



U.S. Department of Energy
**Energy Efficiency
and Renewable Energy**

Bringing you a prosperous future where energy
is clean, abundant, reliable, and affordable

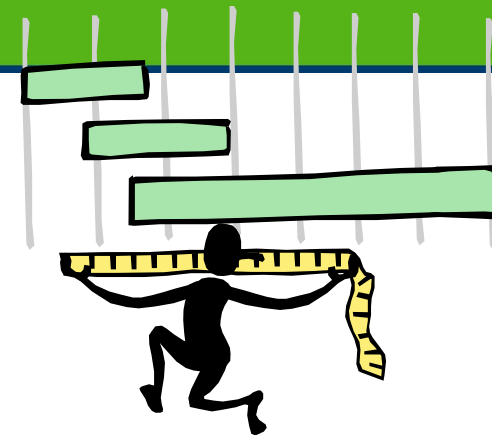
Federal Energy Management Program

Introduction to Measurement & Verification in Super ESPCs



Why do you need M&V?

- Savings guarantees are contractually and legally required
- But guarantees are only as good as the M&V behind them
- M&V verifies guarantees are being met.
- M&V helps allocate risk and identify problems



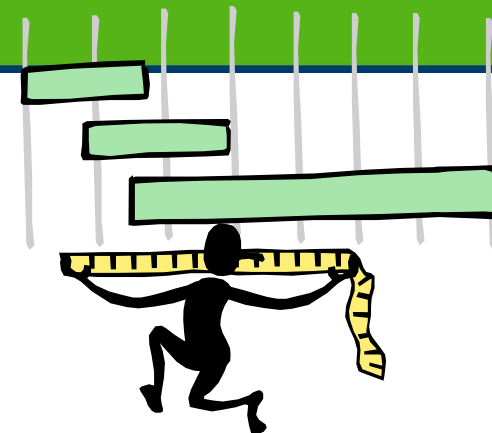
“What you don’t measure, you can’t manage.”

—Jack Welch, former GE CEO



Why does M&V get so much focus?

- Savings can only be measured indirectly
 - Since the goal is to measure the absence of something
- And lots of other factors affect energy use besides the ECMs from the ESPC
 - Weather, occupancy, hours of operation, space usage, plug loads ...
- All this can make assessing savings over long periods tricky





Basic M&V Concepts

- Goal in designing project M&V is to balance savings assurance against added cost
- Good M&V plans require ESCOs to measure key performance parameters of ECMs
- If M&V plan is weak, guarantee will be met only on paper
- The degree of M&V should be proportional to:
 - 1) the ECM's savings; and
 - 2) the ECM's performance risk



FEMP M&V Guidelines, v. 3.0

- For federal energy projects specifically
- Application of International Performance Measurement and Verification Protocol (IPMVP)
- Detailed explanations of m_a in M&V options (A, B, C & D)
- Addresses M&V methods by ECM type
- http://www1.eere.energy.gov/femp/financing/superespcs_mvresources.html



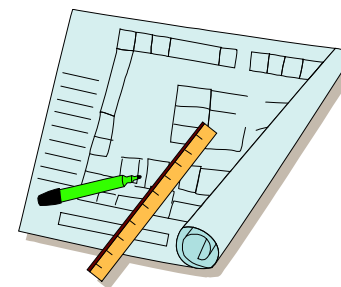
Options A, B, C, and D

- Options address risk allocation
- Measurements differ by:
 - Level – individual system vs. whole building
 - Duration – spot, short-term, periodic, continual
 - Degree of stipulation
 - Cost – can range from 1 to 15% of project cost (average is about 3%)
- Each ECM assigned an M&V option



FEMP M&V Compliance

- Adhering to the FEMP (and IPMVP) guidelines requires:
 - Developing an M&V plan using the defined methods
 - Following the M&V plan
- The important consideration is what is in the plan
- Agency witnessing recommended





How is the guarantee met?

- Savings must exceed payments
- Savings that may be used to pay the ESCO are categorized as:
 - Energy and water cost savings
 - Energy- (and water-) related cost savings



Energy Cost Savings

- Reductions in system use
- Efficiency improvements
- Reductions in peak demand
- Reductions in energy rates
- Shifting time-of-use to lower-cost periods
- Switching to less expensive fuels
- Self-generation (inc. cogeneration/CHP)
- Reduced water and sewer use/cost



Energy-Related Cost Savings

- Usually recurring savings, primarily reduced O&M expenses:
 - Parts & labor costs
 - Emergency repair costs
 - Equipment replacement costs
- Cost savings must come from existing budgets!



One-Time Energy-Related Cost Savings

- Cost avoidance provided by the project:
 - Example: An agency was planning to replace a chiller using funds from O&M or repair & replacement budgets. They included the chiller in the ESPC project and used the O&M/R&R funds as a one-time payment for the ESPC.
- Implementation period energy savings
 - These are savings accrued from ECMs that are installed and performing in advance of full project acceptance

To learn more about permissibility of payments in ESPCs, see the *Practical Guide to Savings and Payments in Super ESPC Task Orders*

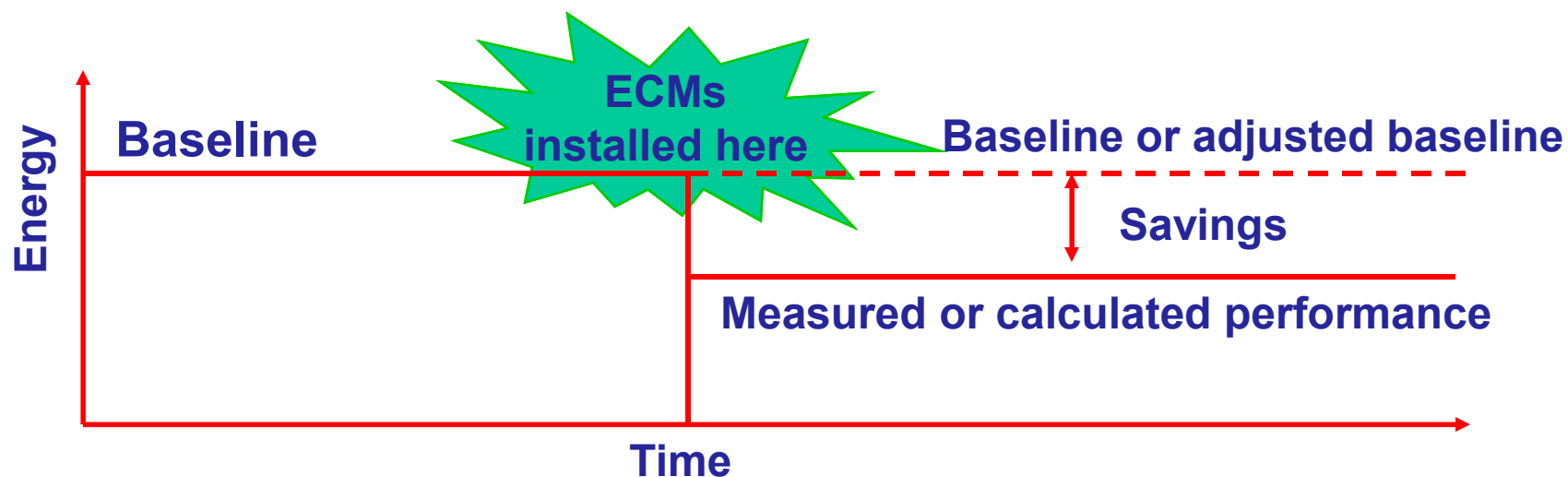


Definition of Savings

$$\text{Energy Savings} = \text{Use}_{\text{Baseline}} - \text{Use}_{\text{Post-Retrofit}}$$

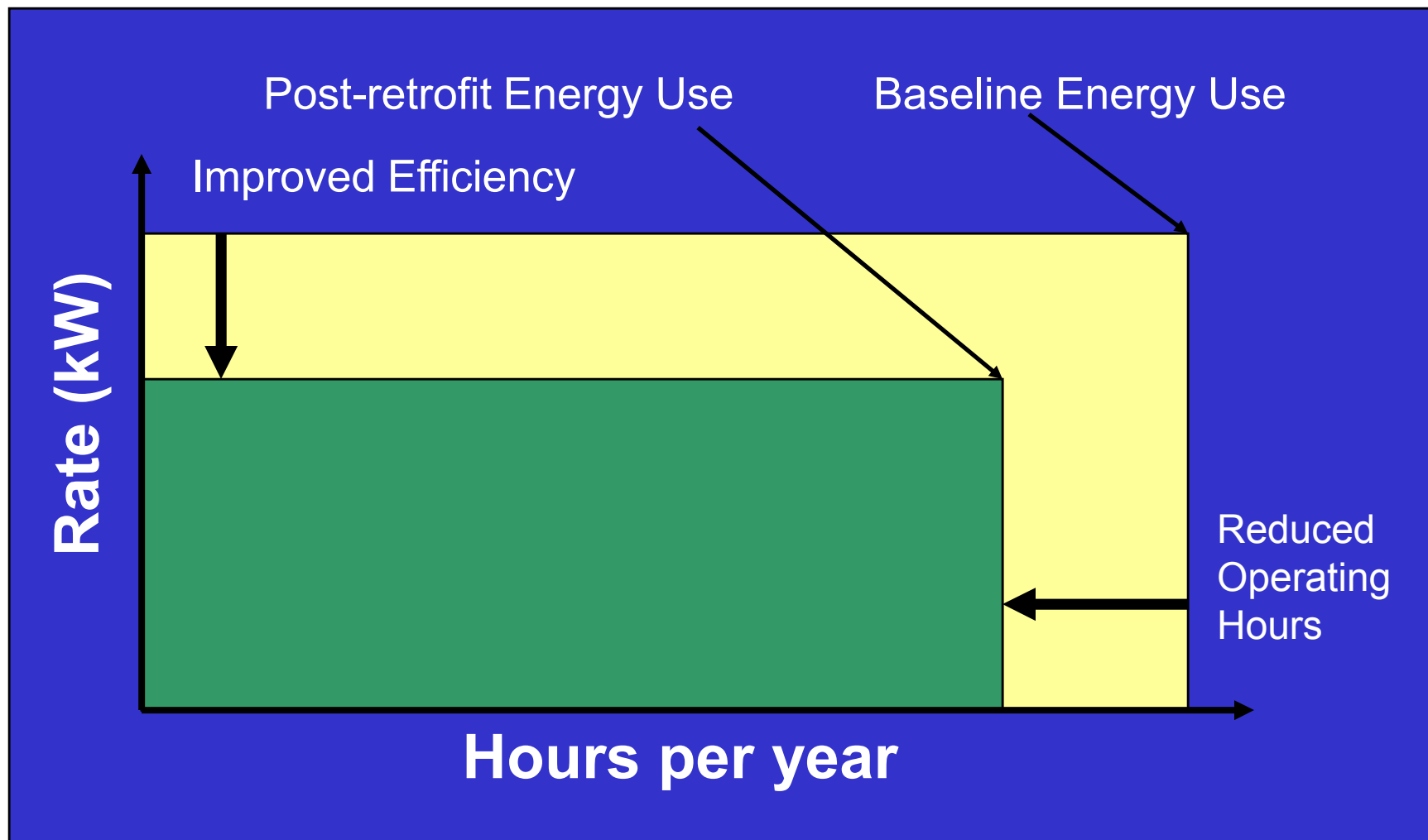
$$\text{Energy Savings} = (\text{Use}_{\text{Baseline}} \pm \text{Adjustment}) - \text{Use}_{\text{Post-Retrofit}}$$

$$\text{Savings (\$)} = \text{Unit Cost} \times \text{Energy Savings}$$



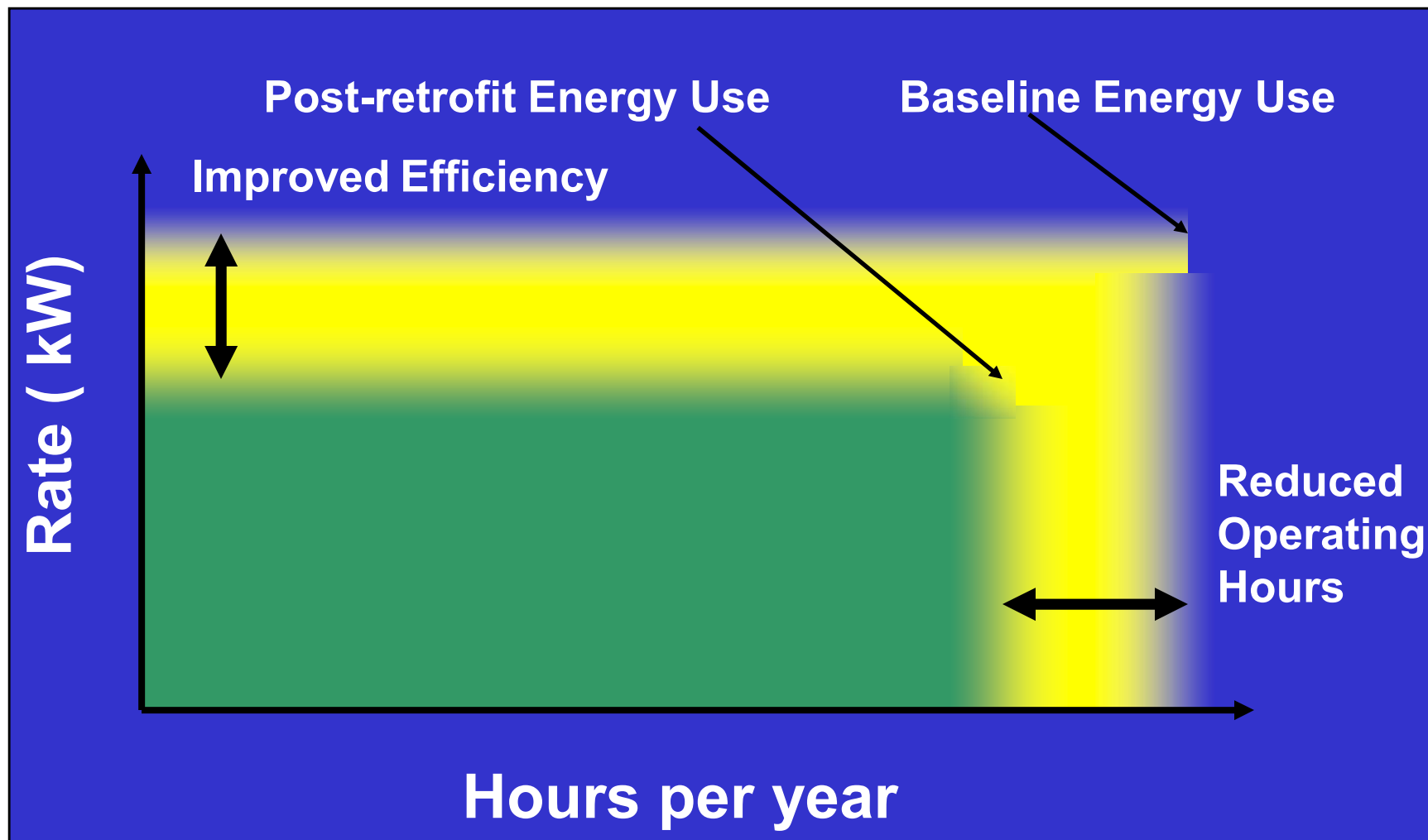


Performance and Usage: Ideal



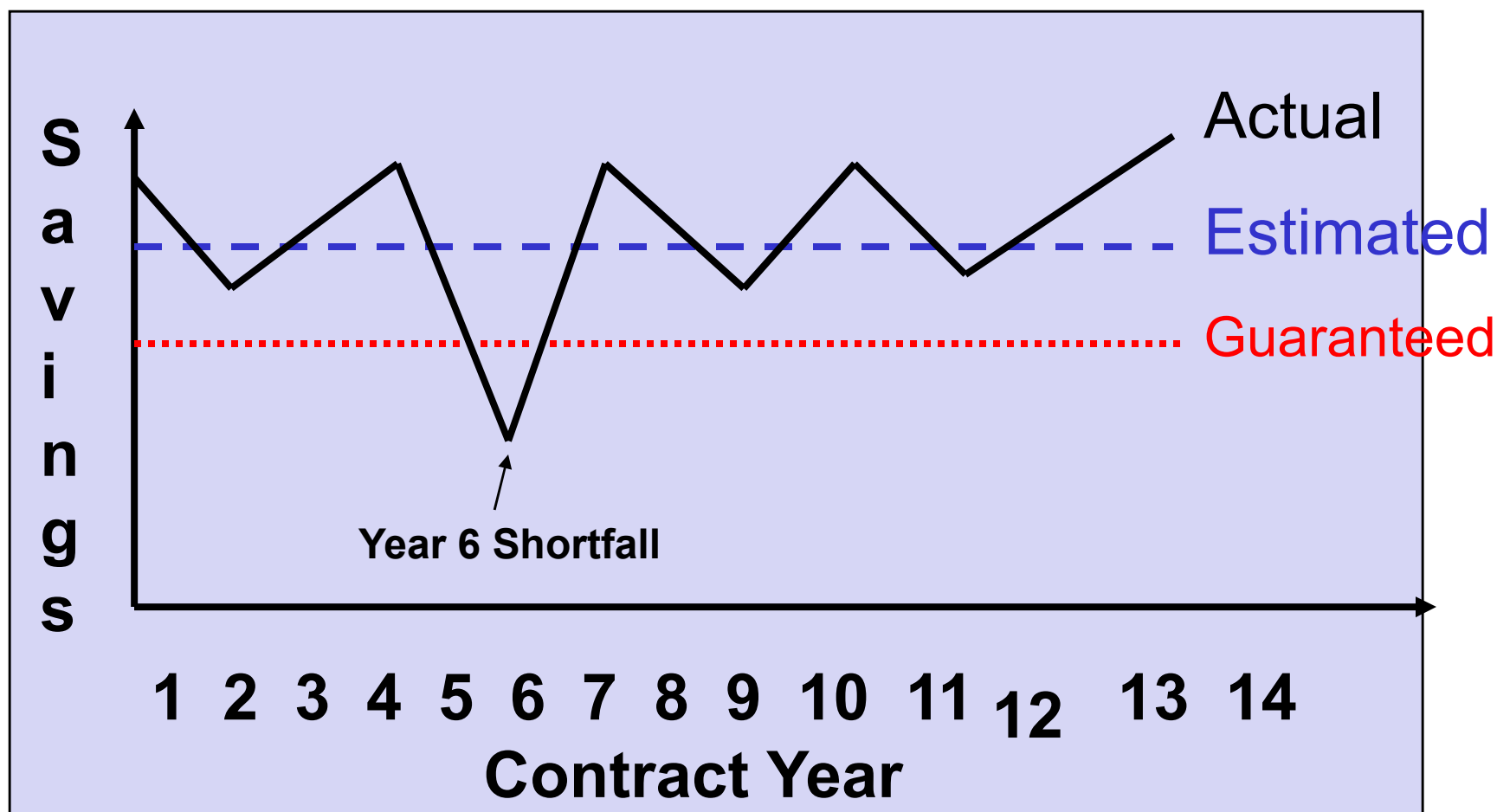


Performance and Usage: Real





Actual saving will fluctuate, but should always exceed guaranteed amount

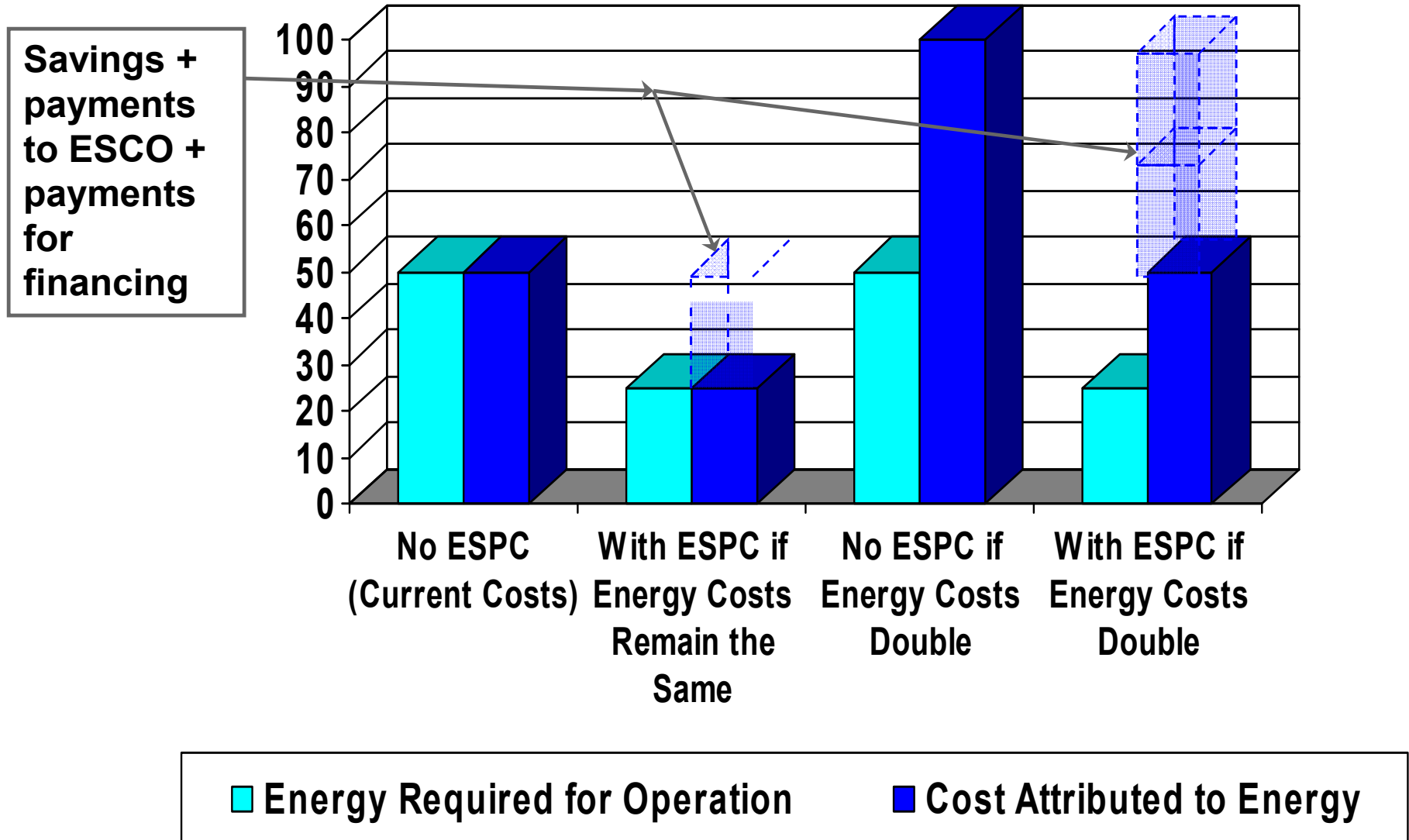




Uncertainty can be reduced, but never eliminated

- Claimed savings are always estimates because savings cannot be measured directly
- Uncertainty is introduced through:
 - Measurement and modeling error
 - Sampling error
 - Simplifying assumptions
 - Other changes at facility
- These factors are inherent in M&V

What if energy prices increase?





Energy Prices and ESPC

- When energy prices go up, “savings” appear to evaporate
- What we usually call savings is better referred to as “cost avoidance”
- What is actual effect of energy price increases on ECMs’ savings (cost avoidance)?
 - A: They go up, not down.
- ESPC can be seen as a hedge against higher energy prices



Review

- Why is M&V needed in ESPC?
- How do we measure savings?
- Who determines the baselines for M&V?
- What are the components of energy usage and savings?
- What is the effect of rising energy prices on an ECM's cost avoidance?