Utilities Manager: Where Did the Promised Savings Go?

Written by Paul Grover, MS Kilawatt Technologies, Inc.
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Reducing energy use is an important economic decision that should be based on sound financial data, measurements and calculations. Most businesses, though, are making economic decisions based on inaccurate (often inflated) dollar savings projections. Thus, the period needed to recoup their investment is much longer than they have been told. Let's look at how this happens.

Most energy-saving companies, consultants and government entities use an "average cost per kilowatt-hour (kWh)" to calculate dollar savings for their energy projects. The building owner is told that the "average cost per kWh" times the number of kWh saved is your projected dollar savings. On its face, this is a reasonable and traceable method. In reality, however, it can grossly overstate the savings.

There are a variety of ways to derive an "average cost per kWh." Such numbers can come from utilities, government statistics or from dividing the cost—*or some portion of the cost*—of a bill(s) by the number of kWh used.

As an example, we'll take a monthly bill from one of our clients that is on the PECO Energy Company (Exelon) High Tension (HT) electricity tariff.

- This Exelon Website tells us the average price for the PECO HT rate was $0.0505/kWh in 2007.
- This U.S. Energy Information Agency Website tells us that the average price of electricity to commercial customers in Pennsylvania was about $0.089/kWh in September 2006.
- If we divide the total cost of the September 2006 bill of $25,012 for our client's facility by the number of kWh used that month (265,000), we come up with a cost of $0.0944/kWh.

Savings Calculations Using Different Average Costs per kWh

Source	Exelon (PECO) HT Rate	EIA for PA	Total Bill Divided by Total kWh	
Avg. Cost	$0.0505/kWh	$0.089/kWh	$0.0944/kWh	
Savings	$3,346	$5,896	$6,253	

For actual monthly bill of 265,000 kWh costing $25,012
Savings for a 25% kWh reduction (66,250 kWh)

If we reduce the kWh use of this building in this month (September 2006) by 25%, or 66,250 kWh, we come up with the dollar savings calculations using the three "average costs per kWh" numbers shown in Table I.

Any of these three numbers is commonly used to calculate savings. The problem is that they don't correspond to the actual savings our client will realize.

One reason is that the amount of money that an energy reduction project will save depends primarily on the number of kilowatt-hours of use (kWh) and the kilowatts of demand (KW) reduced each month and throughout the year—not just the kWh reduced. Actual dollar savings depend on how these two are linked through variables such as winter, summer, heating, demand ratchets and rate blocks, just to name a few. Some commercial electricity tariffs are mind-boggling, containing 30 or 40 or more independent and linked variables. It is these complex rate structures that determine your bills and savings.

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Research, model and verify

If you want to accurately determine financial savings, you must first research, model and verify the formulae for the rate structures that comprise the applicable tariff. That way, when you plug in the kWh and KW numbers for the month—*along with other numbers such as power factor, sales tax, energy efficiency surcharges, etc.* —you come up with the same cost as the utility for that month and tariff.

In our example, we've modeled the tariff and already know the kWh, KW and cost (and other variables) of the monthly bill. To see the real savings from your energy reduction effort, enter the reduced kWh values into our algorithm of the tariff and calculate the actual bill. The difference between the bill without the kWh reduction and the bill that reflects the kWh reduction is your actual savings (in real life, we would calculate a historical baseline cost for that month and subtract the current month bill from the baseline cost to calculate the real savings). As shown in Table II, we can now compare the "savings" from the three average costs per kWh to the actual reduction calculated from the model of the tariff.

Overestimating savings

Why does simply using average cost per kWh usually lead to overestimation of savings? If we chart the algorithms for this tariff, we can see how all the interlocked variables and rate block costs actually contribute to the bill. This data in Fig. 1 shows the different cost blocks produced by the example facility with its unique kWh use and KW demand relative to the PECO HT tariff (every building uses different amounts of electricity and its interactions with the rate will be different).

Savings Calculations Using Different Average Costs per kWh and Using Rate Tariff
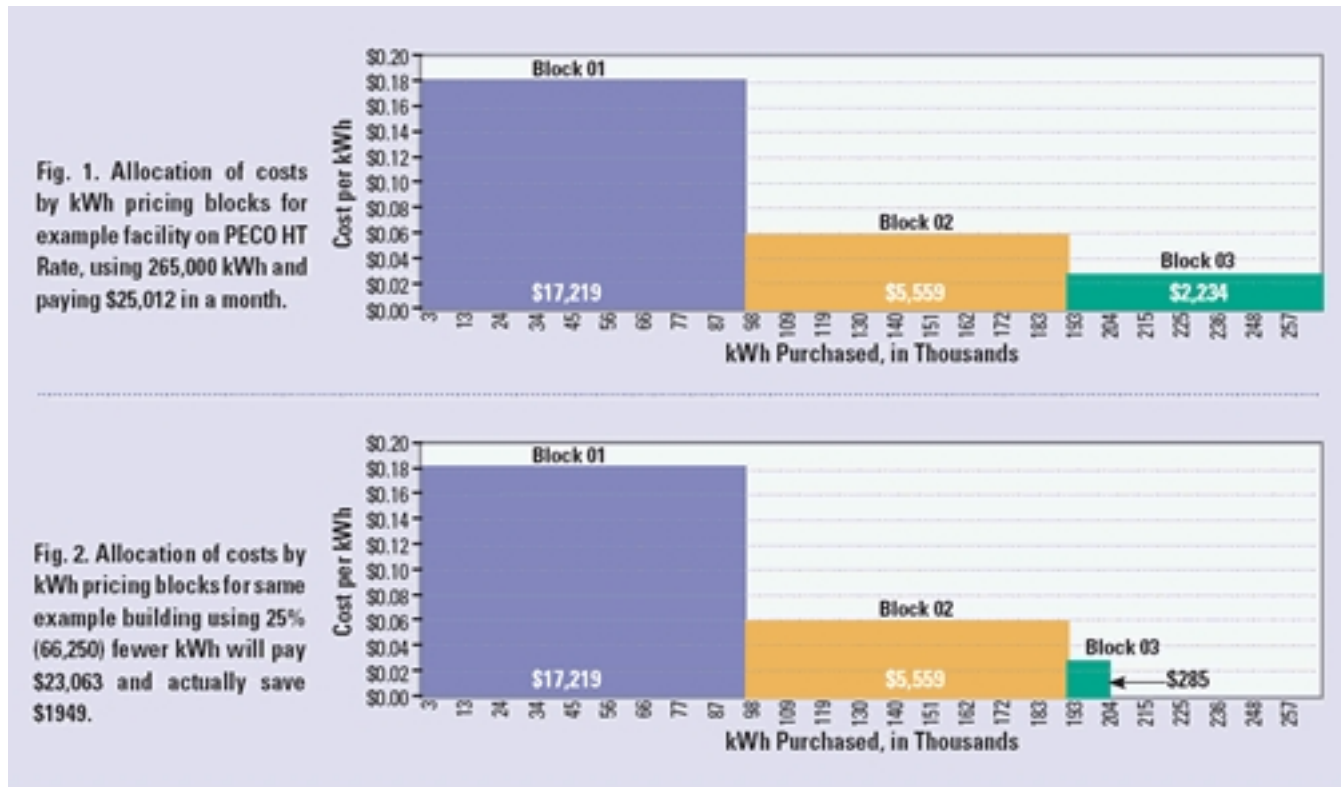
Source	Exelon (PECO) HT Rate	EIA for PA	Total Bill Divided by Total kWh	Actual Savings by Rate Tariff
Avg. Cost	$0.0505/kWh	$0.089/kWh	$0.0944/kWh	
Savings	$3,346	$5,896	$6,253	$1,949

For actual monthly bill of 265,000 kWh costing $25,012
Savings for a 25% kWh reduction (66,250 kWh)

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Because of the complexity of the interactions between kWh and KW, we can see that there are three different pricing blocks for kWh use. The first block of use is charged at about $0.18/kWh while additional blocks cost much less. Note that this first block accounts for $17,219 of the $25,012 bill.

Fig. 1. Allocation of costs by kWh pricing blocks for example facility on PECO HT Rate, using 265,000 kWh and paying $25,012 in a month.

Fig. 2. Allocation of costs by kWh pricing blocks for same example building using 25% (66,250) fewer kWh will pay $23,063 and actually save $1949.

Here's the million-dollar question. If we reduce kWh use by 25%, from which blocks did the dollar reductions come? The answer is shown in Fig. 2. In this example—*as it is in many cases*—reductions are weighted toward the less expensive kWh blocks. Therefore, if most of your kWh reductions come from the block priced at $0.03/kWh, your actual savings will be much less than if you use an "average cost per kWh" of $0.089/kWh.

Conclusion

Businesses need and deserve accurate data and numbers upon which to make sound economic decisions. That's why it is so important for you to remember that actual dollar savings depend on the structure of the tariff and the electricity consumption of the facility in question.

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The only way to accurately quantify savings and paybacks for energy reduction projects is to enter actual kWh, KW and other pertinent values into the algorithm of the tariff and calculate dollar savings against a baseline. Otherwise, your savings will usually be inflated—*in some cases by a factor or two or three*
— and the paybacks on your investments will be much longer than promised or expected.

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