Excess Renewable Energy Sold As Heat

Economic and Financial Analysis

1 Introduction

Renewable energy projects in many Alaska communities have been and are being installed with overcapacity with the intent of supplying excess electricity to heat loads as a way to reduce the need for heating oil in facilities and buildings. This document provides recommendations on how utilities and the Alaska Energy Authority's (AEA) Renewable Energy Fund (REF) economic analysis should value the benefits and costs of excess electricity from renewable energy projects.

Excess energy (or **excess electricity)** is available when renewable energy sources such as wind, hydro, or solar produce more electricity than is required by the grid at any moment. Excess electricity on a grid can cause voltage and frequency disturbances, issues for customers, and damage to infrastructure. The excess energy must be consumed by customers or a load bank (essentially an electric heater that consumes excess energy).

Delivering excess renewable energy to customers is not free, particularly if the infrastructure was intentionally oversized. There are actual costs associated with the generation and delivery of excess electricity to customers; the customers consuming excess renewable energy should be charged for those costs in the form of an excess power rate. An excess power rate should cover the complete cost of generation and delivery of electricity to customers using it. If the excess power rates do not cover the generation and delivery costs, other utility customers will subsidize the sale of excess power through higher rates. Based on information available to AEA, it appears that the excess energy rates that many rural utilities charge are not based on the cost of delivering the energy. Instead, other customers are charged more to subsidize the excess power delivered for heat.

Traditional customers receive what is known as **firm power:** the utility must have sufficient generation that is available to meet the **load** (amount of electricity needed at any point in time). Generation that can be controlled to meet the load is called **dispatchable.** Renewable energy sources such as wind and solar are **non-dispatchable** because they produce power when the wind or sun is available, not when it is needed. Because of this, excess power from renewable can only provide **interruptible power**: the utility does not have to deliver energy when it is needed, only when it is available (the power can be interrupted at any time). Customers using excess energy for heat must rely on backup heating systems because they cannot count on interruptible excess electricity to provide all of their heating needs. To compete with the cost of heating oil and the inconveniences of maintaining two heating systems, excess electricity is sold at a steep discount relative to other electricity in town in order to compete with heating oil.

The value of excess electricity to consumers is generally less than the fuel, generally heating oil, being displaced, since customers would not be able to rely on excess electricity to provide heat as needed. Because of this, customers will expect to pay less for interruptible electricity used for heat than for the equivalent amount of heating oil. Table 1 below shows the equivalent heating cost of heating oil and natural gas relative to electricity. So if heating oil is $4.00 per gallon in the community, customers would likely want to see a savings to make the switch. In this case, the utility would have to charge less than $0.08/kWh for customers to break even.

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Table 1: Equivalent Electricity, Heating Oil and Natural Gas prices

Electricity ($/kWh)	Heating Oil ($/gal)	Natural Gas ($/Mcf)
$ 0.02	$ 1.00	$ 6.62
$ 0.04	$ 2.00	$ 13.24
$ 0.06	$ 3.00	$ 19.86
$ 0.08	$ 4.00	$ 26.49
$ 0.10	$ 5.00	$ 33.11
$ 0.12	$ 6.00	$ 39.73
$ 0.14	$ 7.00	$ 46.35
$ 0.16	$ 8.00	$ 52.97
$ 0.18	$ 9.00	$ 59.59

2 Setting utility customer rates

Utilities are a state sanctioned monopoly; the utility's customers do not have other options for their power. To balance the utility's need to pay for the costs of running the utility and the customer's need for low cost power, utilities should set cost-based rates. A **cost-based rate** will mean that the **revenues** (money collected from customers) will equal the utility's annual **expenses** (the costs of running the utility). Utilities that are e**conomically regulated** must have their rates approved by the Regulatory Commission of Alaska (RCA). All other utilities (mainly owned by cooperatives, city, tribes, and other governments) do not require RCA approval and can charge whatever rate they want. While the RCA calculates PCE reimbursement on the allowable expenses reported by PCE-eligible utilities, the retail rate is not approved by the RCA. It is the utility's responsibility to protect all customers and ensure they all pay a fair price for electricity.

2.1 Expenses

Utility expenses are the costs for running the utility. It is very important that the utility's expenses are carefully tracked so that utility can be sustainable and self-sufficient. If the utility doesn't know how money is spent, it can't make sure that money is being spent on important things—the people, equipment, and supplies—that keep the utility running. The RCA separates utility expenses into four main categories: Personnel expenses, operating expenses, general and administrative expenses, and depreciation and interest.

1. **Personnel expenses** include all expenses associated with the people directly employed by the utility—Direct compensation, employer portion of payroll taxes, and workers' compensation insurance. A utility has four general functions that frequently require staff time: management, bookkeeping, administration, and operations. Utility managers are ultimately responsible for ensuring the financial and operational health of the utility. Utility clerks generally bill customers and fill out the monthly PCE forms submitted to AEA. The operators run the powerhouse, perform maintenance, and ensure that the utility provides stable and reliable power to customers.

2. **Operating expenses** include items and activities that are necessary to ensure the long-term, on-going operation of the utility—Fuel, purchased power, supplies, tools, rental equipment, and contractors. Operations & Maintenance costs are expenses that are incurred on a regular basis and maintenance expenses that are incurred on an annual basis, as well as replacement costs of items under $5,000.

3. **General and Administrative expenses** includes work in order to provide the financial, regulatory, and legal management of the utility. G&A expenses include office expenses for billing customers, insurance, office supplies, office rent, professional services, travel, bad debt, and training.

4. **Depreciation and interest.** *Depreciation* expense estimates the loss of an asset's value over time. An asset is something that has value after purchasing it—generally because it will be used to generate revenue for the utility in the future. Common utility assets include engines and generators, meters and transformers, computers and other office equipment. The *interest* expense includes the amount of interest paid in a given year for loans.

If a utility has more than one customer rate, the expenses should be tracked to understand which customers are responsible for each expense.

2.2 Revenue & Calculating a cost-based rate

A utility must receive enough revenue to cover the utility's expenses; in other words, the utility must make enough money to cover the utility's costs. If sufficient revenue isn't collected, the utility will eventually go bankrupt and will not be able to provide electricity to the community.

The easiest way to make sure the utility gets enough revenue is to charge a cost-based rate. The simplest cost-based rate divides all of the utility's expenses (costs) equally by the kilowatt-hours (kWhs) sold. A cost-based rate ensures that the utility is receiving sufficient revenue to cover the costs to generate and deliver power to customers. Expenses should only include things paid for by the utility: Grant-funded infrastructure, employees paid by another entity, or other gifts should not go into the cost-based rate. The equation below shows how the cost-based rate is calculated if customer rates are the utility's only revenue source.

$$Cost\ based\ rate = \frac{Personnel\ expenses + Operation\ expenses + Administrative\ expenses + Depreciation}{kWh\ sold}$$

If the utility has additional revenue sources (pole rentals, recovered heat sales, other), these revenues are subtracted from the expenses before calculating the cost-based rate.

$$Cost\ based\ rate = \frac{Sum\ of\ Expenses - Other\ Revenue\ Sources}{kWh\ sold}$$

While many PCE-eligible utilities have only one rate for all customers, most large utilities may have multiple customer rate classes. In cases where the expenses are not spread out equally across all kWh sold, it is appropriate that the utility have multiple rates. Customers receiving excess energy would be one of these cases. See section 3.1 and 3.2 below for further guidance.

3 Economic and Financial Analyses of Excess Energy

The REF **economic analysis** evaluates the benefits and costs of the project, but doesn't care who receives the benefits or who pays costs. The entire project proposal is assessed, not each

individual component. If the costs for the project, no matter who pays the costs (utility, customers, REF grant, etc.), are greater than the expected benefits, no matter who receives the benefits (utility, customer, Power Cost Equalization (PCE) program, etc.), then the project would not be considered economically viable. If the total benefits to all parties outweigh the costs paid by all parties, then the project is considered to be economically viable

The **financial analysis** focuses on (1) if the cost-based rates needed recover the costs of generating and delivering the excess power to customers are beneficial to the utility, and (2) if the cost-based rates are financially beneficial to customers. Unlike an economic analysis, the financial analysis only includes the costs actually paid by the utility and customers and does not include grant funds or other subsidies.

It is quite possible that a project can be financially viable but not economically viable, especially if the project receives significant amount of grant funds.

3.1 REF Economic Evaluation of Excess Energy

The economic evaluation assesses the economic viability, not financial viability, of a project. The entire project proposal is assessed, not each individual component. If the costs for the project are greater than the expected benefits, then the project would not be economically viable. If the total benefits to all parties outweigh the costs incurred by all parties, then the project is considered to be economically viable. The economic analysis is indifferent to who receives benefits and who pays costs.

- **Benefits**: Savings to utility customers, non-utility customers, PCE, and others
- **Costs**: Expenses paid for by utility customers, grants from state, federal, and regional governments; non-profits, non-utility

AEA uses an Excel-based economic model to provide the underlying assumptions (such as expected fuel costs), calculations and analysis. The following sections follow the general outline of AEA's economic model.

3.1.1 Costs

Project Capital Cost: All **capital costs** (fixed, one-time expenses incurred on the purchase of land, buildings, construction, and equipment used in the production of energy) should be included in the year that they are expected to be incurred. If the excess energy recovery project is part of a larger renewable energy project, such as wind construction project, the capital costs would all be summed and not reported separately. This should include all infrastructure upgrades that are required for project success—generation, distribution, controls, and metering. All costs required for the project to be fully operational should be included. Even if the applicant is not the owner of the infrastructure, such as a customer that must purchase a new dual fuel boiler with associated controls, the capital cost should be included if it is required for the project to produce, distribute, or consume the excess energy.

The total capital cost would be captured in a project where the applicant has intentionally "oversized" renewable energy generation infrastructure to capture more excess energy specifically to offset heating oil consumption costs. The economic analysis assumes that the applicant had performed the necessary value engineering to correctly size the project to maximize the economic and financial benefits of the project. It will not separate out the excess

energy component of the project, unless there are specific concerns of the long-term financial viability of selling excess energy.

Renewable Heat Scheduled Repairs, O&M, and Other Costs: The applicant should provide estimates for all annual and recurring expenses; if the applicant does not include estimates, AEA will use its own estimates. If it is possible to divide the Scheduled Repairs and O&M between the Electric and Heating portions of the project, that can provide some guidance on what drives the benefit-cost ratio. If the applicant doesn't provide enough information to divide the costs accurately, the renewable energy generation costs can be allocated to the Electric or Heating portions of the Excel model without changing the final results.

If the excess energy project is an addition to an existing project, Renewable Heat Scheduled Repairs, O&M, and Other Costs should capture the annual expenses that are unique to the excess energy project. These should be new costs to the utility and/or building/facility owners. Scheduled Repairs will be large ticket repairs on the system of delivering excess heat—expected repairs on boilers, controls, transformers, etc.

Some unique O&M expenses will be seen by the renewable heat project, these will be included as "Renewable Heat O&M". These costs could include: O&M on boilers, troubleshooting operational issues, controlling the selection of the flow of excess power, and other such activities. If the utility chooses to require customers to operate, maintain, and replace the boilers and controls, the costs incurred by the building/facility owners should still be captured here.

Other new, unique costs associated with the excess energy project may include metering, troubleshooting, controlling, and billing new customers.

3.1.2 Benefits

The vast majority of benefits for a renewable energy project will be from the displaced purchase and storage costs of diesel and heating fuel. In cases where the diesel engines and/or the fossil fuel-fired heaters can be turned off, the Displaced Scheduled Repairs and O&M of the base system can also be included as benefits.

Displaced Fuel Use (electricity): Applicants should be able to provide estimates for monthly excess energy based on expected resource availability and the monthly community load. This displaced fossil fuel-fired energy will be expressed as the gallons of diesel fuel displaced. As projects progress from Reconnaissance to Construction, the precision and granularity of that estimate should be improved. Sufficient information should be provided to AEA during the evaluation process so that AEA's subject matter experts will be able to confirm the estimates.

Displaced Fuel Use (heating): Applicants should be able to provide estimates for monthly excess energy based on expected resource availability, the monthly community load, and the heating needs of customers. This excess energy will be expressed as the amount of heating fuel displaced. As projects progress from Reconnaissance to Construction, the precision and granularity of that estimate should be improved. Sufficient information should be provided to AEA during the evaluation process so that AEA's subject matter experts will be able to confirm the estimates.

Diesels OFF operations: In cases where the renewable energy system expects to turn off the diesel engine or heating oil system, the displaced O&M, scheduled repairs, and other costs can be included in the benefits.

If there are concerns that customers will not buy excess energy for the cost-based rate, additional analysis can be performed and reported to AEA staff as a potential project risk. AEA may decide to discount the expected benefits based on the financial risk.

The **benefit** is the difference between the total cost of the proposed generation and the base fossil fuel generation.

3.1.3 Benefit-Cost Ratio

The Renewable Energy Fund evaluation process uses the benefit-cost ratio as its primary metric for economic viability. The **benefit-cost ratio** (B/C ratio) summarizes the all of the project's benefits and costs into a single number.

The total benefits of the project are found by taking the present value of all of the annual cost savings. The cost is the present value of the project's capital costs.

$$\text{B/C ratio} = \frac{\text{Project Benefits}}{\text{Capital Costs}}$$

Understanding the B/C ratio

B/C ratios communicate the economic viability of a project as a single number making it ideal for communicating benefits and costs in a concise manner.

- A B/C ratio greater than 1 means that the benefits are greater than the capital costs. Even without grant funds, the project should be cost effective and save the utility and customers money.
- A B/C ratio of 1 means that the benefits equal the Capital costs—the project just breaks even.
- A B/C ratio less than 1 means that the costs are greater than the benefits—economically things would be worse than before the project was built. Without grant funds, the project would not be cost effective and the utility and/or customers would lose money.

Since many projects will lead to savings for utilities and customers, even projects with B/C ratios below 1, it can be confusing why AEA would use the benefit-cost ratio to rate projects. The state wants to maximize its return on investment, its "bang for the buck", and wants to promote cost effective designs.

3.2 Financial Analysis of Excess Energy

A financially viable project will benefit customers and the utility—people will save money. The utility should take a close look to make sure that the excess energy can be supplied to customers in a way that is financially beneficial to both the utility and the customer. Customers will not buy excess energy if it costs more than a reasonable replacement. The utility will either lose money or be forced to charge other customers more to subsidize the excess energy customers if it is not financially beneficial to the utility.

3.2.1 Calculating a cost-based rate for excess energy

In this analysis, it is assumed that the utility chooses to sell excess power as electricity to one or more customers. Even with selling excess power to customers, the utility will still need a load bank as the utility may not always have customers that can take all of the excess power—especially in summer time when heat may not be needed.

It is appropriate that excess power customers should have lower rates than firm power customers (i.e. residential, commercial, government facilities guaranteed to receive power when they call for it), but the lower rate should still reflect the cost of delivering excess power to those customers. If it does not, customers not receiving excess power will pay higher rates to cover the extra costs.

There are plenty of common utility expenses that should not be included in the excess power rate. As long as the utility is only supplying excess energy customers with power from the renewable energy system (wind, hydro, solar, etc.), none of the expenses associated with diesel power generation should be included: fuel expenses, diesel O&M, generator depreciation expenses, etc.

While diesel generation costs and all granted-funded assets should be excluded, not all generation and distribution expenses will be excluded from the excess power customers' rate. It may be easiest to think about the functional charges that may be levied against a customer: Customer charges, energy charges, and delivery charges.

- *Customer charges*, if the utility charges them, should recover the costs—such as billing, collections, etc.—that may be incurred on a per customer basis.
- *Energy charges* should recover the costs associated with generating the electricity. This can include depreciation and interest expenses, parts and supplies for O&M on the generation units, the personnel and contractors to do O&M, and other such expenses.
- *Delivery charges* should recover costs for getting the excess energy to customers. This may include the expenses associated with the transmission and distribution system (both capital and operational expenses), the operation and capital costs of switchgear and controls, other utility-owned infrastructure such as boilers that may be needed, and other general and administrative costs not covered by the customer charge.

Table 2: Excess Energy Charges and Expenses

	EXPENSES TO BE INCLUDED	HOW IT SHOULD BE SHARED
CUSTOMER CHARGE	Various administrative costs not covered elsewhere	
ENERGY CHARGE	*Depreciation & interest* for non-grant funded renewable energy assets	% of all RE generation
	Operational costs for renewable energy assets	% of all RE generation
	Maintenance costs for renewable energy assets	% of all RE generation
DELIVERY CHARGE	*Depreciation & interest* for non-grant funded utility-owned boiler assets (may be located in customers' facilities)	All costs to be covered by excess energy customers
	Depreciation & interest for non-grant funded utility-owned distribution assets (lines, transformers, etc.)	% of all sales
	Depreciation & interest for non-grant funded utility-owned controls and switchgear	% of all sales

	Depreciation & interest for non-grant funded utility-owned meters	% of all customers
	Operations and maintenance for distribution assets, controls and switchgear	% of all sales
	Administrative expenses for meter reading, billing, professional services, and other general & administration expenses not covered by customer charge	% of all customers

The expenses specific to excess energy may be easy to determine if the utility has a sufficiently detailed bookkeeping system. Once the expenses are determined, it will be simple to determine an appropriate cost-based rate. If there isn't a customer charge, you will just have to add up the expenses and divide by the expected number of kWhs to be sold as excess energy. In the equations below, the expenses should only include those specific to the excess energy customers, as seen in Table 2 on the previous page.

$$Excess\ energy\ cost\ based\ rate = \frac{Personnel\ + Operations + Administration\ + Depreciation}{Excess\ kWh\ sold}$$

If there is a customer charge or other revenue source, the cost-based rate will be the sum of expenses minus the sum of the annual customer charges divided by the expected number of kWhs to be sold as excess energy.

$$Excess\ energy\ cost\ based\ rate = \frac{Sum\ of\ annual\ expenses - Sum\ of\ annual\ customer\ charges}{Excess\ kWh\ sold}$$

3.2.2 Financial analysis for customers

In the economic analysis of an excess energy project, the heating oil saved by the project is counted as a benefit. Since the benefit of reduced heating oil consumption goes to the building or facility owner, and not directly to the utility, the utility and utility customers are not saving any money. In order for the utility to benefit, the utility must charge the customer to recover the costs of delivering the power to the customers. The utility must receive payment from customers for the project to be financially viable for the utility, especially if the utility has taken out a loan to pay for the infrastructure. Ideally, the utility should charge the cost-based rate calculated in the previous section.

The most basic financial question for a customer will be: Is using electricity cheaper than heating oil? Table 1 on page 2 gives comparison of the relative cost of electricity to the equivalent price of heating oil. So if electricity is priced at $0.10/kWh, heating oil would have to cost more the $5.00/gallon for the customer to save any money.

Customers will likely have more costs than just the electricity. Ideally, a customer would look at the **life cycle cost**, the total cost of ownership over the entire life including the purchase price, maintenance costs, electricity costs, etc. The excess energy customers may have other things to pay for:

1. Will they have to buy the heater?
2. Will they pay for maintenance and replacement of system?
3. Will they have to pay to connect the heater to the grid?

4. Are there other costs?

If the utility is not able to sell the excess energy to customers at the cost-based rate and have it be financially beneficial to customers, it will mean that the utility will (1) lose money, (2) raise rates on other customers, or (3) be unable to sell excess energy.

4 Examples of interruptible rates for excess power

At least two economically regulated utilities have filed special contracts for interruptible power in Alaska: Sand Point Generating and Alaska Electric Light & Power (AEL&P). Sand Point Generating filed special contract for excess wind generation in 2019, while the AEL&P's interruptible rate special contract goes back at least to 2001.

4.1.1 Sand Point Generating

In 2019, TDX Sand Point Generating submitted two special contracts for interruptible power to the RCA.[1] Sand Point Generating is a subsidiary of TDX Power and is economically regulated by the RCA. The special contracts, Excess Energy to Heat Program, are for the sale of excess energy/interruptible power to the local school and clinic.

The contracts include the charges for delivering power to customers. Each Excess Energy customer is separately metered from other sales, and is levied a customer charge (the Small Commercial Customer Charge) for the excess energy account. The customer charge is meant to capture some of the administrative and overhead costs not covered in the energy charge or delivery charge.

The energy charge is limited by the AEA Renewable Energy Fund grant that provided funds for the project. The grant conditions allowed Sand Point Generating to charge customers a rate tied the utility's diesel price. In 2011, the energy charge was set at $0.06/kWh based on $4.54/gallon diesel. The grant language allowed the energy charge to change one percent based on a once percent change in the per gallon cost of diesel. The stipulations of the grant do not allow TDX Sand Point Generating to develop a cost-based rate for the energy, unless the cost of generation is below the allowed energy charge.

TDX Sand Point Generating's proposed tariff would recover costs for delivering excess energy to customers. The delivery charge includes the depreciation and operational expenses associated with the distribution system, metering, switchgear, billing, boilers, and other associated infrastructure and functions. For functions and infrastructure that are used for multiple customer classes, such as transformers and billing, the expenses are divided as either a percentage of total kWh sales or total customers, as is most appropriate in the particular case. No demand charge is levied on the customers because the power is interruptible (a demand charge is a fee based on the amount of power in kW, not energy, drawn by a customer).

In addition to the delivery, energy charge, and customer charge, the utility has additional requirements for excess energy customers. The utility requires that the installation, inspection, and interconnection of the heating equipment must be done by the utility. The customer must have an alternate fuel source with controls that automatically transition between electrical and alternative fuel source heating.

[1] The contracts can be found by searching the RCA's website for TA260-230 and TA262-230

The revenue from excess energy sales is used to reduce the Cost of Power Adjustment (COPA), an adjustment to reflect fluctuations in the cost of fuel and purchased power, for other customers.

4.1.2 AEL&P

Alaska Electric Light & Power is the utility for Juneau. Nearly 100 percent of the utility's electricity is produced by hydropower; in some times of the day and year, the utility has additional hydropower capacity that is not used by firm power customers. AEL&P has several large customers, such as cruise lines and Greens Creek Mine, that will accept interruptible power. The utility has had interruptible rates at least since 2001. One special contract that AEL&P has is with Princess Cruise Lines. The latest amendment to the contract, TA449-1, outlines the charges and responsibilities for each party.

AEL&P charges Princess the average cost of Dorothy Lake generation over past five years. Since the power is only available when there is excess, AEL&P does not include a demand charge. This represents a significant benefit because demand charges make up a significant portion of commercial power customer monthly billings. The revenue from the excess energy contracts are used to reduce the COPA for other customers.

AEL&P provides an interconnection point, but requires Princess to maintain all facilities at the point of sale. The contract also requires that Princess takes corrective action if power factor goes below 95 percent. Power factor is the ratio between the power something draws and the power it actually consumes. A power factor below 95 percent could impact the power quality of other utility customers, and thus the need for Princess to take corrective action.

5 Effect of Excess Electricity for Heat on PCE Reimbursement

If a utility chooses to sell excess electricity for heat, the practice may reduce PCE reimbursement provided by AEA. PCE is designed to reduce the rate that customers pay in PCE-eligible communities to make it more equal to the average rate paid by customers in Anchorage, Fairbanks, and Juneau. PCE is not a subsidy for utilities, instead it subsidizes customers. Depending on how the utility chooses to set the PCE-eligible rates, some customers may find their rates after PCE reimbursement (also known as the effective rate) increase.

The PCE reimbursement is calculated by the RCA based on calculations that includes a number of factors, including the expenses and revenues that the utility includes in its Annual Report, the utility's customer's rates, the **eligible cost per kwh**, the **PCE base rate**, and the **PCE ceiling**.

1. **Eligible expenses:** As mentioned before, the PCE-eligible utility must submit an Annual Report. The report's Income Sheet includes a summary of all of the utility's reported expenses and revenues. RCA staff will analyze the expenses to make sure that all of the expenses are *eligible.* The RCA uses the nationally recognized rules for determining if an expense is eligible. The rules are in place to protect consumers from a utility overcharging them. In general, the rules require that the money spent by the utility must be used and useful and required for the generation, distribution, and administration of the power delivered to customers. If the expense was not required (such as a bank fee from insufficient funds) or was not used to deliver power during the current period (such as debts for fuel from previous years or savings for replacing equipment in the future), then the expense is not eligible.

The other factor that the RCA uses to determine the total eligible expenses is specific to the PCE program. The statute requires that utilities meet a certain generation efficiency depending on the quantity of sales and the percentage of diesel generation. If the utility does not meet the standard, the RCA will impute the eligible diesel fuel cost as if the utility had met the standard as opposed to the actual rate. For instance, assume that a utility consumed 100,000 gallons of diesel, a gallon cost $4/gallon, and had an efficiency of 10 kWh/gal. The total actual fuel cost is $400,000, but the eligible cost will be lower. If the standard was 12 kWh/gallon, the RCA would calculate the number of gallons that would have been needed if the utility met the standard efficiency. So instead of 100,000 gallon, the utility would have been eligible for only 83,333 gallons (100,000 gallons * 10 kwh/gal ÷ 12 kWh/gal). The eligible fuel expense would only be $333,333.

2. **Other revenue**: Any revenue sources such as pole rentals, grants, or waste heat sales decrease how much utility customers have to be charged to cover the utility's expenses. RCA staff ensures that any additional revenue sources are included properly. While grant revenue can be reported to the RCA, it is more common for expenses that are paid for by grants are excluded from the annual report than to include the grant revenue separately.

3. **Sales (kWh)**: RCA staff includes all electricity sold by the utility in the calculation of the total eligible cost per kwh. In order to try to create an incentive for good management, there is a requirement that a utility have a maximum "**line loss**" of 12 percent. Line loss is calculated by

$$Line\ loss = \frac{Total\ generation + Purchased\ Power - (kWh\ sales + Station\ service)}{Total\ generation + Purchased\ Power}$$

Station service is the amount of energy (kWh) consumed in the production of power—this generally includes things like pumps, lights in the powerhouse, computers, switchgear, etc. If the utility has a load bank to regulate voltage, the electricity consumed here will be included in station service.

If line loss is greater than 12 percent, then the value for total kWh sold is imputed to make line loss equal to 12 percent. This will increase the value for kWh sales, what will be referred to as the *effective sales*.

4. **Eligible cost per kWh**: The eligible expenses, other revenue sources, and effective kWh sold are then used to find the eligible cost rate.

$$Eligible\ cost/kWh = \left(\frac{Sum\ of\ Eligible\ Expenses - Other\ Revenue\ Sources}{Effective\ kWh\ sold}\right)$$

5. **PCE Reimbursement rate (or amount)**: The PCE program will only reimburse 95 percent of the eligible cost per kWh above the **PCE base rate** (the weighted average residential rate of Anchorage, Fairbanks, and Juneau) up to the **PCE ceiling** (currently $1.00/kWh). If the residential rate (or community facility rate) is below the eligible cost per kWh, then the residential rate (or community facility rate) will be used. In the following equation the eligible cost per kWh has a maximum value of $1.00/kWh.

$$PCE\ reimbursement\ rate = (Eligible\ cost\ rate - PCE\ base\ rate) * 95\ \text{percent}$$

For instance, if a utility's annual report showed an eligible cost rate of $0.5000/kwh, the residential rate was $0.6000, and the PCE base rate was $0.1902, the PCE reimbursement would be $0.2943/kWh

$$PCE\ reimbursement\ rate = (\$0.5000/\text{kWh} - \$0.1902/kwh) * 95\ \text{percent}$$

$$PCE\ reimbursement\ rate = \$0.2943/kWh$$

6. **PCE Effective rate (or amount)**: PCE-eligible utilities will charge PCE-eligible customers based on the effective rates. The PCE effective rate is the difference between the retail rate and the PCE reimbursement rate.

$$PCE\ effective\ rate = Residential\ retail\ rate - PCE\ reimbursement\ rate$$

For instance, if the residential rate is $0.60/kWh and the PCE reimbursement rate is $0.2943/kWh, the customer will be charged $0.3057/kWh for the first 500 kWhs (for a residential customer) and then the full retail rate for any additional kWhs. If the residential retail rate was set at the cost-based rate of $0.50/kWh the PCE effective would be $0.2057/kWh.

Unless the statutes governing PCE were changed specifically to account for a different value for excess energy being used for heat, calculating how the extra sales will affect the effective rate that customers pay is straightforward if you follow the steps above.

Any expenses that are needed to provide service to customers will increase the amount of ***eligible expenses***. There are two main options for determining how the excess electricity will affect ***sales***:

1. If the excess electricity is sold as electricity, it will be included in ***sales*** as additional kWh.
2. If the excess electricity is not sold as electricity but is instead sold as heat, such as from a heat recovery system or district heating loop, the electricity that consumed will be included as **station service** and not sales.

The revenue that is charged to excess energy customers will be counted under ***other revenue***, it won't matter if it is sold as electricity or heat. These three values will be used to calculate the ***eligible cost rate***. The current ***PCE base rate*** and ***PCE ceiling*** as well as the utility's residential retail rate will be used to determine the customers' effective rate.