Baseline Adjustments

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The methodology to adjust the baseline in performance contracts to account for changes is much more complex than most people realize. Many contracts are signed without defining how, and under what conditions adjustments will be made. The chances for a disagreement at the time of a major change is significant. The objective now should be to develop an agreement that is fair; neither party should garner a windfall gain, and potential risks should be understood and shared. The purpose of this paper is to describe some of the baseline adjustment issues by focusing on the principle of first-in/last-out (FILO).

Potential variables

Many variables (other than efficiency measure design, installation, operation, and maintenance) effect energy use and could be used to adjust the baseline. These include:

- weather (often included in the savings formula - further adjustment not necessary)
- process load or production (if variable and significant should be in savings formula)
- work-days (generally only an issue if period of analysis is short)
- envelope or system efficiency changes
- square feet (added or subtracted)
- internal gains
- "occupied" hours (increased, decreased, or shifted)
- number of occupants
- use of space

Treatment of changes should be bilateral (cut in both directions). For example, if the baseline for an HVAC control measure is decreased due to a (external to the control measure) change in system efficiency (e.g. a new chiller), then it should also increase to account for losses in system efficiency including "normal" degradation (e.g. heat exchanger fouling). The impact of each variable should be assessed for each conservation measure. The cost of data collection and manipulation should be weighed against the potential impact, both at the building level, and at the aggregate. In many cases, it may be best to acknowledge that changes will occur and ignore them. (in both directions)

First-in/last-out (FILO)

Most people acknowledge the impact energy conservation measures have on one another. The order in which these and other changes occur is critical. For example, taken individually a conversion to electronic ballasts and occupancy sensor controls may be cost effective. However, the combined savings is less than the sum of parts, and the economics of the "second" measure may be much less than one measure applied alone. If the ESCO installs electronic ballasts and is paid on the basis of 4,000 measured operating hours, how should the baseline be adjusted if occupancy sensors are added (outside of the contract) and operating hours are reduced to 3,000? FILO would maintain the savings of the first measure and adjust the baseline by the incremental savings of the second measure.

But how should other changes that impact savings (increase or decrease) be handled? Similar to sequential energy conservation retrofits, other changes will interact with the initial energy conservation measure. For example, a large increase in internal gains (e.g. office equipment) will diminish the utilization of a retrofitted high efficiency heating system. Unadjusted space heating energy will go down, but not only because of the energy conservation measure. In fact, if the baseline were adjusted to only reflect the revised internal gain, savings due to the high efficiency heater would also go down. Under the FILO principle, savings from the high efficiency heater would not be subject to reduction due to subsequent changes in the building. Therefore, the baseline adjustment would seek to reduce the savings to the level it would have been if the post retrofit change had not occurred. Assuming measure life is extended due to reduced service, and assuming avoided cost savings escalates at approximately the discount rate, the net present value of the avoided cost remains the same.

What would happen if the internal gains went down resulting in the heating energy use as well as the savings (due to the retrofit) going up? Clearly, a baseline adjustment is in order, but should it allow a windfall profit or just preserve the original savings? Under the FILO principle, only the original savings would be preserved, the additional savings would be attributed to the second measure (the driver for more heat). FILO falls down here if the retrofit measure has a limited life expectancy, or maintenance that is a function of run time. In such a case the bidder would suffer an unfair loss. One solution is to pay for the increased performance but reduce the term of the contract (cap the total payments). Again the avoided cost would remain constant, assuming savings escalation equals the discount rate.

Occupancy

Treatment of a temporarily unoccupied building pushes the FILO principle to the limit. Applying the principle assumes a functional retrofit in an unoccupied building is more than a capacity reduction waiting to happen. The retrofit has permanently reduced the baseline load whether the building is in use or not. Savings due to the building being unoccupied is only the remaining consumption after the retrofit (change in occupancy is the "second measure"). The owner benefits actually increase due to an extended life of the retrofit measure (assuming life is a function of actual run time).

Partial occupancy changes offer additional complexity as different retrofit measures are affected differently. For example, if occupancy hours are increased (e.g. changed from one to two shifts) control system retrofits used to turn equipment off when unoccupied will have less unadjusted savings, while equipment efficiency improvements (e.g. new ballasts and motors) will save more due to longer operating hours. If the FILO principle is applied, the loss of control savings would be attributed to the change in occupancy and the baseline would be adjusted to maintain constant savings. Likewise, the increase in equipment efficiency savings would be attributed to the "second" change (increase in occupancy) and the actual savings would be adjusted down. Even operation of an unoccupied building will involve use of the retrofit measures to varying degrees. Clearly, with such complexity the question of M&V cost effectiveness becomes an issue.

Conclusion

Similar to all performance measurement schemes the principle of FILO is imperfect, however it treats all changes consistently, and provides a good starting point to analyze the issues of baseline adjustment. The M&V focus under FILO is on initial overall performance (bottom line savings) and the long term functional performance of the retrofit capacity to save. Changes to the load will not effect payments, and generally will not change the net present value of avoided cost (assuming life is a function of operating hours and the avoided cost escalates at the discount rate). The performance emphasis will be on the elements that the bidder has control; initial project selection, design, installation, commissioning, operation, and maintenance. Payments will reduce if the retrofit measure deteriorates, fails, or is permanently taken out of service.

Once agreement is reached on the overall principles for baseline adjustments, a matrix should be established to assess their applicability and application to individual energy retrofit measures for each potential variable change. Simplification and technical compromise will then be in order.

	Light Fixture	Light Control	Motor	VAV	On/Off	Reset	Other
weather							
work-days							
process							
envelope							
square feet							
internal gains							
occupied hours							
number of occupants							
use of space							