



Negative Energy Consumption

OVERVIEW

There are several reasons why you might need to enter negative values for energy consumption in Portfolio Manager. Most cases are simple, such as sub-meters from your main grid electric meter that may be used to exclude parking, cell towers, or electricity that is sent to another building on your campus. In all of these cases, you are subtracting **energy that you purchased from your utility**, and you can simply enter a meter with negative values for each month.

If you are using a negative meter to subtract **energy that you produced on site**, however, it is not as simple. A basic example would be using a gas boiler to produce steam, and then measuring steam distributed to the building next door. In this case your boiler takes natural gas as an input, but the thing you produce is steam. If the thing you purchase (natural gas) differs from the thing you want to subtract (steam) then you need to perform additional calculations before you subtract anything.

The purpose of the additional calculations is to express the energy that you want to subtract as an equivalent amount of the input fuel that was used to generate that energy in the first place. For example, suppose you have a chilled water system that requires 100 kBtu of input electricity and produces 300 kBtu of chilled water. Then, 150 kBtu (or, 50%) of the chilled water is sent to a neighboring building. The additional calculations apply the percentage of output that you are subtracting (50%) to your input fuel (electricity). In this case, rather than entering a chilled water meter with a reading of -150 kBtu, you would enter an electric meter with a reading of -50 kBtu. The negative meter you enter is of the same *form* as the original input energy, electricity. This calculation is necessary to provide an equitable assessment when energy changes form.

The subsequent sections of this document outline several possible scenarios in which you might need to enter negative energy consumption values in Portfolio Manager, clarifying when calculations are necessary and what steps you should take:

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SUMMARY OF NEGATIVE CONSUMPTION SCENARIOS

When you enter a negative value for energy consumption in Portfolio Manager, you will be prompted to provide a reason in the “Negative Consumption Justification” dialog box. Figure 1 summarizes the responses you can choose from, as well as the action you should take in each case. The actions depend on the form of energy that is being subtracted (e.g., electricity, natural gas, fuel oil, hot water, chilled water, and steam), and whether the energy is being subtracted in the same form that it was purchased or has changed form in your building. For example, if you use a gas boiler to produce steam, and distribute steam to the building next door, the energy is changing form (from natural gas to steam) between when you purchase it and when you want to subtract it. Before you attempt to subtract any energy from your building, you should consider the form of energy that you want to subtract, and ask yourself: **Did I purchase the energy from my utility in that form?**

If the answer is “Yes”, then you are subtracting **energy that you purchased**. You do not have to do any additional calculations and you can simply enter a meter with negative values for each month. For example, you may wish to exclude your parking garage from your building, and the garage is on a sub-meter from your main electric feed.

If the answer is “No”, then you are subtracting **energy that you produced** on site. For example, you may be operating a heating system that serves two buildings. You are purchasing natural gas from the utility and using this to produce hot water, some of which is then sent to another building for heating. To evaluate the first building, you want to subtract the hot water you’re sending to the second building. In this case, the energy you are subtracting (hot water) is in a different form than the energy you purchased (natural gas). You have transformed energy from one form to another, and will need to perform additional calculations before you can enter your data in Portfolio Manager.

Figure 1 - Negative Consumption Scenarios

Negative Consumption Justification Option	Can I enter negative meter readings directly into Portfolio Manager?
My utility bill shows negative values.	Yes. But we recommend you double-check with your utility to find out why the value is negative. This could happen if a utility estimates earlier readings and later corrects/fixes your values.
I am subtracting energy that I purchased from a utility (such as grid electricity). I am subtracting either: <ul style="list-style-type: none"> Energy being sent to another building Energy being used for part of my property that I want to exclude (e.g., cell tower or parking garage) 	Yes. Negative values may be entered directly off your outgoing sub-meter. If you are excluding part of your property, you may also want to consult the FAQ on this topic. Learn more
I am subtracting energy that I produced at my property (such as steam from a boiler). I am subtracting either: <ul style="list-style-type: none"> Energy being sent to another building Energy being used for part of my property that I want to exclude (e.g., cell tower or parking garage) 	Only after performing additional calculations. Use the Negative Energy Consumption Calculator to help you perform the required calculations. If you are excluding part of your property, you may also want to consult the FAQ on this topic. Learn more
I am subtracting solar or wind energy generated at my property.	No. We offer a special column in onsite Solar and Wind meters, where you can enter information about exports to the grid or to other properties. You may want to consult the Technical Reference on Green Power .
Other	It Depends. Contact customer support (www.energystar.gov/buildingshelp) with a detailed description of your situation, and we'll let you know what to do.



ENERGY YOU PURCHASE FROM A UTILITY

If you want to subtract energy from your property, and you determine that you have purchased the energy from the utility in the same form as the energy that you are subtracting, then entering negative energy consumption in Portfolio Manager is a simple process: you enter the values in Portfolio Manager with a negative sign. Below are examples where this may occur (rows 1 – 2 in Figure 1):

- **My utility bill shows negative values.** This is the simplest case. If there are actually negative values on your utility bill, then you may enter these in Portfolio Manager. We suggest that in these cases you should consult with your utility to understand why the value is negative. The most common reason for a negative bill is that the bill may represent an adjustment for a previous month in which you were overbilled.
- **I am subtracting energy that I purchased from a utility.** This could include the following scenarios:
 - You are sending energy to another building. For example, you purchase electricity from the utility through a single meter that serves your building and a building next door. You have a sub-meter that measures the electricity that goes to the building next door.
 - You are excluding part of your property. For example, your building may have a main electric meter, as well as an electric sub-meter used to subtract and exclude electricity associated with a parking lot or a cell phone tower.

In each of these cases, the form of the energy you want to subtract is the same as the form of the energy you purchased from your utility. Note that the second case above occurs most often with electricity meters. However, it is possible for it to apply to other forms of energy. In a campus setting, for example, it may be possible to have a main natural gas meter for multiple buildings, as well as sub-meters to identify the natural gas use at individual buildings. Remember, though, that if you need to subtract steam, hot water, or chilled water that you produced from your own heating/cooling plant (energy that has changed form), you will need to use the guidance in the following section.

ENERGY YOU PRODUCE: CHILLERS, BOILERS, AND CHP

If you want to subtract energy from your property, and you determine that you have produced the energy on site and it has changed forms, then there are additional calculations required before entering the values in Portfolio Manager. This section addresses energy produced through a chiller, boiler, or cogeneration system at your property. Below are examples where this may occur (row 3 in Figure 1):

- **I am subtracting energy that I produced at my property.** This could include the following scenarios:
 - You are sending energy to another building. For example, you have a central plant that heats a campus of buildings. Building A purchases natural gas to power a gas-fired boiler, which produces steam. The steam is distributed to other buildings on the campus for space heating. To assess Building A, where the boiler is located, you may want to subtract the steam sent to other buildings.
 - You are excluding part of your property. For example, you have an office building with a restaurant on the first floor and you want to benchmark the office only. The building has an electric-driven chiller plant that generates chilled water, which is distributed to both the office and the restaurant.

Figure 2 presents some examples of technologies that you may be using and how energy may change forms as a result. In these cases, when energy is converted from one form to another, one unit of the output energy is not necessarily equal to one unit of the input energy. It is important that the energy leaving the building is converted to a form *equivalent to the incoming energy* before it is entered as a negative meter entry in Portfolio Manager. Users in this situation should download and complete the [Negative Energy Consumption Calculator](#), and enter the output values generated by that calculator into Portfolio Manager.



Figure 2 – Examples of Energy that Changes Form

Example Technology	Energy In (Form A)	Energy Out (Form B)
Chilled Water Plant	Electricity or Natural Gas	Chilled Water
Hot Water Plant	Natural Gas or Fuel Oil	Hot Water
Steam Plant	Natural Gas or Fuel Oil	Steam
Combined Heat and Power (CHP)/Cogeneration Plant	Natural Gas, Fuel Oil, Biomass, Biogas, Coal, Waste Heat, etc.	Hot Water or Steam, Electricity

Why Are Additional Calculations Necessary?

To understand the importance of these additional calculations, consider a central chiller plant with a COP of 3.0. For this plant, for each kBtu of input electricity there are 3 kBtu of output chilled water. If you suppose that half of the output is used at the building and half is used next door (exported off site), then:

- 100 kBtu of electricity in → 300 kBtu of Chilled Water; or
- 100 kBtu of electricity in → 150 kBtu of Chilled Water at Building + 150 kBtu of Chilled Water Next Door

In this situation, you may want to enter an electric meter that captures the electric input (100 kBtu), along with a negative chilled water meter to capture energy delivered to the building next door (150 kBtu):

- +100 kBtu Input Electricity – 150 kBtu Exported Chilled Water = –50 kBtu

Using this method, the property would appear to have a negative value for the total energy consumption! This is clearly incorrect. This unexpected result occurs because the chiller actually produces more output energy than input energy when the energy is transformed from electricity to chilled water.¹ Heating systems (such as boilers producing hot water or steam) result in less output energy than input energy, so the method outlined above would also be incorrect for those cases. It is not possible to perform simple addition/subtraction with energy that is in different forms, even if you convert to a common unit like kBtu.

The [Negative Energy Consumption Calculator](#) will help you express the exported energy in units of the original input fuel. In this case, we observe that 50% of the output from the chiller is sent to the neighboring facility. Therefore, we should express the negative consumption value as 50% of the electricity input. That is, of the total electric input, 50% is transmitted off site (or, 0.50 x 100 kBtu = 50 kBtu of electricity). If the negative value is expressed this way, then the total energy consumption is as follows:

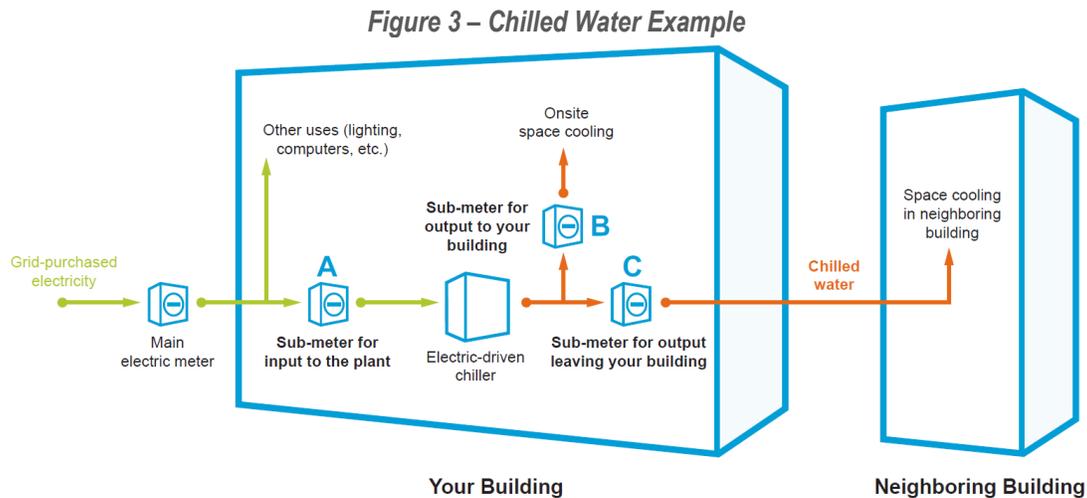
- +100 kBtu Electricity – 50 kBtu Electricity = 50 kBtu

In this case, we correctly see positive energy consumption for the energy used on site. This shows that it is important for a user to enter -50 kBtu of electricity to represent the energy sent off site rather than -150 kBtu of chilled water to get the correct result. The following sections illustrate detailed examples for Chilled Water, Hot Water/Steam, and CHP/Cogeneration plants.

¹Chillers, like all refrigeration systems, measure their efficiency using a coefficient of performance, or COP. A COP is a ratio of the amount of cooling energy output of the system to the electricity required by the system. If you have a chiller with a COP of 3.0 and you supply the chiller with 100 kBtu of electricity, it will produce 300 kBtu of chilled water. The output value is greater than the input energy because the system is using the input energy to transfer heat, rather than to generate energy.

Example: Chilled Water Plant

You have an electric-driven chiller on site that is used to generate chilled water, and that chilled water is then distributed to a neighboring building. In this example, the energy coming into your building is in the form of electricity, and the energy leaving your building is in the form of chilled water. You will need sub-meters to accurately measure the input and production of your plant. An example meter configuration is presented in Figure 3 though others may be possible. For example, if you measure Total chiller output and you measure C, you can compute B as Total minus C.



It is important that the energy leaving the building (C) is converted to a form equivalent to the energy you purchased from the utility, before it is entered as a negative meter entry in Portfolio Manager. To do this, you will enter A, B, and C into the [Negative Energy Consumption Calculator](#) on a monthly basis. The calculator will compute the total output from your chiller (B + C), and then find out the percentage of the output accounted for by each sub-meter. In Figure 4, for example, it is determined that 60% of the chilled water is used on site and 40% is exported. These percentages are applied to your incoming fuel (in this case, the electricity powering your plant). So if 40% of the produced chilled water (or 120,000 kBtu) leaves the building, that equates to 40% of the input electricity (40,000 kBtu) having been sent off site. That electric equivalent value (40,000 kBtu) can be subtracted via a negative electric meter entry.

Figure 4 – Summary of Metered and Calculated Values for Chilled Water Example

	Input to Plant	Total Output	Breakdown of Output	
			Used On Site	Exported
Sub-meter (refer to Figure 3)	A	B + C	B	C
Form of Metered Energy	Electricity	Chilled Water	Chilled Water	Chilled Water
Metered Energy*	100,000 kBtu	300,000 kBtu	180,000 kBtu	120,000 kBtu
Percentage of Chiller Output	N/A	100%	60%	40%
Electric Input Equivalent	100,000 kBtu	N/A	60,000 kBtu	40,000 kBtu

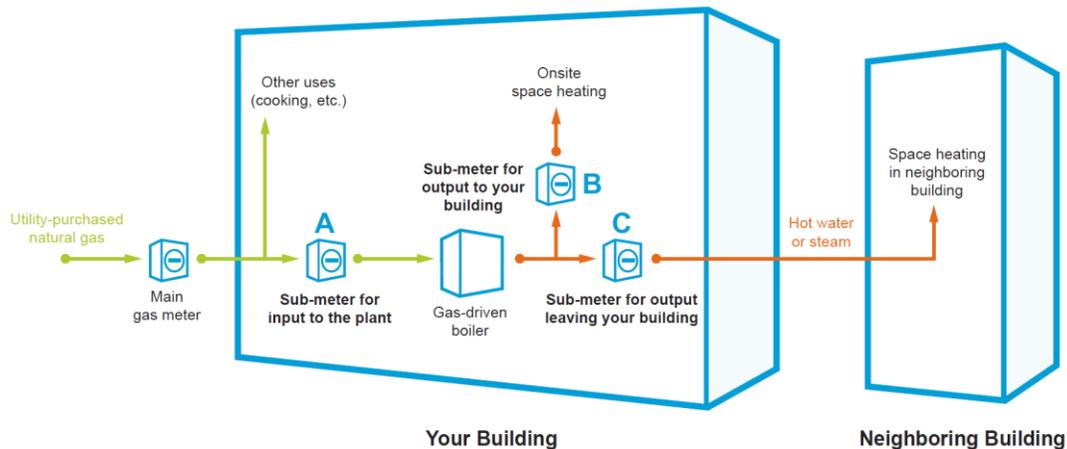
How to Enter Values in Portfolio Manager: The 40,000 kBtu of electric equivalent energy sent off site should be entered as a negative value in a separate Grid-Purchased Electric meter in Portfolio Manager.

*Note that all examples in this section use kBtu as units for simplicity. If you meter in kWh or any other unit, [the Negative Energy Consumption Calculator](#) will automatically perform the conversion.

Example: Hot Water or Steam Plant

You have a natural gas-driven boiler on site that is used to generate hot water or steam, and that hot water or steam is then distributed to a neighboring building. In this example, the energy coming into your building is in the form of natural gas, and the energy leaving your building is in the form of hot water or steam. You will need sub-meters to accurately measure the input and production of your plant. An example meter configuration is presented in Figure 5 though others may be possible (e.g. computing B as measured total system generation minus C).

Figure 5 – Hot Water/Steam Example



Again, it is important here that the energy leaving the building (C) is converted to a form equivalent to the energy purchased from the utility before it is entered as a negative meter entry in Portfolio Manager. To do this, you will enter A, B, and C into the [Negative Energy Consumption Calculator](#) on a monthly basis. The calculator will compute the total output from your boiler (B + C), and then will compute the percentage of the output accounted for by each sub-meter. In Figure 6, for example, it is determined that 66.7% of the energy is used on site and 33.3% is exported. These percentages are applied to your incoming fuel (in this case, the natural gas powering your plant). So if 33.3% of the produced hot water or steam (or 20,000 kBtu) leaves the building, which equates to 33.3% of the input natural gas (33,333 kBtu) having been sent off site. That natural gas equivalent value (33,333 kBtu) can be subtracted via a negative natural gas meter entry.

Figure 6 – Summary of Metered and Calculated Values for Hot Water/Steam Example

	Input to Plant	Total Output	Breakdown of Output	
			Used On Site	Exported
Sub-meter (refer to Figure 5)	A	B + C	B	C
Form of Metered Energy	Natural Gas	Hot Water or Steam	Hot Water or Steam	Hot Water or Steam
Metered Energy Reading*	100,000 kBtu	75,000 kBtu	50,000 kBtu	25,000 kBtu
Percentage of Boiler Output	N/A	100%	66.7%	33.3%
Natural Gas Input Equivalent	100,000 kBtu	N/A	66,667 kBtu	33,333 kBtu

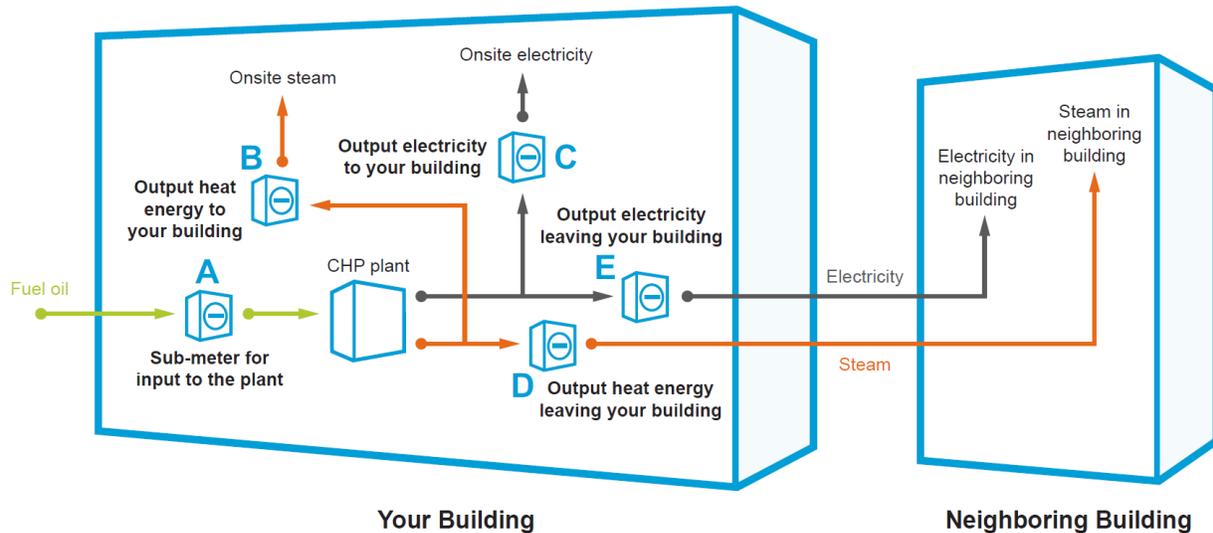
How to Enter Values in Portfolio Manager: The 33,333 kBtu of natural gas equivalent energy sent off site should be entered as a negative value in a separate Natural Gas meter in Portfolio Manager.

*Note that all examples in this section use kBtu as units for simplicity. If you meter in therms or any other unit, the [Negative Energy Consumption Calculator](#) will automatically perform the conversion.

Example: Combined Heat and Power/Cogeneration Plant

For a Combined Heat and Power/Cogeneration plant, there will typically be one form of input energy (Fuel Oil, in this example) and two forms of output energy (Electricity and Steam, in this example). If you are sending both forms of output energy off site, you will need to have five sub-meters to accurately account for all energy use, in the locations shown in Figure 7:

Figure 7 – CHP/Cogeneration Example



Just as with Chilled Water, Hot Water, and Steam plants, the meter readings will be used to determine what percentage of input energy was used to produce each the output energy used in your building and sent off site. In this example, you would enter monthly meter readings from sub-meters A, B, C, D, and E into the [Negative Energy Consumption Calculator](#). The calculator will compute the total output from your CHP system (B+C+D+E) and then find out the percentage of the output accounted for by each sub-meter. As shown in Figure 8, D and E are being sent off site and they represent 37.5% and 6.25% of the total system output, respectively, for a total of 43.75%. So, of the total energy (steam + electricity) that you produce, 43.75% is exported off site and would be entered as a negative consumption value in a separate fuel oil meter in Portfolio Manager. This negative meter would be expressed in units of the incoming fuel oil ($43.75\% \times 100,000 \text{ kBtu} = 43,750 \text{ kBtu}$).

It is of note that the standard calculations provided in Figure 8 and in the [Negative Energy Consumption Calculator](#) relate total output to total input and effectively use a single efficiency for the entire CHP system. It could be possible to try to isolate respective efficiencies of the two output products. For example, you may want to assume that a certain amount of your input fuel was used to produce each of your outputs (steam and electricity). This should not be necessary for the majority of cases. We recommend you start with our approach, but, if you would like to propose an alternative for your specific system, you can contact our customer support desk at www.energystar.gov/BuildingsHelp.

Figure 8 – Summary of Metered and Calculated Values for CHP/Cogeneration Example

	Input to Plant	Total Output	Breakdown of Output			
			Steam Used On Site	Electricity Used On Site	Steam Exported	Electricity Exported
Sub-meter (see Figure 7)	A	B + C + D + E	B	C	D	E
Form of Metered Energy	Fuel Oil	Steam/ Electricity	Steam	Electricity	Steam	Electricity
Metered Energy Reading*	100,000 kBtu	80,000 kBtu	20,000 kBtu	25,000 kBtu	30,000 kBtu	5,000 kBtu
Percentage of CHP Output	N/A	100%	25%	31.25%	37.5%	6.25%
Fuel Oil Input Equivalent	100,000 kBtu	N/A	25,000 kBtu	31,250 kBtu	37,500 kBtu	6,250 kBtu

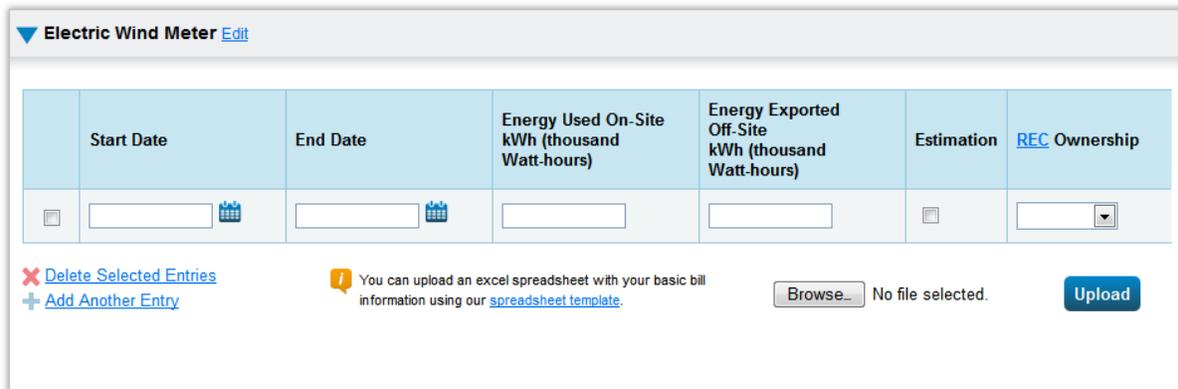
How to Energy Values in Portfolio Manager: The Fuel Oil equivalents from the exported Steam (37,500 kBtu) and exported Electricity (6,250 kBtu) should be added together to get a total exported Fuel Oil equivalent value of **43,750 kBtu**. This should be entered into a Fuel Oil meter in Portfolio Manager as a negative consumption value.

*Note that all examples in this section will use kBtu as units for simplicity. If you meter in Gallons or any other unit, the [Negative Energy Consumption Calculator](#) will automatically perform the conversion.

ENERGY YOU PRODUCE: SOLAR OR WIND ENERGY

If you want to subtract solar or wind energy generated that was at your property (row 4 in Figure 1), this also represents a case of energy changing forms, so the energy cannot be simply entered as a negative electric meter. Here, what you want to subtract (electricity) was not purchased directly from a utility, but rather was produced on site. For this case, there is a designated place in Portfolio Manager’s Electric Solar and Electric Wind meters to enter any solar or wind energy that you are exporting off site, as shown in Figure 9. You may want to consult the Technical Reference on Green Power, at www.energystar.gov/GreenPower for more information about onsite renewable energy.

Figure 9 – Electric Solar/Wind Meter Entry Interface



Electric Wind Meter [Edit](#)

	Start Date	End Date	Energy Used On-Site kWh (thousand Watt-hours)	Energy Exported Off-Site kWh (thousand Watt-hours)	Estimation	REC Ownership
<input type="checkbox"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="checkbox"/>	<input type="text"/>

[Delete Selected Entries](#)

 You can upload an excel spreadsheet with your basic bill information using our [spreadsheet template](#).

 No file selected.

Why Can't I Use a Net Meter?

If your renewable energy generation plant (solar panels or wind turbine) sends its excess energy back into the grid, your bill may be based on a “net” meter. Net metering provides a measurement of the grid-purchased energy that is offset by your onsite renewable energy. It does *not* provide an accurate measurement of the energy that is actually used at your property.

For example, suppose your solar panels produce 10,000 kWh of electricity in one month, and your building uses 7,000 kWh and sends 3,000 kWh back to the grid. In addition, during periods when the solar panel generation was not sufficient, you imported 5,000 kWh from the grid. A “net” reading from your utility may credit your purchases with your exports: 5,000 (Import from Grid) – 3,000 (Export to Grid) = 2,000 kWh. Therefore, your utility gives you “credit” for the exports and only bills you for 2,000 kWh (even though you actually used 5,000 kWh of grid electricity).

Net metering provides you with a financial incentive, which may help you finance your renewable energy system. However, a net meter is not a complete accounting of the energy you need to operate your building. For accurate energy accounting, you must quantify all of the energy you use. You must look beyond the net cost so that you can characterize the total kWh consumption of energy you use on site, both from your own system and from the grid. Without this total kWh consumption value, your building will not receive an accurate ENERGY STAR score.