The Effect of Using "Average Unit Cost" In Savings Calculations

One of the important steps in determining savings that come from instituting energy conservation measures (ECM's) is to place a cost value on the unit of utility measured to have been saved or "avoided." For example, we can measure how many kilowatt hours of savings have been achieved by a given ECM, but then we need to translate that into how much money was saved. This is a fairly straight forward process for many types of utilities such as water, sewer, gas, but not electricity.

Most schools are large enough energy users to have a General Service Demand (GSD) rate. This means that you are paying for two aspects of energy use. You pay one rate for the total "consumption" of energy for the month measured in kilowatt hours (KWH). You pay another rate for the highest amount of power needed at any one time during the month. That is called the "demand" peak and is measured in kilowatts (KW).

Sometimes for budgetary simplicity we might use a number called the "average unit cost" to estimate how much energy is being used or is needed in the future by proposed new facilities. The easiest way to do that for electricity is to take an electric bill from a similar size and type facility, note the total cost, and divide it by the total number of KWH. Although this does not take into account the demand charge of the electric bill, it does give a good idea of total costs for budgetary purposes. For one school district in Florida the average unit cost for electricity is $0.075 per KWH. If you wanted to estimate the costs of a new school, you could estimate the amount of KWH it would use, multiply times $0.075, and you would have a good estimate of costs. In addition to budgeting purposes, some energy managers use this method to spot efficiency opportunities. It is a simple calculation that flags high consumption or exceptions to the norm. However, this method is not appropriate for valuing energy savings from ECM's placed in public schools when the electric bill for that school has both a consumption (KWH) and demand or peak use (KW) component.

If the average unit cost method is used to determine cost savings, you run the risk of greatly overstating the dollar value of savings. The reason is because most ECM's for school districts will not affect the peak load of the school as much as the off-peak load. Savings of off-peak loads do not reduce the demand charge on the energy bill. There are two problems with using the average unit cost to calculate the value of energy savings. One is the "false rate increase" problem and the other is "wrong actual cost" problem.

Let's Look at the Math

Let's say you totaled the past year's bills for one of your schools and arrived at the following data:

Year #1 Consumption:	3,000,000 KWH	Demand: 10,455
	Consumption costs: $141,000	Demand costs: $57,503
	Rate: $0.047/KWH	Rate: $5.50/KW

Total costs: $198,503

Average Unit Cost: $0.0662/KWH

Next, you initiated several ECM's to control energy waste, such as, reducing nighttime lighting, turning off air-conditioning systems at night, and turning off other appliances (computers, water fountains, and soda machines) at night. You did this for one year (assuming no rate changes and weather conditions were identical). Then, you totaled the second year's bills and found that you achieved a 5% savings of KWH. But, since there was no on-peak savings (demand) that number stayed the same.

Year #2 Consumption:	2,850,000 KWH	Demand: 10,455
	Consumption costs: $133,950	Demand costs: $57,503
	Rate: $0.047/KWH	Rate: $5.50/KW

Total costs: $191,453

Average Unit Cost: $0.0672/KWH

KWH Savings: 150,000 KWH
Cost Savings: $7,050

Notice that the average unit cost went up by $0.001. This shows a "false rate increase" of 1.5% when in fact the KWH rate did not actually increase at all. If contractors are allowed to use the average unit cost method to determine the dollar value of savings they could show that a rate increase occurred when in fact it did not actually occur. In this case 1.5% does not seem very significant. However, if this is applied to a $5,000,000 annual school district electrical energy bill, it would equal $75,000 in falsely reported savings.

The "wrong actual cost" problem is a little easier to see. The issue here is taking the 150,000 KWH and multiplying it times the average unit cost of $0.0672/KWH and arriving at $10,080 in cost savings instead of using the actual cost of KWH, which is $0.047, that gives you in reality $7,050 in costs savings. The former overstates cost savings by over 40%.

If your annual school district electrical energy bill is $5,000,000, and the example above is typical of all schools in the district in that you saved 5% in energy consumption for the entire school district the effect would be very significant. Actual savings would be $177,579. But, if you used the average unit cost method to calculate the savings you would arrive at $253,900 in cost savings. This overstates actual savings by $76,221.

If you had an agreement with the contractor for a fee of 35% of the savings, then the true fee to be paid should be $62,152 ($177,579 x 35%). However, if you allowed the contractor to use the average unit cost method, the fee would be $88,865 ($253,900 x 35%). If this fee were paid, it would represent 50% of the actual cost savings actually achieved. You would be paying an extra 15%, or $26,713, to the contractor that should be yours to keep!

The industry standard for calculating the dollar value of savings according to the International Performance Measurement and Verification Protocol (IPMVP) is to use marginal rates (the consumption rate and the demand rate) not an average unit cost, blended rate, or effective rate. This will resolve any of the possible problems outlined above.