

Chapter 5

Valuation Standards for Direct-Use

This chapter describes the standards in 30 CFR 1206.355 and 30 CFR 1206.356 for valuing geothermal resources that you use in direct-use processes for Class 1 leases. For Class 2 and 3 leases, see the Geothermal Payor Handbook- Class 2 & 3 Leases. Direct-use includes commercial and residential space heating; greenhouse heating; industrial and agricultural operations requiring process heat; and other operations where thermal water is the heat source. These resources usually involve warm to hot water and the heat that they produce. Valuation standards group according to the resource's disposition as follows:

- Sales under an arm's-length contract
- Use by the lessee in the lessee's own direct-use facility

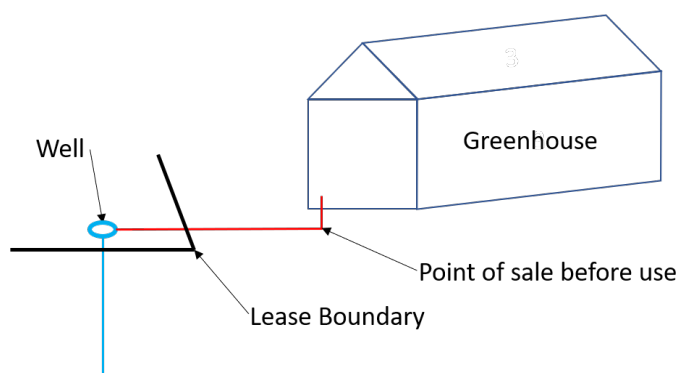
Valuation standards for resources that you sell under an arm's-length contract focus on the contract's gross proceeds with the conditions that the gross proceeds reflects total consideration and reasonable value (see "Exceptions to Acceptance of Arm's-Length Gross Proceeds" in Chapter 2).

Valuation standards for resources that you use in your own direct-use facility are valued under a sequence of three methods, where you determine value under the first applicable method in descending order of appearance. For example, if the first method is not applicable or not workable, valuation falls to the second method, and so on. We will detail the alternative fuel method, appearing as the second benchmark in the non-arm's-length and no-sales valuation standards, in Chapter 5.2.2.

We refer to geothermal resources that you use in direct-use processes as "Direct-Use Resources."

5.1 Arm's-Length Sales

If you sell geothermal resources produced from Class I, II, or III leases at arm's length to a purchaser for direct use, then the royalty on the geothermal resource is the gross proceeds accruing to you from the sale of the geothermal resource to the arm's-length purchaser multiplied by the royalty rate in your lease or that BLM prescribes under 43CFR 3211.18.



See “General Valuation Principles” in Chapter 2 for additional discussion on arm’s-length contracts and gross proceeds.

The sales contract must reflect both a reasonable value and the total consideration that the buyer actually transferred, either directly or indirectly, to the seller (30 CFR 1206.361(b)).

1. ONRR may determine that the gross proceeds do not reflect the reasonable value of the resource because of misconduct by or between the contracting parties, or because you have otherwise breached your duty to market the production to the mutual benefit of yourself and the Federal Government.
2. ONRR may determine that the contract does not reflect that the total consideration is synonymous with the full definition and intent of gross proceeds, as discussed in Chapter 2.

If the contract does not reflect a reasonable value or the total consideration, ONRR may require you to increase the gross proceeds to reflect any additional consideration. Alternatively, for Class I leases, ONRR may require you to use another valuation method in the regulations applicable to dispositions other than under an arm's-length contract. ONRR will notify you to give you an opportunity to provide written information justifying your gross proceeds.

Example 5-1: Arm’s Length Sales

This example shows how to calculate royalties for an arm’s length sale of geothermal resources to a direct use facility.

Assumptions:

- The royalty rate is 10%
- The production sales month is October 2017.
- You sell steam to a nonaffiliated owner of a geothermal greenhouse. The sales contract establishes a price of \$0.015 per thousands of lbs. of steam.
- The pay statement for the month shows 26,140,500 lbs. of steam.

The information reported on Form ONRR-2014 is shown on the following fact sheet.

Form ONRR 2014 Fact Sheet

Product Code	Sales Type Code	Sales MO/YR	Sales Volume	Sales Value	Royalty Value Prior to Allowances
32	ARMS	102017	26140500 lbs. steam	\$392107.50	\$39210.75

How to calculate royalty value prior to allowance:
 $\text{Sales Volume} * \text{Price} * \text{Royalty Rate}$

$$26140500\text{lbs.} * \$0.015/\text{lb.} * 0.10 = \$39210.75$$

Please contact ONRR Royalty Valuation at royaltyvaluation@onrr.gov if you have any questions on how to do these calculations.

5.2 If you use the Geothermal Resource for your own Direct- Use purpose

If you use a geothermal resource for your own direct-use purpose you use the first of three applicable methods. If the first method does not apply you move onto the second method and so on.

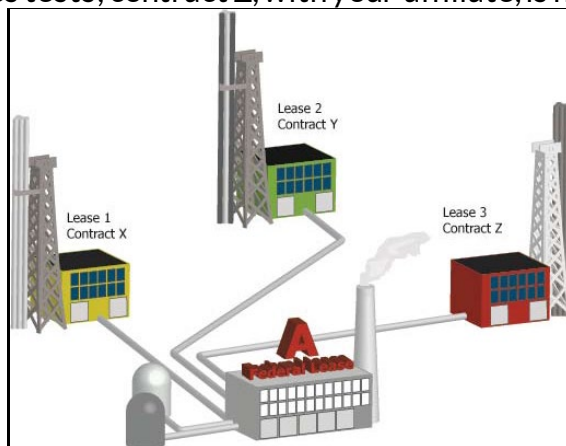
5.2.1 First non-arm's-length valuation benchmark: Weighted Average of Gross Proceeds in Arm's-Length Contracts

Method 1 is applicable only when you purchase, under arm's-length contracts, significant quantities of geothermal resources to operate the same direct-use facility. In this situation, you value the geothermal resource as the weighted average of the gross proceeds that you established in the arm's-length contracts (see example 5-1 below). "Gross Proceeds," for the purpose of determining a weighted average, means contract prices. The volumes of resource that you purchased must meet the significant quantities test.

You must judge the acceptability of the arm's-length contracts by considering their time of execution; duration; terms; quality and volume of resource that you purchased; and other factors that may reflect the value of the resource. If you use only your own production to operate your direct-use facility (that is, you don't purchase significant quantities of geothermal resources under arm's-length contracts), valuation falls to the second method (see further discussion in the following sections).

Example 5-2: Valuing Direct-Use Resources under the First No-Sales Benchmark

As lessee of the Federal lease and owner of direct-use facility A, you purchase most of your geothermal fluids from adjacent non-Federal leases 1, 2, and 3 under contracts X, Y, and Z, respectively. Contracts X and Y are arm's-length, and both meet the comparability and significant quantities tests; contract Z, with your affiliate, is non-arm's length.



Summary Data

Lease	Contract	Contract Type	Production (MMBtu)	Price (\$/MMBtu)	Revenue (\$)
Federal	—	—	8,000	—	—
Lease 1	X	AL	35,000	2.05	71,750.00
Lease 2	Y	AL	30,000	2.12	63,600.00
Lease 3	Z	NAL	12,000	1.85	22,200.00

In this example, you calculate the value of your Federal lease production as the monthly weighted average of prices under your two arm’s-length contracts as follows:

$$\frac{(\$2.05 \times 35,000) + (\$2.12 \times 30,000)}{35,000 + 30,000} = \$2.082308/\text{MMBtu}$$

You report and pay royalty on production of 8,000 MMBtu at a value of \$2.082308/MMBtu, or \$16,658.46.

5.2.2 Second Valuation Method for Direct-Use: Alternative Fuel Valuation

Method 2 for direct-use resources is the Alternative Fuel Valuation. You calculate the value of the geothermal production as a product of (1) the least expensive, reasonable alternative fuel that the geothermal resource replaced and (2) the amount of thermal energy that the geothermal resource displaces.

$$\text{Geothermal Value} = \text{Alternative Fuel Value} \times \text{Thermal Energy Displaced}$$

The value of the alternative fuel is its retail price in the local market, converted to dollars per million British thermal units (\$/MMBtu). Thermal energy displaced is the amount of the alternative fuel, in MMBtu, that you would otherwise use in your direct-use process in place of the geothermal resource. You calculate the amount of thermal energy displaced from the equation in Section 5.3 below.

You determine the price of the alternative fuel, the amount of thermal energy displaced, and the geothermal value for each month that you have production. The following steps will guide you through the valuation process.

Step 1: Select the least expensive, reasonable alternative fuel that you would otherwise use in place of the geothermal resource.

Step 2: Obtain the price (value) of your alternative fuel from your local supplier and convert it to \$/MMBtu (see “Valuing Your Alternative Fuel” below).

Step 3: Calculate the amount of thermal energy displaced (see “Calculating Thermal Energy Displaced” below).

Step 4: Calculate the geothermal value and allocate it to leases as necessary (see Example 5-4 below).

Step 5: Report on Form ONRR-2014, for each Federal lease, the allocated thermal energy displaced in MMBtu and allocated dollar value and pay royalties accordingly.

5.2.2.1 Selecting Your Alternative Fuel

The alternative fuel is the one that you would reasonably use at your location and in your facility in place of the geothermal resource. Answer the following questions to make your selection.

1. Did you previously use this fuel before converting to geothermal?
2. Is the alternative fuel compatible with and commonly used in processes like yours?
3. Is the alternative fuel available in the local market?

If you answer “yes” to question 1, don’t go any farther: your selected fuel is the one that you are actually replacing and is the reasonable alternative. If you answer “no” to question 1, then you must also consider questions 2 and 3. For example, natural gas may be the most commonly used fuel in processes like yours, but it might not be available at your location. In this case, another fuel, such as diesel or heating oil, might be your reasonable alternative. If you have access to more than one type of fuel in your area, choose the least expensive one that would be compatible with your facility or process.

5.2.2.2 Valuing Your Alternative Fuel

The value of your selected alternative fuel is the unit price that others normally pay in the local retail market. Thus, when natural gas is the alternative, value will be the commercial rates—including cost-of-gas, cost-of-service, and other rates normally charged—available from your local distribution company or utility. When diesel, heating oil, propane, coal, or another fuel is the alternative, value will be that fuel’s retail price normally available from distributors or other sources in the local market. You are responsible for obtaining and documenting the value of your alternative fuel for each month that you report production. You must state the value of the alternative fuel in terms of \$/MMBtu. If the price of the alternative fuel is in another unit of measurement, such as cents-per-gallon or dollars-per-therm (100,000 Btu), you must convert to equivalent \$/MMBtu based on the fuel’s gross heating value (heat of combustion or heat content, see Examples 5-1 and 5-2 below). Your local distributor should be able to give you the fuel’s heating value.

The following examples demonstrate how to convert an alternative fuel price, in this case heating oil, to the required units of \$/MMBtu.

Note : Calculate prices to six decimal places when converting to \$/MMBtu

Example 5-3: Converting a Heating Oil Price from \$/Gallon to \$/MMBtu

- Alternative fuel = No. 1 heating oil
- Heating value = 138,800 Btu/gal
- Price = \$0.795/gal
- Unit value of alternative fuel:

$$\frac{\$0.795}{\text{gal}} \times \frac{1 \text{ gallon}}{138,800 \text{ Btu}} \times \frac{1,000,000 \text{ Btu}}{1 \text{ MMBtu}} = \$5.727666/\text{MMBtu}$$

The following examples demonstrate how to convert an alternative fuel price, in this case natural gas, to the required units of \$/MMBtu.

Example 5-4: Converting a Natural Gas Price from \$/Therm to \$/MMBtu, with Monthly Service Charges

When natural gas is the alternative fuel, value will be the commercial rates—including cost-of-gas, cost-of-service, and other rates normally charged—available from your local distribution company or utility:

- Alternative fuel = Natural gas
- Cost of gas = \$0.2639/therm (\$2.639/MMBtu)

This is a cost-of-service contract: You must convert therms to MMBtu:

- Basic cost of service = \$0.0844/therm * 10 = (\$0.844/MMBtu) (1 therm= 10 MMBtu)
- Service charge: \$500/month

Thermal energy displaced = 12,000 MMBtu

In this example, use the amount of thermal energy displaced to calculate the component value of the service charge:

$$\text{Unit Value of Service Charge} = \frac{\$500}{12,000 \text{ MMBtu}} = \$0.041667/\text{MMBtu}$$

The unit value of the alternative fuel is the sum of the price rates:

$$\$2.639 + \$0.844 + \$0.041667 = \$3.524667/\text{MMBtu}$$

5.2.2.3 Calculating Thermal Energy Displaced

Thermal energy displaced is the amount of thermal energy that would otherwise be used by the direct use facility in place of the geothermal resource. That amount of thermal energy (in Btu) displaced by the geothermal resource will be determined by the equation (30 CFR 1206.356(a)(2)):

$$\text{Thermal Energy Displaced} = \frac{(h_{in} - h_{out}) \times \text{Density} \times 0.133681 \times \text{Volume}}{\text{Efficiency Factor}}$$

where:

- **h_{in}** = Enthalpy in Btu per pound (Btu/lb) of the geothermal fluid entering the direct-use facility, based on inlet temperature
- **h_{out}** = Enthalpy in Btu/lb of the spent geothermal fluid leaving the direct-use facility, based on outlet temperature
- **Density** = Density in pounds per cubic foot (lb/ft³) of the geothermal fluid entering the direct-use facility, based on inlet temperature and generally calculated as the reciprocal of the specific volume
- **0.133681** = Constant factor in cubic feet per gallon (ft³/gal) to convert gallons to cubic feet
- **Volume** = Gallons of geothermal fluids produced
- **Efficiency Factor** = The efficiency factor accounts for stack and boiler heat losses that would occur with combustion of the alternative fuel. 0.7 for coal and 0.8 for natural gas, diesel, heating oil, and other refined petroleum produced

Sample calculations of thermal energy displaced are available in Example 5-5 and Example 5-6.

Enthalpies (h_{in} and h_{out}) are for saturated liquid (water) at the corresponding inlet and outlet temperatures. Determine them from standard steam tables available in engineering and thermodynamic handbooks, such as:

- *Steam Tables: Thermodynamic Properties of Water Including Vapor, Liquid, and Solid Phases (English Units)* (John Wiley and Sons)
- *CRC Handbook of Chemistry and Physics* (CRC Press, Inc.)
- *ASME Steam Tables* (American Society of Mechanical Engineers)
- Or appropriate online calculators

Calculate density as the reciprocal of the specific volume of saturated liquid (water) that corresponds to the inlet temperature:

$$\text{Density} = \frac{1}{\text{Specific Volume}}$$

Specific volumes are given in the steam tables.

5.2.3 Third valuation method for direct use- other valuation methods

Select the efficiency factor that corresponds to your alternative fuel. You may propose a different efficiency factor, but you must receive our approval to use it.

Calculate the thermal energy displaced to the nearest whole Btu. For valuation and reporting purposes, convert the Btu to MMBtu by dividing by one million (1,000,000). Maintain six decimal places to calculate your geothermal value, rounding to the nearest whole cent, to report Sales Value on Form ONRR-2014. Round the thermal energy displaced to the nearest whole MMBtu to report Sales Volume on the Form ONRR-2014.

The third method is a royalty determined by any other reasonable method approved by ONRR under 30 CFR 1206.364.

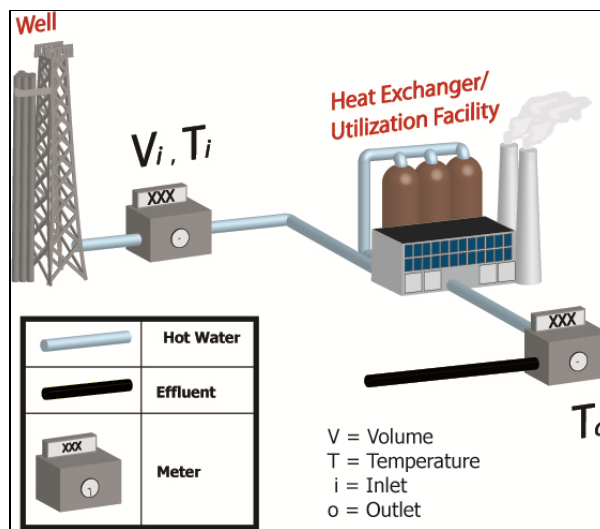
To request guidance or to propose a valuation method, please contact the Royalty valuation mailbox at royaltyvaluation@onrr.gov.

5.3 Resource Measurements

You need the following three resource measurements to calculate thermal energy displaced:

1. Volume in gallons of geothermal fluid entering your direct-use facility.
2. Temperature in degrees Fahrenheit (°F) of the geothermal fluid at the inlet to your direct-use facility.
3. Temperature in °F of the spent geothermal fluid at the outlet of your direct-use facility.

Figure 5-1 below shows the general location of measurement points. You may need other measurements if your production is from more than one lease. The Bureau of Land Management (BLM) must approve your metering system and measurement points prior to operation.



5.4 Allocation to Leases

When you use geothermal resources from more than one lease in your direct-use facility and you commingle the production, you must allocate your calculated thermal energy displaced and geothermal value to individual leases.

Allocation must come from:

- The proportion of measured wellhead or lease production.
- The allocation schedule in your unitization or communitization agreement.
- Any other BLM approved measurement or allocation method.

BLM must approve your allocation method before you use it. BLM must also approve any commingling and measurement of non-Federal geothermal fluids you use in your direct-use facility.

5.5 Reporting on Form ONRR-2014

Report volumes and values calculated under the alternative fuel method on Form ONRR-2014 as follows:

- **Sales Volume:** Amount of thermal energy displaced in MMBtu allocated to the lease
- **Sales Value:** The dollar value of geothermal production allocated to the lease as calculated by the alternative fuel method
- **Royalty Value:** Product of Sales Value and lease royalty rate

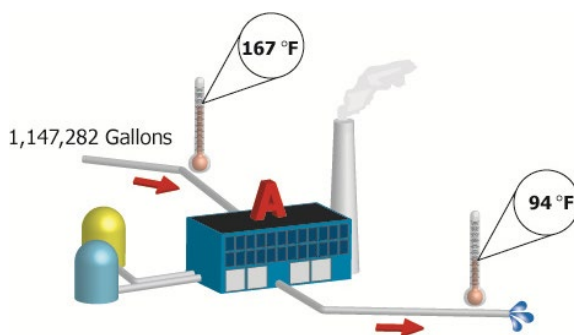
5.6 Example Valuations Using the Alternative Fuel Method

Examples 5-5 and 5-6 below illustrate valuation of geothermal resources using the alternative fuel method. These examples assume hand or online calculation of thermal energies displaced, with inlet and outlet temperatures given as weighted averages of periodic recordings. If your metering system automatically calculates and totals thermal energy displaced, then you need to only download this amount and multiply it by the alternative fuel value (price) to calculate and report your geothermal value.

Example 5-5 Calculating Value under the Alternative Fuel Method When Production Is from a Single Lease

Figure 5.2

In this example, you use only your own Federal lease production in your direct-use facility A. The selected alternative fuel is heating oil (efficiency factor = 0.8) with an equivalent value of \$5.727666/MMBtu. The lease royalty rate is 10%.



- Month's resource measurements
 - Production = 1,147,282 gal
 - Inlet temperature = 167°F
 - Outlet temperature = 94°F
- From steam tables
 - Enthalpy of inlet fluid (h_{in}) = 134.97 Btu/lb
 - Specific volume of inlet fluid = 0.016434 (ft³/lb)
 - Calculated density of inlet fluid

$$\frac{1}{0.016434 \text{ ft}^3/\text{lb}} = 60.849458 \text{ lb}/\text{ft}^3$$

Enthalpy of outlet fluid (h_{out}) = 62.06 Btu/lb

- Thermal energy displaced

$$\frac{(134.97 - 62.06) \text{ Btu}/\text{lb} \times 60.849458 \text{ lb}/\text{ft}^3 \times 1,147,282 \text{ gal}}{0.8}$$
- Value of geothermal resource

$$\$5.727666/\text{MMBtu} \times 850.537940 \text{ MMBtu} = \$4,871.60$$
- Report on Form ONRR-2014 (royalty rate = 10%)

Sales Volume	851 MMBtu
Sales Value	\$4,871.60
Royalty Value	\$487.16

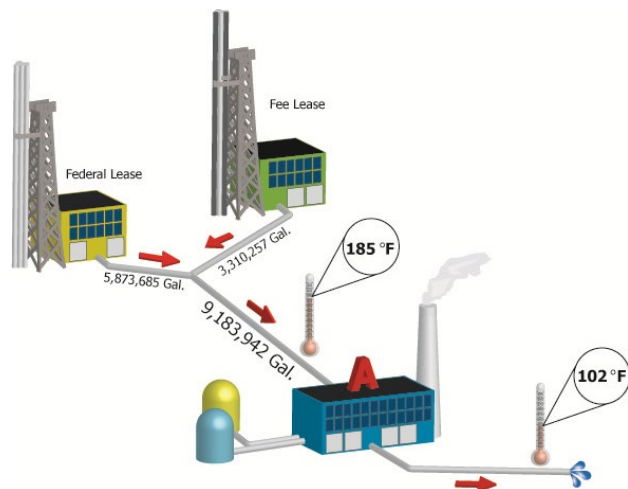
Example 5-6 Calculating Value under the Alternative Fuel Method When Production Is from More Than One Lease

In this example as shown on Figure 5-3 below, you use both your Federal lease production and production from an adjacent private lease, which you also own, to operate direct-use facility A. BLM has approved commingling and has established allocation on the basis of proportionate well production.

Figure 5-3

The alternative fuel is natural gas (efficiency factor = 0.8) with the following rates:

- Cost of gas = \$0.1795/therm (\$1.795/MMBtu)
- Basic cost of service = \$0.0764/therm (\$0.764/MMBtu)
- Service charge = \$750/month



The Federal lease royalty rate is 10%.

- Month's resource measurements
 - Federal lease production = 5,873,685 gal
 - Private lease production = 3,310,257 gal
 - Total production = 9,183,942 gal

Federal lease allocation factor:

$$\frac{5,873,685 \text{ gal}}{9,183,942 \text{ gal}} = 0.639560$$

- Inlet temperature = 185°F
- Outlet temperature = 102°F
- From steam tables
 - Enthalpy of inlet fluid (h_{in}) = 153.01 Btu/lb
 - Specific volume of inlet fluid = 0.016539 ft³/lb

Calculated density of inlet fluid:

$$\frac{1}{0.016539 \text{ ft}^3/\text{lb}} = 60.463148 \text{ lb/ft}^3$$

- Enthalpy of outlet fluid (h_{out}) = 70.04 Btu/lb

- Thermal energy displaced

Volume of 1 gallon in cubic feet = 0.133681 ft³/gal

$$\frac{(153.01 - 70.04) \text{ Btu/lb} \times 60.463148 \text{ lb/ft}^3 \times 0.133681 \text{ ft}^3/\text{gal} \times 9,183,942 \text{ gal}}{0.8}$$

- Value of alternative fuel

Unit value of service charge:

$$\frac{\$750}{7,698.758134 \text{ MMBtu}} = \$0.097418/\text{MMBtu}$$

Unit value of alternative fuel:

$$\$1.795 + \$0.764 + \$0.097418 = \$2.656418/\text{MMBtu}$$

Value of geothermal resource

$$\$2.656418/\text{MMBtu} \times 7,698.758134 \text{ MMBtu} = \$20,451.12$$

Value allocated to Federal lease:

$$\$20,451.12 \times 0.639560 = \$13,079.72$$

Report on Form ONRR-2014 (royalty rate = 10%)

Sales Volume, allocated to lease

$$0.639560 \times 7,698.758134 \text{ MMBtu} = 4,924 \text{ MMBtu}$$

Sales Value \$13,079.72

Royalty Value \$1,307.97

If, for some reason, the alternative fuel method is unworkable, valuation falls to the third method: "other reasonable method approved by ONRR" (see section 5.2.3).