Savings Calculation Factors

If you are going to pay a contractor to reduce your organizations energy use based on behavior modification strategies and the fee is based on the amount saved, you need to understand how such savings should be calculated. If you don't understand these factors you are at risk of giving away a significant share of the savings you should be keeping.

Key Concepts – Issues

- **Baseline** – base energy use, base year, etc., that will be compared to future consumption.
  ISSUE: Succeeding year's consumption must be compared to a base year in order to determine what the change was. Simply showing projected savings and actual savings does not tell the whole story.

- **Adjusted baseline** – the usage or consumption that would have occurred without the energy conservation measures.
  ISSUE: In each year succeeding the base year there will likely be changes that will affect consumption, such as, the adding of conditioned building area, increase or decrease in operating hours, weather and temperature changes, and changes in the nature of plug loads (e.g. computers and other office equipment). Even if no measures are employed, actual consumption could go up or down. Therefore, modifications are made to the baseline for each succeeding year to obtain a more accurate "apples to apples" comparison.

- **Modifications to the baseline** – adjustments that are made to the original baseline to make a more accurate comparison to what the consumption would have been.
  ISSUE: Modifications can be made for routine changes such as temperature differences over the two periods being compared or for one-time changes such as added building space. The risk here is that the baseline could be inflated by adding a lot of adjustments that may not be valid. A higher baseline will result in higher reported savings whether or not those savings have actually occurred. For example, a load creep factor is often used to adjust the baseline. Load creep is the small incremental addition of increased energy demand due to added plug loads, mechanical wear and tear, maintenance, and other factors. You should be very careful about stipulating a load creep percentage. A load creep for aging mechanical equipment of 1% per year is reasonable. A load creep for plug loads is much more variable and could go up or down.

- **IPMVP** – The International Performance Measurement and Verification Protocol has been established as the industry standard for how to determine the savings achieved by energy conservation measures.
  ISSUE: The IPMVP Volume I is a fairly technical document, but it is readable by the average facility manager. Make sure that contractors that claim to base their savings calculation on the IPMVP explain how they do it. If you have a large fee to pay to the contractor, they should provide you with an M&V Plan to explain how they are calculating the savings. If it seems too technical to understand, then you should hire a third party to verify the approach and the calculations. It could be well worth the cost.

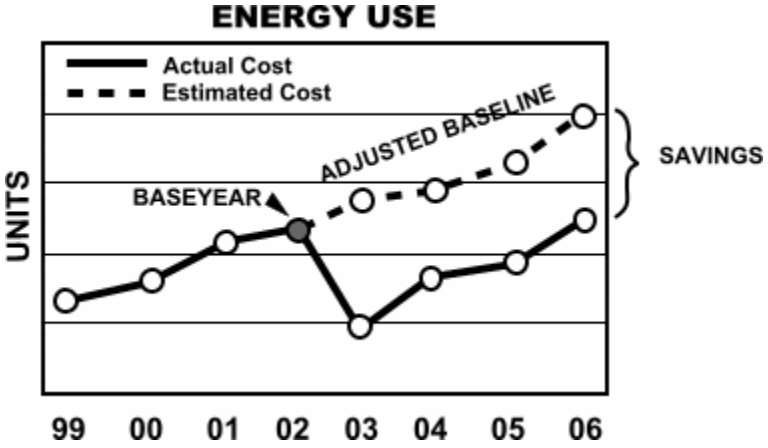
- **Valuing Savings** – Once the units of consumption are calculated (kilowatts and kilo-watt hours) they need to be valued to determine the cost savings.
  ISSUE: Most school electric bills have a charge for consumption and a separate charge for demand. The cost savings of consumption should be calculated separately from the demand savings. Using average unit cost or a blended rate is not appropriate for calculating savings that are achieved in behavioral modification programs. This is a practice whereby the total cost of the electric bill (both the demand, kW, charge and the consumption, kWh, charge) is divided by the total units of consumption (kWh only) to get an average cost per kWh. This practice is appropriate for developing energy budgets or as a general indicator for benchmarking. But, it is not the industry standard practice for calculating energy cost savings. Measures that save primarily off-peak energy, which is typical of behavior modification programs, should be valued by the kWh-related rate only. Otherwise, you risk overvaluing the savings by as much as 25% to 40%.

Computing Savings

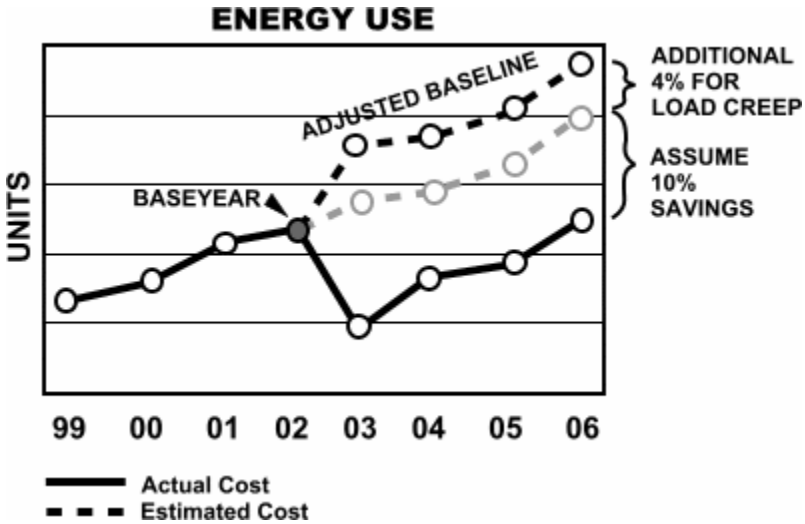
IPMVP – Concepts and Options for Determining Energy and Water Savings – Volume I
Chapter 3 – Basic Concepts and Methodology, 3.1 Introduction

Energy Savings = Baseyear Energy Use – Post-Retrofit Energy Use +or– Adjustments

Adjustments are commonly made to restate Baseyear energy use under post-retrofit conditions. Such adjustment process yields savings which are often described as "avoided energy use" of the post-retrofit period.



This graph shows the concepts explained in IPMVP. Adjustments are made to the baseyear data to estimate as realistically as possible what the cost *would have been* in the years following the implementation of the energy conservation measure. One would reasonably expect the energy use trend to continue in a similar trend as before the energy conservation measures were applied. The savings (in units of consumption, kWh) are calculated by subtracting the new actual energy use, "post retro-fit energy use," from the projected baseline, "baseyear energy use + or – adjustments." The calculation of the adjusted baseyear is the most likely place where mistakes can be made.



The graph above shows the effect of adding a 4% escalation factor (such as load creep) to the computed adjusted baseline. In this case, reported savings could increase by 40%. If payments to the contractor are based on a percentage of savings, then this seemingly small percentage increase can amount to a large increase in payment to the contractor.

Valuing Savings

Once savings have been calculated, a value must be placed on it. The IPMVP addresses this as follows.

> "4.5 Energy Prices
> Energy cost savings may be calculated by applying the price of each energy or demand unit to the determined savings. The price of energy should be the energy provider's rate schedule or an appropriate simplification thereof. Appropriate simplifications use marginal prices which consider all aspects of billing affected by metered amounts, such as consumption charges, demand charges, transformer credits, power factor, demand ratchets, early payment discounts."

By this definition, the average unit cost method would not be considered an "appropriate simplification" since it is not possible to determine the effect on costs of the two significant components of an energy bill – consumption cost and demand cost.

For example, the consumption charge (or cost of energy, measured in kilowatt-hours, kWh) might be 5.5 cents/kWh. The demand (peak) charge might be $5.00 per kilowatt, KW. Most schools have a rate that includes both an energy charge and a demand charge. When you take the total cost of the bill and divide it by the energy used, in kWh, you could get a number such as 8 cents per kWh. This is often done when calculating energy budgets. But, it is not appropriate for valuing energy savings because if the savings are predominantly in off peak time, such as is typical with behavioral modification programs in schools, then you are liable to overvalue the savings achieved. Multiplying energy savings by 8 cents/kWh instead of 5.5 cents/kWh will overstate savings by over 40%.

When you achieve savings during off-peak times of the day, such as turning off lights, computers, soda machines, water heaters, etc., during the night, the energy you save affects only the energy charge on the bill, 5.5 cents/kWh. If you are able to turn something off consistently during the peak energy use time of the day or run something that uses less energy than before, when classes are in full session and the kitchen is in full operation, then you could get some credit for peak savings. But, it is very difficult to find things to turn off during that time of the day.

The best way to value savings is utility bill reconstruction. You simply measure the amount of peak KW reduction and multiply it times the KW rate. Then, you measure the amount of energy reduction and multiply it by the energy rate. You add the two together and you have a fairly accurate account of your savings. Most computer programs that are designed to measure energy savings can easily do the calculations.

For more information on IPMVP go to the Efficiency Valuation Organization website.