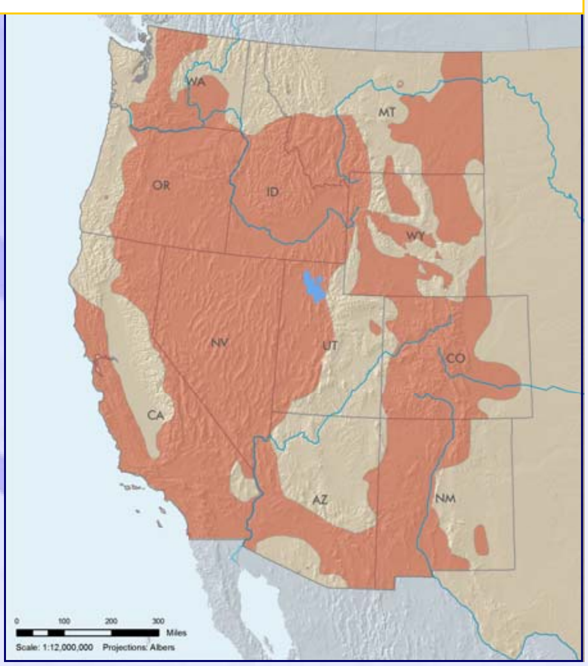
- Alaska
- Arizona
- California
- Colorado
- Idaho
- Montana
- Nevada
- New Mexico
- Oregon
- Utah
- Washington
- Wyoming

Areas of Geothermal Potential in Alaska



In total, about 530 million acres in the 12 western states, including Alaska, are identified as having geothermal potential for indirect or direct applications, with about 480 million acres providing potential for electrical production. The hottest resources and where commercial electrical generation would most likely occur, are generally within central and northern Nevada, western Utah, southern and central Idaho, southern and northeastern California, southeast Oregon, and along the Cascade mountain range.

Areas of Geothermal Potential in the Western States



Estimates of short term (2015) and long term (2025) electrical power generated from geothermal resources provided in this report are derived primarily from the Western Governors' Task Force Report (WGA 2006), with input from state geothermal programs and others in the geothermal industry. Thirty year estimates of potential electrical generation capacity from identified geothermal resources come from the United States Geologic Survey (USGS) report, released October 2008 tilted *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States.*

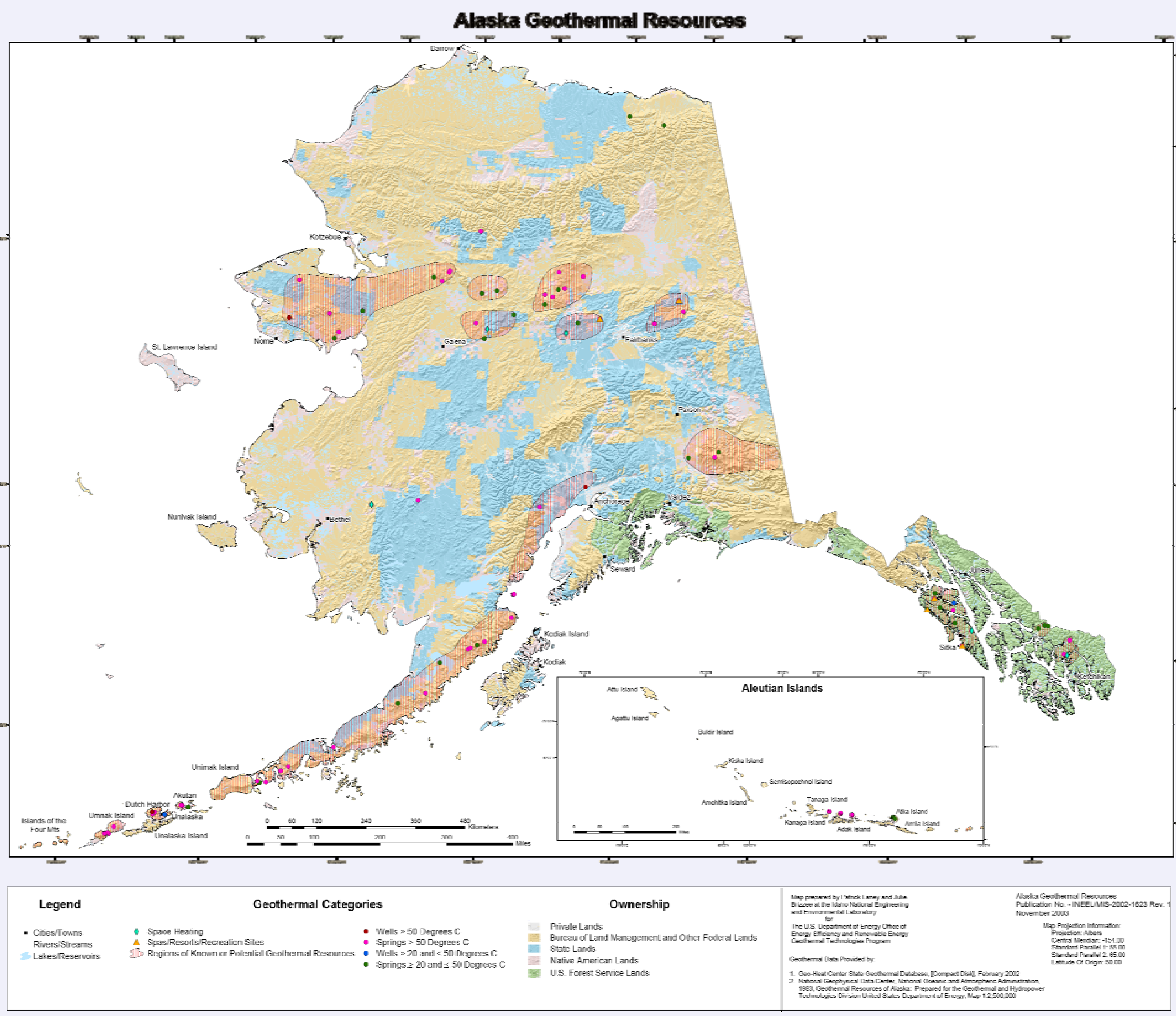
ESTIMATED CAPACITY

The USGS (2008) estimates 8,876 megawatts (MW) of electrical power could be generated from identified geothermal resources in the Western United States. The mean estimated power production resources from undiscovered resources is 27,598 MW, bringing the total estimated mean capacity for electrical power production from geothermal to 34,474 MW. Additionally, estimated potential for new technologies range from 345,100 to 727,900 MW.

Alaska

Resource Geography

Alaska has four distinct geothermal resource regions: The Aleutian Volcanic Arc (which includes the Aleutian Islands as well as the Alaska Peninsula and Cook Inlet volcanoes), The Central Alaskan Hot Springs Belt (CAHSB), The Wrangell Volcanic Cluster, and The Alaskan Panhandle (Kolker 2007). The CAHSB has low to moderate temperature resources while the Aleutian Volcanic Arc holds high-temperature geothermal systems (Crimp 2006). The Wrangell Volcanic Cluster may have the potential for geothermal energy development: The Eastern Copper River Basin (ECRB), close to the western part of the Wrangell volcanoes, has been the subject of geothermal exploration because it contains mud volcanoes, unusual features associated with pressurized groundwater and/or hydrothermal aquifers. Little is known of the potential of the Alaskan Panhandle as no exploration of sites (beyond temperature measurements and aquatic geochemical surveys) has been performed.



Laney, 2003a, http://geothermal.id.doe.gov/maps/ak.pdf

Alaska

Utilization

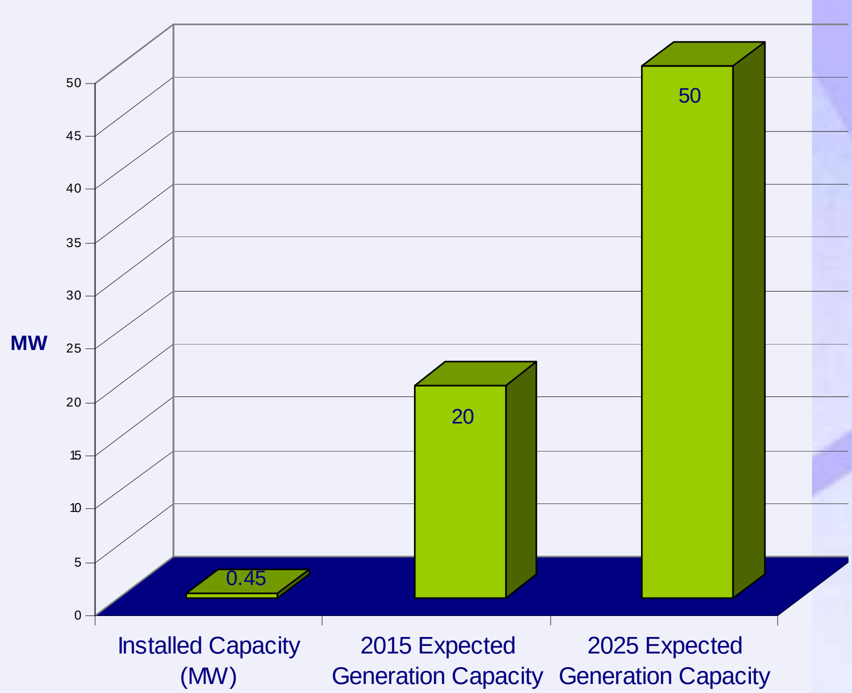
Initial exploration efforts occurred during the 1970s and 80's to help define resource locations but inadequate funding stalled more substantive development. Currently field investigations are on-going to characterize and further identify geothermal areas, particularly near the Chena Hot Springs Resort, where the state's only current geothermal power plant (a two-unit binary system) came on-line in 2006 providing power to the resort and as a demonstration plant. The Chena Hot Springs plant is unique in that it is capable of producing power from a low-temper-ature aquifer (demonstrating the recent advances made in geothermal technology) (USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Alaska during the next 30 years at 677 MW, with a total low-high range of 236 MW to 1,359 MW.

Geothermal energy is not presently used for large-scale electricity production. Direct-use applications such as building heating are common throughout the state and many surface resources have been developed for recreational purposes. The most difficult challenges facing geothermal power plant development in Alaska are the remote locations of known or potential geothermal resource areas, placing potential generation facilities far from existing transmission lines and resulting in high capital costs to build power plants.. A high-temperature (above 302 degrees Fahrenheit [°F], 150 degrees Celcius [°C]) hydrothermal reservoir identified on Unalaska Island has been considered for the development of a 15 MWe (megawatts electric) power plant to supply the city of Unalaska and Dutch Harbor, one of the nation's most active seaports. In addition, the State of Alaska is proposing approximately 36,057 acres in 16 tracts on the south flank of Mount Spurr for geothermal exploration and development (Mount Spurr Geothermal Lease Sale No. 3). On September 10, 2008, the Mount Spurr lease sale was held. The area lies entirely within the Kenai Peninsula Borough, approximately 40 miles west of the village of Tyonek and about 80 west of Anchorage (Diel, 2008). However, the challenges of transmitting the electricity over the terrain separating the energy source from the city, coupled with subsidies for diesel generation, have necessitated additional feasibility studies to implement geothermal power (USDOE 2007a). Field exploration of the leases would likely start in the summer of 2009 (MacKenzie 2008).

Geothermal Electrical Generation



WGA 2006

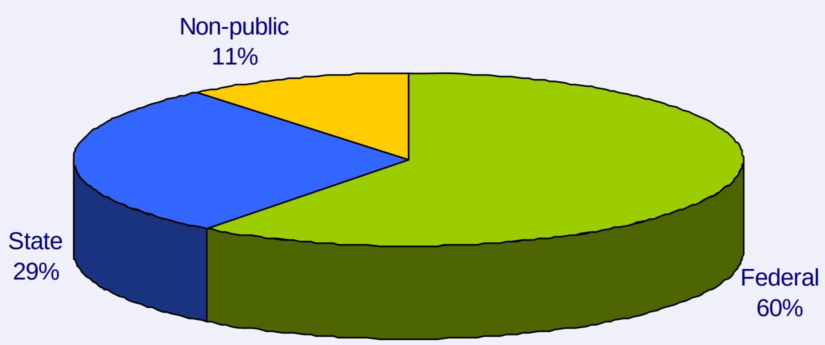
Alaska

Laws and Regulations

Alaska classifies geothermal resources as Mineral (though waters below 120°C are available for appropriation as groundwater and are subject to ground water law statutes), and the state claims ownership of all geothermal resources, including those under private lands. The state gives the landowner preferential right to prospecting permits and/or leases.

The Alaska Department of Natural Resources, Division of Oil and Gas, is responsible for the development of the state’s geothermal resources (Battocletti 2005). Alaska has established a Geothermal State Working Group with leadership from the Alaska Energy Authority. The Alaska group brings together state and regional energy professionals to promote the increased utilization of the state's geothermal resources (USDOE 2007a). The state presently has no renewable portfolio standard (RPS) or renewable energy standard (RES) (Richter 2007). Alaska has no state funding allocated specifically for geothermal resource development. The state has not passed greenhouse gas (GHG) reduction legislation but established a Climate Impact Assessment Committee in 2006 to examine and prepare recommendations regarding potential future GHG legislation (Camp 2007). The Alaska State Chamber of Commerce published a document in January 2008 in support of a state-wide energy policy that includes the study and development of Alaska’s geothermal resources (ACC 2008).

Land Ownership



NRCM 2008

Alaska

Technical Capabilities

Alaska universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The University of Alaska has participated in various research and exploration projects throughout Alaska, including the investigation of the Chena Hot Springs area (USDOE 2007a).

Electrical Power Generation and Capacity

Alaska has an installed geothermal electricity production capacity of 0.45 megawatt (MW) with a running capacity of 0.40 MW, all of which comes solely from the Chena plant. Four projects are in development, with a total potential capacity of 45.6-60.6 MW; 20 MW in the short-term (2015), 50 MW in the long-term (2025) (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* provides a mean probability of electrical power generation for identified geothermal resources on all lands in Alaska during the next 30 years at 677 MW, with a total low-high range of 236 MW to 1,359 MW(USGS 2008).

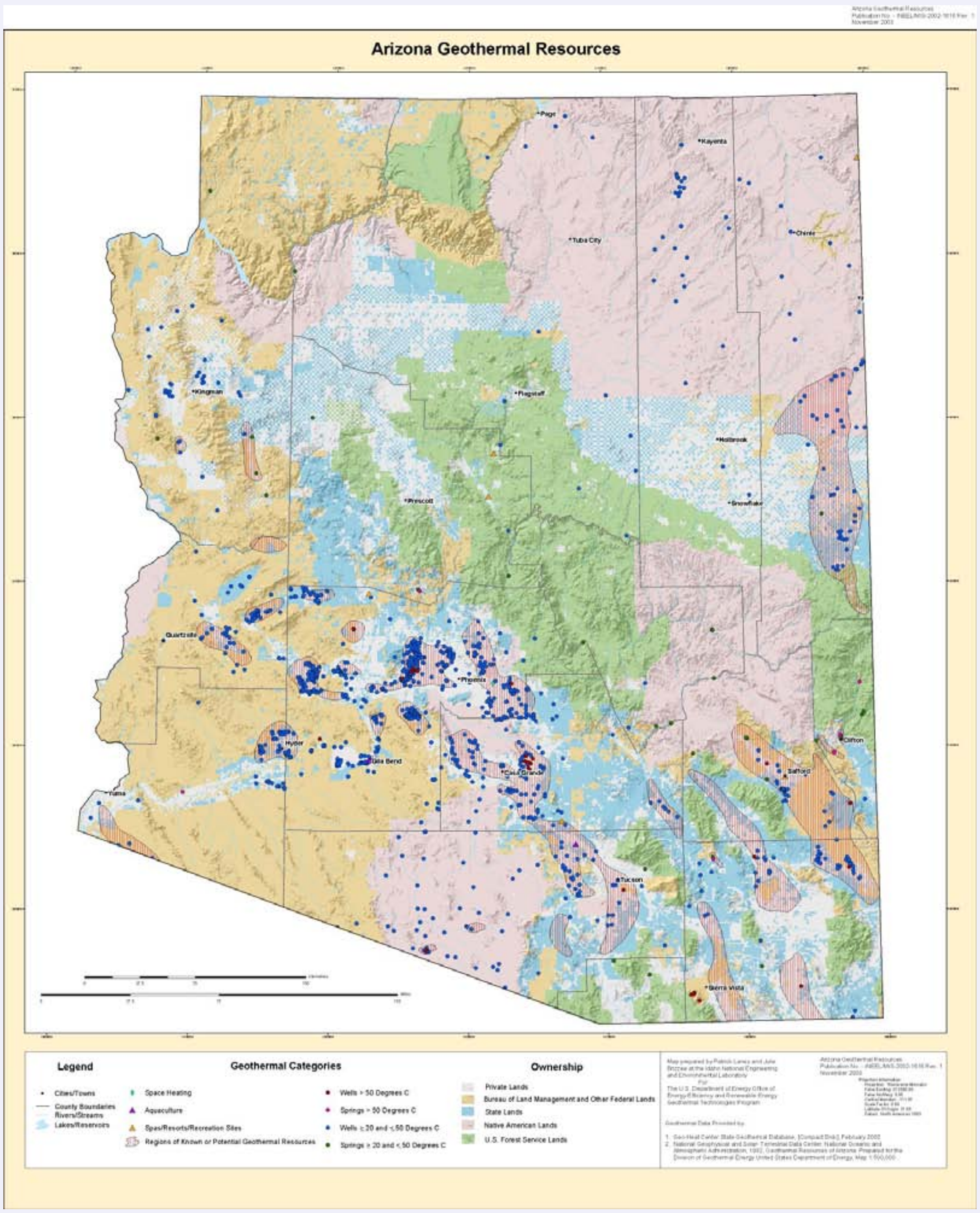
Tribal Lands

The NANA Regional Corporation is currently conducting a Geothermal Assessment Program Feasibility Study to assess potential for power generation on Native Alaska lands in the NANA region (NANA 2007). Source: NANA regional Corp website: http://www.eere.energy.gov/tribalenergy/pdfs/0711review_nana.pdf.

Arizona

Resource Geography

High-temperature geothermal resources have yet to be discovered in Arizona; most known resources of any temperature are located south of the Colorado plateau. Three locations: Buckhorn Baths in Apache Junction, Castle Hot Springs in the Bradshaw Mountains, and Childs on the Verde River exhibit potential for geothermal resources and may warrant exploration (ADC 2008), while geothermal development plans for the counties of Cochise, Graham, Greenlee, Maricopa, Pima, Pinal, Santa Cruz and Yuma were completed in the 1970s (USDOE 2007a).



Laney, 2003a, http://geothermal.id.doe.gov/maps/az.pdf

Arizona

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Arizona during the next 30 years at 26 MW, with a total low-high range of 4 MW to 70 MW.

Utilization

Current development focuses on direct, recreational, and therapeutic use, particularly aquaculture, agriculture and spas. Indirect-use research is on-going: A United States (U.S.) Department of Energy (DOE) grant to drill an exploration well near Clifton Hot Springs in Greenlee County was awarded to the joint groups of Arizona Public Service (APS), Northern Arizona University, Arizona State University, New Mexico University and the Ormond Group (USDOE 2007a). The water temperature ranges from 158-180° F (302-356° C) (ADC 2008). Researchers anticipate this area has the potential to generate 20 MW of electric power (USDOE 2007a). A geothermal power plant has been in planning for several years at this site, but confirmation drilling is required before construction can begin. Northern Arizona University also received US DOE funding to perform geophysical and geochemical testing in the previously unexplored areas of San Francisco Volcanic Field (ADC 2008, Fleischmann 2007).

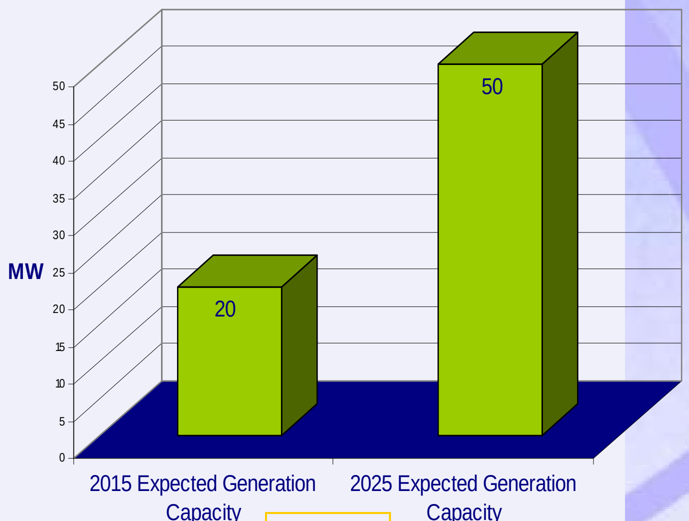
Technical Capabilities

There are several agencies, universities, and private companies assisting in the efforts to further explore Arizona's geothermal capabilities. This collaboration includes: Vulcan Power, Northern Arizona University, Arizona State University, New Mexico University, Arizona Public Service, and the Ormond Group. Northern Arizona University (NAU) is also participating in outreach efforts to educate Arizona's population regarding geothermal resources in addition to it's San Francisco research (USDOE 2007a).

Electrical Power Generation and Capacity

No geothermal plants exist in the state as of present. One project (Clifton Hot Springs) is currently in development, with a projected potential of 2-20 MW, 20 MW short-term and 50 MW long-term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Arizona during the next 30 years at 26 MW, with a total low-high range of 4 MW to 70 MW (USGS 2008).

Geothermal Electrical Generation



WGA 2006

Tribal Lands

Tribal lands in Arizona make up roughly 27 percent of the state's land. No geothermal direct use facilities are known to be operating on these lands. Those who work with tribes in Arizona assert that continued education and public involvement are essential if tribal leaders will pursue geothermal projects (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Arizona are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_arizona.html (USDOE 2007b).

Arizona

Tribes with Potential Geothermal Resources in Arizona
Ak Chin Indian Community of the Maricopa Indian Reservation
Cocopah Tribe
Colorado River Indian Tribes of the Colorado River Indian Reservation
Fort Apache Reservation
Fort McDowell Yavapai Nation of the Fort McDowell Indian Reservation
Fort Mojave Indian Tribe
Fort Yuma Indian Reservation
Gila River Indian Community of the Gila River Indian Reservation
Havasupai Tribe of the Havasupai Reservation
Hopi Tribe of Arizona:
San Carlos Apache Tribe of the San Carlos Reservation
Northern lands
Eastern lands
Southwestern lands
Kaibab Indian Reservation
Hualapai Indian Tribe of the Hualapai Indian Reservation:
San Juan Southern Paiute Tribe
Northern lands
Southern lands
Maricopa Indian Community of the Salt River Reservation
Maricopa Indian Reservation
Navajo Nation:
Four Corners Region lands (Northeast Arizona, Northwest New Mexico, and Southeast Utah)
North Central Arizona and Central Utah lands
East Central lands in Arizona
Four Corners Region lands (Northeast Arizona, Northwest New Mexico, and Southeast Utah)
Southeastern lands in Arizona
Southwestern lands in Arizona
Paiute Indians of the Kaibab Indian Reservation
Pascua Yaqui Tribe
Quechan Tribe of the Fort Yuma Indian Reservation
Salt River Pima-Maricopa Indian Community of the Salt River Reservation
Salt River Reservation
Tohono O'odham Nation
Tonto Apache Tribe
White Mountain Apache Tribe of the Fort Apache Reservation
Yavapai-Apache Nation
Yavapai-Prescott Tribe of the Yavapai Reservation

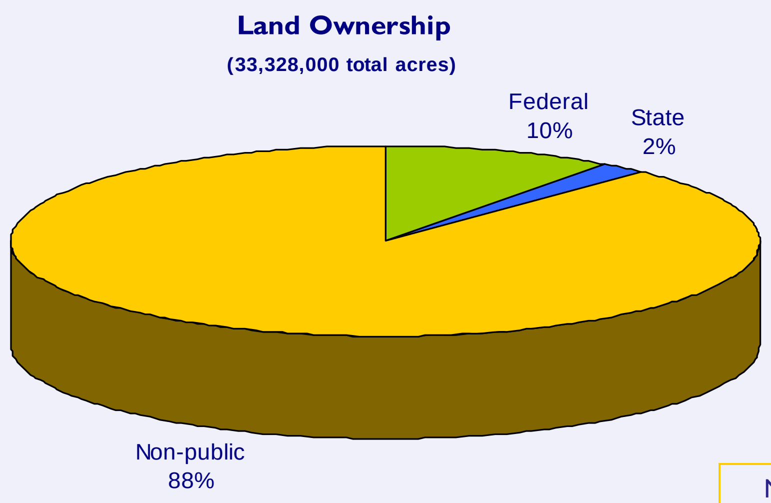
Arizona

Laws and Regulations

The State of Arizona classifies geothermal resources as *sui generis,* indicating that they are not covered by a 'Use Class' but effectively are in a class of their own. The state claims ownership of all geothermal resources on state lands and reserves the right to lease or withhold these state lands for the purpose of leasing (Battocletti 2005).

Several state agencies are involved with any potential geothermal project. The Arizona Department of Environmental Quality (DEQ) is responsible for the disposal of waters associated with geothermal projects. The State Department of Water resources must be consulted to obtain well construction permits and to secure water rights, and the Department of Commerce Community Planning Office should be contacted regarding planning and zoning issues across the state (Battocletti 2005). Arizona's Geothermal Working Group has established two primary tasks: collecting data on all of the current state geothermal applications and documented resources, and identifying future energy development activities that will be the most beneficial to the state (USDOE 2007a).

Arizona has set a RPS of 7 percent by 2017 and 15 percent by 2025 (60 percent of which will come from solar and 30 percent of which will be distributed energy). The RPS for geothermal electrical and geothermal heat pumps is 15 percent by 2025 (Richter 2007). There is currently no state funding or incentive for geothermal development (USDOE 2007). The state has GHG reduction targets aiming for year 2000 GHG levels by 2020 and 50 percent below 2000 levels by 2040, and is considering legislation to set these targets (Camp 2007).



NRCM 2008

California

Resource Geography

California has several high-potential geothermal areas, and much of the state, with the exception of the Central Valley and the far northwest corner, displays potential for geothermal resources (USDOE 2007). Twenty-five known geothermal resource areas exist in the state (CEC 2008), including north of Santa Rosa at the Geysers, in the northeastern part of the state, in the Owens Valley and eastern Sierras, in the Mojave Desert, and at the Salton Sea and Imperial Valley in southern California (CDC 2008, CEC 2008, USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in California during the next 30 years at 5,404 MW, with a total low-high range of 2,422 MW to 9,282 MW.

Utilization

California currently leads the nation and world in geothermal electricity generation, with seven percent of the state's total power production output coming from geothermal resources (USDOE 2007a). Six counties produce geothermal resources hot enough for electrical power generation (CDC 2008). The state has over 600 active, high-temperature geothermal wells (with fluids over 212°F, 100°C) and 230 injection wells (CEC 2008).

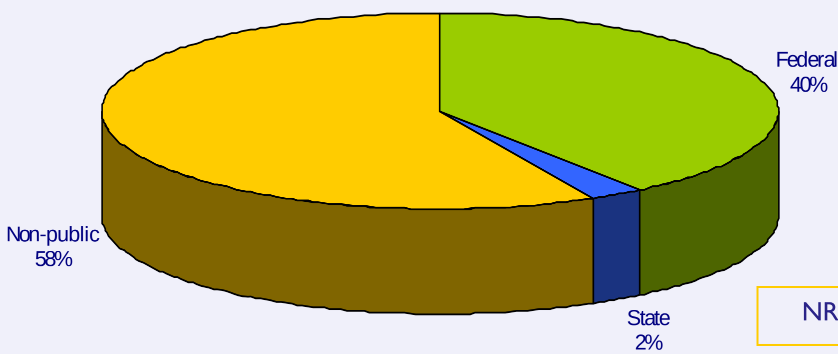
There are 15 electrical power projects in various stages of development in California (with a total MW potential of 921.3-969.3), and the Western Governor's Association Geothermal Task Force projects up to 2,400 MW of additional power production capacity for potential near-term development (Richter 2007). Direct use of geothermal power in California is expanding and consists of aquaculture, agriculture, recreation, and food dehydration (CDC 2008). The largest concentration of geothermal aquaculture facilities in the US is in the Imperial Valley (Rafferty 1999).

Technical Capabilities

California universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The California Energy Commission maintains databases of geothermal resource information and produces numerous reports on state resources and development opportunities (USDOE 2007a).

Land Ownership

(99,822,000 total acres)



NRCM 2008

California

California- CDC 2002. ftp://ftp.consrv.ca.gov/pub/oil/maps/Geothermal/MapS-11.pdf

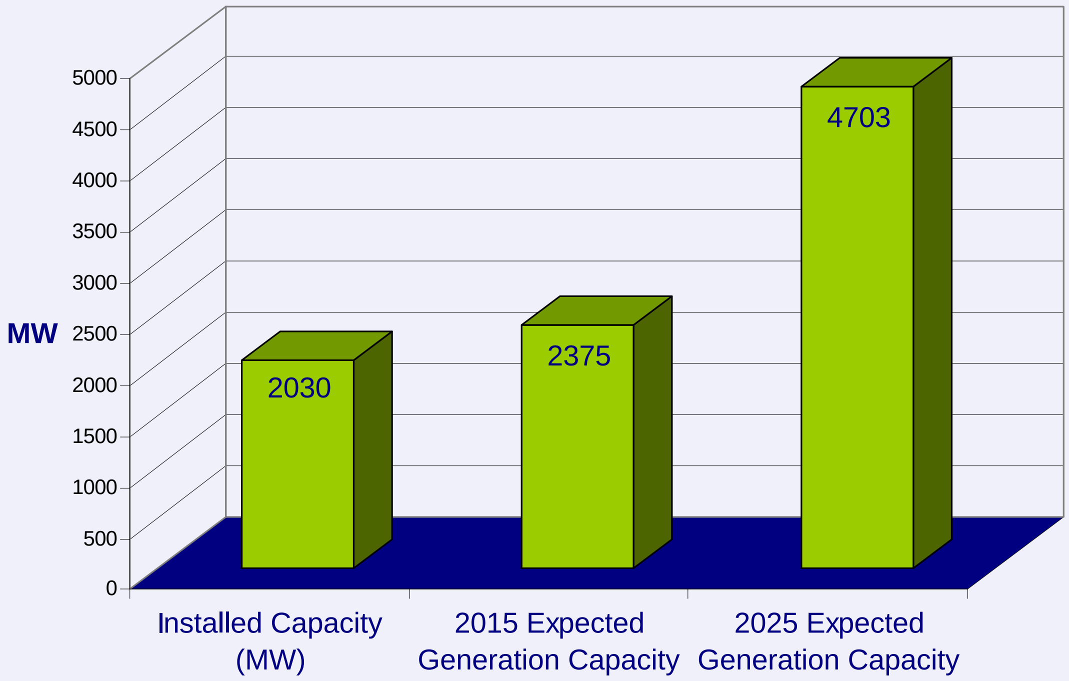
California

Electrical Power Generation and Capacity

Approximately 40 percent of total world-wide geothermal plant production takes place in California, largely due to the presence of the Geysers, a collection of 41 geothermal power plants located north of San Francisco, which is the world's largest producer of geothermal power. Additional plants are located in the Imperial Valley (east of San Diego), at Coso Hot Springs near Ridgecrest, at Amedee/Wineagle near Susanville, and at the Mammoth Lakes area in Long Valley (USDOE 2007a).

California has a literature-cited installed geothermal power capacity of 2,492.10 MW, with a current running capacity of 2030.47 MW. Approximately 14,379 GWh (gigawatt hour) of geothermal energy is produced annually from 49 plants (composed of 67 units total). These plants include binary, dry steam, single flash, double flash, dual flash, hybrid-biomass/geothermal, and dry team-low pressure reaction types (Richter 2007) and include sites at Amedee, Casa Diablo, East Mesa, Glass Mountain, Heber, Honey Lake, and Salton Sea, in addition to those previously mentioned (USDOE 2007a). The same literature cites a short-term projected geothermal electricity generation potential for the state of 2,375 MW, with a long-term potential of 4,703 MW (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in California during the next 30 years at 5,404 MW, with a total low-high range of 2,422 MW to 9,282 MW (USGS 2008). Recently, development has been limited or stalled by transmission issues and delays resulting from federal and state permitting regulations. However, geothermal power production capacity is increasing in California (Fleischmann 2007).

Geothermal Electrical Generation



WGA 2006

California

Tribal Lands

Maps and data for geothermal resources on tribal lands in California are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_california.html (USDOE 2007c). The table on the following two pages indicates which tribes data is available for at the DOE website.

Tribes with Potential Geothermal Resources in California	
Agua Caliente Band of Cahuilla Indians of the Agua Caliente Indian Reservation	Alturas Indian Rancheria of Pit River Indians
Auburn Rancheria	Augustine Band of Cahuilla Mission Indians
Barona Reservation	Bear River Band of the Rohnerville Rancheria
Benton Paiute Reservation	Berry Creek Rancheria of Maidu Indians
Big Lagoon Rancheria of Smith River Indians	Big Pine Band of Owens Valley Paiute Shoshone Indians
Big Sandy Rancheria of Mono Indians	Big Valley Band of Pomo Indians of the Big Valley Rancheria
Bishop Reservation	Blue Lake Rancheria
Bridgeport Paiute Indian Colony	Buena Vista Rancheria of Me-Wuk Indians
Cabazon Band of Cahullia Mission Indians of the Cabazon Reservation	Cahuilla Band of Mission Indians of the Cahuilla Reservation
Cahto Indian Tribe of the Laytonville Rancheria	California Valley Miwok Tribe (formerly the Sheep Ranch Rancheria of Me-Wuk Indians)
Campo Band of Diegueno Mission Indians of the Campo Indian Reservation	Capitan Grande Band of Mission Indians of the Barona Reservation
Capitan Grande Band of Mission Indians of the Viejas Reservation	Cedarville Reservation of Northern Paiute Indians
Chemehuevi Indian Tribe of the Chemehuevi Reservation	Cher-Ae Heights Indian Community of the Trinidad Rancheria
Chicken Ranch Rancheria of Me-Wuk Indians	Chico Rancheria
Cloverdale Rancheria of Pomo Indians	Coast Indian Community of Yurok Indians of the Resighini Rancheria (see Resighini Rancheria)
Cold Springs Rancheria of Mono Indians	Colorado River Indian Tribes of the Colorado River Indian Reservation
Colusa Rancheria	Cortina Indian Rancheria
Coyote Valley Band of Pomo Indians	Cuyapaipe Community of Diegueno Mission Indians of the Cuyapaipe Reservation
Death Valley Timbi-Sha Shoshone Band	Dry Creek Rancheria of Pomo Indians
Elem Indian Colony of Pomo Indians of the Sulphur Bank Rancheria	Elk Valley Rancheria
Enterprise Rancheria of Maidu Indians	Fort Bidwell Indian Community of Paiute Indians
Fort Independence Indian Community of Paiute Indians	Fort Mojave Indian Tribe
Fort Yuma Indian Reservation	Greenville Rancheria of Maidu Indians
Grindstone Creek Rancheria of Wintun-Wailaki Indians	Guidiville Rancheria
Hoopa Valley Tribe	Hopland Band of Pomo Indians of the Hopland Rancheria
Inaja Cosmit Band of Diegueno Mission Indians of the Inaja and Cosmit Reservation	Jackson Rancheria of Me-Wuk Indians
Jamul Band of Mission Indians, Jamul Indian Village	Karuk Tribe
Kashia Band of Pomo Indians of the Stewarts Point Rancheria	La Jolla Band of Luiseno Mission Indians of the La Jolla Reservation
La Posta Band of Diegueno Mission Indians of the La Posta Indian Reservation	Lone Pine Paiute Shoshone Reservation
Los Coyotes Band of Cahuilla Mission Indians of the Los Coyotes Reservation	Lytton Band of Pomo Indians at the Lytton Rancheria
Manchester Band of Pomo Indians of the Manchester-Point Arena Rancheria	Manzanita Band of Diegueno Mission Indians of the Manzanita Reservation

California

Tribes with Potential Geothermal Resources in California (continued)	
Mechoopda Indian Tribe of Chico Rancheria	Mesa Grande Band of Diegueno Mission Indians of the Mesa Grande Reservation
Middletown Rancheria of Pomo Indians	Mooretown Rancheria of Maidu Indians
Morongo Band of Cahuilla Mission Indians of the Morongo Reservation	North Fork Rancheria of Mono Indians
Paiute-Shoshone Indians of the Bishop Community of the Bishop Reservation	Pala Band of Luiseno Mission Indians of the Pala Reservation
Paskenta Band of Nomlaki Indians (see Grindstone Creek Rancheria)	Pauma Band of Luiseno Mission Indians of the Pauma and Yuima Reservation
Pechanga Band of Luiseno Mission Indians of the Pechanga Reservation	Picayune Rancheria of Chukchansi Indians
Pine Community of the Lone Pine Reservation	Pinoleville Band of Pomo Indians
Pit River Tribe: XL Ranch and Likely and Lookout Rancherias Quartz Valley Indian Community of the Quartz Valley Reservation	Big Bend, Montgomery Creek, and Roaring Creek Rancherias
Ramona Band or Village of Cahuilla Mission Indians	Potter Valley Rancheria of Pomo Indians
Redwood Valley Rancheria of Pomo Indians	Quechan Tribe of the Fort Yuma Indian Reservation
Rincon Band of Luiseno Mission Indians of the Rincon Reservation	Redding Rancheria
Rohnerville Rancheria	Resighini Rancheria (formerly known as the Coast Indian Community of Yurok Indians of the Resighini Rancheria)
Rumsey Indian Rancheria of Wintun Indians	Robinson Rancheria of Pomo Indians
San Pasqual Band of Diegueno Mission Indians	Round Valley Indian Tribes of the Round Valley Reservation (formerly known as the Covelo Indian Community)
Santa Rosa Band of Cahuilla Mission Indians of the Santa Rosa Reservation	San Manuel Band of Serrano Mission Indians of the San Manuel Reservation
Santa Ysabel Band of Diegueno Mission Indians of the Santa Ysabel Reservation	Santa Rosa Indian Community of the Santa Rosa Rancheria
Sherwood Valley Rancheria of Pomo Indians	Santa Ynez Band of Chumash Mission Indians of the Santa Ynez Reservation
Smith River Rancheria	Sheep Ranch Rancheria of Me-Wuk Indians (see California Valley Miwok Tribe)
Stewarts Point Rancheria	Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria (Verona Tract)
Sycuan Band of Diegueno Mission Indians	Soboba Band of Luiseno Mission Indians of the Soboba Reservation
Wiyot Tribe Table Bluff Reservation	Susanville Indian Rancheria of Paiute, Maidu, Pit River & Washoe Indians
Torres-Martinez Band of Desert Cahuilla Mission Indians	Trinidad Rancheria
Tuolumne Band of Me-Wuk Indians of the Tuolumne Rancheria	Table Mountain Rancheria
United Auburn Indian Community of the Auburn Rancheria	Tule River Indian Tribe of the Tule River Reservation
Utu Utu Gwaitu Paiute Tribe of the Benton Paiute Reservation	Twenty-Nine Palms Band of Mission Indians (Chemehuevi)
Washoe Tribe of Nevada and California of the Woodfords Community	Upper Lake Rancheria
Viejas Reservation	Yurok Tribe of the Yurok Reservation

California

Laws and Regulations

California classifies geothermal resources as Mineral and claims ownership of these resources where they occur on state-owned land; otherwise, the resource is the property of the owner of the mineral estate. Permits for siting power plants greater than or equal to 50 MW on all lands, including federal lands, are issued by the California Energy Commission. The Division of Oil, Gas, and Geothermal Resources is the lead agency for the environmental review of exploratory wells (excluding Imperial County) and permits the drilling, operation, plugging, and abandonment of all production and injection wells. The local authority is the lead agency for the environmental review of developmental wells, pipelines, and power plants generating less than 50 MW (Battocletti 2005). California has established a Geothermal State Working Group, with leadership from the California Energy Commission. The California group brings together state and regional energy professionals for workshops and other outreach activities. A geothermal industry summit was held in Sacramento in 2004, during which geothermal stakeholders examined opportunities for further development in relation to California's RPS legislation, as well as grid interconnection and industry partnership topics (USDOE 2007a).

The state's RPS requires ten percent renewable energy by 2010, with a minimum of one percent over the previous year for 2004-2010. The RPS mandates geothermal electric growth of one percent over the previous year, at least 20 percent by 2010, and a long-term goal of 33 percent by 2020 (Richter 2007). The state offers supplemental energy payments applicable to geothermal power plants through its RPS, as well as energy efficiency rebates (USDOE 2007a). In 2006 California passed a GHG law setting reduction targets of 1990 levels by 2020 and 80 percent below 1990 levels by 2050. The state requires a performance standard for electricity generation and sales of 1,100 lbs of CO_2 per MWh (Camp 2007).

Colorado

Resource Geography

Expert opinion suggests Colorado has a large geothermal resource base, although development in the state has been limited to direct-use applications (USDOE 2007a). When last inventoried in 1993, Colorado had 59 sites with water temperatures above 95° F (35° C) and 34 geothermal wells (CGS 2007). High-temperature resources exist at greater depth beneath most of the mountainous regions of the state (CGS 2007, CSWG 2007, USDOE 2007a). From preliminary heat flow and geothermal gradient maps, several areas can be identified that have potential for geothermal power generation. These locations include the Mt. Princeton area near Buena Vista, the Waunita Hot Springs area in southeast Gunnison County, the San Luis Basin especially along its margins, the San Juan Mountains near Ouray and Rico, Pagosa Springs, the Raton Basin west of Trinidad, and possibly an area near Somerset. Also, past geothermal and geochemistry studies at hot springs in the Steamboat Springs area indicate geothermal resources at depth may have temperatures above 250° F (121° C). Oil and gas development has also indicated geothermal resource potential in both the Denver and San Juan Basins (CSWG 2007).

Utilization

Geothermal electric power has not historically been considered competitive given low energy prices in the state. Thus further exploration and analysis is needed to characterize known geothermal prospects and determine what would be needed for development. As suggested above, some resources may require deep drilling, while small power units similar to the plant at Chena Hot Springs in Alaska may be applicable in some locations (Fleischmann 2007). Current plans for development continue to focus on direct-use, particularly for recreation, therapeutic properties and aquaculture. Several unique aquaculture-related projects are currently in operation, i.e. alligator farms (Clutter 2001).

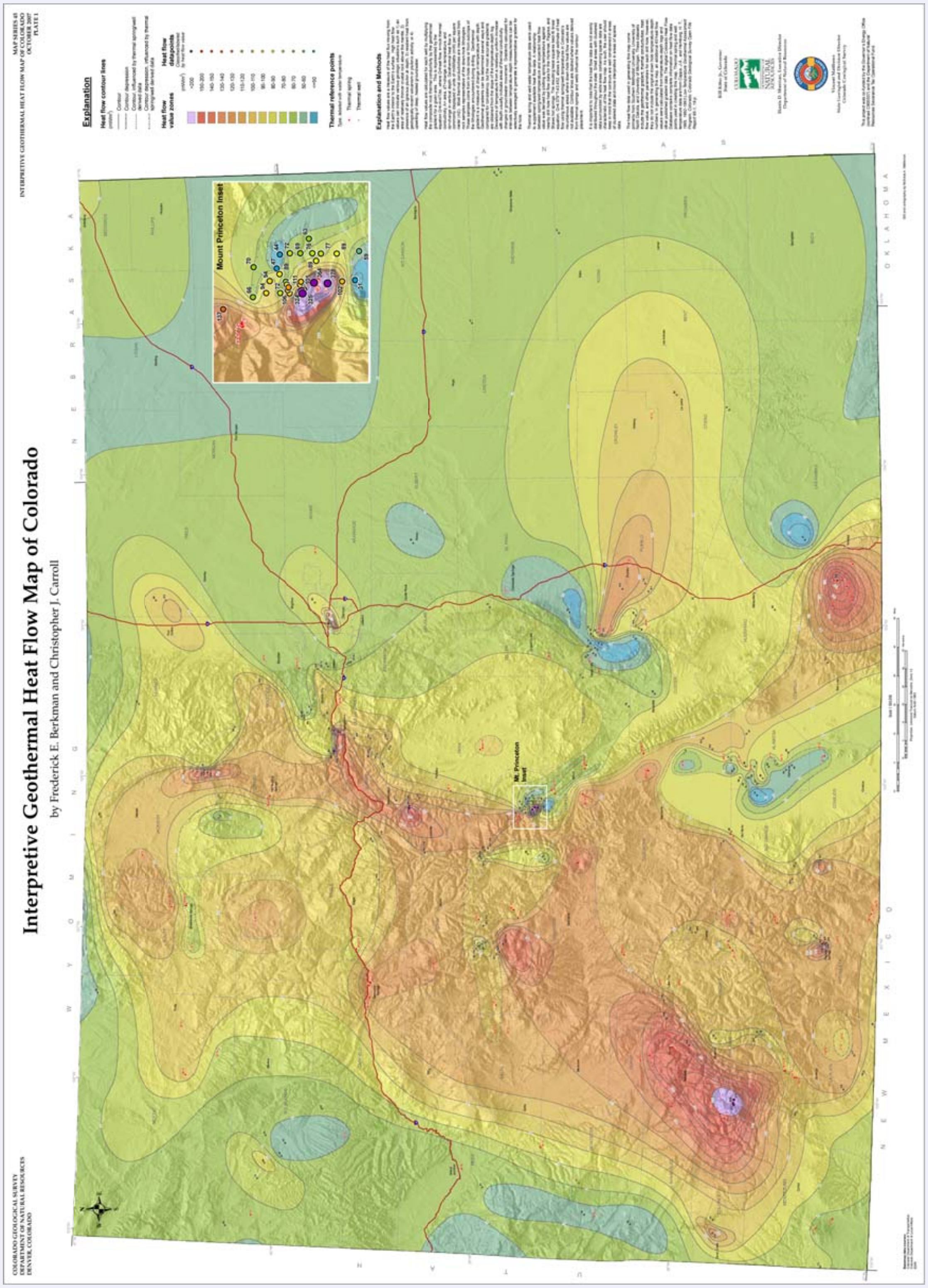
ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Colorado during the next 30 years at 30 MW, with a total low-high range of 8 MW to 67 MW.

Technical Capabilities

Colorado universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The Colorado Geological Survey has conducted and published various assessments of the state's geothermal resource base, while the National Renewable Energy Laboratory in Golden, Colorado is the nation's leading institution for the research and development of renewable energy technologies, including geothermal energy (USDOE 2007a). Currently the Colorado Geological Survey is compiling a Colorado-specific geothermal database, which will be used to create an updated and more detailed state-wide heat flow map and geothermal gradient map (CSWG 2007).

Colorado



CGS 2007b, http://geosurvey.state.co.us/Default.aspx?tabid=484

Colorado

Technical Capabilities

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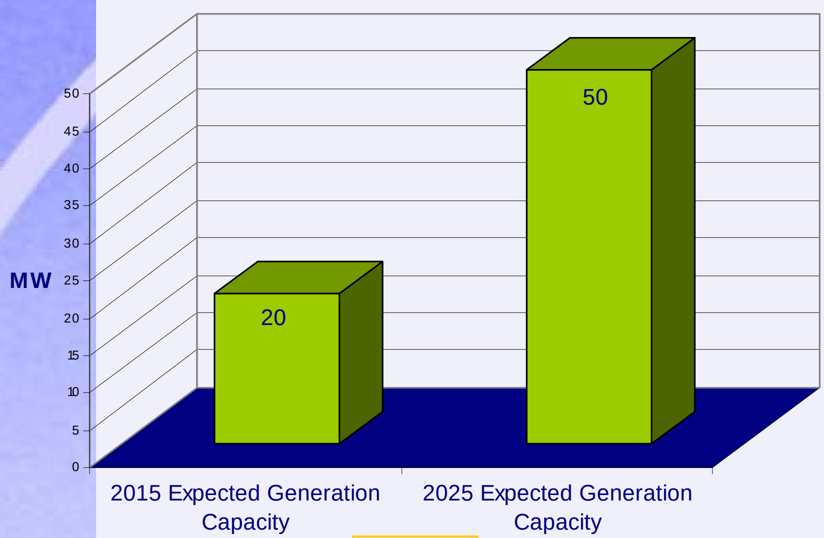
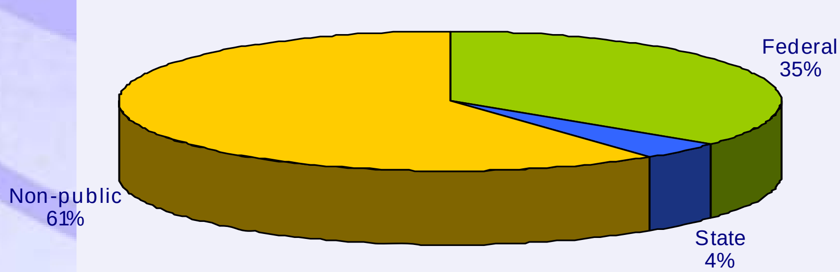
Geothermal Electrical Generation



WGA 2006

Land Ownership

(66,387,000 total acres)



NRCM 2008

Electrical Power Generation and Capacity

No geothermal power plants are currently proposed for the state, but literature cites a short-term geothermal potential of 20 MW, with a long-term potential of 50 MW (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Colorado during the next 30 years at 30 MW, with a total low-high range of 8 MW to 67 MW (USGS 2008). The Colorado Geological Survey reports that the state displays a number of criteria for geothermal power potential, including quarternary volcanoes and fault lines, and one of the highest high flows in the US. Studies indicate that Colorado may have some of the best high-temperature resources in the country for extraction via "enhanced geothermal system" or "hot dry-rock" technology (CGS 2007). (A hot dry-rock resource is deep, hot crystalline rock that can be used to generate geothermal energy by pumping water down to the rock and thus heating it before it returns to the surface) (Battocletti 2005).

Colorado

Tribal Lands

Maps and data for geothermal resources on tribal lands in Colorado are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_colorado.html (USDOE 2007d). Tribes for which information is available are listed below.

Tribes with Potential Geothermal Resources in Colorado
Southern Ute Indian Tribe of the Southern Ute Reservation: Main tribal lands Western-most tribal lands
Ute Mountain Tribe of the Ute Mountain Reservation

Laws and Regulations

The State of Colorado classifies geothermal resources as Water and stipulates that geothermal resources are publicly-owned. A property right to a hot dry-rock resource is an incidence of the overlaying surface, unless several resources are transferred with the subsurface estate expressly (Battocletti 2005).

The Colorado Division of Water Resources is the lead state agency administering geothermal resource rules and regulations, as well as overseeing the permitting of injection wells. The US Environmental Protection Agency (EPA), Region 8, has primacy however, and oversees the administration of underground fluid injection wells. The state Department of Public Health and Environment's Water Quality Control Division is responsible for administering surface disposal of wastewater, including geothermal fluids (Battocletti 2005). Colorado has established a Geothermal State Working Group with leadership from Delta-Montrose Electric Association. The Colorado group is in the process of bringing together state and regional energy professionals to work together to promote the increased utilization of the state's geothermal resources (USDOE 2007a). Colorado has a RPS of 20 percent by 2020 for investor-owned utilities (IOUs) and ten percent for rural co-ops and municipality utilities (four percent solar for 2007-2010 for IOUs only) (Richter 2007). Outside of the RPS the state offers no incentives for geothermal development and no funding is available at the state level for development (USDOE 2007a). Presently Colorado has no GHG laws or legislation pending, but does participate in the National Climate Registry (Camp 2007).

Idaho

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Idaho during the next 30 years at 333 MW, with a total low-high range of 81 MW to 760 MW.

Resource Geography

Idaho has both low-temperature geothermal sources for potential direct-use and high-temperature sites (concentrated in the southern part of the state) that may provide opportunities for electricity production (Crimp 2006).

Utilization

Current development focuses on community heating though construction of the state's first geothermal power generation facility, a 10-MW plant at Raft River (approximately 200 miles southeast of Boise) that was completed in January 2008 (USDOE 2007a, USGI 2008).

Past exploration and development efforts have been limited, as low energy costs and the small size of the state's population did not necessitate new sources of electric power. Thus, further exploration and characterization of Idaho's geothermal resources is needed to better define the state's resource potential (Fleischmann 2007). In addition to Raft River, three other sites are being investigated for potential electricity generation: the China Cap site in Caribou County (with a literature-estimated capacity of 100 MW), an area near Willow Springs (with a literature-estimated capacity of 100 MW) (USDOE 2007a), and a site at Crane Creek in western Idaho (with a literature-estimated value of 100-179 MW) (Neely 2007).

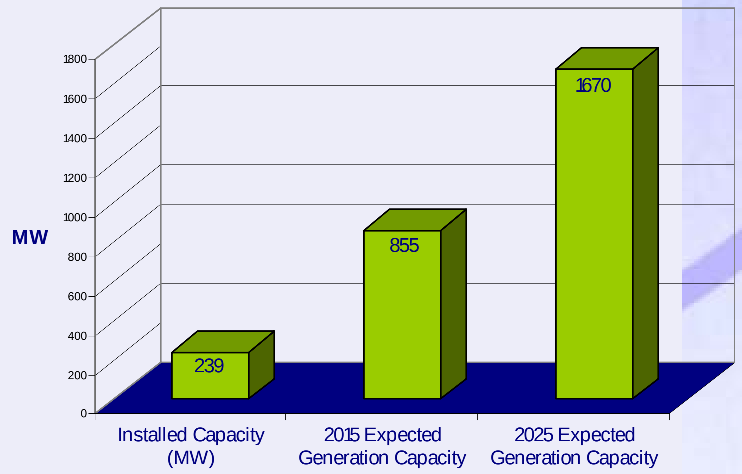
Technical Capabilities

The Idaho National Laboratory houses national expertise in the research and development of geothermal energy resources. The laboratory maintains databases of geological characteristics to aid in the characterization and development of geothermal reservoirs nationwide. Additionally, the Energy Division of the Idaho Department of Water Resources provides technical support for geothermal projects in the state and conducts educational outreach activities to promote further geothermal development (USDOE 2007a).

Electric Power Generation and Capacity

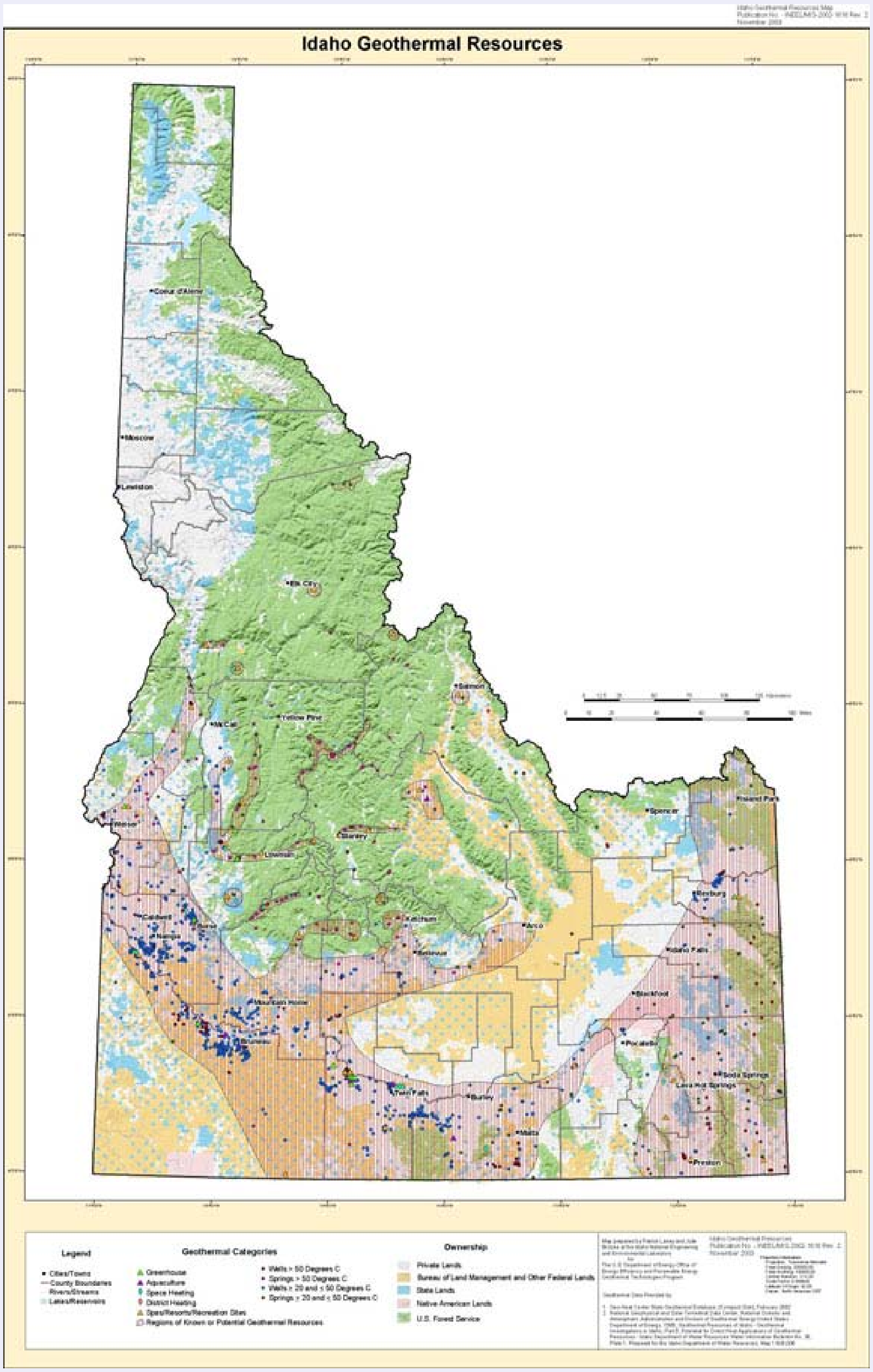
Four projects are in development, with a total literature-estimated MW potential of 39-239. Literature-cited potential energy production from geothermal resources places estimates at 855 MW short-term and 1,670 long-term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Idaho during the next 30 years at 333 MW, with a total low-high range of 81 MW to 760 MW (USGS 2008).

Geothermal Electrical Generation



WGA 2006

Idaho



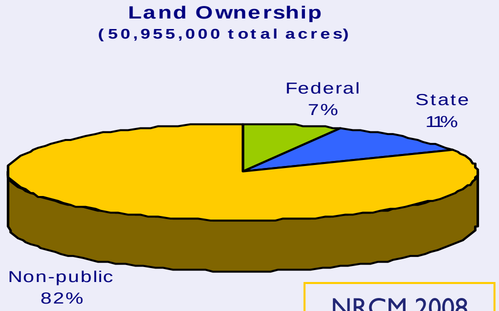
Laney, 2003c, http://geothermal.id.doe.gov/maps/id.pdf

Idaho

Tribal Lands

Tribal lands in Idaho make up roughly 1.1 percent of the state's land. The largest reservation is the Fort Hall Reservation north of Pocatello, where potential for geothermal resource development has been suggested by research in the area (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Idaho are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_idaho.html (USDOE 2007e). Tribes for which information is available are listed below.

- Coeur D'Alene Tribe of the Coeur D'Alene Reservation
- Duck Valley Reservation
- Fort Hall Reservation
- Kootenai Tribe
- Nez Perce Tribe
- Shoshone-Bannock Tribes of the Fort Hall Reservation
- Shoshone-Paiute Tribes of the Duck Valley Reservation



NRCM 2008

Laws and Regulations

Idaho classifies geothermal resources as *sui generis* and Water. Groundwater with a temperature greater than or equal to 212°F at the well bottom fall under the category of *sui generis* and is further classified as a "geothermal resource." Groundwater between 85-212°F at the well bottom is classified as a "low temperature geothermal resource." The state claims ownership of all geothermal resources underlying state and school lands and holds the right to regulate development and use of all of the state's geothermal resources (Battocletti 2005).

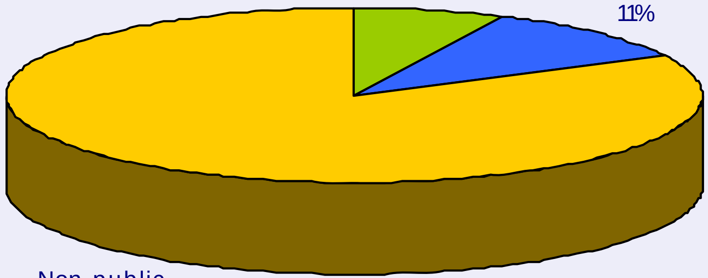
The Idaho Department of Water Resources issues water rights, well-drilling permits, and injection well permits. The state's DEQ Water Quality Division is responsible for administering surface disposal of wastewater, including geothermal fluids. The Idaho Department of Lands has a process that includes permitting, bonding, and royalties. The state does not have comprehensive environmental review statutes and does not coordinate permitting at the state level. Developers must obtain permits from state and local boards and agencies. The use of "geothermal resources" (as classified by the state) does not require a permit to appropriate water unless it will decrease groundwater in any aquifer or other groundwater resource, or measurably decrease groundwater available from prior water rights. The use of "low-temperature geothermal resources" requires a permit to appropriate water (Battocletti 2005). Idaho has established a Geothermal State Working Group, with leadership from the Idaho Energy Division. The group organizes workshops to promote the increased utilization of the state's geothermal resources (USDOE 2007a).

Idaho currently has no RES or RPS (Richter 2007) but does offer incentives for geothermal development, including low-interest loans and sales tax exemption for equipment used in construction of geothermal plants. Minimal state funding is allocated for geothermal development (most previous research has been federally funded) (USDOE 2007a). The state has no GHG laws or pending legislation. As of May 2007, the Director of the Idaho Department of Environmental Quality is, by executive order, to develop GHG reduction strategies (Camp 2007).

Montana

Resource Geography

The state of Montana has more than 50 geothermal areas and at least 15 high-temperature sites. There are seven locations with surface temperatures above 149° F (65°C), plus 20 locations with temperatures above 110°F (43° C). Low- and moderate-temperature wells and springs can be found in nearly all areas of Montana (MDEQ 2008).



The US DOE and Montana state government have joined together to organize a database of locations where geothermal resources have been identified. Records show at least 15 high-temperature sites, several with estimated deep reservoir temperatures exceeding 176.7°C. Some of these sites are located in the vicinity of Helena, Bozeman, Ennis, Butte, Boulder, and White Sulphur Springs (Fleischmann 2007, MDEQ 2008).

Utilization

While there are many areas in Montana with the potential to support geothermal electrical generation, development has thus far been limited to direct-use applications due to the proximity of previously proposed plans to Yellowstone National Park, an issue that created controversy and concern. Geothermal electrical development has also been overlooked in the past due to the state's low fossil fuel prices, small population, and lack of transmission access to remote locations (Fleischmann 2007). Current development focuses on direct-use (mostly recreational and therapeutic). One private company is currently exploring the possibility of installing a small binary plant near an existing spa (Battocletti 2005).

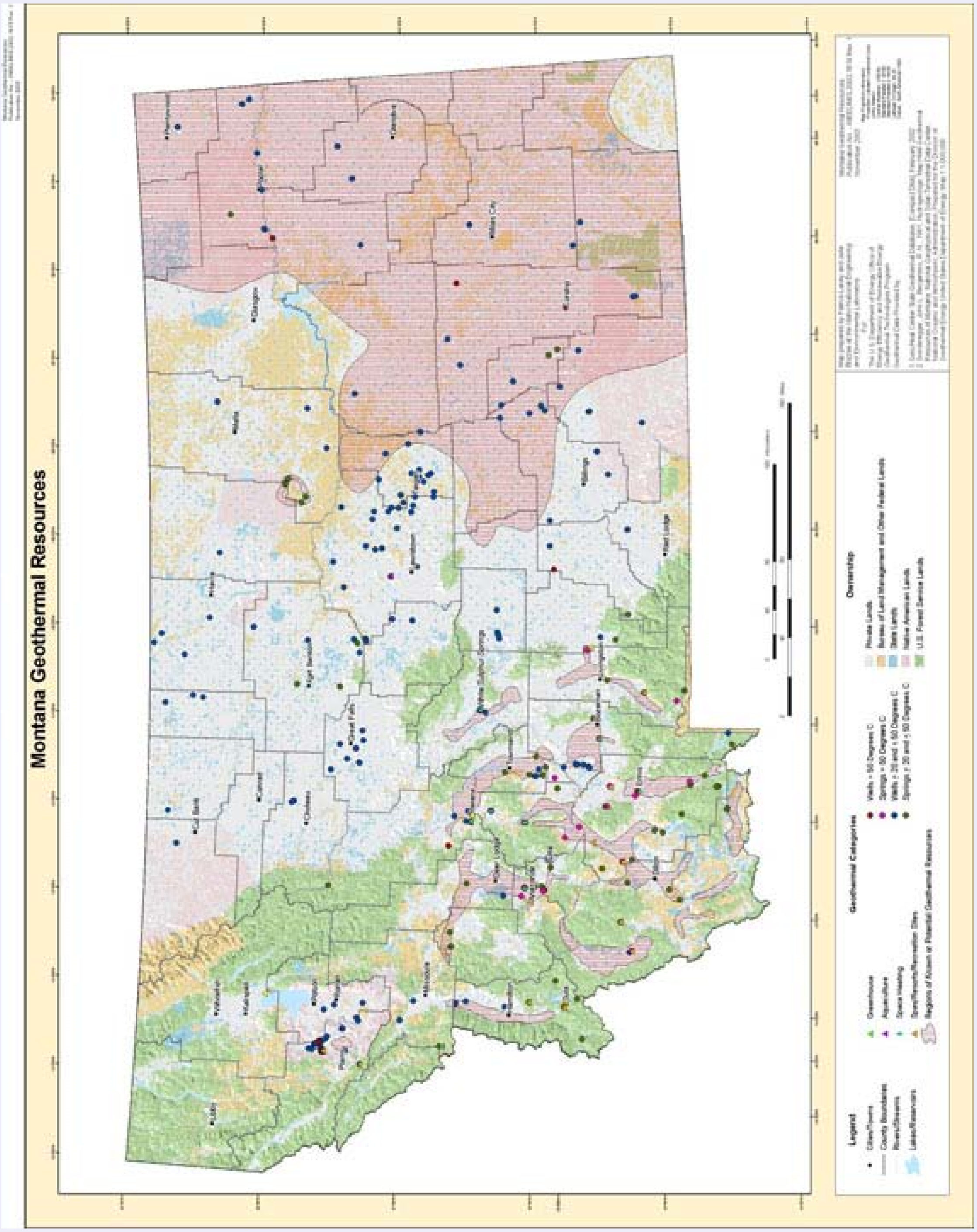
Electrical Power Generation and Capacity

There is presently no installed geothermal electric capacity in the state. The Western Governors' Association report did not identify geothermal resource potential for electrical generation in Montana, however, input for state and industry acknowledge that new technologies and undiscovered resources may yield geothermal resources that are viable for electrical generation in the future. A recent study regarding deep oil wells at Poplar Dome Oil Field (located on the Fort Peck Indian Reservation in northeast Montana) indicated potential for generating one MW from producing oil wells or three MW by deepening and hydrofracturing unused wells. This area currently produces 20,000 barrels per day of water at 130°C and there is interest in the possibility of the area supporting small geothermal power plants (USDOE 2007a). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Montana during the next 30 years at 59 MW, with a total low-high range of 15 MW to 130 MW (USGS 2008).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Montana during the next 30 years at 59 MW, with a total low-high range of 15 MW to 130 MW.

Montana



Laney, 2003d, http://geothermal.id.doe.gov/maps.mt.pdf

Montana

Maps and data for geothermal resources on tribal lands in Montana are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_montatna.html

Tribes with Potential Geothermal Resources in Montana
Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation: Eastern lands Western lands
Blackfeet Tribe of the Blackfeet Indian Reservation
Chippewa-Cree Indians of the Rocky Boy's Reservation
Confederated Salish & Kootenai Tribes of the Flathead Reservation
Crow Tribe: Main tribal lands Easternmost lands
Flathead Reservation
Fort Belknap Reservation
Fort Peck Indian Reservation: Eastern lands Western lands
Gros Ventre & Assiniboine Tribes of the Fort Belknap Reservation
Northern Cheyenne Tribe of the Northern Cheyenne Indian Reservation
Rocky Boy's Reservation

Laws and Regulations

The state of Montana classifies geothermal resources as *sui generis* and claims ownership to geothermal resources on state lands. State water laws apply to all geothermal development involving production and diversion of geothermal fluids. Groundwater is defined by the state as a public reserve that must be appropriated (Battocletti 2005).

The Montana Department of Natural Resources and Conservation is responsible for issuing water rights and well construction permits. The US EPA, Region 8, oversees the administration of underground fluid injection. The Montana Department of Environmental Quality (DEQ) is responsible for administering surface disposal of wastewater, including geothermal fluids (Battocletti 2005). A state Geothermal Working Group is planned for Montana (USDOE 2007). The state currently has a RPS that requires IOUs to obtain 5 percent of their energy from renewable sources for years 2008-2009, 10 percent for 2010-2014, and 15 percent for 2015 and each year after (Richter 2007). Geothermal power plants are eligible for RPS incentives as well as tax credits, grants, and loans; however, no state funding is currently available specifically for geothermal development (USDOE 2007a). In May 2007, Montana passed GHG legislation prohibiting the approval of new coal generating units unless 50 percent of CO_2 emitted is captured and sequestered (Camp 2007).

Nevada

Resource Geography

High-temperature (>150°C) resources suitable for electric power production are located primarily in the northwest portion of the state, while direct-use occurs state-wide, particularly in regard to food processing plants. There are several geothermal research facilities in the state, and field investigations are ongoing to further characterize geothermal resources (NCMR 2008, USDOE 2007a).

Utilization

Nevada is second to California in levels of geothermal electricity production. Direct-use in the state consists primarily of agriculture drying and industrial applications such as mining (Lund 2003).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Nevada during the next 30 years at 1,391 MW, with a total low-high range of 515 MW to 2,551 MW.

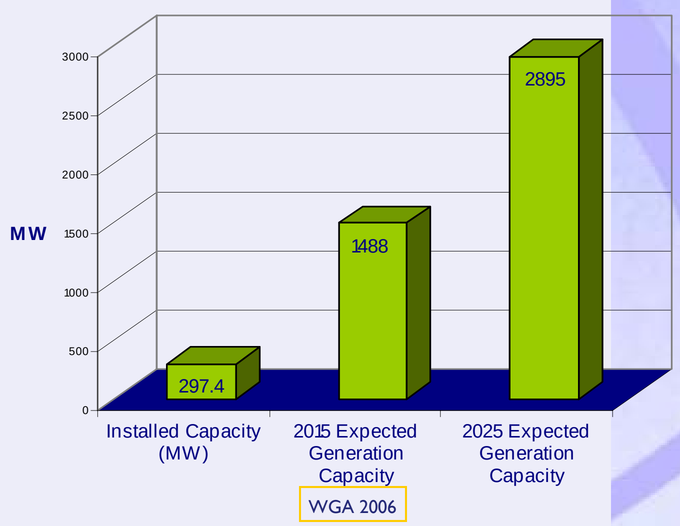
Technical Capabilities

Nevada universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The Great Basin Center for Geothermal Energy, part of the University of Nevada at Reno (UNR), conducts geologic research and has produced a database of Nevada's geothermal resources to accelerate projects in the Great Basin region. Additionally, the UNR Redfield branch campus will feature a Renewable Energy Center for research and education in renewable energy systems (USDOE 2007a).

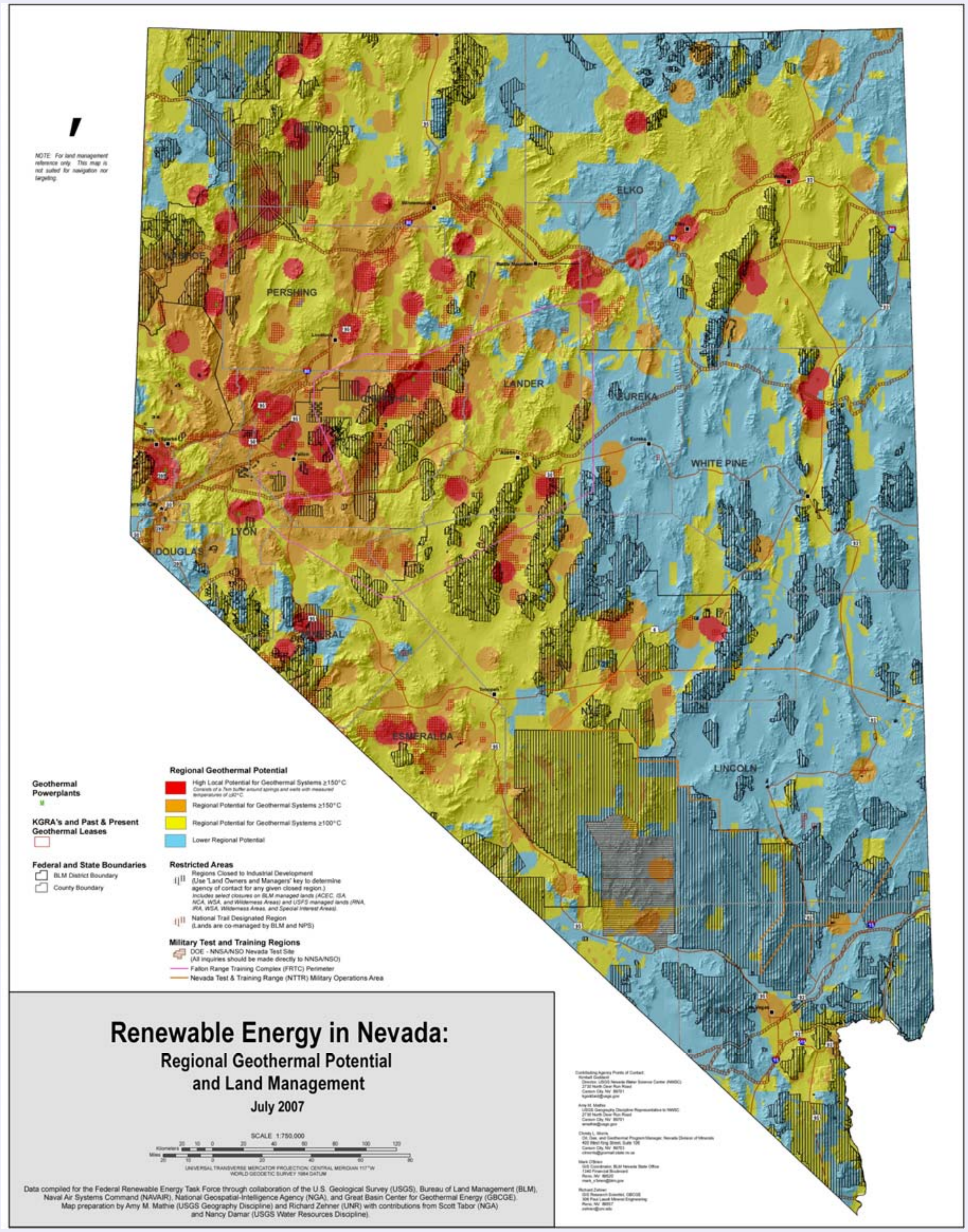
Electrical Power Generation and Capacity

There are 15 geothermal plants (totaling 40 units) in operation in the state (NCMR 2008). A 20-MW capacity plant was commissioned at Steamboat in November 2005, the first in response to the state's RPS. Literature-cited potential energy production from geothermal resources places estimates at 1,488 MW short-term and 2,895 long-term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Nevada during the next 30 years at 1,391 MW, with a total low-high range of 515 MW to 2,551 MW (USGS 2008). Future plans include power generation in the Pumpernickel Valley, Stillwater, and Salt Wells areas and within Washoe, Churchill, Humboldt, and Elko Counties. Power purchase contracts have already been established with local utilities for proposed power plant construction at some locations (USDOE 2007a). Additionally, on August 5, 2008, a BLM lease sale for geothermal resources was held for lands in Churchill, Elko, Esmeralda, Humboldt, Lander, Mineral, Nye and Pershing Counties. The manner in which Nevada has combined federal and state efforts to develop geothermal resources has been very effective and could serve as a model for other states (Battocletti 2005).

Geothermal Electrical Generation



Nevada



UNR 2007, http://www.unr.edu/Geothermal/pdffiles/NV_GEOTHERM.pdf)

Nevada

Tribal Lands

Tribal lands in Nevada make up roughly 1.7 percent of the state's land. There are three tribal reservations of particular interest for geothermal development opportunities. One is the Pyramid Lake Paiute Reservation located 50 miles north of Reno, where extensive exploration has been performed and development is likely within the next few years. The others are in the Walker River Paiute Reservation and the Fallon Reservation and Colony of the Paiute-Shoshone tribe. Developers have expressed interest in geothermal projects in both reservations, although no projects have yet been proposed. However, the Fallon Reservation and Colony abuts existing geothermal power facilities at Stillwater, and tribal leaders are involved in the process for the new facility being developed there (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Nevada are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_nevada.html (USDOE 2007g). Tribes for which information is available are listed below.

Tribes with Potential Geothermal Resources in Nevada
Confederated Tribes of the Goshute Reservation
Duck Valley Reservation
Duckwater Shoshone Tribe of the Duckwater Reservation
Ely Shoshone Tribe
Fallon Reservation and Colony
Fort McDermitt Paiute and Shoshone Tribes of the Fort McDermitt Indian Reservation
Fort Mojave Indian Tribe
Goshute Reservation
Las Vegas Tribe of Paiute Indians of the Las Vegas Indian Colony
Lovelock Paiute Tribe of the Lovelock Indian Colony-
Moapa Band of Paiute Indians of the Moapa River Indian Reservation
Paiute-Shoshone Tribe of the Fallon Reservation and Colony
Pyramid Lake Paiute Tribe of the Pyramid Lake Reservation
Reno-Sparks Indian Colony
Shoshone-Paiute Tribes of the Duck Valley Reservation
Summit Lake Paiute Tribe
Te-Moak Tribes of Western Shoshone Indians: Battle Mountain Band South Fork Band Elko Band Wells Band
Walker River Paiute Tribe of the Walker River Reservation
Winnemucca Indian Colony
Yerington Paiute Tribe of the Yerington Colony and Campbell Ranch
Yomba Shoshone Tribe of the Yomba Reservation
Washoe Tribe of Nevada and California: Carson Colony Dresslerville Community Stewart Community

Nevada

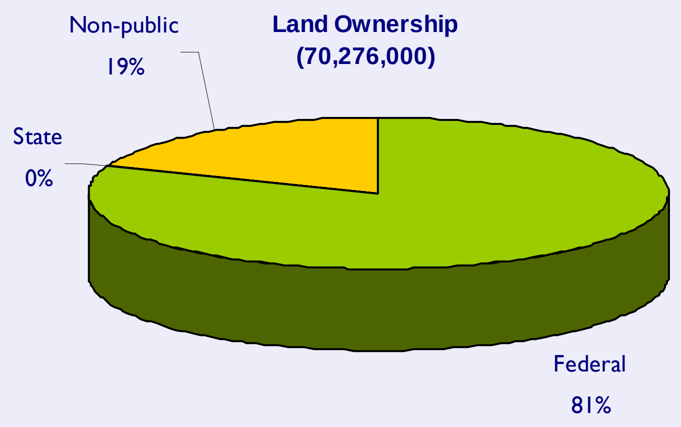
Laws and Regulations

Nevada classifies geothermal resources as both Mineral and Water. Resources in the state belong to the owner of the surface estate unless they have been reserved by or conveyed to another individual (NCMR 2006, Battocletti 2005).

The state's lead geothermal regulatory agency is the Division of Minerals Commission on Mineral Resources, which issues permits to drill or operate geothermal wells. The length of the permitting process varies depending on well type, location, and the agencies involved. Permitting for a commercial or industrial well could take 45 days whether on private or federal lands. Permitting for wells on federal land by a federal agency takes a minimum of three months; however, periods of a year or more are typical. Unlike California, Idaho, and the Pacific Northwest, where a number of the best geothermal prospects are located on USFS land, most of Nevada's promising resources are on federal land managed by the BLM (Battocletti 2005).

The Nevada Department of Conservation and Natural Resources Division of Water Resources are responsible for issuing water rights. The state Department of Conservation and Natural Resources Bureau of Water Pollution Control oversees the administration of underground fluid injection wells as well as the administration of surface disposal of wastewater, including geothermal fluids. The Nevada Department of Environmental Protection administers the Clean Water and Clean Air Acts (Battocletti 2005). Nevada has established a Geothermal State Working Group, with leadership from the Nevada Division of Minerals-Oil, Gas and Geothermal Program. The Nevada group brings together state and regional energy professionals to promote the increased utilization of the state's geothermal resources (USDOE 2007a).

The state's RPS stipulates a requirement of 20 percent renewable energy by 2015 (solar being 5 percent of annual and 1 percent of total generation). The RPS for geothermal electric and hot water district heating systems recommends an increase of up to 20 percent by 2015 (Richter 2007). Nevada's geothermal development is primarily federally funded; however, the state offers the incentive of property-tax exemption for geothermal power plants (USDOE 2007a). The state has no GHG reduction targets but is considering GHG legislation (SB422) that would require power plant emissions to be below 2006 levels for 2011-2014, below 2005 levels in 2015, one percent below each of the previous years for 2016-2019, and one and a half percent below 2019 levels for 2020 (Camp 2007).



NRCM 2008

New Mexico

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in New Mexico during the next 30 years at 170 MW, with a total low-high range of 53 MW to 343 MW.

Resource Geography

New Mexico contains abundant geothermal resources throughout a large temperature gradient (USDOE 2007a). In a recent update of the geothermal database for New Mexico, 359 discrete thermal wells and springs were identified (NMEMNRD 2007). Resources suitable for most development are concentrated in the west and north-central regions of the state, with high-temperature gradients ranging from 1.6°F to 2.5°F per 100 feet of depth (NMEM 2006). There are no geothermal power plants currently operating; however, direct-use applications are ongoing. The northwest region contains volcanic activity from the Valles Caldera in the Jemez Mountain Range (west of Los Alamos), where the only known high-temperature geothermal system in the state occurs (base temperatures in this system exceed 500°F, 260°C) (USDOE 2007a). During the 1970s and 1980s a large geothermal power project was under development in the Valles Caldera; however, regulatory and resource issues led to the cancellation of the project (demonstration projects revealed inconsistent reservoir permeability and low productivity, though drilling and testing indicated a viable potential of 20 MW) (Fleischmann 2007).

While other potential geothermal resource areas exist, limited research has been done and most areas are without apparent surface manifestations. These areas are high risk, and developers in the state may need government funding to aid with early exploration and to reduce the high investment risk associated with their development. Sites in eight counties (Doña Ana, Grant, Hidalgo, McKinley, Rio Arriba, San Miguel, Sandoval, and Valencia), have been identified as potential geothermal resources (NMEMNRD 2007). The Rio Grande Rift area, specifically near Las Cruces, also needs to be explored in greater detail (Fleischmann 2007).

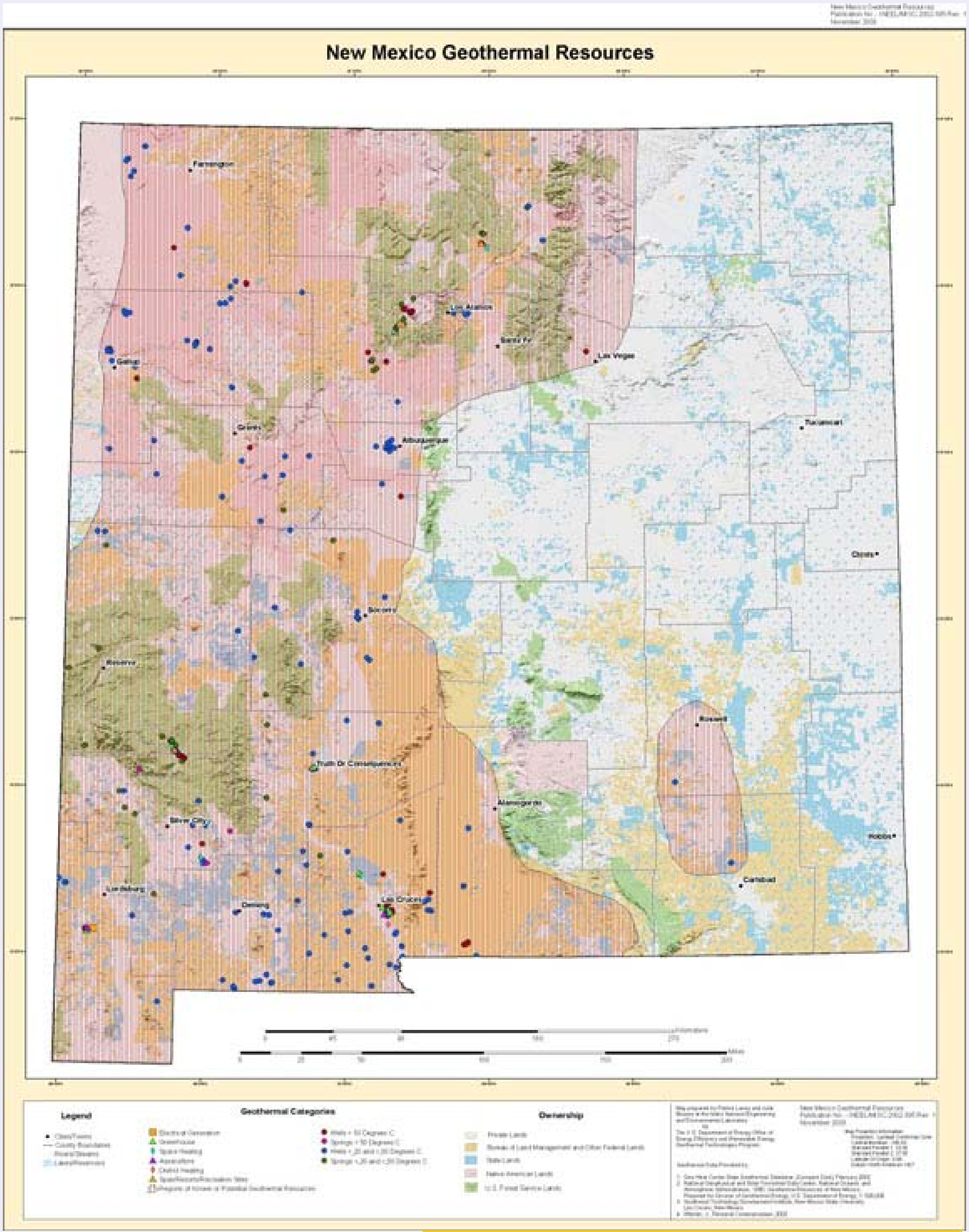
Utilization

There are no geothermal power plants operating; however, current development has included electric power production. An attempt to introduce geothermal electricity production occurred in the southwest at the Burgett Geothermal Greenhouses (near Cotton City) but was suspended due to design problems (NMEM 2006, USDOE 2007a). Drilling has occurred at two locations where small power units will be installed to provide electricity for an aquaculture facility and greenhouse. Other direct-use applications are ongoing (USDOE 2007a).

Technical Capabilities

New Mexico universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. New Mexico State University (NMSU) at Las Cruces conducted geothermal research that resulted in the development of a geothermal space-heating system that at one point heated up to 30 campus buildings such as dorms and athletic facilities. Sandia National Laboratory in Albuquerque is one of the three main national laboratories working on geothermal research and development (USDOE 2007a).

New Mexico



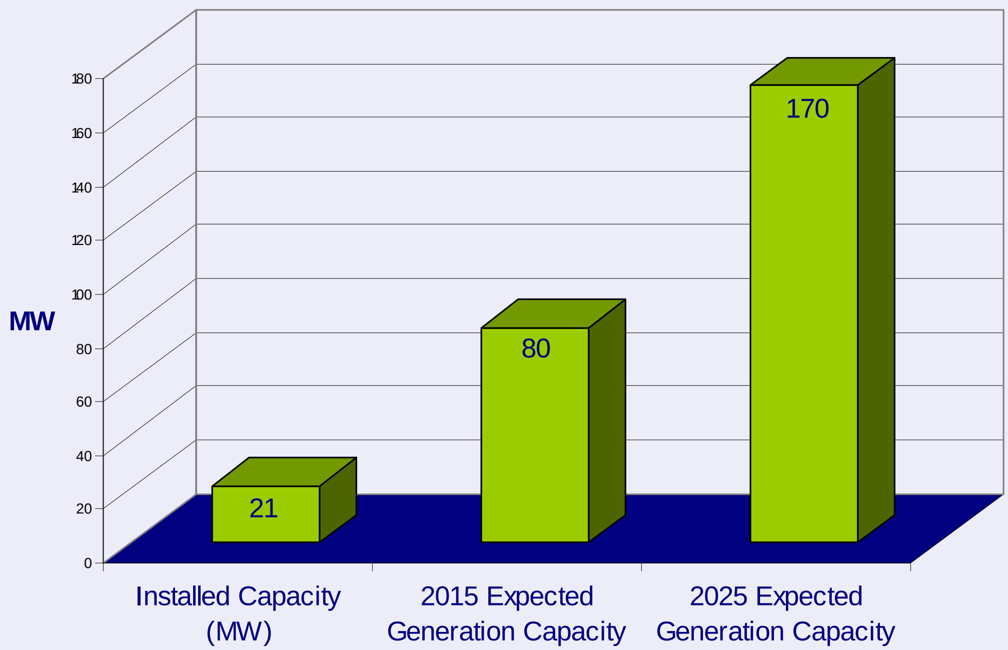
Lacey, 2003e, http://geothermal.id.doe.gov/maps/nm.pdf

New Mexico

Electrical Power Generation and Capacity

In the near term, development is likely for small-scale power. The state has two projects in development, with a total estimated potential of 21 MW. Literature estimates cite a short-term geothermal electricity generation potential of 80 MW and a long-term potential of 170 MW (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in New Mexico during the next 30 years at 170 MW, with a total low-high range of 53 MW to 343 MW (USGS 2008).

Geothermal Electrical Generation



WGA 2006

Tribal Lands

Tribal lands in New Mexico make up roughly 8.4 percent of its total acreage, and several locations on tribal reservations have been identified as having potential for geothermal development. This includes tribal lands in the San Juan Basin of northwest New Mexico, where considerable oil and gas drilling has occurred and intermediate-temperature fluid has been encountered. Another potential area is in the Jemez Mountains (in the vicinity of Valles Caldera). From 2002-2004, the Pueblo of Jemez worked with USDOE, who cost-shared a feasibility study to install a geothermal direct-use heating facility. The study concluded that there were business opportunities related to geothermal resources, but further drilling is needed before these applications can be developed on the site (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in New Mexico are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_newmexico.html (USDOE 2007h). Tribes for which information is available are listed on the following page.

New Mexico

Tribes with Potential Geothermal Resources in New Mexico
Jicarilla Apache Tribe of the Jicarilla Apache Indian Reservation
Mescalero Apache
Navajo Nation: Northwestern lands in New Mexico Northeastern lands in New Mexico Southwestern lands in New Mexico Southeastern lands in New Mexico Alamo Navajo Chapter Canoncito (Tohajiileeh) Chapter Ramah Navajo Chapter
Pueblo of Acoma
Pueblo of Cochiti
Pueblo of Isleta
Pueblo of Jemez
Pueblo of Laguna
Pueblo of Nambe
Pueblo of Picuris
Pueblo of Pojoaque
Pueblo of San Felipe
Pueblo of San Ildefonso
Pueblo of San Juan
Pueblo of Sandia
Pueblo of Santa Ana
Pueblo of Santa Clara
Pueblo of Santo Domingo
Pueblo of Taos
Pueblo of Tesuque
Pueblo of Zia
Pueblo of Zuni
Ute Mountain Tribe of the Ute Mountain Reservation

New Mexico

Laws and Regulations

New Mexico classifies geothermal resources as Mineral if the fluid produced has a temperature greater than 250°F and as Water if the fluid produced has a temperature less than or equal to 250°F. The state claims ownership of geothermal resources when and where it holds the mineral rights. If the fluid produced is "mineral," the resource is under the primary jurisdiction of the Oil Conservation Division of the New Mexico Energy, Minerals, and Natural Resources Department for drilling. This agency coordinates with the US EPA, Region 8, which has authority over wastewater discharge to surface waters in the state. Both of these latter agencies, in addition to the state Environmental Department, have regulatory authority over geothermal discharge permits. The New Mexico State Land Office leases the lands of the state mineral estate (Battocletti 2005).

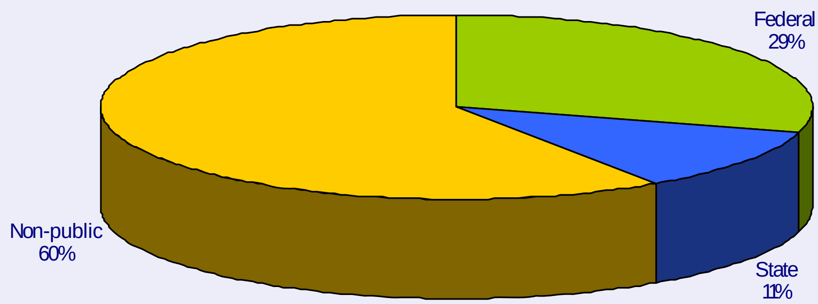
Geothermal fluid under 250°F is considered "water," and the resource is under the primary responsibility of the New Mexico Office of the State Engineer in regards to drilling and permitting. New Mexico does not have comprehensive environmental review statutes.

The state's RPS requires 20 percent renewable energy by 2020 for IOUs, 10 percent for rural co-ops and municipality utilities, with one Kilowatt (KW) of geothermal energy counting as two KW (Richter 2007). In addition to the state's RPS, geothermal resource development qualifies for the US Department of the Interior Energy Efficiency and Renewable Energy's bond program (USDOE 2007). New Mexico has established a Geothermal State Working Group, with leadership from the New Mexico Energy, Minerals, and Natural Resources Department (USDOE 2007a).

New Mexico does not have GHG laws or pending legislation; however, the state has a GHG reduction target that outlines 2000 levels by 2012, 10 percent below 2000 levels by 2020, and 75 percent below 2000 levels by 2050 (Camp 2007). There is no state funding for geothermal development. Most funding has come from the federal level from the US DOE (USDOE 2007a).

Land Ownership

(77,674,000 total acres)



NRCM 2008

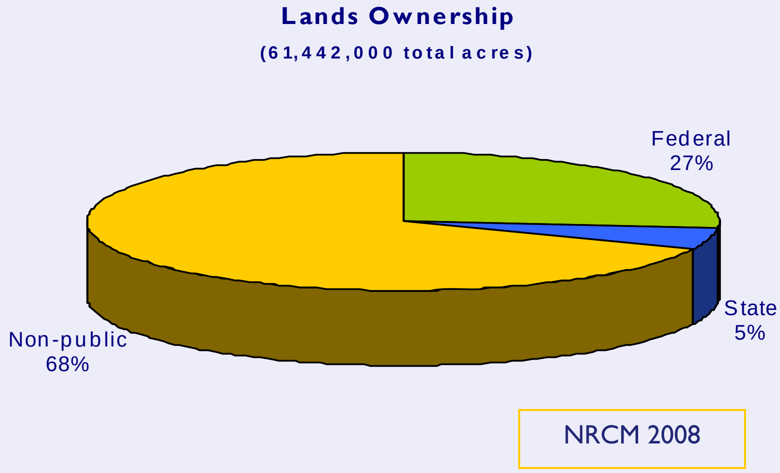
Oregon

Resource Geography

Oregon's geothermal resources are located primarily in the central and eastern regions of the state, with some activity occurring in the Cascade Range and in the southeast basin and range areas (USDOE 2007a). The state's geothermal resource base has been well documented, and numerous direct-use projects have been constructed (primarily street and building heating, and recreational and therapeutic use) (Fleischmann 2007).

Utilization

While a small-scale geothermal power plant ran in south-central Oregon in the mid 1980s, the state currently has no plants in operation (Fleischmann 2007, ODE 2008). Indirect use is being pursued, and several promising resource sites have been identified. Resources that may have significant potential for power-plant development on a small scale include Klamath Falls, Lakeview, Summer Lake, Malheur River, and Vale (ODGMI 2003, USDOE 2007a). Researchers in Oregon are experimenting with geothermal heat and power technologies for alternative fuel production, and expansions are planned for several direct-use facilities (Fleischmann 2007).



Development has and will continue to focus on direct use and further exploration of potential sites for geothermal electricity generation. While several large-scale geothermal power plants are under development, their success is contingent upon coordinated federal and state efforts to conduct EISs (Fleischmann 2007).

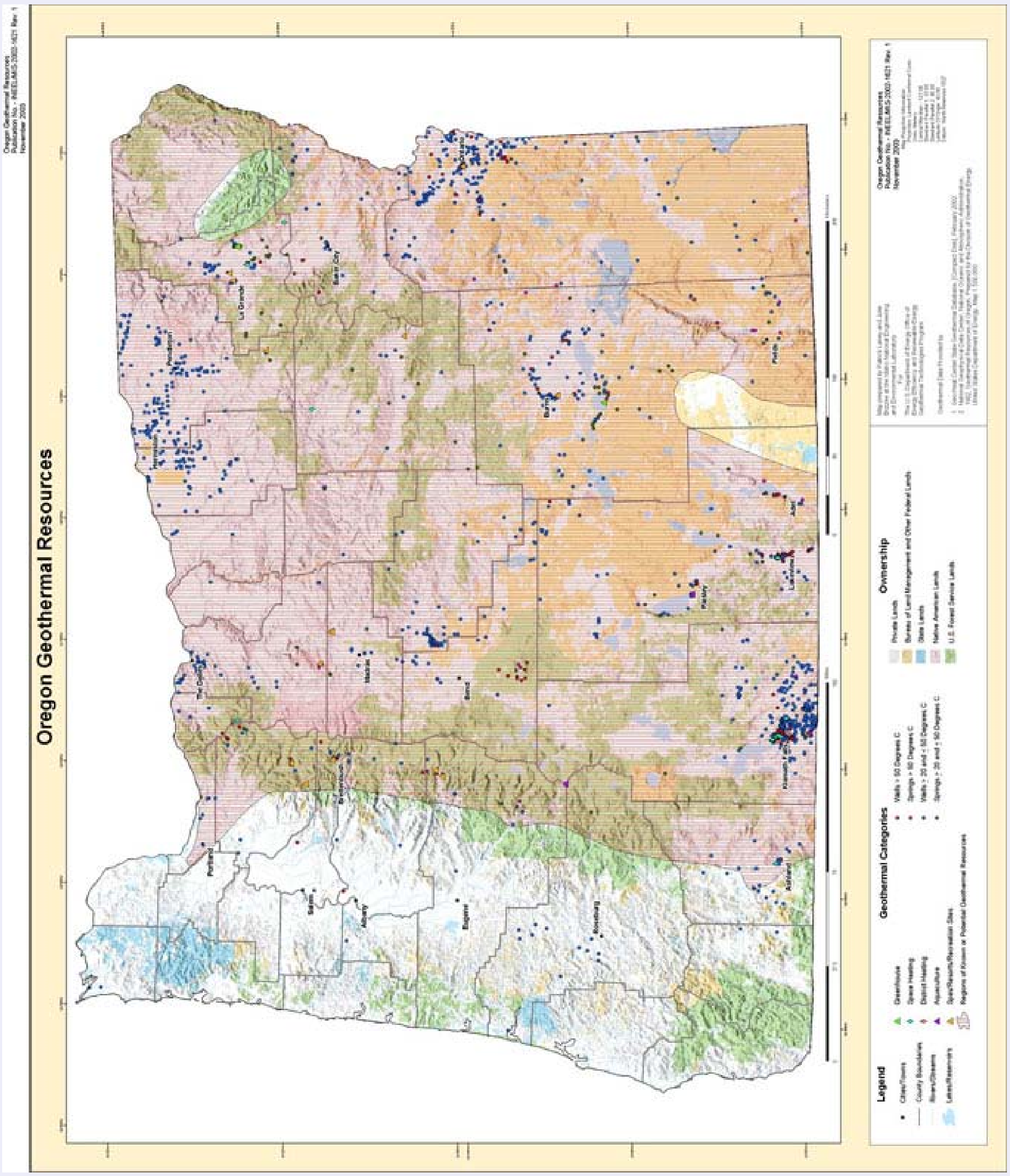
Technical Capabilities

The Oregon Institute of Technology's Klamath Falls campus houses the Geo-Heat Center, a national resource for the research and development of geothermal energy. The Geo-Heat Center aids in the transfer of technical information and provides project development support for geothermal direct-use applications (USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Oregon during the next 30 years at 540 MW, with a total low-high range of 163 MW to 1,107 MW.

Oregon



Laney, 2003f, http://geothermal.id.doe.gov/maps/or.pdf

Oregon

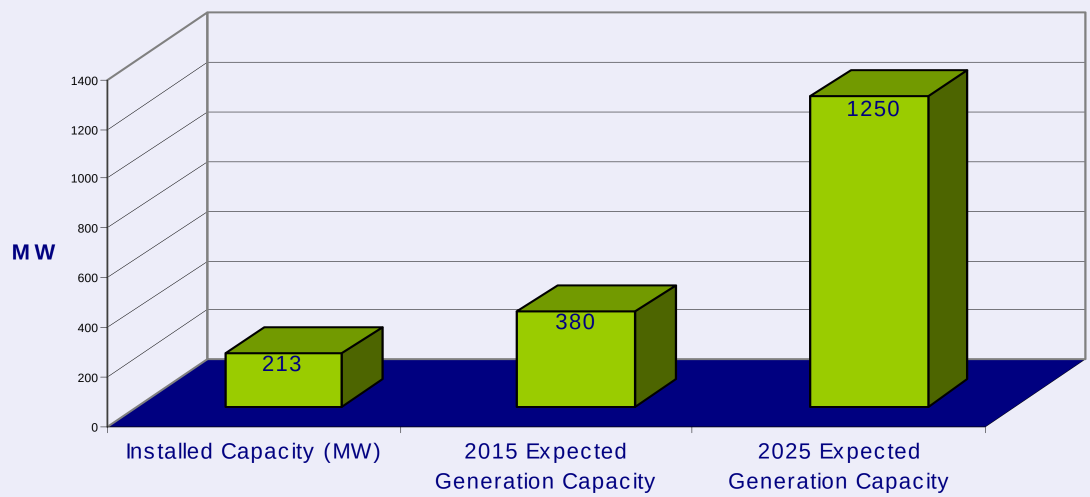
Electrical Power Generation and Capacity

There are four geothermal power plant projects in development in the state, with a total literature-estimated potential of 128.2-213.2 MW. Projected potential for the state is 380 MW in the short term and 1,250 MW in the long term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Oregon during the next 30 years at 540 MW, with a total low-high range of 163 MW to 1,107 MW (USGS 2008).

Geothermal leases for the Crump Geyser site (in Warner Valley, south-central Oregon) have been secured by a private developer. Data for this site indicate temperatures in excess of 180°C, and the potential for electricity generation has been estimated at 85 MW. Research shows Newberry Volcano (near Bend in central Oregon) holds resources sufficient for a 30-MW plant that is in the initial planning stages (ODGMI 2003, USDOE 2007a). In July 2006, Davenport Power executed a 20-year power sales agreement with Pacific Gas & Electric (PG&E) involving the sale of 60-120 MW of geothermal-produced electricity from the proposed Newberry Site. The first 30-MW phase of this projected is scheduled to begin operation in 2009, with the second 30-MW phase in 2010, and the remaining 60-MW phase in 2011 (USDOE 2007a).

The main difficulties pertaining to development of geothermal power plants in this state have been a lack of transmission access and regulatory hurdles similar to those experienced in California in association with development on federal lands (Fleischmann 2007).

Geothermal Electrical Generation



WGA 2006

Oregon

Laws and Regulations

Oregon classifies geothermal resources as Mineral if the temperature of the bottom hole is greater that 250°F (121°C) and as Water if the temperature of the bottom hole is less than 250°F (121°C). The state claims ownership of all geothermal resources located on state and private land (Battocletti 2005). The Oregon DEQ is the primary agency for the disposal of water in either surface or injection well applications. Geothermal resources classified as "water" are regulated by the state Water Resources Department, while resources classified as "mineral" are regulated by the Oregon Department of Geology and Mineral Industries. The Department of State Lands issues exploration permits and drilling leases for resources on state-owned land. Oregon does not have comprehensive environmental review statutes. A developer must obtain permits directly from local land use boards (Battocletti 2005).

The state Energy Facility Siting Council (EFSC) has jurisdiction over geothermal energy facilities of 38.95 MW or greater (Battocletti 2005). The state has a RPS requiring large utilities to generate 25 percent of their power from renewable energy sources by 2025, with lesser requirements for small utilities (Richter 2007). Oregon has established a Geothermal State Working Group, with leadership from the Oregon Department of Energy, which is shared by the state of Washington (USDOE 2007a).

Incentives for geothermal development include low-interest loans, business energy tax credits, and cash incentives through the Energy Trust of Oregon resources (USDOE 2007a). The state passed GHG legislation in 2007 that requiring GHG levels be 10 percent below 1990 levels by 2020 and 75 percent below 1990 levels by 2050. Oregon has a GHG emission generation performance standard for electric generation and sales of 675 lbs CO_2 per MWh (Camp 2007).

Tribes with Potential Geothermal Resources in Oregon
Burns Paiute Tribe of the Burns Paiute Indian Colony
Celilo Indian Village
Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians
Confederated Tribes of the Grand Ronde Community
Confederated Tribes of the Siletz Reservation
Confederated Tribes of the Umatilla Indian Reservation (Cayuse, Umatilla, and Walla Walla Tribes)
Confederated Tribes of the Warm Springs Reservation
Coquille Tribe
Cow Creek Band of Umpqua Indians
Fort McDermitt Paiute and Shoshone Tribes of the Fort McDermitt Indian Reservation
Grand Ronde Community
Klamath Indian Tribe-
Siletz Reservation
Umatilla Indian Reservation (Cayuse, Umatilla, and Walla Walla Tribes)
Warm Springs Reservation
Warm Springs Tribe of the Celilo Indian Village

Utah

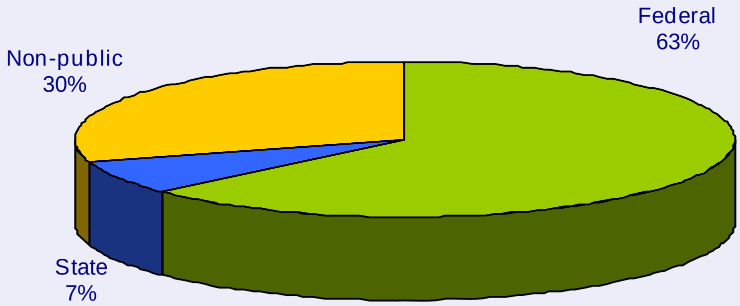
Resource Geography

The majority of the state's renewable energy comes from geothermal sources (Nielsen 2002), which are abundant in the western and central parts of the state (UGS 2008). Geothermal resources range from low to high temperature (above 150°C). The majority of the systems suitable for power production are located within the Sevier thermal area, a region of southwest Utah covering a portion of the eastern Basin and Range Physiographic Province, and part of the Basin and Range-Colorado Plateau transition zone (Harja 2007, UGS 2008).

Research indicates that geothermal resources underlie much of the Wasatch Front, where a large portion of the state's population resides (Fleischmann 2007). Known high-temperature systems include the Roosevelt KGRA and the Cove Fort-Sulphuredale KGRA (USGS 2008). Literature from state offices suggests several known resource areas for potential development, including Abraham (Crater Springs) Hot Springs area, the Meadow-Hatton area, Joseph Hot Springs, and the Newcastle, Monroe-Red Hill, and Thermo Hot Springs areas. Other areas with development potential that have been previously investigated but lacked identified resources include the Drum Mountains-Whirlwind Valley area (near the Millard-Juab County line) and the Beryl area in western Iron County. The same office suggests the need for further exploration of the west side of Black Rock Desert in Millard County, where bottom hole temperatures of 380°F (193°C) were measured during exploratory oil and gas well drilling in 1980 (Harja 2007), as well as the Escalante Desert (UGS 2008).

Land Ownership

(52,588,000 total acres)



NRCM 2008

Utilization

The potential extent of Utah's geothermal resources is not well understood, and the geology of the resources is complicated in some areas. Lack of transmission capacity may hinder development for indirect use in some areas; however, direct use is diverse and ongoing throughout the state (Fleischmann 2007).

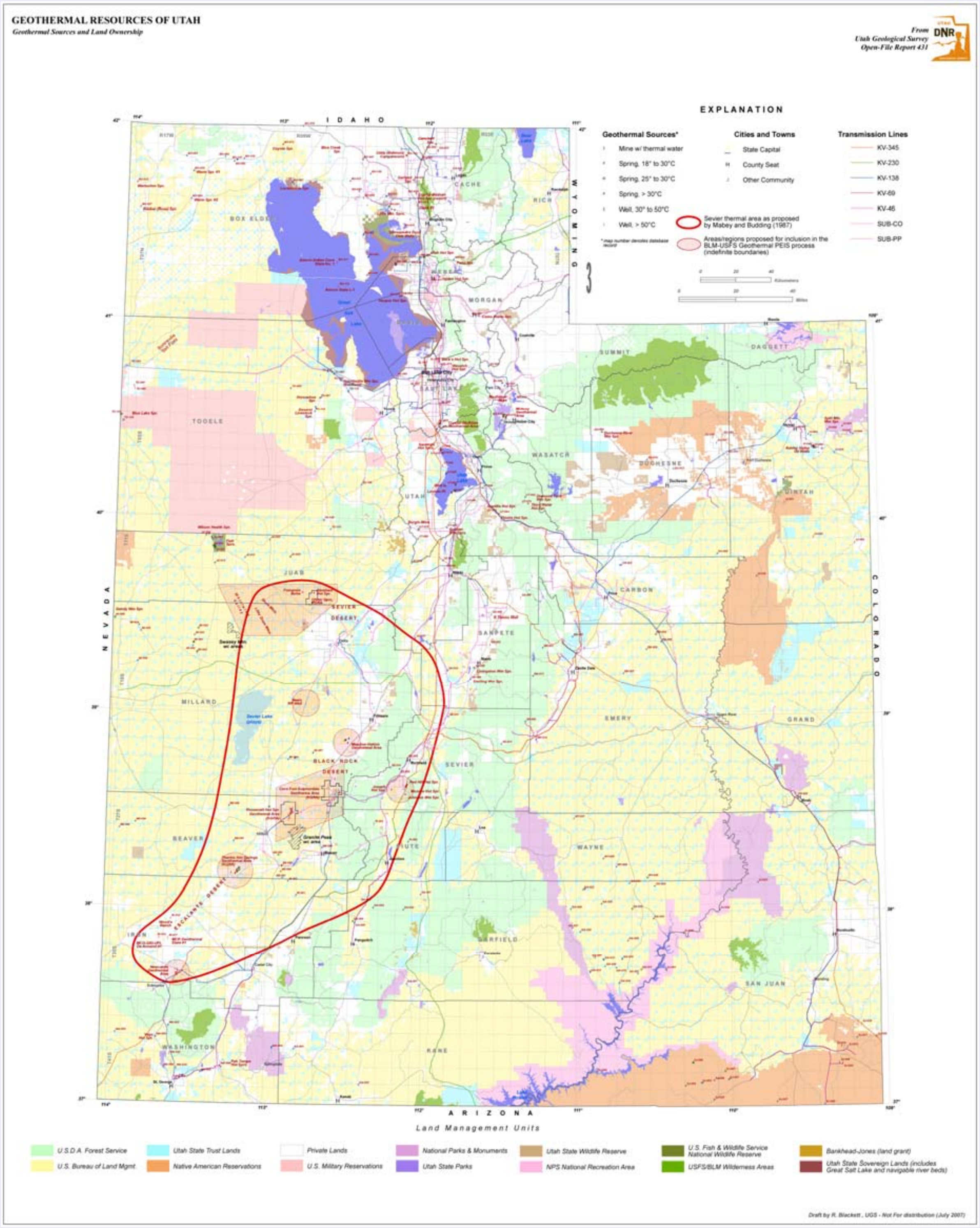
Technical Capabilities

Utah universities, state agencies, and private firms contribute technical capabilities to the local and national geothermal communities. The Utah Geological Survey maintains a database of geothermal resource information to support development projects.

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Utah during the next 30 years at 184 MW, with a total low-high range of 82 MW to 321 MW.

Utah



Mabey, D.R. and K.E. Budding, 1987

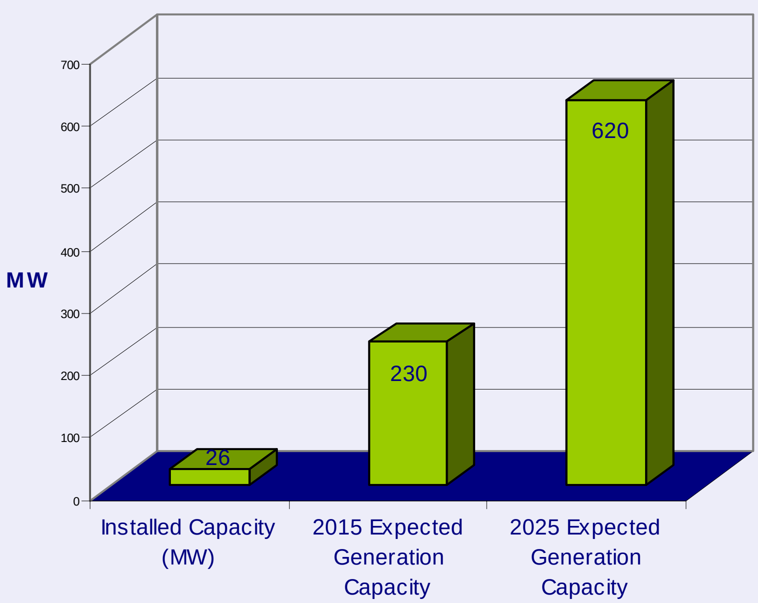
Utah

Electrical Power Generation and Capacity

Utah (along with California and Nevada) is one of the few states in the region to have developed geothermal power plants. The state has three geothermal power plants (one running, two decommissioned). Types of plant include binary, single flash , and dry steam. Current geothermal electrical output is 26 MW, with a literature-projected potential of 48-183 MW (including MW projections for two projects in development). Short-term potential is cited as 230 MW, with 620 MW long term (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Utah during the next 30 years at 184 MW, with a total low-high range of 82 MW to 321 MW (USGS 2008).

The state's first geothermal power plant (the Blundell geothermal plant) came online at Roosevelt Hot Springs (in Beaver County) in 1984 and has remained online since. While it currently produces 26 MW gross power, expansion has been planned that will add approximately 33 MW contingent on the resource. On April 17, 2008 a rig test was conducted and the results were encouraging. Two other facilities were built at Cove Fort-Sulphurdale KGRA (in Beaver County) during the same time period, with a total capacity of 12 MW (UGWG 2005, USDOE 2007a). While these plants were decommissioned in 2003, new owners (ENEL North America) have been successful in obtaining additional federal geothermal leases within the KGRA (Harja 2007).

Geothermal Electrical Generation



WGA 2006

Utah

Tribal Lands

Tribal land covers roughly 4.4 percent of Utah's land. The largest section of this land is located in the southeast, as part of the Navajo nation. Significant geothermal potential has not been indicated in this area; however, there are several Paiute reservations near Cove Fort and Roosevelt Hot Springs, as well as tribal land in southwestern Utah, that may be promising for geothermal development. The site of the Renaissance project is near tribal land, and the developer is working with the Northwestern Shoshoni Tribe on the project (Fleischmann 2007). Maps and data for geothermal resources on tribal lands in Utah are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_Utah.html (USDOE 2007j). Tribes for which information is available are listed below.

Tribes with Potential Geothermal Resources in Utah
Confederated Tribes of the Goshute Reservation
Goshute Reservation
Navajo Nation: Four Corners region lands North central Arizona and central Utah lands
Northern Ute Indian Tribe of the Uintah and Ouray Reservation: Eastern lands Western lands
Northwestern Band of Shosoni Nation
Paiute Indian Tribe of Utah: Lands in central Utah Main reservation in southwestern Utah
Skull Valley Band of Goshute Indians
Ute Mountain Tribe of the Ute Mountain Reservation

Laws and Regulations

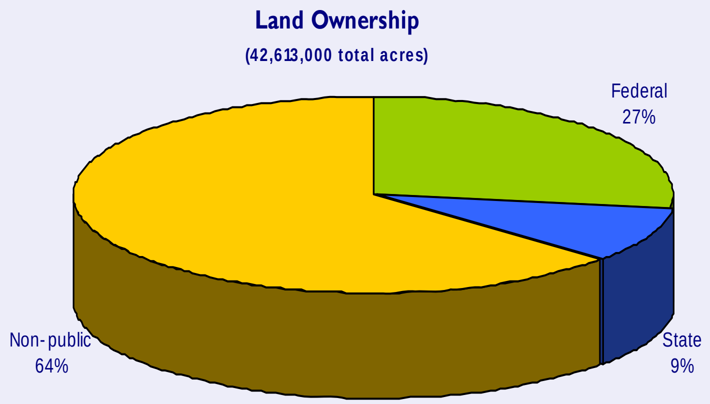
Utah classifies geothermal resources as Water. Ownership is derived from an interest in the land and not from an appropriated right to geothermal fluids. The right to a geothermal resource is based on ownership of the mineral rights or surface rights, which are usually obtained by direct ownership or leasing (Battocletti 2005).

The state Department of Natural Resources Division of Water Rights has jurisdiction and authority over all geothermal resources and issues water rights and well construction permits. The Utah Division of Water Quality oversees fluid disposal plans and permits. State regulations do not apply on tribal land, which makes up 4.4 percent of the state (Battocletti 2005). Utah does not have a comprehensive environmental review statute, nor a RES or RPS (Richter 2007). Utah has established a Geothermal State Working Group, with leadership from the Utah Geological Survey. The state does not have state funding for geothermal research or projects; however, the US DOE funds specific research. Utah offers sales-tax exemption for the purchase of leasing of equipment used to generate energy for geothermal plants resources (USDOE 2007). In August 2007, Utah developed state goals to reduce GHG emissions 15 percent by 2020 as part of its union with the Western Climate Initiative (Camp 2007).

Washington

Resource Geography

While the state has high volcanic activity, only the Cascade Range holds high potential for moderate- to high-temperature geothermal resources, particularly in the Northern Cascade Mountains (Nielsen 2002). The most recent assessment of the state's geothermal potential was completed in 1994 and identified 34 thermal springs (primarily in the Cascade Mountains) and 941 thermal wells (primarily in the Columbia Basin) (USDOE 2007a).



NRCM 2008

Utilization

Geothermal resources in Washington have been virtually undeveloped. There are no district heating systems or large buildings using the resource. There are no commercial developments such as aquaculture or greenhouses and no power plants. Resource use is currently limited to recreational and therapeutic applications (Geo-Heat 2007). Low energy prices and lack of knowledge about the state's resource base have contributed to this status (Fleischmann 2007).

Several exploration leases are pending but are associated with important scenic areas where environmental considerations could prohibit development. There are no near-term plans to develop geothermal resources in the Columbia Basin (USDOE 2007a). Near-term developments of any kind are likely to focus, at least initially, on the expansion of direct-use applications, though literature cites one geothermal power plant project in development, with a potential capacity of 50-100 MW (Richter 2007).

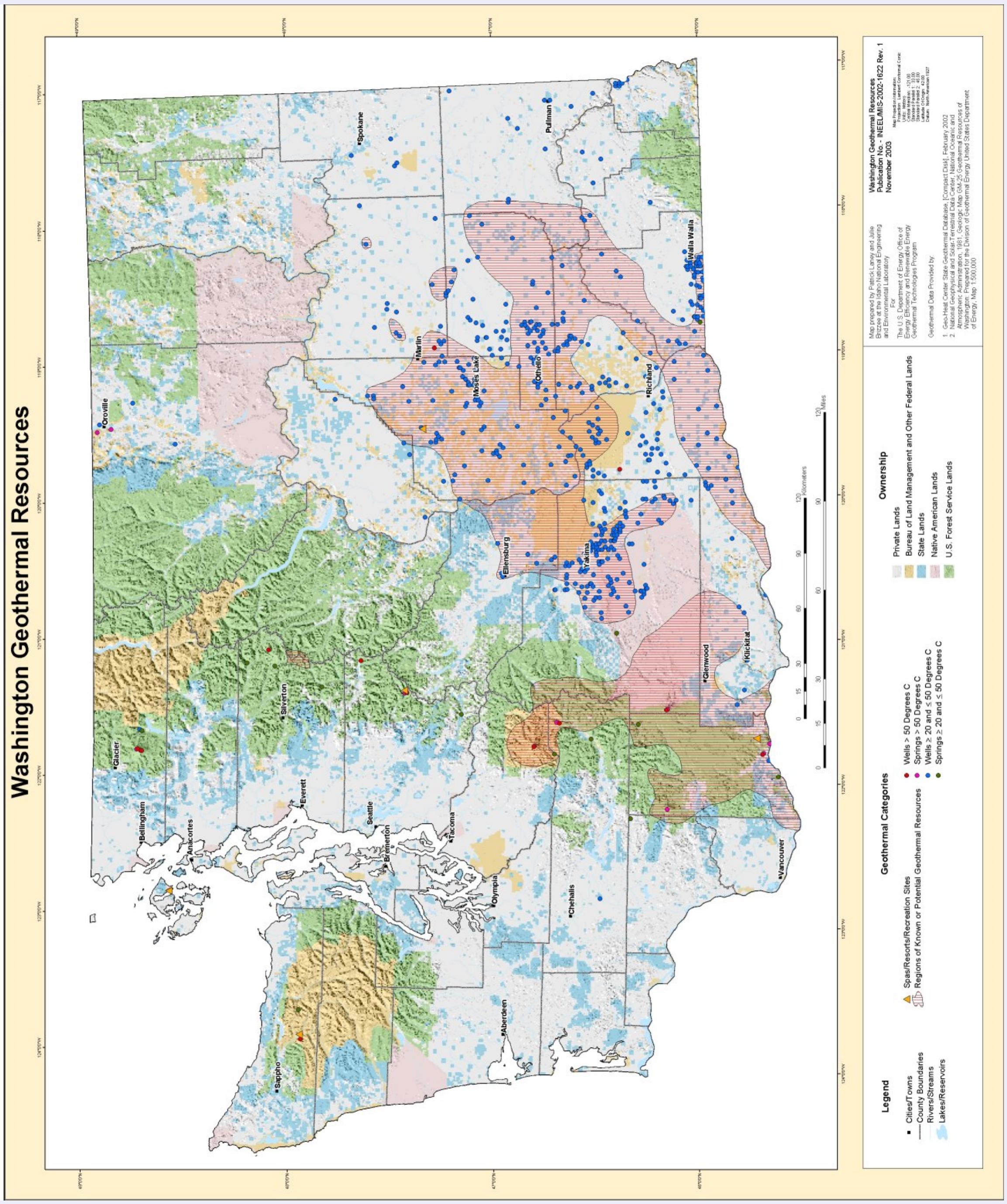
Technical Capabilities

The geothermal experts at the Washington State University Extension Energy Program have world-class expertise in high- and low-temperature geothermal energy. The group has prepared a series of guides on developing geothermal energy and a series of case studies on geothermal heat pumps (USDOE 2007a, WSUEEP 2004).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Washington during the next 30 years at 23 MW, with a total low-high range of 7 MW to 47 MW.

Washington



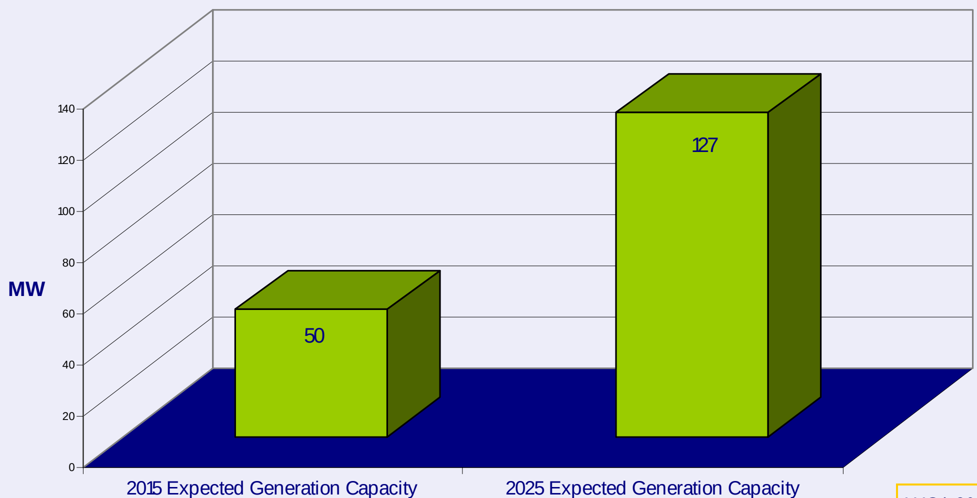
Lacy, 2003g, http://geothermal/id.doe.gov/maps.wa.pdf

Washington

Electrical Power Generation and Capacity

Potential projected geothermal electrical output is undefined, but literature estimates site a short-term projection of 50 MW, with long-term projections of 600 MW for sites at Mount Baker and Wind River in the Cascade Range (WGA 2006). The USGS report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Washington during the next 30 years at 23 MW, with a total low-high range of 7 MW to 47 MW (USGS 2008).

Geothermal Electrical Generation



WGA 2006

Laws and Regulations

Washington classifies geothermal resources capable of generating electricity (no specific temperature is defined) as *sui generis*. All direct-use geothermal resources are considered to be groundwater and regulated as such. The state Department of Ecology is responsible for issuing water rights, well construction permits, and fluid disposal plans, including underground injections. Developers must also secure ownership or lease rights from the Washington Department of Natural Resources Division of Lands. Environmental review is required under Washington's State Environmental Policy Act. The Washington Energy Facility Site Evaluation Council (EFSEC) determinations operate in lieu of state environmental reports and has the authority to issue permits under the Federal Clean Air Act and Clean Water Act (Battocletti 2005, http://www.energy.wsu.edu/documents/renewables/washington.pdf); however, its jurisdiction covers only plants 250 MW and greater. Washington has an RPS that requires 3 percent renewable energy by 2012 and 15 percent by 2020, with less than 5 MW capacity counting as double (Richter 2007). Geothermal development incentives for the state include eligibility under the RES and utility-run incentives. Washington has a combined Geothermal Working Group with the state of Oregon (USDOE 2007a).

In April 2007 the state passed GHG legislation (SSB6001), which mandates that GHG levels be at 1990 levels by 2020, 25 percent below 1990 levels by 2035, and less than 50 percent of 1990 levels (or 70 percent below current projected annual emissions for 2050) by 2050. Washington also has a GHG emission generation performance standard for electric generation and sales of 1,100 lbs of CO_2 per MWh (Camp 2007).

Washington

Tribal Lands

Map and data for geothermal resources on tribal lands in Washington are available through the DOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_Washington.html (USDOE 2007k). Tribes for which information is available are listed in table A-10 below.

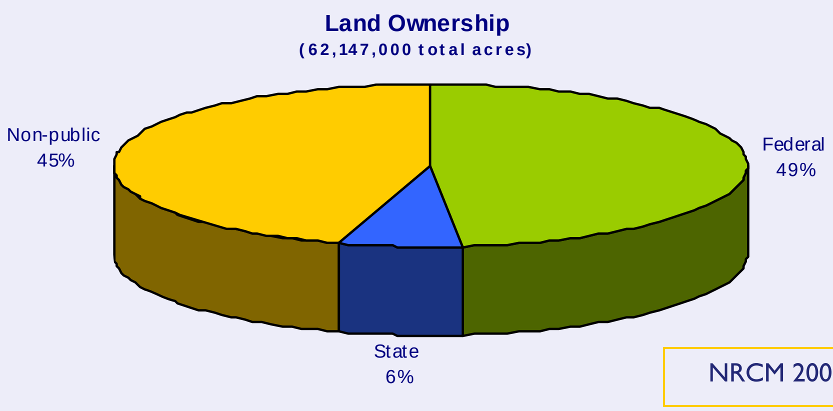
Tribes with Potential Geothermal Resources in Washington	
Colville Reservation	Chehalis Reservation
Confederated Tribes of the Colville Reservation	Confederated Tribes of the Chehalis Reservation
Hoh Indian Tribe of the Hoh Indian Reservation	Confederated Tribes and Bands of the Yakama Indian Nation
Kalispel Indian Community	Jamestown S'Klallam Tribe
Lummi Tribe of the Lummi Reservation	Lower Elwha Klallam Tribal Community
Muckleshoot Indian Tribe	Makah Indian Tribe of the Makah Indian Reservation
Nooksack Indian Tribe	Nisqually Indian Tribe of the Nisqually Reservation
Port Gamble S'Klallam Tribe	Payallup Tribe of the Puyallup Reservation
Quileute Tribe of the Quileute Reservation	Port Madison Reservation
Samish Indian Tribe	Quinault Tribe of the Quinault Reservation
Shoalwater Bay Tribe of the Shoalwater Bay Indian Reservation	Sauk-Suiattle Indian Tribe
Snoqualmie Tribe	Skokomish Indian Tribe of the Skokomish Reservation
Squaxin Island Tribe of the Squaxin Island Reservation	Spokane Tribe of the Spokane Reservation
Suquamish Indian Tribe of the Port Madison Reservation	Stillaguamish Tribe
Tulalip Tribes of the Tulalip Reservation	Swinomish Indians of the Swinomish Reservation
Yakama Indian Nation	Upper Skagit Indian Tribe

Wyoming

Resource Geography

The majority of Wyoming's geothermal resources are concentrated in the state's northwest corner, in and around Yellowstone National Park. Elsewhere, groundwater at elevated temperatures occurs beneath large areas, and research indicates that the state has a substantial geothermal resource base. High-temperature geothermal hotspots outside of environmentally sensitive areas (such as Yellowstone and the protected area of Hot Springs State Park in Thermopolis) could be suitable for electricity generation (USDOE 2007a).

One KGRA near Jackson Hole has been identified and may be capable of yielding high-temperature water (aside from Yellowstone). The possibility of volcanic and magmatic activity exists along the northern end of Jackson Hole, which may indicate geothermal reservoirs. Outside of this area it is likely geothermal development will require very deep drilling analogous to oil and gas exploration (Lyons 2003, USDOE 2007a).



NRCM 2008

Utilization

Geothermal development in the state has so far been limited to direct-use applications, specifically for recreational and therapeutic purposes. Concern and controversy surrounding the development of geothermal resources near Yellowstone National Park has precluded development of resources near Yellowstone (USDOE 2007a). Wyoming's sparse population is also a causal factor associated with limited geothermal development. Finally, most renewable energy efforts in the state have focused primarily on harnessing wind power (Fleischmann 2007).

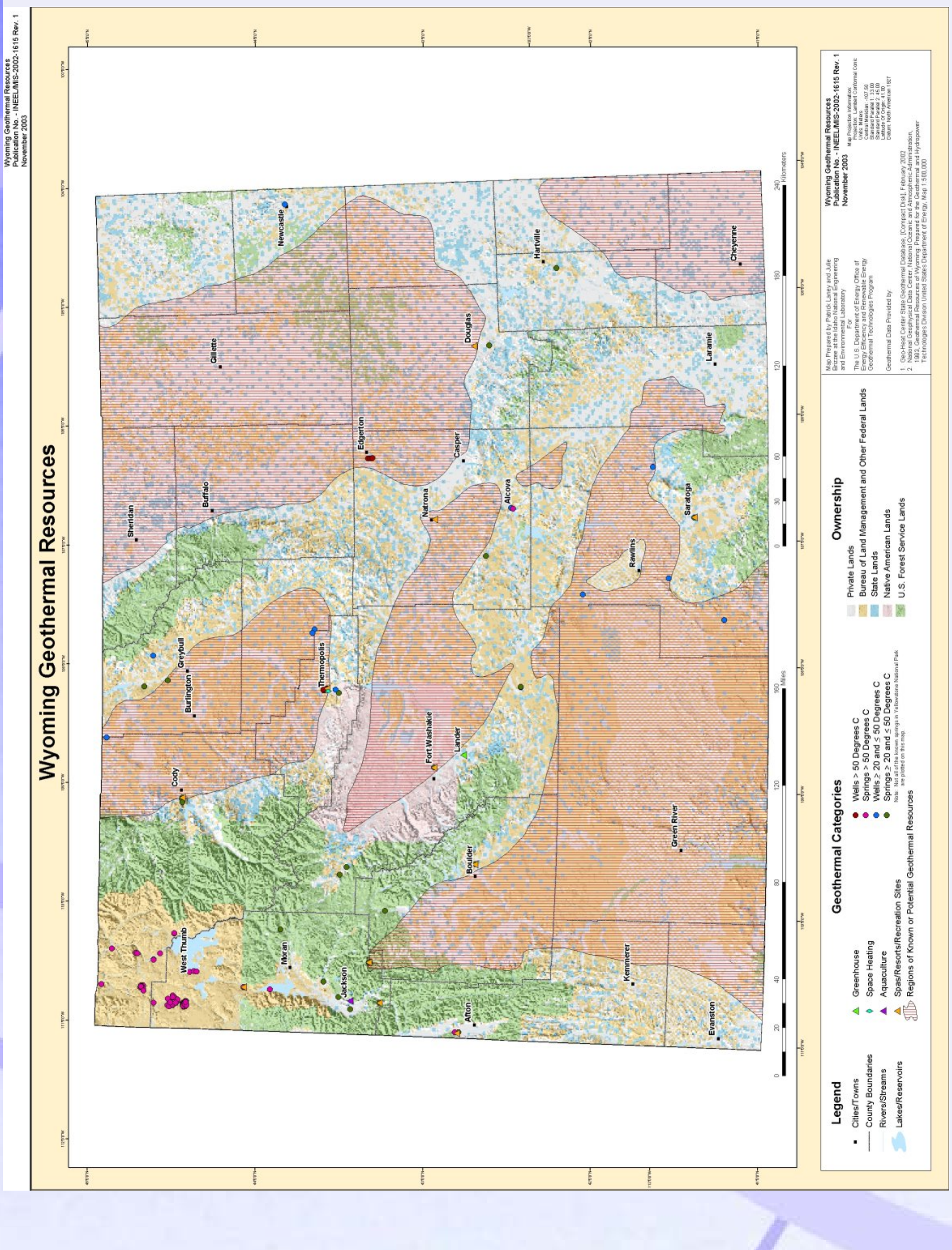
Technical Capabilities

Wyoming's coal resources are among the richest in the world, and the state possesses a wide variety of other energy sources. Renewable energy efforts are concentrated on harnessing wind energy, and little work has been done to harness Wyoming's geothermal potential. In the 1980s, studies were done for the Western Area Power Administration to evaluate the geothermal potential of resources near Thermopolis for electricity generation (USDOE 2007a).

ESTIMATED CAPACITY

The USGS (2008) estimates a mean probability of electrical power generation for identified geothermal resources on all lands in Wyoming during the next 30 years at 39 MW, with a total low-high range of 5 MW to 100 MW.

Wyoming



Laney, 2003h, http://geothermal.id.doe.gov/maps/wy.pdf

Wyoming

Electrical Power Generation and Capacity

The Western Governors' Association report did not identify geothermal resource potential for electrical generation in Wyoming, however, input for state and industry acknowledge that new technologies and undiscovered resources may yield geothermal resources that are viable for electrical generation in the future. The USGS estimates in its report titled *Assessment of Moderate- and High-Temperature Geothermal Resources of the United States* a mean probability of electrical power generation for identified geothermal resources on all lands in Wyoming during the next 30 years at 39 MW, with a total low-high range of 5 MW to 100 MW (USGS 2008). There is interest in the potential for developing small geothermal electricity units in conjunction with oil and gas wells present in Wyoming. A demonstration project at the Teapot Dome oil field (operated by the US DOE) is under development and would install a binary unit for electrical generation and use on-site. This demonstration project, if successful, could lead to greater investment in Wyoming's geothermal resources (USDOE 2007a).

Tribal Lands

A Map and data for geothermal resources the Northern Arapaho tribe and Shoshone Tribe of the Wind river reservation in Wyoming is available through the USDOE tribal energy program at: http://www1.eere.energy.gov/tribalenergy/guide/geo_Wyoming.html (USDOE 2007l).

Laws and Regulations

Wyoming classifies geothermal resources as Water, and regulates them as a groundwater resource. Geothermal rights are a public resource and only available through appropriation. The State Engineer's Office is responsible for issuing water rights and well construction permits and is the lead agency in overseeing geothermal production wells. The state DEQ is responsible for administering surface and groundwater disposal of wastewater, including geothermal fluids (Battocletti 2005, Heasler 1985). Wyoming does not have comprehensive environmental review statutes, nor does it have a RES or RPS (Richter 2007). The state has no GHG laws or pending legislation. Wyoming has established a state Geothermal Working Group. The only incentive for geothermal development is sales-tax exemption for equipment used to generate renewable energy resources (USDOE 2007a).

Tribal Lands

Beyond those included in the aforementioned state profiles, no other geothermal projects have been developed recently on tribal lands, but there is significant potential for such development. For example, the Jemez Pueblo, the Acoma Pueblo lands west of Albuquerque, the Navajo Indian Reservation, the lands of the Jicarilla Apache tribe, and the Zia Pueblo lands have lower temperature geothermal potential. The analysis of geothermal potential relative to tribal lands deserves more attention to determine the extent to which developing these resources might involve or affect tribes. An informal analysis suggests that 57 reservations may have some potential for geothermal electricity production, representing approximately 10 percent of the American Indian population on reservations and Tribal Jurisdictional Statistical Areas (TJSAs, in Oklahoma). Another 72 reservations and TJSAs may have potential for geothermal direct-use applications (Dunley 2007).

Statutes, Policies, and Analyses

The following discussion covers the statutes and policies that may be relevant to geothermal development on tribal lands. These include the National Environmental Policy Act, the National Historic Preservation Act, the American Indian Religious Freedom Act, Executive Order 13007 on Indian Sacred Sites, the DOE policy on American Indians, and Environmental Impact Assessment analysis (Dunley 2007).

National Environmental Policy Act. The National Environmental Policy Act is an umbrella law that requires environmental reviews of federal actions, including environmental impact statements (EISs) and environmental assessments (EAs). This review process includes analysis of social impacts of the proposed actions when appropriate and may be utilized to review the social and environmental impacts of federal projects on tribal lands.

National Historic Preservation Act. The National Historic Preservation Act of 1966, amended in 1992, establishes a federal policy of encouraging preservation of cultural resources for present and future generations. The federal lead agency for a proposed action is responsible for initiating the "Section 106" review process and for consulting with the State Historic Preservation Officer and the Advisory Council on Historic Preservation. For example, in the case of several proposed Medicine Lake geothermal projects, the US Forest Service, as the Surface Managing Agency, initiated the Section 106 review process. The review included such issues as protection of Native American graves, archeological sites and resources, spiritual and vision quest sites, and paleontological resources (Dunley 2007).

American Indian Religious Freedom Act. The American Indian Religious Freedom Act of 1978 holds that federal agencies shall protect and preserve the religious freedom of American Indians. Although this issue was addressed during the Medicine Lake approval processes, the issue of spiritual values, in the public context, has still not been completely defined. More work will need to be done (Dunley 2007).

Executive Order 13007 on Indian Sacred Sites. Executive Order 13007 of 1996 (61 Federal Register 26771) provides that federal agencies are required to accommodate access to and ceremonial use of sacred sites by Indian religious practitioners, and to avoid adverse effects to sacred sites and to maintain their confidentiality. The act requires that, for any proposed action, agencies ascertain the impacts of the proposed activity on places of religious significance, sacred sites, plant species for food and healing, air quality, visual quality, noise quality, wildlife and game habitat, spiritual significance, battlegrounds, vision quest, power places, and other tribal activities such as hunting, camping, and gathering (Dunley 2007).

Tribal Lands

The Indian Development Act. The Geothermal Steam Act does not allow for BLM leasing on Indian reservations. The Indian Development Act provides that the BLM can be a technical consultant to a Native American tribe interested in negotiating with industry for development of geothermal resources at tribal lands. The BLM, if invited by the tribe, could facilitate the negotiation between the tribe and the developer (Dunley 2007).

Minerals Management Service Office of Indian Compliance and Asset Management. This office is a special organization within the Minerals Revenue Management dedicated to serving mineral-producing tribes and individual Indian mineral owners. Based in Denver, the office is a focal point for Indian mineral issues and contact with the Indian community (Dunley 2007).

American Indian and Alaska Native Tribal Government Policy, US Department of Energy. DOE first developed a policy governing its work with American Indians in 1992. The policy states that the department will identify and seek to remove impediments to working directly and effectively with tribal governments on DOE programs. Further, the policy committed DOE to consider Indian cultural issues in all its programs. Secretary Abraham has reaffirmed DOE's government-to-government policy (Dunley 2007).

Tribal Energy Self-Sufficiency Act (Draft). This bill is planned to be introduced in the Senate. Its provisions make energy projects eligible for revolving loans, loan guarantees, interest subsidies, and other incentives under the Indian Financing Act of 1974 (Dunley 2007).

Guidelines for Permitting on Tribal Lands

As sovereign nations, tribes have inherent authority over their land. Their approval must be obtained to use or lease tribal resources (e.g., land, water, and minerals). Tribes are not subject to state regulation and can negotiate with state and local governmental agencies.

Permitting on tribal land can take different paths, depending on the tribal authority provided by treaty or prescribed by constitutions developed under the Indian Reorganization Act of 1934, powers specified by Congress, and the inherent tribal authority the tribe asserts as a Sovereign Nation (Battocletti 2005).

Tribal Lands

The following are general tenets of law in Indian Country

- Federal agencies, such as the EPA, work directly with tribes on a "government to government" basis. Indian Country lands cannot be leased under the Geothermal Steam Act. They can be leased under agreements with the tribe itself or with the Indian Enterprise Corporations formed by the tribe, both with limitations on the rights granted. Often the tribes do not have commercial codes in place and cannot be sued without their permission (Battocletti 2005).

- Lands are generally (but not always) held in trust by the US and administered by the Bureau of Indian Affairs, which is generally the SMA in Indian Country when there is a third party lease or mineral management agreement (Battocletti 2005).

- Tribes can undertake exploration on their own, without BIA oversight. Even if there is no lease, there will be times in a tribally initiated project that will require working with BIA (Battocletti 2005).

- Tribes can write their own regulations or adopt the regulations of other federal, state, or local agencies. They may voluntarily relinquish sovereignty for a limited time and defined purpose to take advantage of another state, federal, or local agency's rules and oversight (Battocletti 2005).

- Tribes with appropriate regulations in place can apply for primacy over the Clean Air, Safe Drinking Water, and Clean Water Acts (Battocletti 2005).
- Projects with impacts outside of Indian Country may be subject to local and state permitting regulation (Battocletti 2005).

- Where no tribal ordinances applicable to a proposed action exist, an express federal statute allocating governmental authority over specific activities may control. Inherent tribal authority may also be preempted by a comprehensive federal regulatory scheme (Battocletti 2005).

- Tribes are not subject to NEPA unless they use funds from federal agencies such as the DOE. In some cases, BIA is the lead agency for NEPA on trust lands (Battocletti 2005).

- Where lands within Indian Country have been "allotted" to individual tribal members and then sold to non-Native Americans, another layer of jurisdictional uncertainty is created (Battocletti 2005).

- Tribes generally lack a history of natural resource development. Because of recent growing appreciation and expanded assertions of inherent sovereign powers by tribes, they may have difficulty accepting that there are jurisdictional authorities imposed by federal regulatory schemes for natural resource development on their land (Battocletti 2005).

- To determine the permitting path for a particular project, tribal sovereignty, tribal ordinances and codes, and tribal preferences must be weighed, along with other federal authorities. Tribes, consultants advising tribes, and members of industry forming contractual development agreements with tribes are urged to ensure that standard requirements for safety, health, environment, and conservation of the resource are applied to the project as would be done by responsible geothermal exploration and development projects on federal, state, and private lands, where permitting and regulatory requirements are more clearly outlined (Battocletti 2005).

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