Royalty Policy Committee

Geothermal Valuation Subcommittee Report

May 2005

WHY THE GEOTHERMAL VALUATION SUBCOMMITTEE FORMED

At the October 28, 2004, meeting, the Royalty Policy Committee (RPC) formed the Geothermal Valuation Subcommittee (Subcommittee) to address Minerals Management Service's (MMS) geothermal royalty valuation regulations in an effort to simplify the language and reduce administrative costs to the geothermal industry. The RPC requested that the Subcommittee work together to come up with more efficient royalty valuation methods that will ensure a fair return to the government as well as encourage geothermal development.

By memorandum dated November 15, 2004, the Assistant Secretary, Land and Minerals Management (Attachment 1) requested that the Director, MMS, through the RPC Subcommittee, develop a report and recommend changes that can be made immediately without any regulatory or legislative changes, as well as those which require regulatory and legislative changes. The Assistant Secretary also charged the Subcommittee to look at recommending changes to geothermal royalty valuation methods, including the complex "netback" valuation method[1], to make royalty valuations more efficient and effective for government as well as ensuring that the government receives fair market value, but not discourage geothermal development, including direct use, on Federal lands.

It is a high priority of the Secretary of the Department of Interior to meet the goals of the National Energy Policy to diversify our energy supply through the development of renewable energy. To continue to meet these goals, the Subcommittee addressed this issue for direct use of geothermal resources as well as the royalty value of geothermal resources used in electrical generation operations.

The Subcommittee held its first teleconference on December 14, 2004, to start on its mission to address geothermal royalty issues that hamper energy development. On January 25th and 26th, 2005, the Subcommittee held a two-day meeting in Denver, Colorado. The Subcommittee held additional teleconferences on March 4, April 6th, 13th, 18th, and 21st. The Subcommittee also developed the Geothermal Valuation Subcommittee Charter (Attachment 2).

In early May 2005, the Subcommittee issued its report to the RPC. This report details the recommendations of the Subcommittee for consideration of the RPC at its meeting scheduled for May 26, 2005.

GEOTHERMAL VALUATION SUBCOMMITTEE

The Subcommittee is comprised of the following members:

William E. Barger – Chair
Orme Lewis – Vice Chair

[1] The netback valuation, currently used to compute royalties from the sale of electricity from Federal geothermal production, calculates royalties under non-arm's-length or no sales situations by subtracting monthly transmission and generating deductions from the electricity sales value.

Steven Enedy – NCPA
Keith Nelson – State of California, State Controller's Office
Karl Gawell – Geothermal Energy Association
Kevin Talkington – Calpine Energy
Ed Robey – Lake County, California
Christy Morris – State of Nevada
Theresa Walsh Bayani – MMS
Herb Black – MMS
Richard Estabrook – Bureau of Land Management (BLM)

The role of the MMS and BLM Subcommittee representatives was to provide the Subcommittee staff support, and these Federal government representatives were not voting members. All other Subcommittee representatives listed above were voting members.

In addition to the above members, the following representatives also participated in the meeting/teleconferences:

Dale Burgett – Burgett Geothermal Greenhouses, Inc.
Tom Goerold – National Renewable Energy Lab
Jody Erickson – National Geothermal Collaborative
Missy Payne – Caithness Energy
Ellen Allman – Caithness Energy
Joe Greco – Caithness Energy
Paul Zavesov – ORMAT

The Subcommittee agreed that a recommendation to the RPC required a simple majority of the attending voting Subcommittee members. In addition, the Subcommittee agreed that consensus was what they would strive to achieve.

FEDERAL STATISTICS:

Currently, there are 50 Federal producing geothermal leases in Utah, New Mexico, California, and Nevada which include 15 electrical generation projects[2]; and 4 direct use projects (2 of the 4 direct use operations are combination electrical generation and direct use projects). The royalty rates for the geothermal leases are generally 10 percent, with the exception of 12 producing leases at The Geysers, California, and 7 non-producing leases, that are greater than 10 percent. The royalty rate for byproducts[3] is 5 percent; currently, MMS collects negligible royalties on sulfur byproducts only from a field in California. Minimum royalty for geothermal leases is $2 per acre per year. Of note,

[2] Two electrical generation projects are located in Utah; however, detailed information related to these projects was not readily available for the Subcommittee to include in the analysis performed.
[3] Byproducts are any mineral or minerals (excluding oil, gas, and helium) which are found in solution or developed in association with geothermal fluids and which have a value of less than 75 per centum of the value of the geothermal energy or are not, because of quantity, quality, or technical difficulties in extraction and production, of sufficient value to warrant extraction and production by themselves (for example, sulfur, zinc, etc.; 30 CFR Section 206.351).

there are numerous known active geothermal resources located on non-federal lands within the United States.

Royalty revenues totaled approximately $11,000,000 in 2004. The Geysers Field in California is the world's largest geothermal producer of dry steam[4] and accounts for about 61 percent of the Federal geothermal royalty revenues. The total 2004 royalties from flash plants[5] account for approximately 35.5 percent of the royalty revenues, and binary plants[6] and the direct utilization projects[7] account for approximately 3.5% percent of the total royalties.

The current royalty valuation methods for geothermal resources are grouped by usage including electrical generation, direct use, and byproduct recovery, and by disposition of the resources including arm's-length sales[8], non-arm's-length sales, and no sales within each group. Non-arm's-length and no sales categories employ benchmarks to determine value. Currently, the valuation methods employed for the geothermal leases include 13 netback method[9] projects, 2 negotiated percentage-of- revenue methods covering The Geysers, and 4 direct use methods[10].

SUBCOMMITTEE DELIBERATIONS AND RECOMMENDATIONS:

Deliberations:

The Subcommittee together with involved stakeholders considered and discussed at length various options for valuing geothermal production used in direct use and electrical generation. Some options for direct use under non-arm's-length or no sales conditions included using the lowest alternative fuel value tied to a commodity such as coal or wood chip values; using a fixed price for coal or wood chips adjusted for inflation; using natural gas as alternative fuel multiplied by a factor such as 50 percent to encourage direct use in an effort to account for hot water used in place; and using an average binary electrical generation value as a basis for valuing the direct use of geothermal resources.

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[4] Dry steam plants use hydrothermal fluids that are primarily steam. The steam goes directly to a turbine which drives a generator that produces electricity.

[5] Hydrothermal fluids are used in flash plants to make electricity. Fluid enters a separator (or a series of separators) that are held at a lower pressure than the fluid, causing some of the fluid to rapidly vaporize, or "flash." The vapor then drives a turbine.

[6] Binary includes hot geothermal fluid (below 400 degrees F) and a secondary (hence "binary") fluid with a much lower boiling point than water that passes through a heat exchanger where heat from the geothermal fluid causes the secondary fluid to flash to vapor, which then drives the turbine.

[7] Direct utilization, defined under 30 CFR Section 206.351, means any process other than electrical generation in which the thermal energy of the geothermal resource is utilized, including, but not limited to, space heating, greenhouse operations, and industrial or agricultural process heat.

[8] Arm's-length contracts are agreements arrived at in the market place between independent, nonaffiliated parties with opposing economic interests (30 CFR Section 206.351).

[9] Geothermal netback valuation method equals electrical sales value minus transmission costs minus generating costs. Annual cost rates and monthly deductions establish the costs of power generation and transmission (30 CFR 206 Sections 352-354).

[10] For valuing direct use resources under non-arm's-length or no sales situations, the value is the first applicable of three benchmarks of which the second benchmark is the alternative fuel method (30 CFR Section 206.355).

The Subcommittee also considered various options to using the netback valuation method for electrical generation including modifying the royalty rates in the leases using a tiered approach (2-5 percent royalty rate); using a tiered approach to percent of gross proceeds for the sale of electricity based on the type of plant (dry steam, flash, and binary); using a negotiated percent-of- revenues method (similar to The Geysers); and using a single percent of gross proceeds of the sale of electricity for all project types.

Recommendations for Geothermal Royalty Valuation Methods:

The Subcommittee recommends that for direct use and electrical generation operations, MMS should implement new valuation regulations to address the valuation of geothermal resources under non-arm's-length and no sales situations. In addition, the Subcommittee recommends retaining the current valuation standards for arm's-length situations when valuing geothermal resources used in direct use and electrical generation operations. The recommendations of the Subcommittee for consideration of the RPC are as follows:

Direct Use Operations:

For arm's-length sales situations (new and existing leases): The lessee shall pay a royalty on the geothermal resources sold to a direct use facility under arm's-length conditions or sold under arm's-length conditions after electricity has been generated, based on a royalty rate in the lease multiplied by the gross proceeds the lessee derives from the sale of the geothermal resources. No change in royalty valuation under the current rules or in royalty rates for new or existing leases.

Non-arm's-length or no sales situations–(existing producing leases): MMS, in consultation with BLM, will develop and publish a royalty schedule (similar to the schedule shown on page 8 of this report) every 3 years for lessees to use to determine the royalties due on direct use operations. The royalty schedule will be based on the wellhead (inlet) temperature and an "assumed" fixed outlet temperature. (Note: BLM/MMS will determine the outlet temperature based on a future study of existing direct use facilities). The lessee will meter wellhead (inlet) temperature and monthly production and use the published royalty schedule to determine monthly royalties due. The BLM will not require the lessees to install meters to measure the outlet temperature of the geothermal resource.

The BLM performed an analysis to determine the feasibility of using binary electrical generation values as a basis for valuing direct use of Federal geothermal resources (Attachment 3). The results of that analysis concluded that the bottom of the binary value range was the lowest value when compared to various direct use valuation methods. In addition, the study shows that the binary valuation (approximately $0.28/MMBtu - $0.77/MMBtu) is comparable to alternative fuel valuation using Powder River Basin coal spot prices published by Energy Information Administration of the Department of Energy (currently approximately $0.30/MMBtu).

The Subcommittee discussed using binary, coal, and wood chips prices to value geothermal resources. Attachment 4 shows a direct use hypothetical example (10,000 MMBtu/month) that compares the value of Powder River coal spot prices to wood chips and natural gas prices for sample months from 1997 through 2002. After further deliberations, the Subcommittee recommends that the 3-year historical average of published Powder River Basin coal spot price be used to develop the royalty value in the royalty schedule for direct use basically because of its continuity of value and public availability. However, the minimum total royalty paid in any year must be at least the minimum royalty ($2/acre/year (43 CFR § 3211.10)).

The following equation, used to develop the royalty schedule on page 8, shows an example of the calculations for determining royalty due as a function of temperature of the geothermal resource used for direct use:

$$R_{Tin} = \frac{\rho \times (T_{in} - T_{out})}{e} \times P_{prbc} \times F_{rr}$$

where:

R_{Tin} = royalty due as a function of inlet temperature, $/$10^6$ gallons
ρ = water density at inlet temperature, lbms/gallon
T_{in} = measured inlet temperature, °F
T_{out} = established proxy outlet temperature, °F
e = boiler efficiency factor for coal (75%)
P_{prbc} = 3-year historical average of Powder River Basin coal ($/MMBtu)
F_{rr} = lease royalty rate

Non-arm's-length or no sales situations: (new producing leases): For the first 5 years of production, the lessee would pay royalties on the minimum royalty due ($2/acre). After 5 years, the lessee would determine royalties using the same royalty schedule described above. The minimum royalty payment for the first 5 years would be an incentive to encourage the direct use of geothermal resources. Under this recommendation, the BLM may have to change the lease terms for new geothermal leases to reflect the new minimum royalty requirement for the first 5 years that a lease is in producing status.

Pros:

- Can be accomplished through the regulatory process in approximately 1 year time period;
- Eliminates outlet temperature metering for geothermal resources and thus, reduces metering costs for the lessees. Outlet temperature probes and recorders cost approximately $500 to $2000 each;
- Reduces operating costs--up to $15,000 per computer system/operation--to lessees in direct use operations involving intermittent flow (common in greenhouse or space heating applications). Using the fixed outlet temperature in the royalty

schedule simplifies thermal energy calculations and largely eliminates the need for a computerized system;

- Provides the lessee a simplified royalty reporting process using a published royalty schedule;
- Makes it easier to verify royalties due and identify possible problems outside of the audit process;
- Reduces audit costs for both companies and the government;
- Establishes more predictable royalty requirements for industry to plan on;
- Produces a more predictable revenue stream for Federal, state and local governments to plan on;
- Encourages development for new leases due to minimum royalty the first 5 years the lease produces;
- May result in increased development for direct use operations and thus, may result in higher revenues to the U.S. Treasury, states and counties in the long term;
- Uses publicly available Powder River coal spot prices to value the geothermal resources. The Powder River coal spot prices are relatively stable;
- Encourages efficient utilization of geothermal resources because of a constant outlet temperature; and
- Encourages the development and use of geothermal resources on public lands for direct use purposes – greenhouses, fish farming, mine operations, building heating, and similar uses.

Cons:

- Using 2004 historical royalty data, this option would reduce royalty revenues by $33,800 to the U.S. Treasury, states, and counties from existing leases;
- May reduce royalty revenues to the U.S. Treasury, states, and counties for new leases during the first 5 years of production due to minimum royalty ($2 per acre per year); and
- Doesn't account for comparable arm's-length sales of geothermal resources to the same direct use facility when the lessee uses geothermal production under non-arm's-length or no sales situations in that same facility.

Sample Royalty Schedule For Direct Use Geothermal Operations

Assume Lease Royalty Rate: 10%
Royalty Schedule Effective Through: May 31, 2008

If your average monthly wellhead temperature (°F) is above…	*But not more than…*	*Your royalty ($/million gallons) is…*
120	130	1.640
130	140	4.920
140	150	8.200
150	160	11.480
160	170	14.760
170	180	18.040
180	190	21.320
190	200	24.600
200	210	27.880
210	220	31.160
220	230	34.440
230	240	37.720
240	250	41.000
250	260	44.280
260	270	47.560
270	280	50.840
280	290	54.120
290	300	57.400
300	310	60.680
310	320	63.960
320	330	67.240
330	340	70.520
340	350	73.800
350	360	77.800

Royalty due will be the greater of the royalty calculated from this table above or the minimum royalty of $2/acre/year (43 CFR §3211.10). For direct use operations where the average producing wellhead temperature is 120°F or less, minimum royalty is due.

Assumptions:

Outlet temperature = 120°F
Value = $0.30/MMBtu (approximate Power River Coal value over past 3 years)
Boiler efficiency = 75%

Electrical Generation Operations:

Arm's-length sales situations: (new and existing leases). The lessee shall pay a royalty on the geothermal resources sold under arm's-length conditions to a plant that generates electricity based on a royalty rate in the lease multiplied by the gross proceeds the lessee derives from the sale of the geothermal resources. No change in royalty valuation under the current rules or in royalty rates for new or existing leases.

Non-arm's-length or no sales situations: (existing producing leases). The lessees will negotiate individually with MMS to determine the value of the geothermal resources sold under non-arm's-length or no sales situations. The goal of the negotiations will be to strive for revenue neutrality. Royalties would be based on the royalty rate in the lease multiplied by a negotiated "imputed factor" or a percentage-of-revenue method multiplied by the gross proceeds from the sale of electricity. Since leases at The Geysers are under the current valuation regulations and royalties are paid on the percent-of-revenue method (imputed factor multiplied by the gross proceeds from the sale of electricity), the recommended proposal is to retain the current negotiated imputed factor for The Geysers leases. For other existing producing leases, MMS would base the "imputed factor" on an analysis of the net present value of the royalties that a lessee would have paid under their current royalty valuation method, the netback calculation.

For example,

$$R_{due} = IF_{negotiated} \times GP_{elect} \times RR$$

where:

R_{due} = royalty due
$IF_{negotiated}$ = Imputed factor or percentage-of-revenue method negotiated with the MMS, states, and the lessee
GP_{elect} = The gross proceeds from the sale of electricity
RR = lease royalty rate

Assume a Lease Royalty Rate of 10 %
Assume a Negotiated Imputed Factor of 50 %
Assume the Gross Proceeds from the Sale of Electricity = $10,000 for January 2005.

January 2005: Royalty due = $500:

$$R_{due} = IF_{negotiated} \times GP_{elect} \times RR$$

or

$$\$500 = .50 \times \$10{,}000 \times .10$$

MMS analyzed the current electrical generation operations by plant type (binary, flash, and dry steam) and from the royalties paid under the current netback valuation method and the negotiated method for The Geysers, calculated the average percentage of the gross proceeds from the sale of electricity. Based on this analysis, MMS determined that

under the current valuation methods, the average imputed factors for 2004 by plant type are as follows (Attachment 5):

Binary Plants-- Imputed Factor is approximately 6.33 % of the gross proceeds from the sale of electricity;

Flash Plants -- Imputed Factor is approximately 50.56 % of the gross proceeds from the sale of electricity; and

Dry Steam (The Geysers) -- Imputed Factor is approximately 39.01 % of the gross proceeds from the sale of electricity.

Based on this analysis, the Subcommittee recommends that the negotiated "imputed factors" under the new valuation regulations range from 5% to 55% of the gross proceeds from the sale of electricity.

Non-arm's-length or no sales situations: (new leases, existing leases with future production or existing producing leases with "qualified expansion"): During the first 10 years of production from new or existing leases with future geothermal production used in electrical generation, or existing producing leases that expand production by at least 10%, the lessee will calculate royalties using 50 % of 35 % of the gross proceeds from the sale of electricity (or "imputed factor" of 17.5%) multiplied by the lease royalty rate.

After the first ten years of the new or expanded production, the lessee will calculate royalties using a fixed "imputed factor" of 35% of the gross proceeds from the sale of electricity multiplied by the lease royalty rate.

The MMS calculated the average "net royalty percentages" (imputed factor multiplied by the lease royalty rate) for all plant types currently under the netback method and The Geysers negotiated method and concluded that the average net royalty percentages for all plant types for 2003 and 2004 is approximately 3.64 percent and 3.94 percent, respectively (Attachment 6).

Under the netback method, historically during the beginning years of an electrical generation project (between 1-10 years), lessees pay a very low percentage of the gross proceeds from the sale of electricity and in later years of the project (after 10 years), the percentage increases . Under the current netback method, the minimum value for royalty purposes is 1% of gross proceeds from the sale of electricity.[11]

The recommended proposal for new or qualified expansion leases attempts to replicate this historical trend under the netback method over the long term. Attachment 7 shows a

[11] The MMS Geothermal Payor Handbook-Product Valuation states that MMS's administrative policy does not allow the combined transmission and generating deductions to exceed 99% of the electricity value; that is, the resource value cannot be less than 1% of the lessee's gross electricity sales proceeds.

hypothetical example of annual royalty revenues for a future 10 MW plant at various net royalty percentages (between 1-5 % of the gross proceeds from the sale of electricity).

Attachment 7 also shows the Subcommittee's proposed method and illustrates that in the earlier years of an electrical generation project (between 1-10 years); the lessee would pay 50 % of the imputed factor of 35% multiplied by the gross proceeds for the sale of electricity multiplied by an assumed royalty rate of 10 percent (or 1.75% net royalty percentage). After 10 years the lessee would pay the full rate using the imputed factor of 35% of the gross proceeds from the sale of electricity multiplied by an assumed royalty rate of 10 percent (or 3.5% net royalty percentage).

The Subcommittee discussed the situation regarding whether or not the recommended method will be mandatory or optional for existing producing leases under the non-arm's-length or no sales situations where geothermal resources are used for electrical generation. However, no consensus was reached.

Pros:

- Easier royalty calculations for industry and MMS;
- Provides certainty and simplicity for existing and new leases;
- More predictable for industry to project royalties due when planning new projects or expansions;
- Strives for minimum revenue impacts over the long term;
- Can be accomplished through the rulemaking process in approximately 1 year time period;
- Encourages development of geothermal resources used to generate electricity;
- May increase development and revenues to the U.S. Treasury, states, and counties in the long term;
- Requires royalties to be paid starting in the first year of production from new leases, ensuring royalty income when state and local governments need revenue to address local socio-economic impacts;
- For all existing producing leases, the proposal is expected to be revenue neutral;
- For new leases, the proposal is expected to increase revenues over the next ten years and may be revenue neutral over the long run;
- Makes it easier to verify royalties due and identify possible problems outside of the audit process;
- Reduces otherwise significant audit costs for government (currently netback projects require approximately 2000 man hours and cost up to $129,000 per audit for a 3 year cycle)[12];
- Reduces otherwise significant audit costs for companies;
- Reduces revenue uncertainties for Federal, state and local governments and companies created by the need to adjust past royalty payments based upon audits conducted years later;
- Establishes more predictable royalty requirements for industry to plan on; and

[12] The State of California provided the audit estimate for netback projects.

- Results in a more predictable revenue stream for Federal, state and local governments to plan on.

Cons:

- Requires additional data and resources upfront for both industry and MMS/states when negotiating imputed factors for existing producing leases currently under the netback method. MMS would negotiate "imputed factors" for existing producing leases currently under the netback method (there are currently 15 electrical generation projects of which all but the 2 Geysers projects are currently using the netback valuation method);
- Risk of a negative revenue impact for the government if electricity prices are higher and/or costs are lower than anticipated; and risk of negative impact on companies if prices are lower and/or costs higher than anticipated.
- Regulations defining a "qualified expansion" may be difficult to administer;
- May increase litigation risks if issues related to the negotiation of the imputed factors are not agreed upon for existing producing leases; and
- Doesn't account for comparable arm's-length sales of geothermal resources used for electrical generation operations when the lessee uses geothermal production under non-arm's-length or no sales situations in the same electrical generation operation.

The Subcommittee did not define "qualified expansion" and therefore, recommends that the new valuation regulations define what projects qualify for expansion. The estimated timeframe for promulgating new valuation regulations is approximately 1 year. The estimate to negotiate the imputed factors with the MMS, states, the lessees for the 13 projects currently under the netback method for existing producing leases is approximately an additional 1 year.

ADDITIONAL BACKGROUND INFORMATION AND ROYALTY REVENUE IMPACTS:

While precise future royalty rates may be difficult to determine, the general trend can be interpreted. The Geothermal Energy Association believes that looking forward, prices for new geothermal power are expected to be lower than the past two decades while the technology and capital required are expected to increase. Based upon these trends, it is reasonable to suggest going-forward lower royalty revenues than the average of today's producing leases:

- Today, the lowest percentage of gross proceeds from the sale of electricity is on binary power plants, which have higher plant capital costs. In the future, binary plants are expected to be the fastest growing segment of the domestic industry as more of the medium range temperature resource is used and as environmental requirements mitigate towards binary cycle facilities. Other technologies that are under development, such as Kalina cycles, also have a high capital cost compared to the flash and dry steam plants that dominate historical royalties.

- The highest royalty value geothermal resource is the dry steam resources at The Geysers. This is the only dry steam resource known or expected in the US, and it comprises roughly 40% of the total U.S. geothermal production. New areas coming into development will have lower value steam resources.
- Based upon detailed analysis published by the California Energy Commission under its PIER program, identified high and medium temperature resources in California and Nevada that could be developed in the future generally cost more, involve deeper or more difficult resources, and pose greater uncertainty. These characteristics would produce lower royalty returns than the historical averages.
- Geothermal leases on public lands have in the past returned profits under prices fixed by standard-offer contracts issued under the Public Utilities Regulatory Policy Act of 1978 (PURPA). Such contract opportunities are not expected to be the norm for the future, and instead more modest fixed-price contracts are being promoted by state RPS programs in California and Nevada.

It also may be more appropriate to look at other renewable resources as comparable sources to determine royalties, rather than oil and gas. Oil and gas resources have significantly greater marketability and value, whereas geothermal, like other renewable resources, are diffuse and generally have to be used where they are found. For solar and wind on public lands, the royalty charge is a relatively new phenomenon. Only wind facilities are charged a rental which BLM has recently established at a rate of 3% of estimated gross proceeds.

For electrical generation operations over the next decade, the proposal is to provide new production from new leases and new production from existing leases a fixed-gross proceeds royalty from the sale of electricity at 50% of the proposed full rate of 35%. This change may actually increase revenues in the earlier years compared to continuing these leases under the netback system. Under the netback, new production from new leases and new production from existing leases could be expected to pay only 1% of the gross proceeds from the sale of electricity multiplied by the royalty rate in the lease for their first several years of production. Under the system now proposed, all leases would pay a 17.5% of the gross proceeds from the sale of electricity multiplied by the royalty rate in the lease beginning in their first year of production through their tenth year of production. While a precise estimate is beyond our analysis, it appears highly likely that this new revenue proposal may result in additional dollars for royalty income over the next ten years.

For direct use applications, the market value of the resource has serious constraints. Like all geothermal resources, it is not economic to transport the resource very far from its source. But, in addition, if the resource is too far from the facility or the temperature is too low for the operation, it is essentially a stranded resource. It has to be used on-site typically by a local rancher, farmer, or community. Similar to the justification for offering a reduced value for other stranded resources, such as a coal lease that would otherwise be bypassed, it is in the public and governments best interest to encourage its use.

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, DC 20240

NOV 15 2004

Memorandum

To: Johnnie Burton, Director, Minerals Management Service
Kathleen Clarke, Director, Bureau of Land Management

From: Rebecca W. Watson, Assistant Secretary, Land and Minerals Management

Subject: Simplification of Royalty Valuation Process for Geothermal Resources

I would appreciate the two of you putting your heads together to address a barrier to geothermal resource production on public lands. I want to continue the Secretary's efforts to meet the goals of the National Energy Policy to diversify our energy supply through the development of renewable energy.

Recently, while visiting geothermal operators in California and Nevada, it was brought to my attention that cumbersome processes for assessing geothermal royalties were a disincentive to the production of geothermal resources from federal lands. The complex "net back" calculation used to compute royalties from the sale of electricity from federal geothermal production often requires more than a year to complete from the start of geothermal plant operation. This creates financial uncertainty for producers, since an operator must finance a project prior to initiation of operations. In the opinion of operators, the royalty ultimately collected is often less than the time and resources required by the government and geothermal producers to figure the payment, and audit the payment. In addition, under existing processes, direct users pay a much higher share of royalty per therm of energy utilized than electrical producers. For example, a rose grower who simply taps a geothermal reservoir for heating greenhouses pays more royalty than a producer who sells electricity to the grid. This does not make sense, and creates a disincentive for direct use of geothermal resources on public lands.

I mentioned this briefly to Johnnie at one of our regularly scheduled meetings and she suggested that the Mineral Management Service's Royalty Policy Committee address this issue. I am pleased that a Geothermal Subcommittee was recently formed under the Royalty Policy Committee to focus on geothermal royalty issues. I encourage this subcommittee to work expeditiously to address geothermal royalty issues that hamper energy development.

I suggest that this subcommittee, with the concurrence of both of you, look at recommending changes to geothermal royalty valuation methods to make royalty valuations more efficient and effective for industry and the government. These recommendations should ensure the government receives fair market value, but not

discourage geothermal development, including direct use, on Federal lands. I would like recommendations for changes that can be accomplished immediately within the current regulatory and legislative framework as well as those that will require regulatory and legislative change. Recommendations should include pros and cons as well as general steps and estimated timeframes for implementation.

Ideally, I would like to have this report with any additional information needed to make decisions on recommended royalty changes by March 30, 2005. If this date is unrealistic, please provide an alternate date and rationale for its use.

It continues to be a high priority of this Secretary to make continued progress on the development of renewable energy from public lands and resources. I appreciate your efforts in support of this important objective.

Royalty Policy Committee
Geothermal Valuation Subcommittee
Charter

Official Designation

Geothermal Valuation Subcommittee (Subcommittee) of the Royalty Policy Committee (RPC).

Scope and Objectives

The Subcommittee will recommend changes to geothermal royalty valuation methods to make royalty valuations more efficient and effective for government as well as ensuring that government receives fair market value, but not discourage geothermal development on Federal lands.

The Subcommittee is tasked with providing the RPC a report recommending changes that can be accomplished immediately within the current regulatory and legislative framework as well as those that will require regulatory and legislative changes. The Subcommittee will provide the report to the RPC members at least 20 days prior to the next scheduled RPC meeting on May 26, 2005.

Duration and Termination

The RPC established the Subcommittee in October 2004 and the Subcommittee will continue as long as necessary to accomplish the above stated objectives but no longer than 2 years from the date the RPC charter is filed.

Bureau Responsible for Providing Necessary Support

The Department of the Interior, Minerals Management Service.

Estimated Number and Frequency of Meetings

The Subcommittee will meet as necessary to accomplish its assignment, subject to the approval of the Committee Chair.

Travel Expenses

Each appointed non-Federal member or appointed alternate if attending in place of the appointed member will be reimbursed for travel expenses incurred when attending Committee and Subcommittee meetings in accordance with Federal travel regulations as implemented by the Department of the Interior.

Membership

Membership will be balanced in terms of perspective, functions to be performed, and expertise required by the Subcommittee. The Subcommittee may include people who are not members of the Committee. The Committee Chair will appoint Subcommittee members.

Voting

Any official action of the Subcommittee requires the approval of simple majority of the attending voting Subcommittee members.

Internet Homepage

Information on the Royalty Policy Committee may be found on MMS's Internet site, http://www.mms.gov/mmab/RoyaltyPolicyCommittee/rpc_homepage.htm

William E. Barger 27 April 2005

William E. Barger Date
Chair, Geothermal Valuation Subcommittee of
The Royalty Policy Committee

Theresa Walsh Bayani Date
Manager, Indian Oil and Gas
Compliance and Asset Management

Direct Use Valuation Based on Binary Electrical Generation

Purpose and Conclusions

In response to a request from the Minerals Management Service, Geothermal Royalty Subcommittee, the MMS and Bureau of Land Management conducted a study to determine the feasibility of using binary electrical generation as a basis for valuing the direct use of federal geothermal resources. The results of this study show that this method would result in a royalty value of $0.03-$0.08/MMBTU[1] of heat extracted.

Methodology

To perform this study, monthly production and generation data from October, 1998, through January, 2005, were gathered from binary plants in California and Nevada. Data included monthly production, temperature into the plant, temperature out of the plant, and net generation. From this, a "net efficiency" was calculated by dividing the thermal energy extracted from the resource (MMBTUs) by the net generation (MWhs). Overall efficiency using this method averages 42.72 MMBTU/MWh[2], with a 2-sigma (95%) confidence level of ±41%, indicating a large degree of variation in the data.

Two attempts were made to classify the data in such a way to reduce the amount of variation. In the first attempt, a correlation between net efficiency and resource, or inlet temperature was plotted (see Figure 1). From this graph it can be seen that no discernable correlation exits. In the second attempt, the data were classified by month in an effort to identify the effect of seasonal ambient temperature changes on generation efficiency. Figure 2 shows the results of this analysis. It is possible that seasonal operational changes, or other factors may also be partially responsible for the fluctuations in Figure 2.

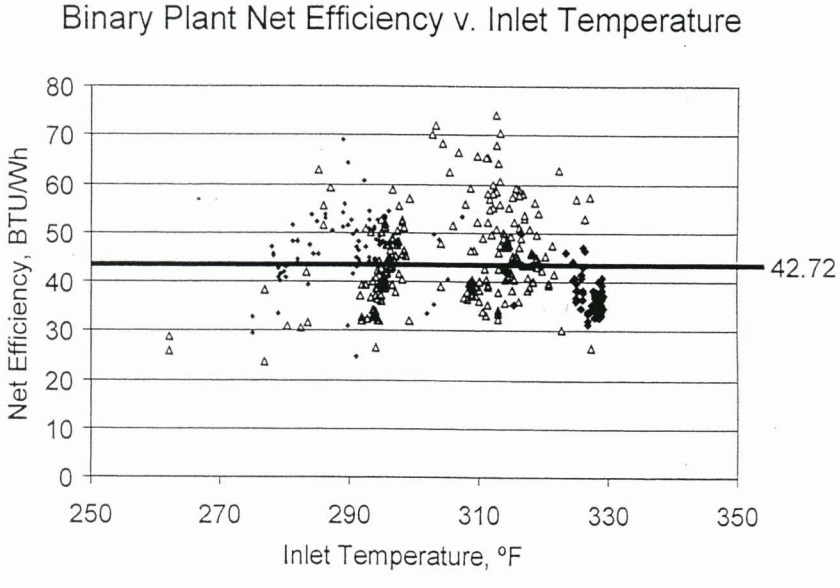


Figure 1

While there does appear to be a correlation between net efficiency and month, this classification of data results in too few points per class to perform a valid statistical analysis. However, it is apparent that on the whole, net efficiency is a stronger function of ambient temperature than of resource temperature. The bottom line is that an average

[1] MMBTU = millions of British Thermal Units
[2] MMBTU/MWh is equivalent to BTU/Wh

efficiency of 42.72 MMBTU/MWh is the most appropriate value to use for this analysis with the amount of data that are available.

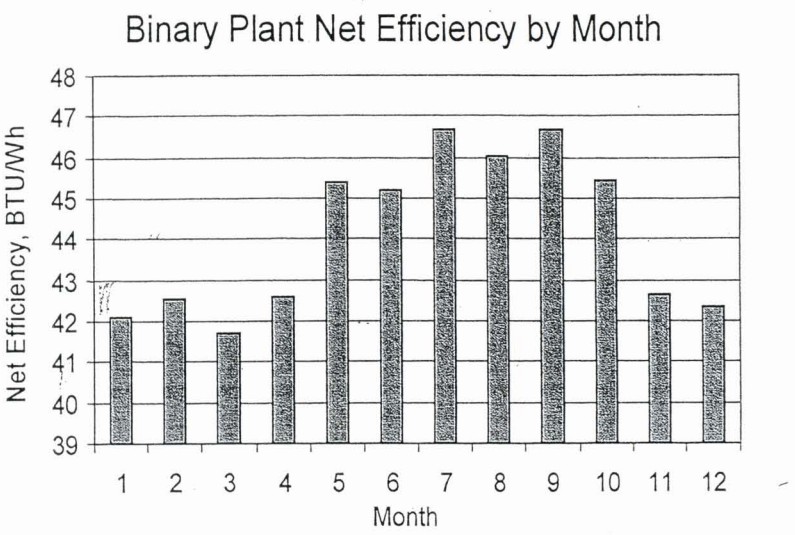


Figure 2

The next step in the analysis is to value the electricity generated from binary plants. Unfortunately, research to date has yet to yield a publicly available and simple to use index for wholesale electric prices. Some investigation of the California Independent System Operator, California Energy Commission, Western Area Power Administration, and historical electrical prices paid for geothermal generation has bracketed wholesale prices in the $40/MWh to $110/MWh range.

Finally, from earlier discussions with the committee, a flat royalty rate of 3% of gross proceeds has been proposed for all electrical generation plants. For this analysis, therefore, it is assumed that a 3% flat rate would be used to value electrical generation from binary plants.

Valuation of direct use resources based on binary generation can be determined through the following equation:

$$R_{du} = \frac{P}{42.72} \times P_e \times .03$$

where:

R_{du} = Royalty due on direct use production, $
P = Production, MMBTU extracted
P_e = Electrical price, $/MWh

Results

Substituting $40/MWh and $110/MWh into the above equation, gives a direct use royalty value of $0.028/MMBTU and $0.077/MMBTU, respectively. Figure 3 shows a comparison of the various direct use valuation methods that have been discussed by the subcommittee. Binary valuation results in the lowest value of all the methods. It is also important to note that valuation using coal, wood chips, or natural gas is based on "displaced energy", where the binary valuation is based on "extracted energy". Displaced energy uses an efficiency factor to account for heat lost during the combustion of the alternative fuels. The efficiency factor typically adds 25% to 33% to the value of those

fuels. The reason for not using displaced energy for binary generation is that heat loss and exchanger efficiency is already taken into account by using net generation values. This also serves to lower the overall value of this method.

To implement this method, more data would need to be gathered to refine the "net efficiency" number used for this analysis. More importantly, a publicly available and simple to use index would need to be identified to value wholesale electric prices.

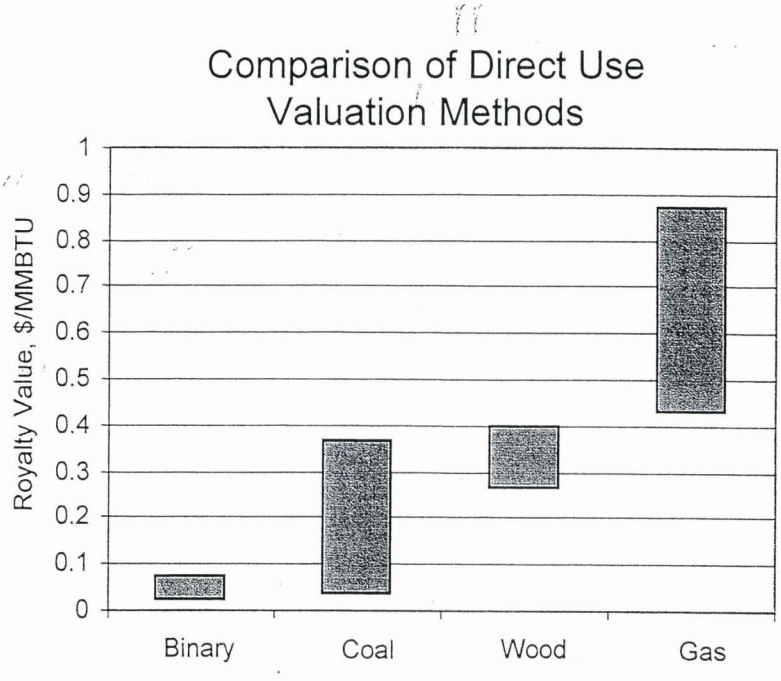
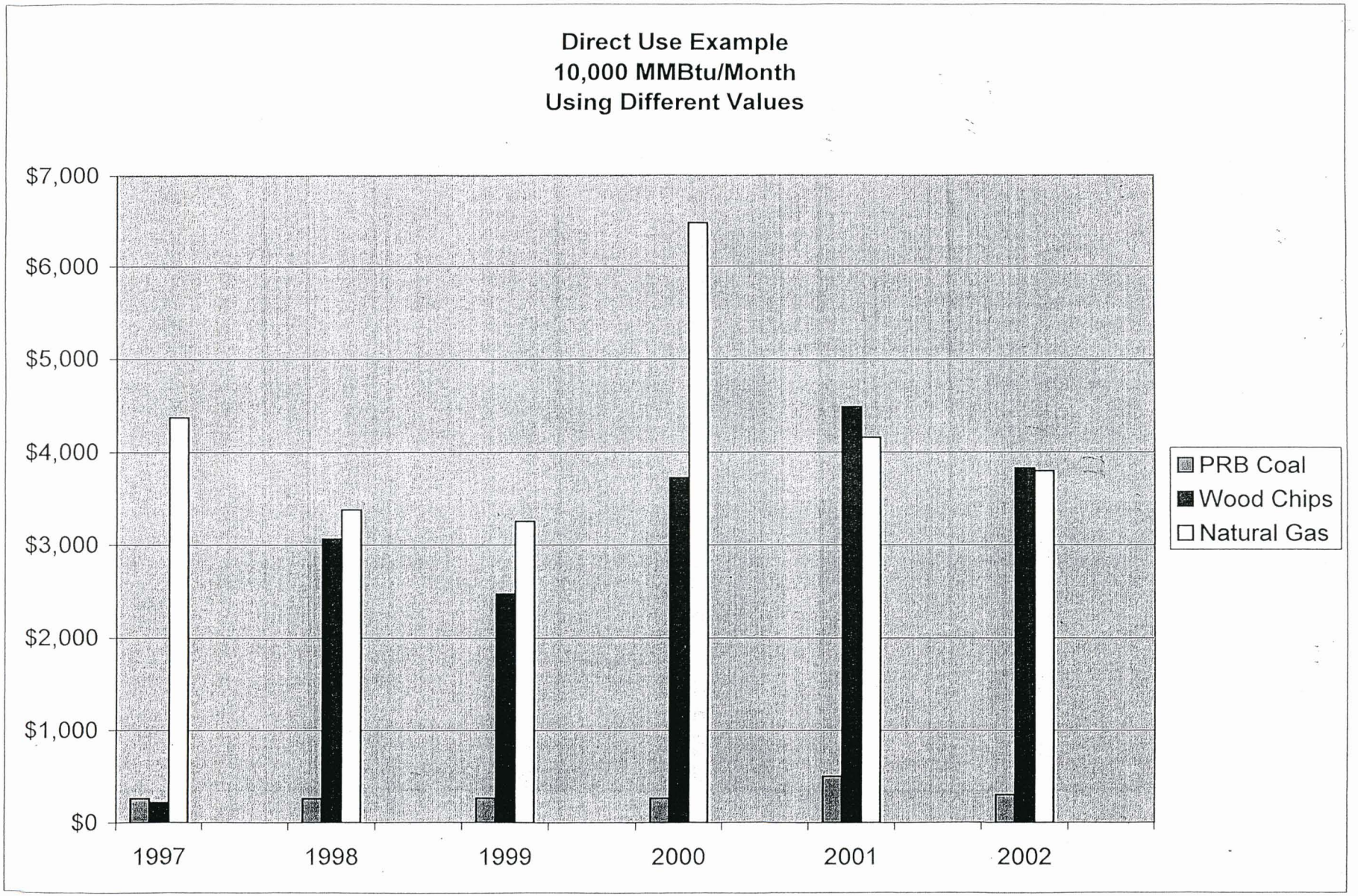
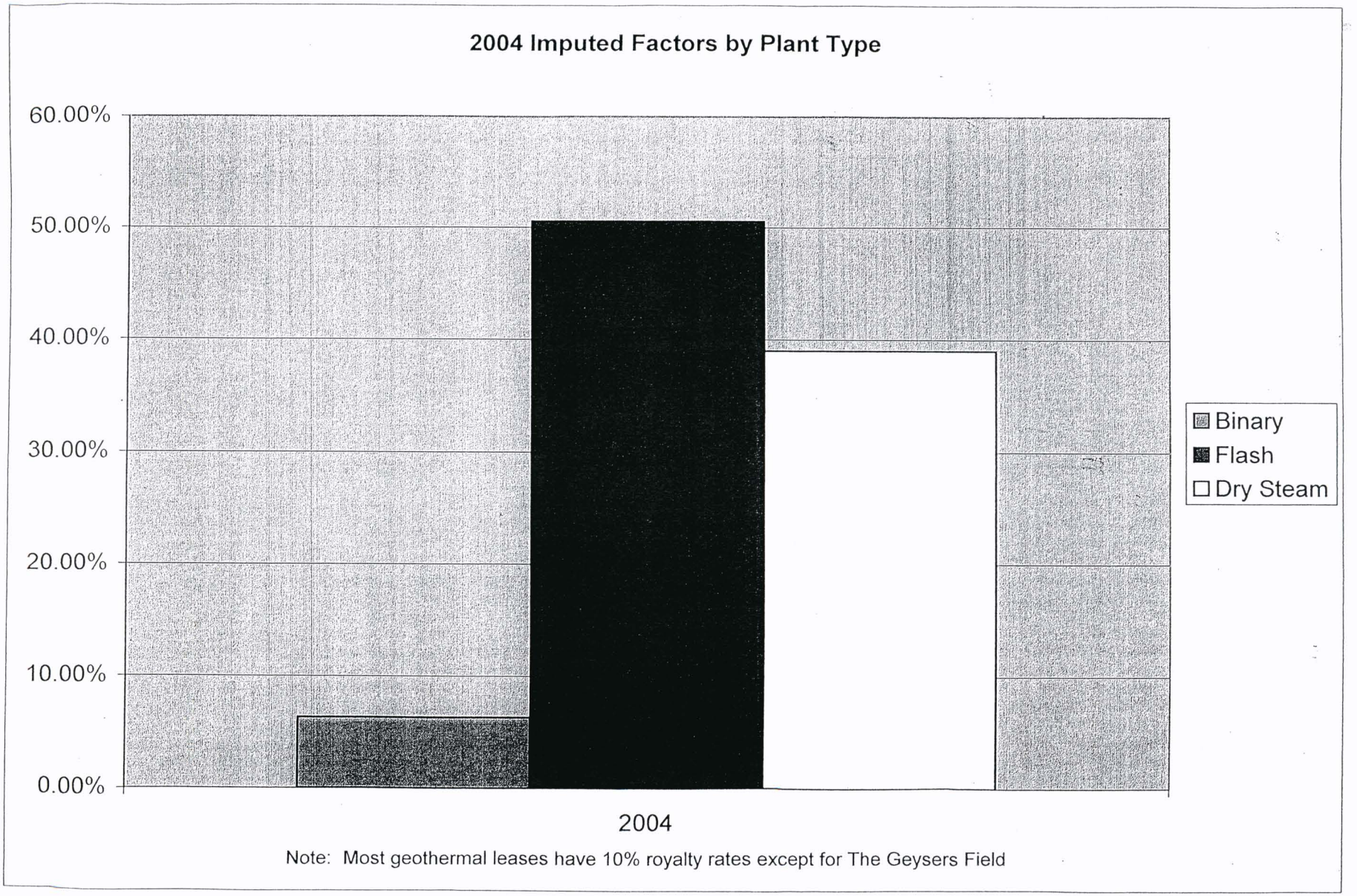
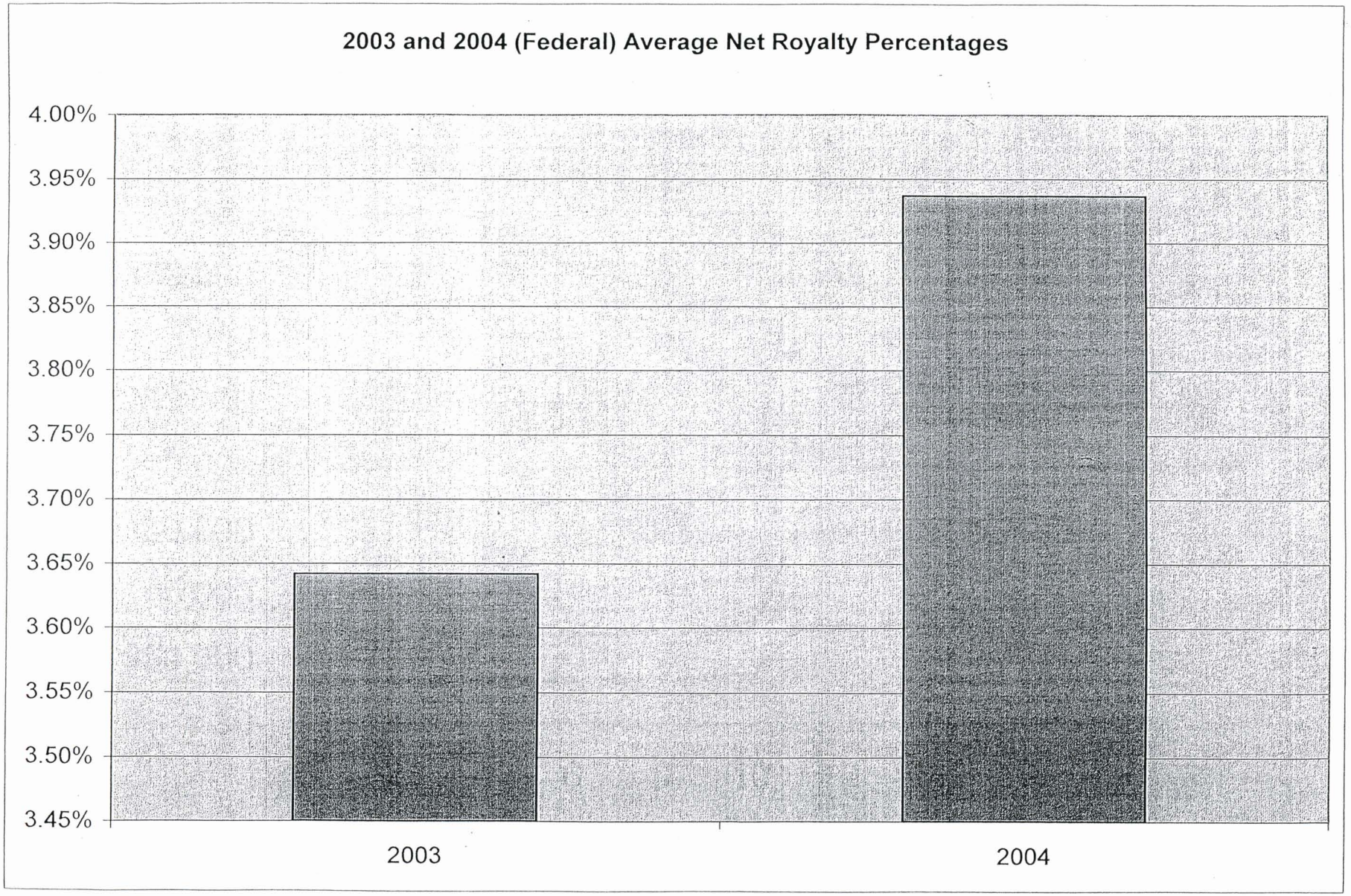


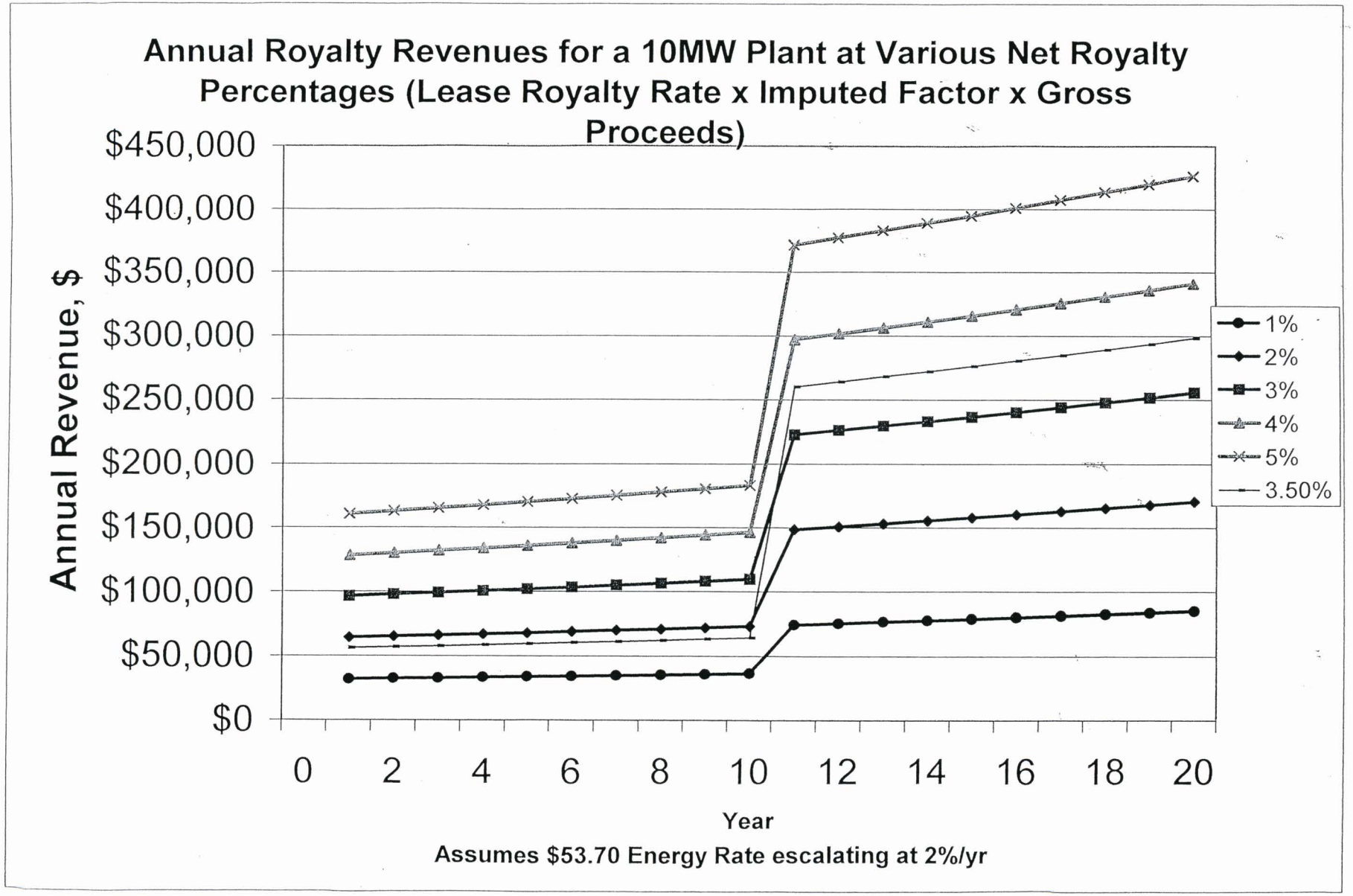
Figure 3


Direct Use Example
10,000 MMBtu/Month
Using Different Values
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
1997
1998
1999
2000
2001
2002
PRB Coal
Wood Chips
Natural Gas



Note: Most geothermal leases have 10% royalty rates except for The Geysers Field


2003 and 2004 (Federal) Average Net Royalty Percentages
4.00%
3.95%
3.90%
3.85%
3.80%
3.75%
3.70%
3.65%
3.60%
3.55%
3.50%
3.45%
2003
2004


Annual Royalty Revenues for a 10MW Plant at Various Net Royalty Percentages (Lease Royalty Rate x Imputed Factor x Gross Proceeds)
Annual Revenue, $
$450,000
$400,000
$350,000
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$0
0
2
4
6
8
10
12
14
16
18
20
Year
1%
2%
3%
4%
5%
3.50%
Assumes $53.70 Energy Rate escalating at 2%/yr

The graph is based on an analysis contributed with the Subcommittee's gratitude by Ellen Allman of Caithness Energy. This is a 20 year projection of annual royalties for a new 10MW geothermal power plant.

MMS added the line showing the proposed 3.5% effective royalty rate for new electrical generation projects. All rates shown are cut by 50% for the first 10 years.

Assumptions:

Size of Plant, MW	10
Availability, %:	98%
Starting Energy Rate, $/MW:	53.70
Effective Annual Capacity Rate, $/MW	21.10
Inflator, %	2%
Lease Royalty Rate, %	10%