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RENEWABLE ENERGY

Increased Geothermal Development Will Depend on Overcoming Many Challenges

Statement of Jim Wells, Director
Natural Resources and Environment

July 11, 2006

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Highlights

Highlights of GAO-06-930T, a testimony to Pete Domenici, Chairman, Energy and Natural Resources Committee, U.S. Senate

Why GAO Did This Study

The Energy Policy Act of 2005 (Act) contains provisions that address challenges to developing geothermal resources, including the high risk and uncertainty of developing geothermal power plants, lack of sufficient transmission capacity, and delays in federal leasing. Among the provisions are means to simplify federal royalties on geothermal resources while overall collecting the same level of royalty revenues. This testimony summarizes the results of a recent GAO report, GAO-06-629. In this testimony, GAO describes: (1) the current extent of and potential for geothermal development, (2) challenges faced by developers of geothermal resources, (3) federal, state, and local government actions to address these challenges, and (4) how provisions of the Act are likely to affect federal geothermal royalty disbursement and collections.

What GAO Recommends

GAO concluded that it will be difficult for the Department of the Interior (DOI) to demonstrate that it intends to collect the same level of geothermal royalties as called for in the Energy Policy Act because the Minerals Management Service (MMS) does not systematically collect sales revenue data from electricity sales. Therefore, GAO recommends that the Secretary of the Interior instruct the appropriate managers within MMS to systematically collect these data, and DOI agreed.

www.gao.gov/cgi-bin/getrpt?GAO-06-930T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Jim Wells at (202) 512-3841 or wellsJ@gao.gov.

What GAO Found

Geothermal resources currently produce about 0.3 percent of our nation's total electricity and heating needs and supply heat and hot water to about 2,300 direct-use businesses, such as heating systems, fish farms, greenhouses, food-drying plants, spas, and resorts. Recent assessments conclude that future electricity production from geothermal resources could increase by 25 to 367 percent by 2017. The potential for additional direct-use businesses is largely unknown because the lower temperature geothermal resources that they exploit are abundant and commercial applications are diverse. One study identified at least 400 undeveloped wells and hot springs that have the potential for development. In addition, the sales of geothermal heat pumps are increasing.

The challenges to developing geothermal electricity plants include a capital-intensive and risky business environment, technological shortcomings, insufficient transmission capacity, lengthy federal review processes for approving permits and applications, and a complex federal royalty system. Direct-use businesses face numerous challenges, including challenges that are unique to their industry, remote locations, water rights issues, and high federal royalties. The Act addresses many of these challenges through tax credits for geothermal production, new authorities for the Federal Energy Regulatory Commission, and measures to streamline federal leasing and simplify federal royalties, which totaled $12.3 million in 2005. In addition, the Department of Energy and the state of California provide grants for addressing technology challenges. Furthermore, some state governments offer financial incentives, including investment tax credits, property tax exclusions, sales tax exemptions, and mandates that certain percentages of electricity within the state be generated from renewable resources.

Under the Act, federal royalty disbursement will significantly change because half of the federal government's share will now go to the counties where leases are located. Although the Act directs the Secretary of the Interior to seek to maintain the same level of royalty collections, GAO's analysis suggests this will be difficult because changing electricity prices could significantly affect royalty revenues. Finally, MMS does not collect sales data that are necessary to monitor these royalty collections.

Source: GAO.

Glenwood Hot Springs, Colorado (left) and geothermal power plant at The Geysers, California (right).

Mr. Chairman and Members of the Committee:

We are pleased to participate in the Committee's hearing to discuss the development of geothermal energy on federal lands and the role of geothermal resources in the nation's portfolio of alternative energy sources. We previously testified that fossil fuels, such as coal, oil, and natural gas, provide about 86 percent of our nation's total energy consumption, with the rest coming from other sources, including nuclear energy and renewable resources, such as hydroelectric energy, wind, solar energy, and geothermal resources.[1] Our nations' long-standing reliance on imported crude oil and natural gas and disruptions in their supply highlight the need to develop renewable energy sources. Among these sources is geothermal energy. Geothermal energy is a unique renewable resource in that it can provide power that is independent of weather and climate, thereby enabling a consistent and uninterrupted supply of heat and electricity. Geothermal energy also creates fewer environmental impacts than the production of natural gas and other conventional fossil fuels. Because many areas that have the potential to produce additional geothermal energy are located on federal lands, the federal government plays a major role in the future development of geothermal energy.

Harnessing geothermal energy, however, is not easy. Developers of geothermal energy face many challenges, including the high risk and uncertainty of developing geothermal power plants, lack of sufficient capacity to transmit electricity from these plants to consumers, inadequate technology, and delays in leasing federal lands, which supply about 50 percent of the geothermal resources used to generate electricity. To address these and other challenges, the Congress included detailed provisions in the Energy Policy Act of 2005.

My testimony today is based on a report we recently completed entitled *"Renewable Energy: Increased Geothermal Development Will Depend on Overcoming Many Challenges."* In this report, we addressed: (1) the current extent of and potential for geothermal development; (2) challenges faced by developers of geothermal resources; (3) federal, state, and local government actions to address these challenges; and (4) how provisions of the Energy Policy Act are likely to affect federal geothermal royalty disbursements and collections. In addressing these issues, we reviewed

[1]See *Meeting Energy Demand in the 21st Century: Many Challenges and Key Questions*, GAO-05-414T (Washington, D.C.: March 16, 2005).

key studies on the extent and potential of geothermal development, interviewed a variety of government and industry officials, reviewed substantial supporting documentation and the Energy Policy Act, analyzed geothermal royalty data, and toured geothermal electricity plants and other facilities in California, Idaho, Nevada, and Oregon.

In summary, we found the following:

- Although locally important, geothermal resources produce a very small portion of our nation's total electricity and heating needs. In 2004, geothermal resources generated about 0.3 percent of the nation's total electricity and supplied heat and hot water directly to about 2,300 district heating systems, fish farms, greenhouses, food drying plants, spas, and resorts. The most recent estimates of future electricity generation from geothermal resources suggest that the current production of 2,500 megawatts of electricity—enough to supply 2.5 million homes—could increase to as much as 12,000 megawatts in 11 years. Although the future potential of other geothermal applications is less known, about 400 undeveloped geothermal wells and hot springs could supply heat and hot water directly to a variety of businesses and other organizations.

- The developers of geothermal resources face significant financial, technical, and logistical challenges. Geothermal electric power plant developers face a capital intensive and risky business environment in which obtaining financing and securing a contract with a utility are difficult, where recouping the initial investment takes many years, and where transmission expenses could be costly due to remote locations or capacity constraints on the electric grid. These developers must also use exploration and drilling technologies that are inadequate for the unique attributes of geothermal reservoirs. Developers of electric power plants on federal lands face additional administrative and regulatory challenges and a complicated royalty payment system. Businesses and individuals trying to tap geothermal resources for direct use face unique marketing, financing, and technical challenges and, in some cases, must contend with remote locations, restrictive state water rights, and high royalties.

- To address the many challenges of developing geothermal resources, federal, state, and local governments have implemented a number of incentives and initiatives, many of which show promise. However, it is too early to assess their overall effectiveness. To address the capital intensive and risky nature of developing geothermal power plants, the Energy Policy Act grants developers a federal tax credit. Some states also encourage the production of electricity from renewable energy by granting various tax credits or by passing laws or adopting policies requiring that public

utilities provide a minimum percentage of their electricity from renewable energy. To address technological challenges, the federal government and the state of California awarded research and development grants through the Department of Energy's Geothermal Technologies Program and the California Energy Commission, respectively. The Energy Policy Act gives the Federal Energy Regulatory Commission new authorities to address transmission limitations and contains provisions designed to improve the efficiency of federal geothermal leasing and to simplify or reduce federal geothermal royalties.

- How federal royalties are shared will change significantly since passage of the Act, and the total amount of royalties collected could change significantly if electricity prices also change. While the Act continues to provide that 50 percent of federal geothermal royalties will be disbursed to the states in which the federal leases are located, an additional 25 percent will now be disbursed to the counties in which the leases are located, leaving only 25 percent to the federal government. The Act also directs for most leases that the Secretary of the Interior seek to maintain the same level of royalty revenues as before the Act, but our analysis suggests that this will be difficult because of two factors. First, because lessees in certain situations will have the option of choosing a different formula for calculating royalties, changing electricity prices could significantly affect the percentage of future royalty revenues that they pay. Second, the Minerals Management Service (MMS) does not routinely collect from royalty payors the gross sales revenue figures for the electricity they sell so MMS cannot determine if or how these future royalty revenues differ from what lessees would have paid before the Act. We have made recommendations to the Secretary of the Interior to instruct the appropriate managers within MMS to collect from royalty payors the gross sales revenue figures from electricity sales. MMS has agreed to do so.

Background

Geothermal energy is literally the heat of the earth. This heat is abnormally high where hot and molten rocks exist at shallow depths below the earth's surface. Water, brines, and steam circulating within these hot rocks are collectively referred to as geothermal resources. Geothermal resources often rise naturally to the surface along fractures to form hot springs, geysers, and fumaroles. For centuries, people have used naturally occurring hot springs as places to bathe, swim, and relax. More recently, some individuals have constructed buildings over these springs, transforming them into elaborate spas and resorts, thereby establishing the first direct use of geothermal resources for business purposes. Businesses have also established other direct uses of geothermal resources by drilling wells into the earth to tap the hot water for heating

buildings, drying food, raising fish, and growing plants. Where the earth's temperature is not high enough to supply businesses with geothermal resources for direct use, people have made use of the ground's heat by installing geothermal heat pumps. Geothermal heat pumps consist of a heat exchanger and a loop of pipe extending into the ground to draw on the relatively constant temperature there for heat in the winter and air conditioning in the summer.

Geothermal resources can also generate electricity, and this is their most economically valuable use today. Only the highest temperature geothermal resources, generally above 200 degrees Fahrenheit, are suitable for electricity generation. When companies are satisfied that sufficient quantities of geothermal resources are present below the surface at a specific location, they will drill wells to bring the geothermal fluids and steam to the surface. Upon reaching the surface, steam separates from the fluids as their pressure drops, and the steam is used to spin the blades of a turbine that generates electricity. The electricity is then sold to utilities in a manner similar to sales of electricity generated by hydroelectric, coal-fired, and gas-fired power plants.

In the United States, geothermal resources are concentrated in Alaska, Hawaii, and the western half of the country, primarily on public lands managed by the Bureau of Land Management (BLM). The Congress set forth procedures in the Geothermal Steam Act of 1970 for leasing these public lands, developing the geothermal resources, and collecting federal royalties. Today, BLM leases these lands and sets the royalty rate, and the Minerals Management Service (MMS)—another agency within the Department of the Interior (DOI)—collects the federal geothermal royalties and disburses to the state governments its share of these royalties as required by law. In 2005, MMS collected $12.3 million in geothermal royalties, almost all of which was derived from the production of electricity.

Current Geothermal Development Is Limited, and Estimated Potential for Additional Development Varies

Geothermal resources currently account for about 0.3 percent of the annual electricity produced in the United States, or 2,534 megawatts—enough electricity to supply 2.5 million homes. Even though the percentage of electricity generated from geothermal resources is small nationwide, it is locally important. For example, geothermal resources provide about 25 percent of Hawaii's electricity, 5 percent of California's electricity, and 9 percent of northern Nevada's electricity. As of January 2006, 54 geothermal power plants were producing electricity, and companies were constructing 6 additional geothermal power plants in California, Nevada, and Idaho that collectively will produce another 390 megawatts of electricity. Over half of the nation's electricity generated from geothermal resources comes from geothermal resources located on federal lands in The Geysers Geothermal Field of northern California; in and near the Sierra Nevada Mountains of eastern California; near the Salton Sea in the southern California desert; in southwestern Utah; and scattered throughout Nevada.

Industry and government estimates of the potential for electricity generation from geothermal resources vary widely, due to differences in the date by which forecasters believe the electricity will be generated, the methodology used to make the forecast, assumptions about electricity prices, and the emphasis placed on different factors that can affect electricity generation. Estimates published since 1999 by the Department of Energy, the California Energy Commission, the Geothermal Energy Association, the Western Governor's Association, and the Geo-Heat Center at the Oregon Institute of Technology indicate that the potential for electrical generation from known geothermal resources over the next 9 to 11 years is from about 3,100 to almost 12,000 megawatts. A more comprehensive and detailed study of electricity generation from all geothermal resources in the United States was published in 1978 by the U.S. Geological Survey (USGS). This assessment estimated that known geothermal resources could generate 23,000 megawatts if all of them were developed. The USGS estimate is greater because it did not consider how much electricity could be economically produced, given competing commercial sources of electricity. In addition, the USGS estimated that undiscovered resources could generate an additional 72,000 to 127,000 megawatts. In short, geothermal resources that could generate electricity are potentially significant but largely untapped.

In 2005, over 2,300 businesses and heating districts in 21 states used geothermal resources directly for heat and hot water. Nearly all of these are on private lands. About 85 percent of these users are employing geothermal resources to heat homes, businesses, and government

buildings. While most users heat one or several buildings, some users have formally organized heating districts that pipe hot water from geothermal wells to a central facility that then distributes it to heat many buildings. The next most plentiful direct use application is for use by resorts and spas, accounting for over 10 percent of sites. About 244 geothermally heated resorts and spas offer relaxation and therapeutic treatments to customers in 19 states. Two percent of geothermal direct use applications consist of heated greenhouses in which flowers, bedding plants, and trees are grown. Another two percent of geothermal direct use applications are for aquaculture operations that heat water for raising aquarium fishes for pet shops; catfish, tilapia, freshwater shrimp and crayfish for human consumption; and alligators for leather products and food. Other direct use geothermal applications include dehydrating vegetables, like onions and garlic, and melting snow on city streets and sidewalks.

The potential for additional direct use of geothermal resources in the United States is uncertain due to the geographically widespread nature of low-temperature geothermal resources and the many different types of applications. USGS preformed the first national study of low-temperature geothermal sites in 1982, but this study was not specific enough to identify individual sites for development. In 2005, the Geo-Heat Center at the Oregon Institute of Technology identified 404 wells and springs that might be commercially developed for direct use applications—sites that had the appropriate temperatures and are within 5 miles of communities.

Geothermal heat pumps have become a major growth segment of the geothermal industry. They make use of the earth's warmer temperature in the winter to heat buildings and use the earth's cooler temperature in the summer for air conditioning. The Geothermal Heat Pump Consortium estimated that 1 million units were in operation in all 50 states as of January 2006. Because geothermal heat pumps are effective where ground temperatures are between 40 and 70 degrees F, they can be installed in almost any location in the United States and, therefore, constitute the most widespread geothermal application and represent the greatest potential for future development.

Geothermal Development Faces Many Challenges

The development of geothermal resources for electricity production faces major challenges, including high risk and financial uncertainty, insufficient transmission capacity, and inadequate technology. Geothermal groups reported that most attempts to develop geothermal resources for electricity generation are unsuccessful, that costs to develop geothermal power plants can surpass $100 million, and that it can take 3 to 5 years for

plants to first produce and sell electricity. Although some geothermal resources are easy to find because they produce tell-tale signs such as hot springs, most resources are buried deep within the earth—at depths sometimes exceeding 10,000 feet—and finding them often requires an in-depth knowledge of the area's geology, geophysical surveys, remote sensing techniques, and at least one test well. The risks and high initial costs associated with exploring for and developing geothermal resources limit financing. Moreover, few lenders will finance a geothermal project until a contract has been signed by a utility or energy marketer to purchase the anticipated electricity. Geothermal industry officials describe the process of securing a contract to sell electricity as complicated and costly. In addition, lack of available transmission creates a significant impediment to developing geothermal resources for electricity production. In the West where most geothermal resources are located, many geothermal resources are far from existing transmission lines, making the construction of additional lines economically prohibitive, according to federal, state, and industry officials. Finally, inadequate technology adds to the high costs and risky nature of geothermal development. For example, geothermal resources are hot and corrosive and often located in very hard and fractured rocks that wear out and corrode drilling equipment and production casing.

Developing geothermal resources for direct use also faces a variety of business challenges, including obtaining capital, overcoming specific challenges unique to their industry, securing a competitive advantage, distant locations, and obtaining water rights. While the amount of capital to start a direct-use business that relies on geothermal resources is small compared to the amount of capital necessary to build a geothermal power plant, this capital can be substantial relative to the financial assets of the small business owner or individual, and commercial banks are often reluctant to loan them money. Challenges that are unique to certain industries include avoiding diseases in fish farms; combating corrosive waters used in space heating; and controlling temperature, humidity, and light according to the specifications of the various plant species grown in greenhouses. Even when overcoming these unique challenges, successful operators of direct use businesses may need to secure a competitive advantage, and some developers have done so by entering specialty niches, such as selling alligator meat to restaurants and constructing an "ice museum" in Alaska where guests can spend the night with interior furnishings sculptured from ice. Furthermore, developing direct uses of geothermal resources is also constrained because geothermal waters cannot be economically transported over long distances without a significant loss of heat. Even when these resources need not be moved,

obtaining the necessary state water rights to geothermal resources can be problematic. In areas of high groundwater use, the western states generally regulate geothermal water according to some form of the doctrine of prior appropriations, under which specific amounts of water may have already been appropriated to prior users, and additional water may not be available.

Developing geothermal power plants on federal lands faces additional challenges. Power plant developers state that the process for approving leases and issuing permits to drill wells and construct power plants has become excessively bureaucratic. BLM and Forest Service officials often have to amend or rewrite resource or forest management plans, which can add up to 3 years to the approval process. Delays in finalizing the resource and forest management plans and in conducting other environmental reviews have resulted in backlogs of lease applications in California and Nevada, particularly when the public has raised more environmental issues. Geothermal applications, permits, and environmental reviews are also delayed by a lack of staff and budgetary resources at the BLM state and field offices that conduct the necessary work and when BLM must coordinate with the Forest Service, which manages land in some project areas. In addition, developers of geothermal resources for both power plants and direct uses faced a challenging federal royalty system prior to the Energy Policy Act. While developers of geothermal power plants generally did not consider the federal royalty system to be a major obstacle in constructing a geothermal power plant, some described paying royalties as burdensome and reported expending considerable time and expense on royalty audits. On the other hand, some developers of geothermal resources for direct use stated that the federal royalty system was a major obstacle and no longer economically feasible.

Efforts by Federal, State, and Local Governments to Address the Challenges of Developing Geothermal Resources Show Promise

The Energy Policy Act of 2005 includes a variety of provisions designed to help address the challenges of developing geothermal resources, including the high risk and financial uncertainty of developing renewable energy projects and the lack of sufficient transmission capacity. Provisions within the Act address high risk and financial uncertainty by providing tax credits and other incentives. For example, starting on January 1, 2005, the Act extends for 10 years a tax credit on the production of electricity from geothermal resources for already existing plants and for any new plants producing by December 31, 2007. The Act also provides a financial incentive for tax-exempt entities, such as municipalities and rural electric cooperatives, by allowing the issuance of clean renewable energy bonds for the construction of certain renewable energy projects, including geothermal electricity plants. Investors can purchase the bonds, which pay back the original principal and also provide a federal tax credit instead of an interest payment. Another provision in the Act may decrease the high risk of geothermal exploration by directing the Secretary of the Interior to update USGS's 1978 Assessment of Geothermal Resources, which is in need of revision because significant advancements in technology have occurred since its publication. The Act addresses transmission challenges by providing the Federal Energy Regulatory Commission (FERC) with new authorities in permitting transmission facilities and in developing incentive-based rates for electricity transmission in interstate commerce. FERC can now approve new transmission lines in certain instances when a state fails to issue a permit within 1 year of a company's filing of an application, and companies that acquire FERC permits for transmission facilities can acquire rights of way through eminent domain proceedings. In November 2005, FERC initiated the rulemaking process for establishing these rates.

State governments are also addressing the financial uncertainty of developing renewable energy projects by creating additional markets for their electricity through Renewable Portfolio Standards (RPS). An RPS is a state policy directed at electricity retailers, including utilities, that either mandates or encourages them to provide a specific amount of electricity from renewable energy sources, which may include geothermal resources. To date, 22 states plus the District of Columbia have RPSs, and three other states have set RPS targets, although not all states have significant geothermal resources. Additional state programs also provide tax credits and other financial incentives for renewable energy development, including electricity generation from geothermal resources. These incentives include property tax incentives, sales tax incentives, and business tax credits.

To address technological challenges, the state of California and the Department of Energy provide financial assistance and grants to the geothermal industry. California's Geothermal Resources Development Account competitively awards grants to promote research, development, demonstration, and commercialization of geothermal resources. California's Public Interest Energy Research Program also funds awards for renewable resource projects, including geothermal projects. On the federal side, the Department of Energy's Geothermal Technologies Program competitively awards cost-sharing grants to industry for research and development. In the past, program funds have been used to pioneer new drill bits, demonstrate the large scale use of low-temperature geothermal resources to generate electricity, produce new seismic interpretation methods, commercialize geothermal heat pumps, develop slimhole (reduced diameter) drilling for exploration, and produce a strategy for reinjection at The Geysers Geothermal Field. The program's budget was $23 million in fiscal year 2006. However, the President's budget contains no funding for fiscal year 2007, and the House's proposal for fiscal year 2007 is to appropriate a substantially reduced amount of $5 million. In contrast to these funding decisions, the Senate Energy and Water Appropriations Subcommittee just recently approved a budget of $22.5 million for geothermal research and development. While the future impacts of reduced or eliminated funding for geothermal technology is uncertain, industry representatives believe that this funding is necessary to address the near-term need to expand domestic energy production and the long-term need to find the breakthroughs in technology that could revolutionize geothermal power production.

The Energy Policy Act also contains provisions aimed at addressing the challenges of developing geothermal resources on federal lands. Specific provisions are aimed at streamlining or simplifying the federal leasing system, combining prospective federal lands into a single lease, and improving coordination between DOI and the Department of Agriculture. The Act also requires the Secretary of the Interior and the Secretary of Agriculture to enter into a memorandum of understanding that establishes an administrative procedure for processing geothermal lease applications and that establishes a 5-year program for leasing of Forest Service lands and reducing its backlog of lease applications, as well as establishing a joint data retrieval system for tracking lease and permit applications. Finally, the Act also contains provisions that simplify and/or reduce federal geothermal royalties on resources that generate electricity and on resources put to direct use. MMS is in the early stages of implementing these provisions, and hence it is too early to assess their overall effectiveness.

Geothermal Royalty Disbursements Will Change Significantly, and Changes in Electricity Prices Could Alter Total Royalty Collections

A royalty provision of the Energy Policy Act redistributes the federal royalties collected from geothermal resources—cutting in half the overall geothermal royalties previously retained by the federal government. Established by the Geothermal Steam Act of 1970, as amended, the prior distribution provided that 50 percent of geothermal royalties be retained by the federal government and the other 50 percent be disbursed to the states in which the federal leases are located.[2] While the Energy Policy Act continues to provide that 50 percent of federal geothermal royalties be disbursed to the states in which the federal leases are located, an additional 25 percent will now be disbursed to the counties in which the leases are located, leaving only 25 percent to the federal government. The Act also changes how the federal government's share of geothermal royalties can be used. Prior to passage of the Act, 40 percent of the federal government's share was deposited into the reclamation fund created by the Reclamation Act of 1902, and 10 percent was deposited into the general fund of the Department of the Treasury. For the first 5 fiscal years after passage of the Act, the federal government's share is now to be deposited into a separate account within the Department of the Treasury that the Secretary of the Interior can use without further appropriation and fiscal year limitation to implement both the Geothermal Steam Act and the Energy Policy Act.

While, for most leases, the Energy Policy Act directs that the Secretary of the Interior seek to maintain the same level of royalty revenues as before the Act, our analysis suggests that this will be difficult because changing electricity prices could significantly affect the percentage of future royalty revenues collected. Electricity prices are not possible to predict with certainty, and as discussed below, changing prices could significantly impact royalty revenues because electricity sales account for about 99 percent of total geothermal royalty revenues. The Act contains provisions for each of three specific types of leases that generate electricity: (1) leases that currently produce electricity, (2) leases that were issued prior to passage of the Act and will first produce electricity within 6 years following the Act's passage, and (3) leases that have not yet been issued.

For leases that currently produce electricity, future geothermal royalty revenues will depend on electricity prices. The Act specifies that the Secretary of the Interior is to seek to collect the same level of royalties

[2]30 U.S.C. § 191 (a). The State of Alaska is an exception to this provision, receiving 90 percent.

from these leases over the next 10 years as it had before the Act's passage but under a simpler process. Prior to passage of the Act, lessees of most geothermal electricity projects paid federal royalties according to a provision within MMS's geothermal valuation regulations referred to as the "netback process." To arrive at royalties due under this process, lessees are to first subtract from the electricity's gross sales revenue[3] their expenses for generation and transmission and then multiply that figure by the royalty rate specified in the geothermal lease, which is from 10 to 15 percent.[4] The Act simplifies the process by allowing lessees, within a certain time period, the option to request a modification to their royalty terms if they were producing electricity prior to passage of the Act. This modification allows for royalties to be computed as a smaller percentage of the gross rather than the net sales revenues from the electricity so long as this percentage is expected to yield total royalty payments equal to what would have been received before passage of the Act. Royalty revenues from a geothermal lease currently producing electricity will remain the same if the lessee elects not to convert to the new provision of the Act. On the other hand, if the lessee converts to the new provision, royalty revenues should remain about the same only if DOI negotiates with the lessee a future royalty percentage based on past royalty history and if electricity prices remain relatively constant. If royalties are based on historic percentages of gross sales revenues and electricity prices increase, however, royalty revenues will actually decrease relative to what the federal government would have collected prior to passage of the Act. The federal government will receive less revenue under this situation because expenses for generation and transmission do not increase when electricity prices increase, and the higher royalty rate specified in the lease is not applied to the increase in sales revenues.

For the second type of lease—leases that were issued before the Act and that will first produce electricity within 6 years after the Act's passage—royalty revenues are likely to drop somewhat because lessees are likely to take advantage of an incentive within the Act. The Act allows for a 50 percent decrease in royalties for the first 4 years of production so long as

[3]The valuation regulations 30 C.F.R. § 206.352 (c) (1) (ii) actually call for using gross proceeds, not sales revenue, in this calculation. The Energy Policy Act also refers to the term gross proceeds. Gross proceeds are all financial compensation accruing to the lessee from the sales of electricity. Since sales revenues are generally the largest component of gross proceeds, we use the two terms synonymously in this report for simplicity.

[4]Deductions are estimates that are to be recalculated at the beginning of each year. Prior year's deductions are to be adjusted based on actual costs during that year.

the lessee continues to use the netback process.[5] Because of the substantial reduction in royalties, it is likely that lessees owning leases issued before passage of the Act will elect to pay only 50 percent of the royalties due on new production for the 4- year period allowed by the Act. This incentive also applies to sales revenues from the expansion of a geothermal electricity plant, so long as the expansion exceeds 10 percent of the plant's original production capacity. Owners of geothermal electricity plants currently paying royalties under the netback process may elect to take the production incentive for new plant expansions if they perceive that the royalty reduction is worth the additional effort and expense in calculating payments under the netback process and worth the possibility of being audited.

It is difficult to predict exactly how royalty revenue from the third type of lease—leases that have not yet been issued—will change, but it appears that revenue impacts are likely to be minor, based on our review of historic royalty data. The Act specifies that the Secretary of the Interior should seek to collect the same level of royalty revenues over a 10-year period as before passage of the Act. The Act also simplifies the calculation of royalty payments by providing that, for future leases, royalties on electricity produced from federal geothermal resources should be not less than 1 percent and not greater than 2.5 percent of the sales revenue from the electricity generated in the first 10 years of production. After 10 years, royalties should be not less than 2 percent and not greater than 5 percent of the sales revenue from the electricity. Our analysis of data for seven geothermal projects showed that lessees were paying a wide range of percentages after 10 years of production—from 0.2 to 6.3 percent. Three of the seven projects paid under the minimum 2 percent royalty rate prescribed in the Act, suggesting that some projects in the future could pay more under the Act's new provisions than they would otherwise have paid. On the other hand, one project paid greater than the maximum 5 percent prescribed in the Act, suggesting that it is possible for a plant to pay less in the future than it would otherwise have paid. However, neither the amount that the one plant would have overpaid nor the amounts that the three plants would have underpaid are significant.

Even though provisions of the Energy Policy Act may decrease royalties on direct use applications, the impact of these provisions is likely to be small because total royalty collections from direct use applications are

[5]Pub. L. No. 109-58 § 224 (2005).

minimal. In fiscal years 2000 through 2004, MMS reported collecting annually about $79,000 from two direct use projects, or less than 1 percent of total geothermal royalties. While a provision of the Act may encourage the use of federal geothermal resources for direct use by lowering the federal royalty rate, we believe based on challenges facing developers that it is unlikely that this royalty incentive alone will stimulate substantial new revenues to compensate for the loss in revenue due to the lower royalty rate. We believe that in order to substantially increase the development of federal direct use applications, developers must overcome the relatively high capital costs for investors, unique business challenges, and water rights issues.

Finally, MMS does not routinely collect data from the sales of electricity that are necessary to demonstrate that MMS is seeking to maintain the same level of royalty collections from geothermal resources, as directed by the Energy Policy Act. For most geothermal leases, MMS will need to calculate the percentage of gross sales revenues that lessees will pay in future royalties from electricity sales and compare this to what lessees would have paid prior to the Act. However, MMS does not routinely collect these data. Accordingly, we are recommending that the Secretary of the Interior instruct the appropriate managers within MMS to collect from royalty payors the gross sales revenues from the electricity they sell. MMS has agreed to do so.

Conclusions

The Energy Policy Act of 2005 addresses a wide variety of challenges facing developers of geothermal resources. The Act incorporates many of the lessons learned by state governments and federal agencies in an attempt to provide financial incentives for further development and make federal processes more efficient. However, the Act was only recently adopted, and insufficient time has passed to assess its effectiveness. Several of the Act's major provisions will be left to the federal agencies within DOI for implementation, and the drafting and public comment period for regulations that implement these provisions will not occur overnight. Agencies will also need to spend considerable time and effort in working out the details for implementation and securing the necessary budgets. Hence, the fate of a significant portion of our nation's geothermal resources depends on the actions of these federal agencies.

Mr. Chairman, this concludes my prepared statement. I would be pleased to respond to any questions that you or other Members of the Committee may have at this time.

Contact and Acknowledgments

For further information about this testimony, please contact me, Jim Wells, at 202-512-3841 or wellsj@gao.gov. Contributors to this testimony include Ron Belak, John Delicath, Dan Haas, Randy Jones, Frank Rusco, Anne Stevens, and Barbara Timmerman.

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