

Methodology for the Evaluation of an Energy Savings Performance Contracting Program for the U.S. Federal Government

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Outline of Presentation

- Background on Super ESPC Program
- Issues motivating the evaluation
- Evaluation methodology
- Preliminary results

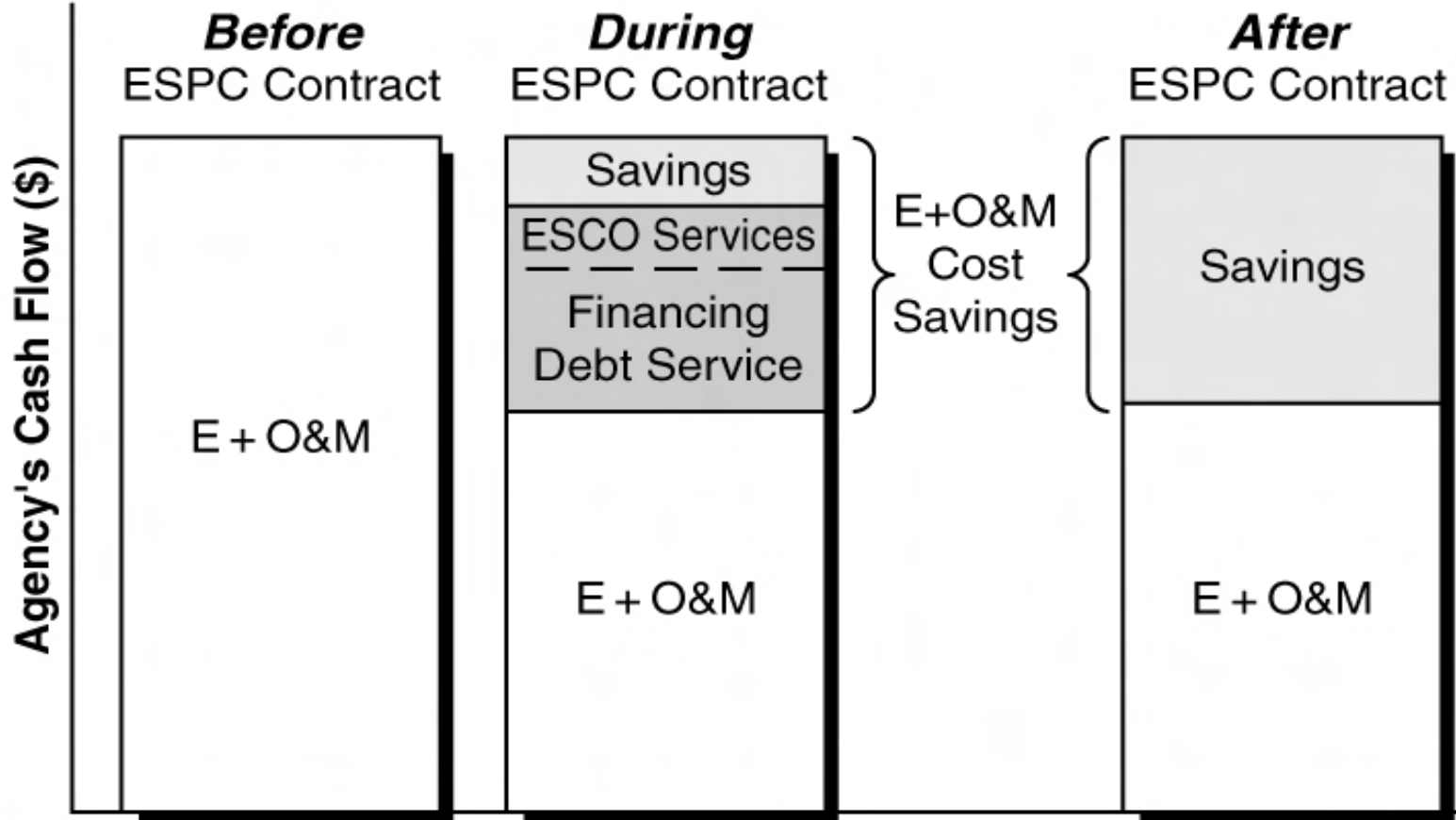
Acronyms

- **DOE**: U.S. Department of Energy
- **ECM**: Energy Conservation Measure
- **ESCO**: Energy Services Company
- **ESPC**: Energy Savings Performance Contract
- **FEMP**: Federal Energy Management Program (a program within DOE)
- **M&V**: Measurement and verification

Energy Policy Act of 2005 Set Ambitious Goals for U.S. govt

- Cut building energy use intensity (compared to 2003) by 2% per year in 2006 through 2015
- Increase use of renewable energy to:
 - >3% 2007 - 2009
 - >5% 2010 - 2012
 - >7.5% 2013 -
- How to pay for these improvements?

An ESPC allows energy conservation goals to be met with no net budget increases



E+O&M = operating budgets for energy and energy-related operations and maintenance

FEMP's Super ESPCs

- Federal government had authority to do ESPC since the 1980s
- Difficulty of awarding + inexperience of Contracting Officers led to few awards
- FEMP's Super ESPC “umbrella contracts” streamlined the process
 - Competitively awarded to qualified ESCOs
 - Contracting regulations satisfied
- Federal agencies access the ESCOs by writing Delivery Orders under the Super ESPCs
 - Regional contracts
 - Technology specific contracts

Program Statistics, 1998-2007

- 161 Super ESPC Projects awarded
- \$910 million in investment
- \$2.2 billion in guaranteed cost savings
- 136×10^{12} BTU savings over life of projects

How the process works

- ESCO meets with site to discuss potential project
- ESCO prepares Initial Proposal
- If site agrees, ESCO performs a detailed energy survey, prepares Final Proposal
- Agency and ESCO sign the contract
- ECM Construction
- ECM Commissioning
- Multi-year Performance period
 - ESCO may perform O&M, R&R on installed ECMs
 - Annual M&V report

Motivation for Evaluation

- Super ESPCs evolved as decentralized contracting mechanism
- DOE holds master contract, but agencies implement, award and administer the individual projects (Delivery Orders)
- DOE involved up to award, but in the performance period the agency takes over
- How is the program doing?
 - Projects delivering guaranteed savings?
 - M&V techniques working?
 - ESCOs adhering to FEMP standards?

Main Objectives

- Compare predicted and guaranteed Super ESPC cost and energy savings with the savings actually achieved
- Estimate realization rates
 - Percent of guaranteed cost savings achieved
 - Percent of estimated (proposed) energy savings achieved
- Improve M&V techniques

Evaluation Outline

- Collect the latest annual M&V report for all ongoing projects
- Extract reported energy and cost savings
 - Compare with estimated energy savings
 - Compare with guaranteed cost savings
- Recalculate savings for a PPS subsample of M&V reports stratified by
 - Census region
 - Status re August 2001 consistency modifications
- Calculate savings using whole-facility analysis for a smaller subsample

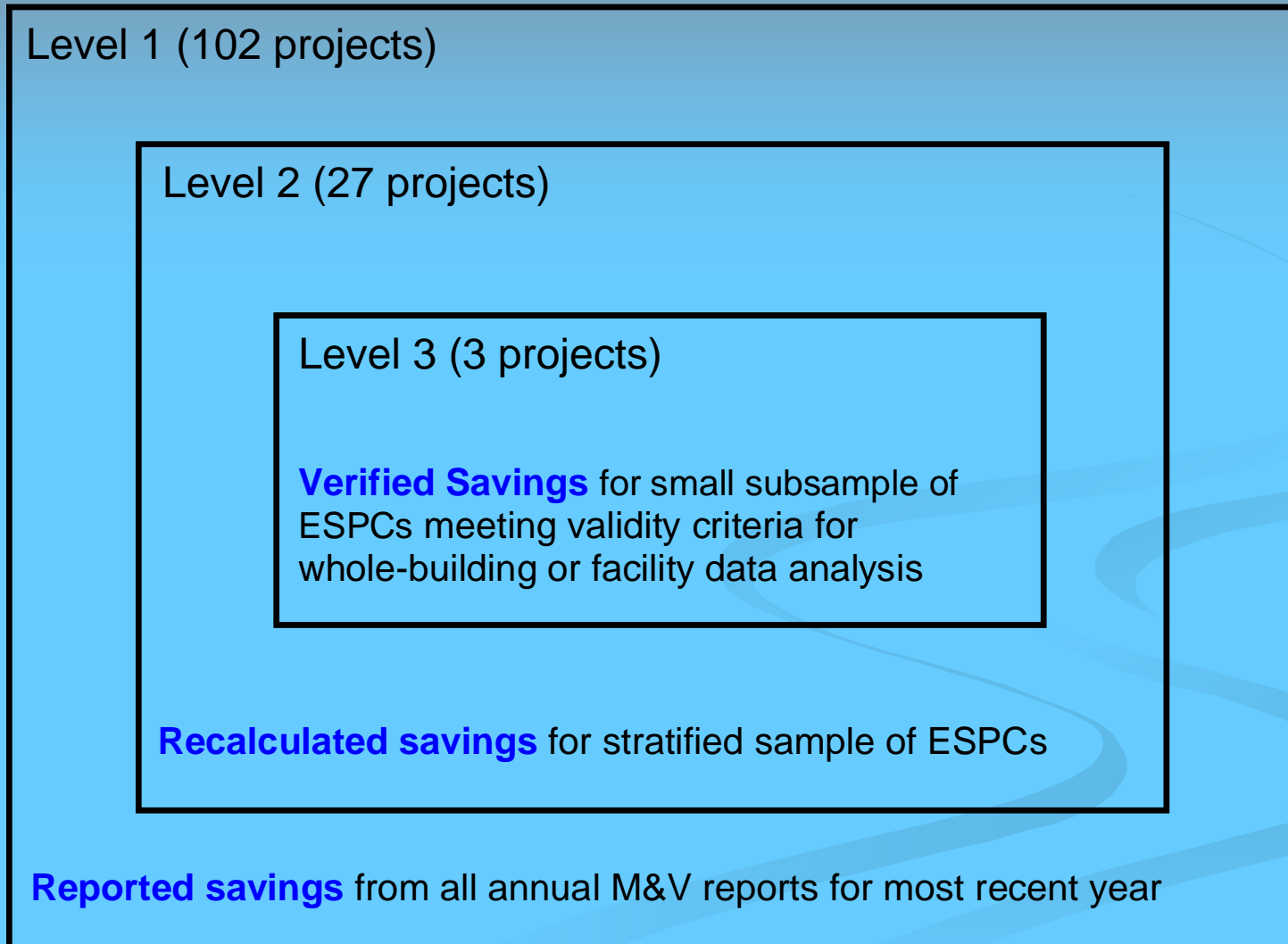
Level

1

2

3

Evaluation Design



Level 1: Document collection

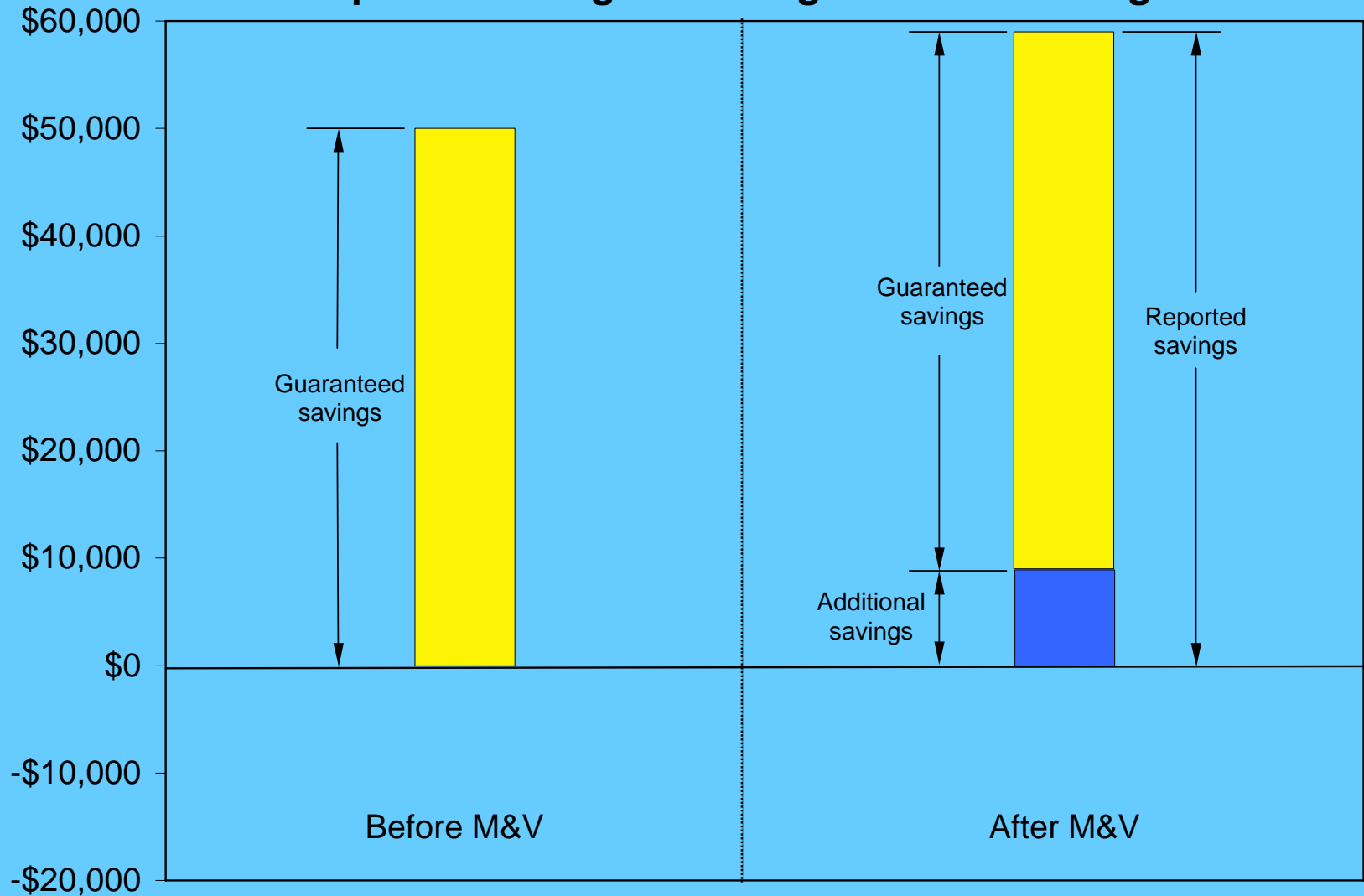
- Study population consists of all Super ESPC projects that
 - were in the performance period
 - had produced at least one annual report by April 2006
- 102 annual reports collected in all
- Delivery Order schedules another important source of information
 - Award
 - Most current

How the Process Works

- ESCO estimates the energy savings from the project. This becomes the **Proposed Energy Savings**
- Site and ESCO negotiate utility prices and escalation rate
 - Usually based on today's prices with constant escalation
- Given utility rates and energy savings, ESCO can calculate cost savings for each year. ESCO guarantees a portion of this (~91% usually). This is the **Guaranteed Cost Savings**.
- Each year, ESCO measures energy savings, applies agreed-upon rates, and calculates cost savings. This is the **Reported Annual Cost Savings**.
- If Reported > Guaranteed, performance is met. Otherwise, payment from site to ESCO is reduced by amount of shortfall.

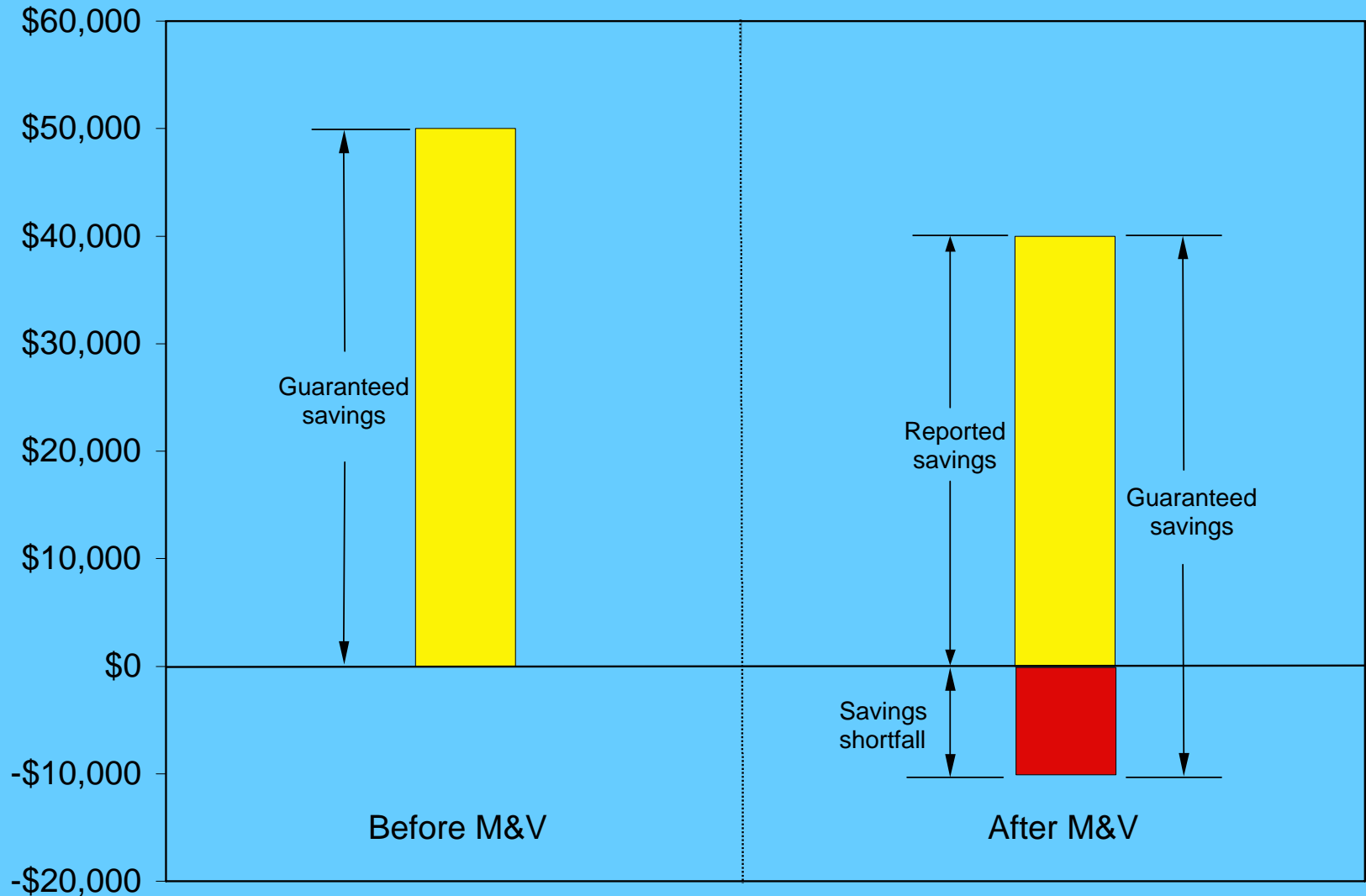
How results are shown

Reported savings exceed guaranteed savings



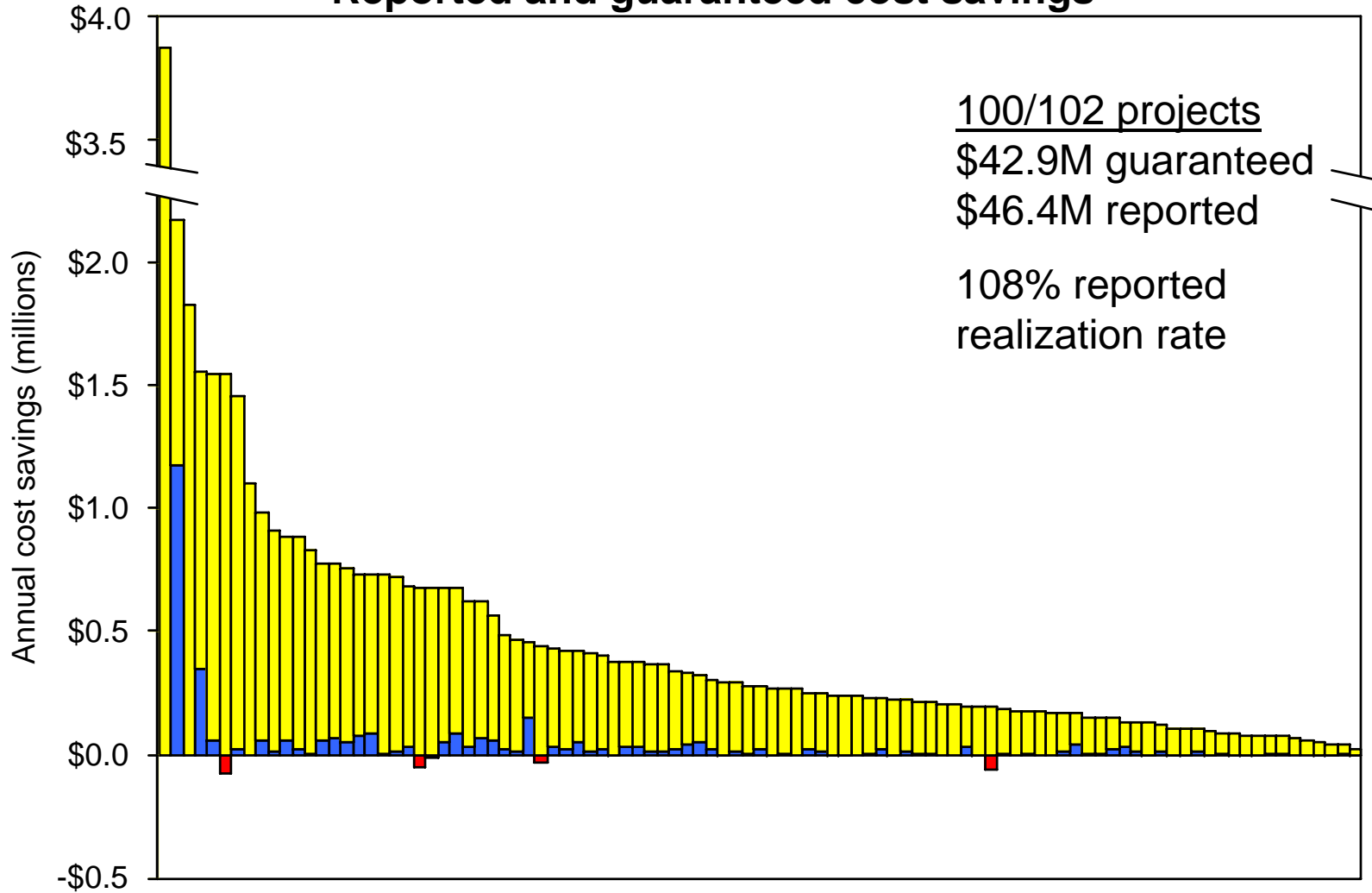
How results are shown

Reported savings less than guaranteed savings



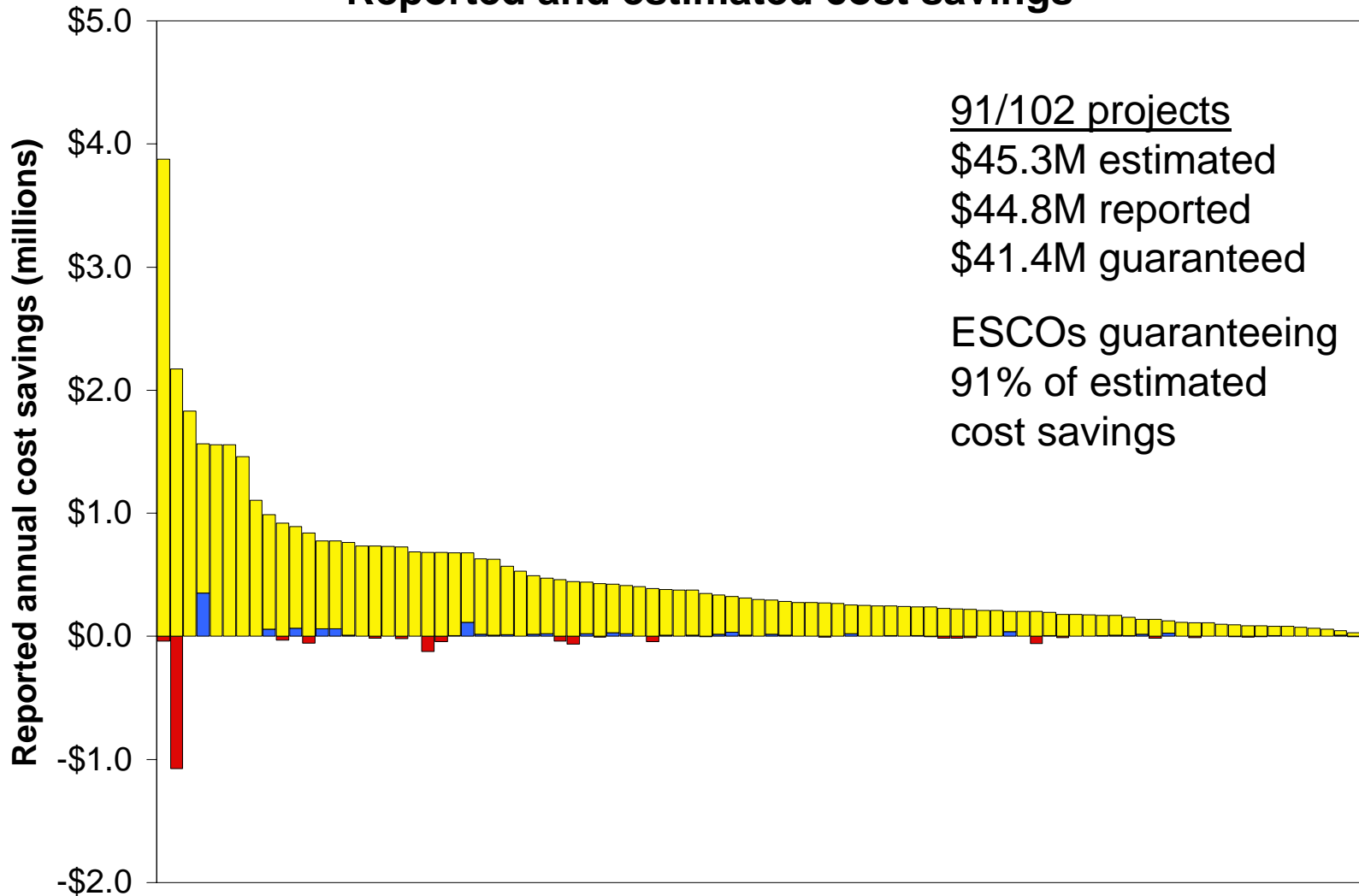
Cost savings

Reported and guaranteed cost savings



Cost savings

Reported and estimated cost savings



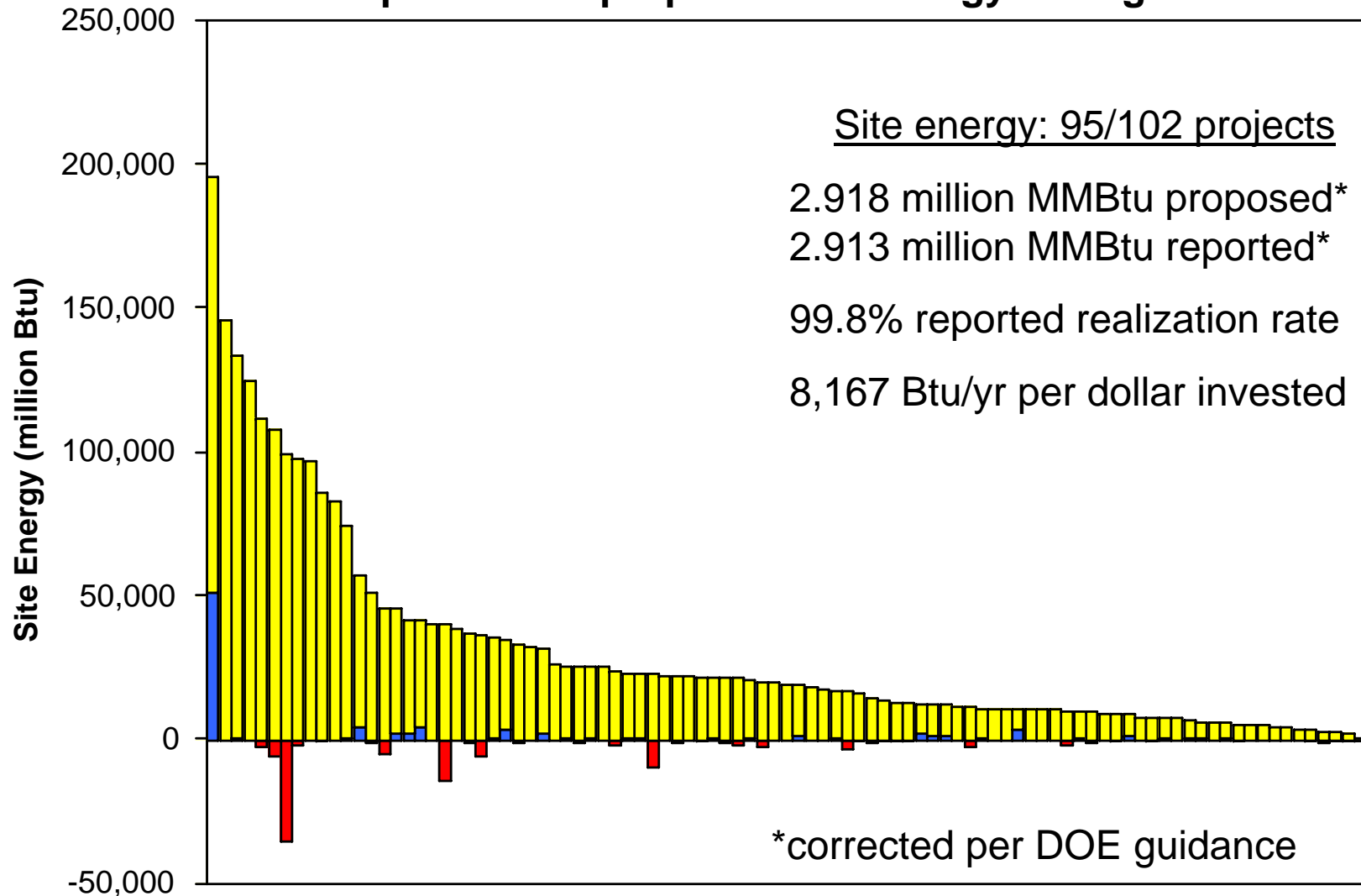
M&V Techniques

Type A methods predominate



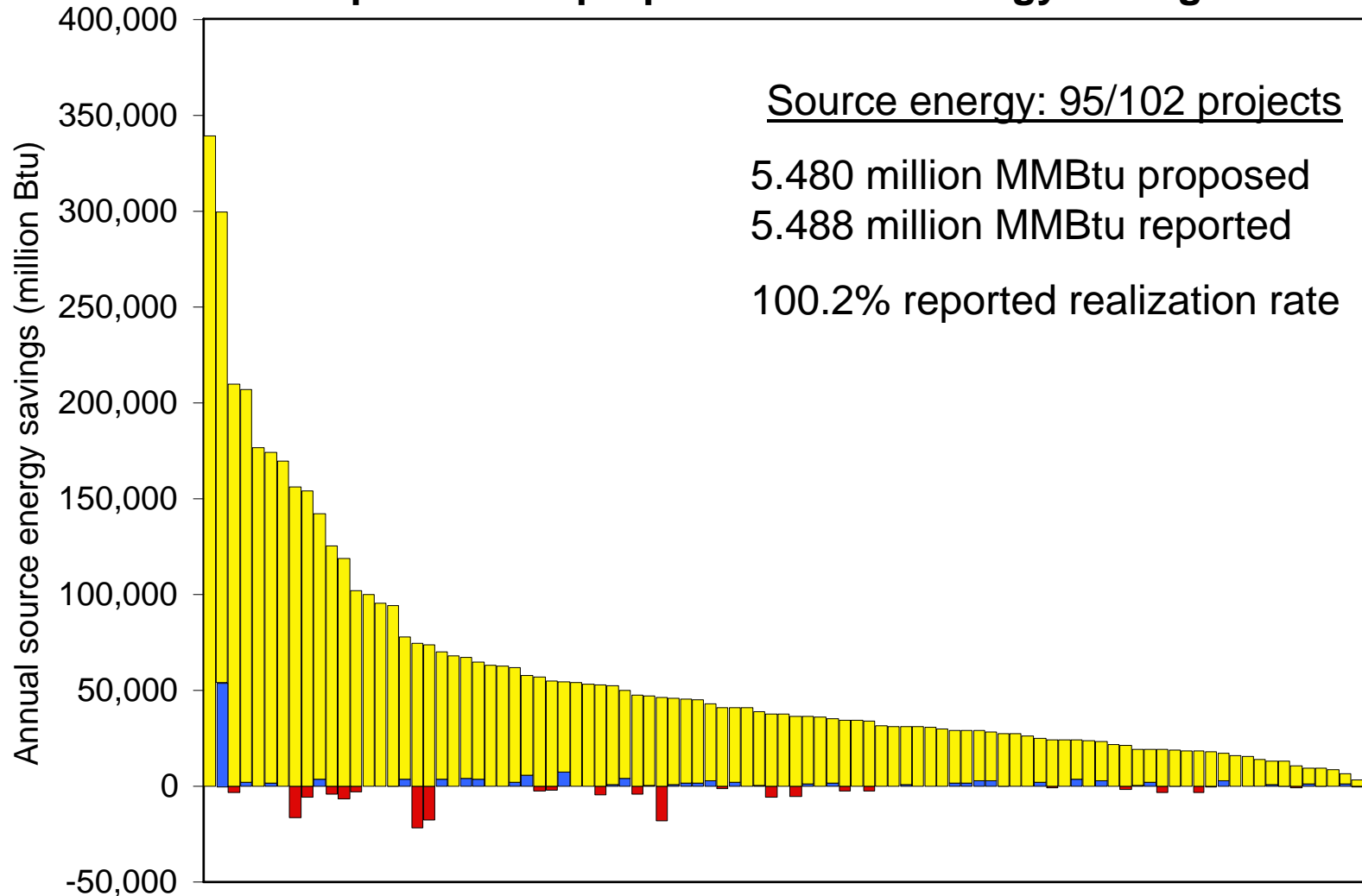
Site energy savings

Reported and proposed site energy savings



Source energy savings

Reported and proposed source energy savings

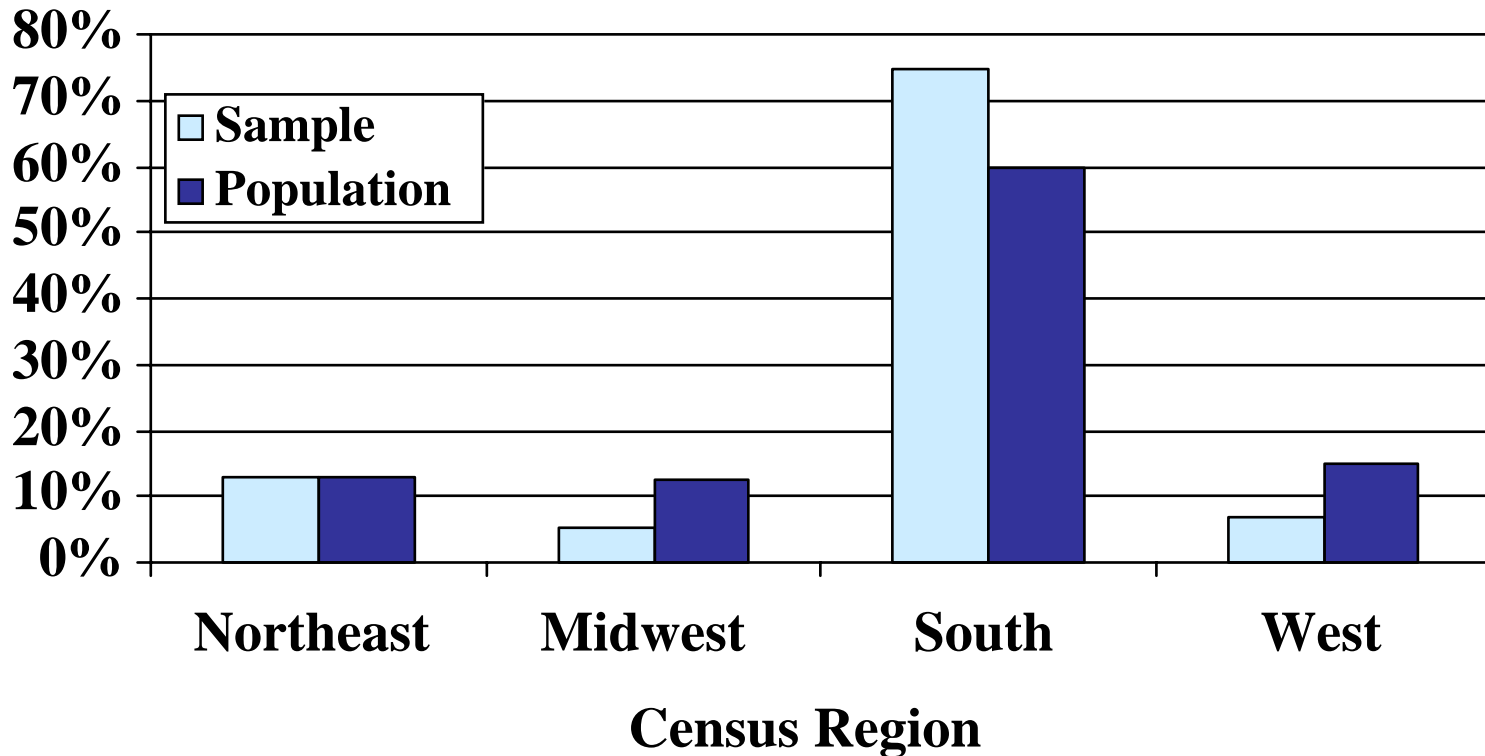


Level 2: Recalculated savings

- Based on a sample of 25 projects
- Probability proportional to savings (PPS)
- Sample is stratified according to age (before/after consistency mods) and census region
- Savings recalculated according to M&V plan
 - Verifying the math
 - Using actual values for some key parameters
- Objective is to determine ratio of recalculated to reported savings
 - This sample size allows ratio to be determined within 5% of population mean, with 90% confidence

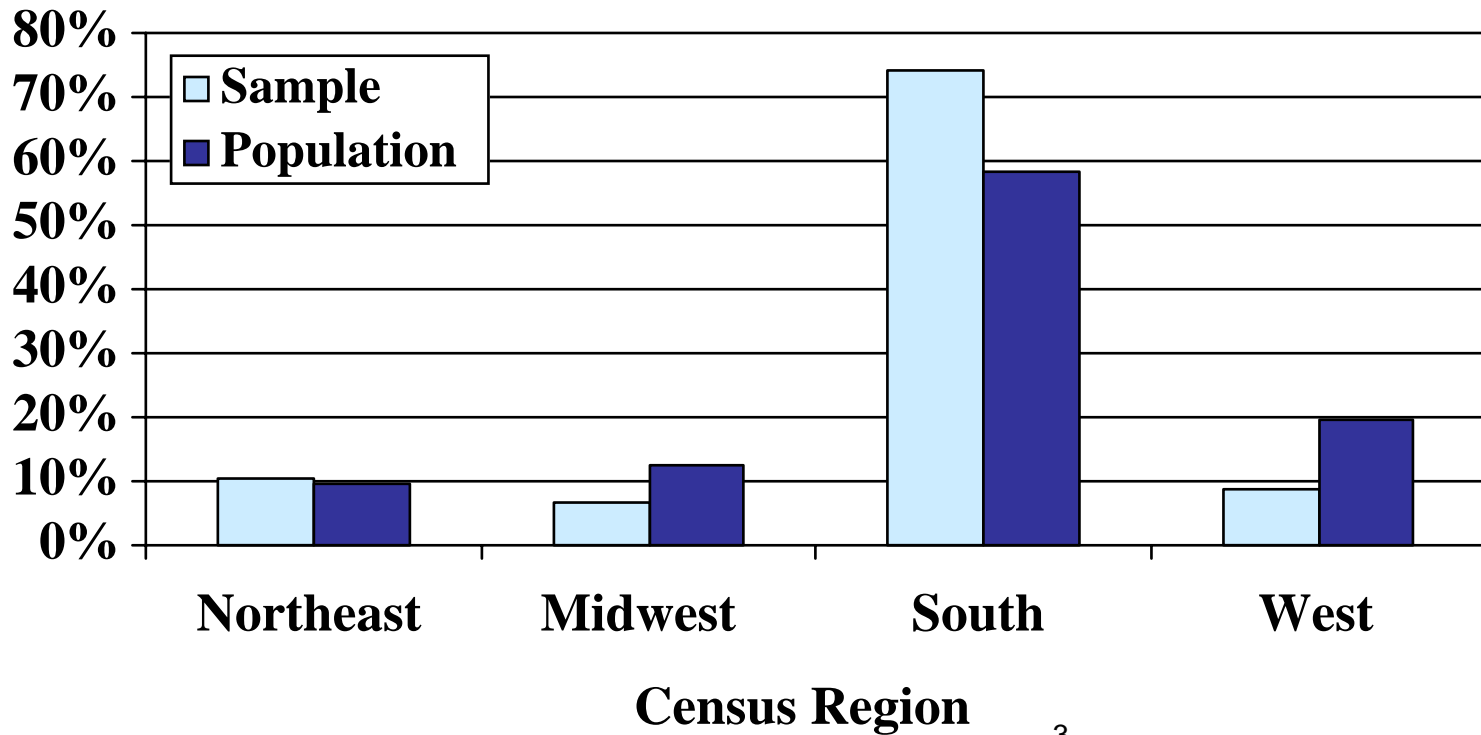
Sample stratified by census region

Percent of GCS by Census Region



Sample also stratified by status (before/after) with respect to August 2001 consistency mods

Percent of GCS Awarded After Consistency Mods
in Each Census Region



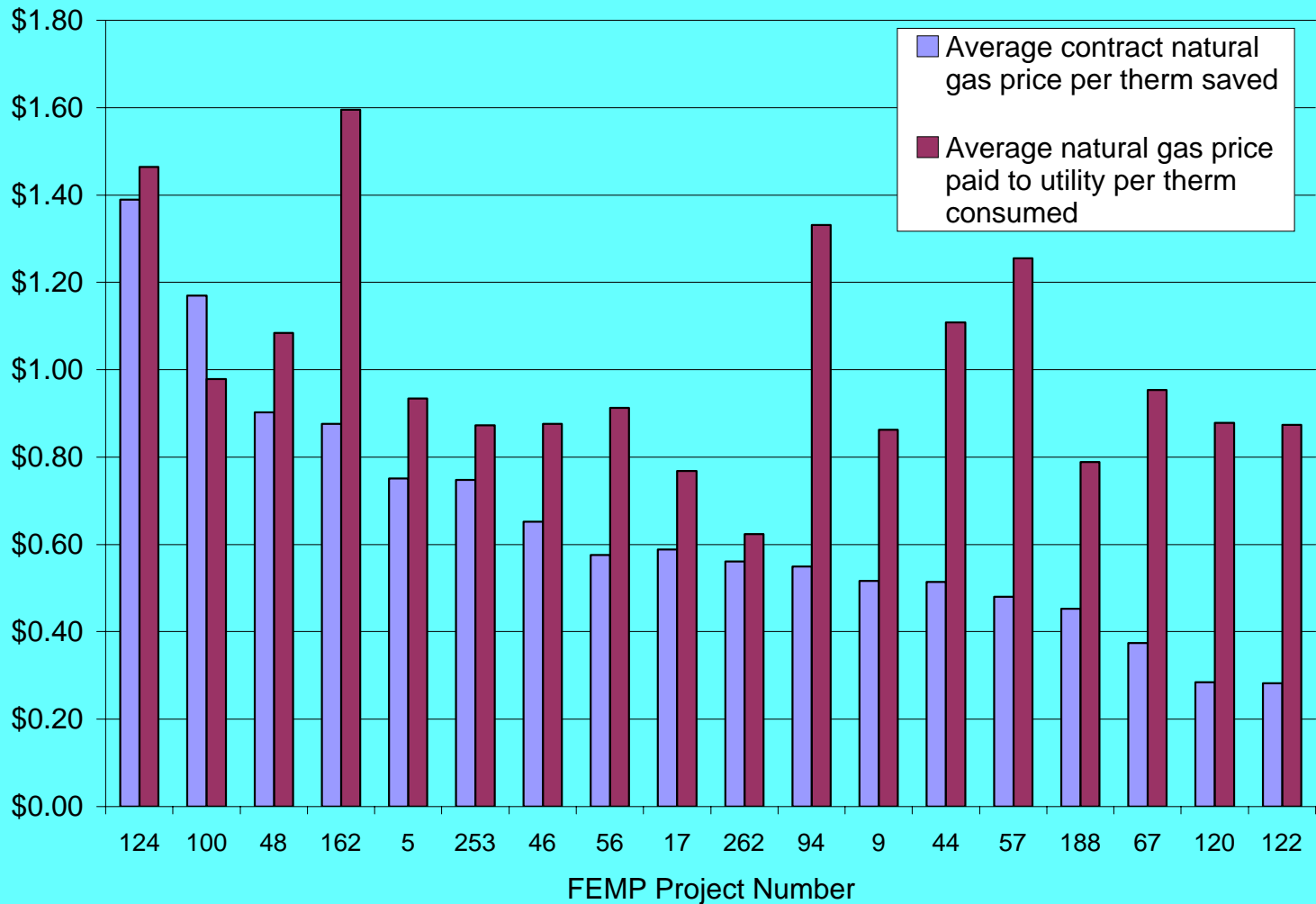
Preliminary Level 2 Results

- Recalculated savings within 1% of reported
- Errors appear random: spreadsheet mistakes, using wrong escalation rates
 - As likely to favor the government as to favor the ESCO
- Comparison between contract and actual rates shows savings are higher than reported

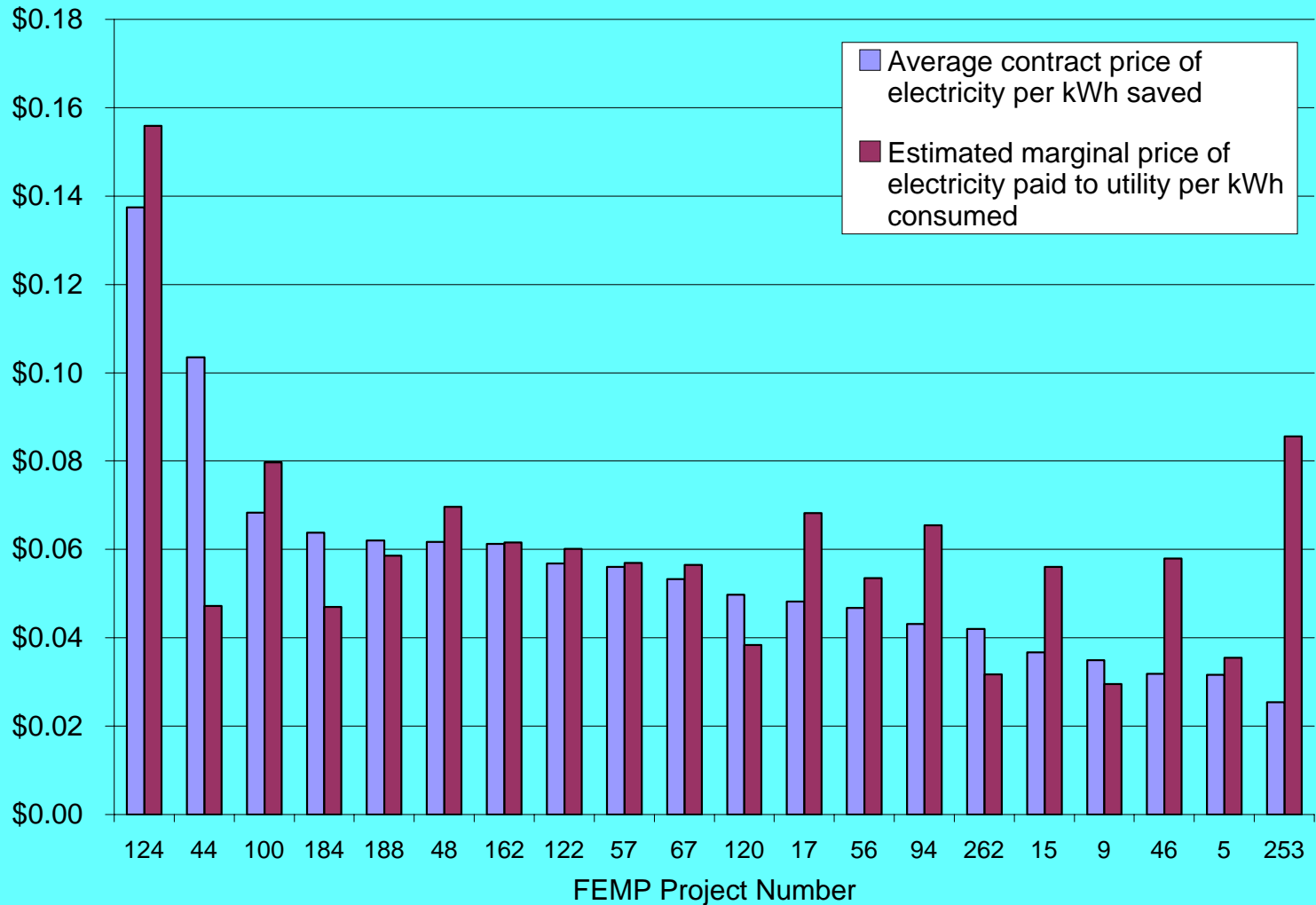
Actual vs. Contract Utility Rates

- During contract negotiations, ESCO and agency agree on how energy savings will be valued over life of contract
- “Contract” rates usually based on current rates plus fixed annual escalation
 - EIA projects energy prices into the future for various fuels
- In general we are finding actual utility rates at the sites to be moderately higher than the contract rates

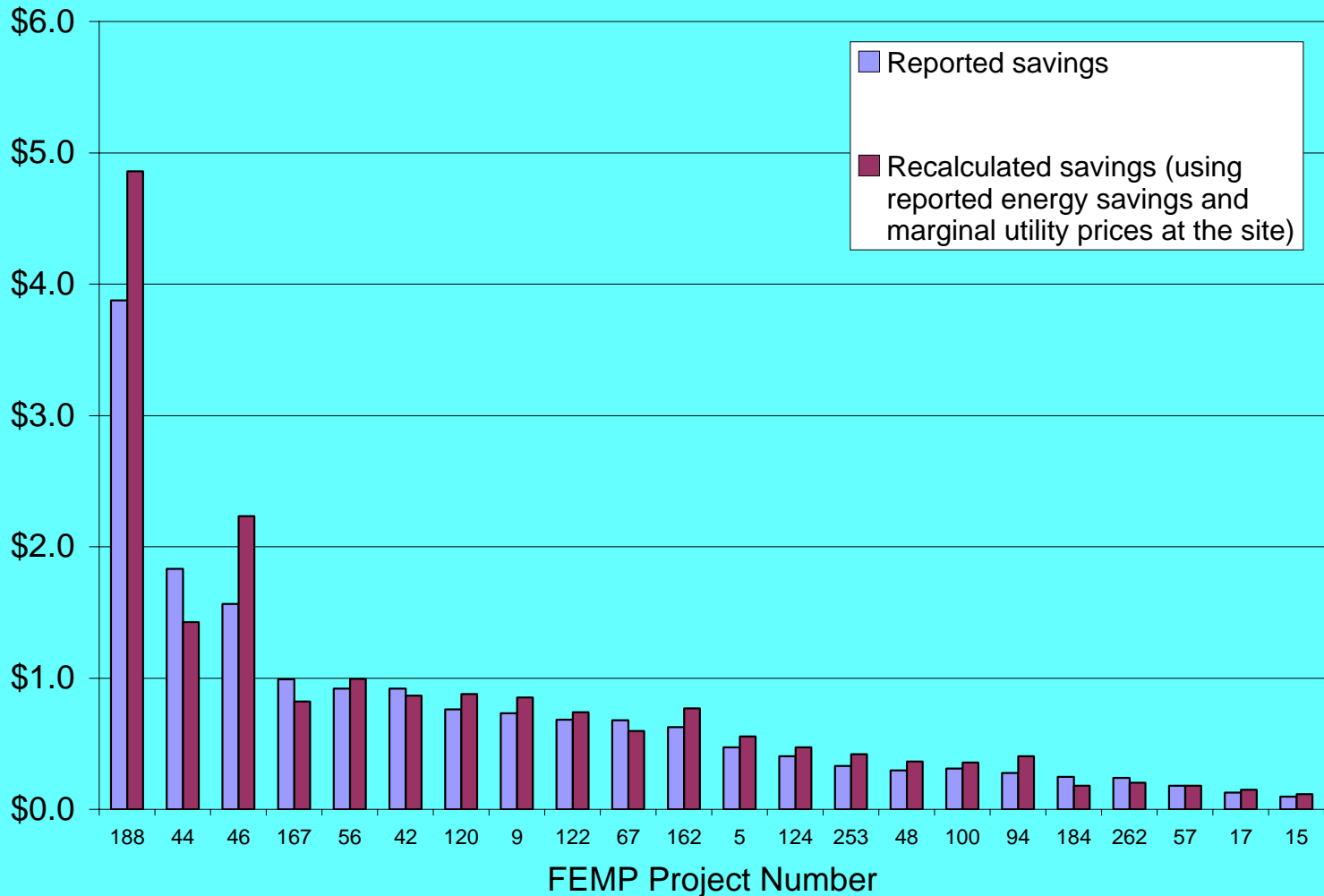
Natural gas prices



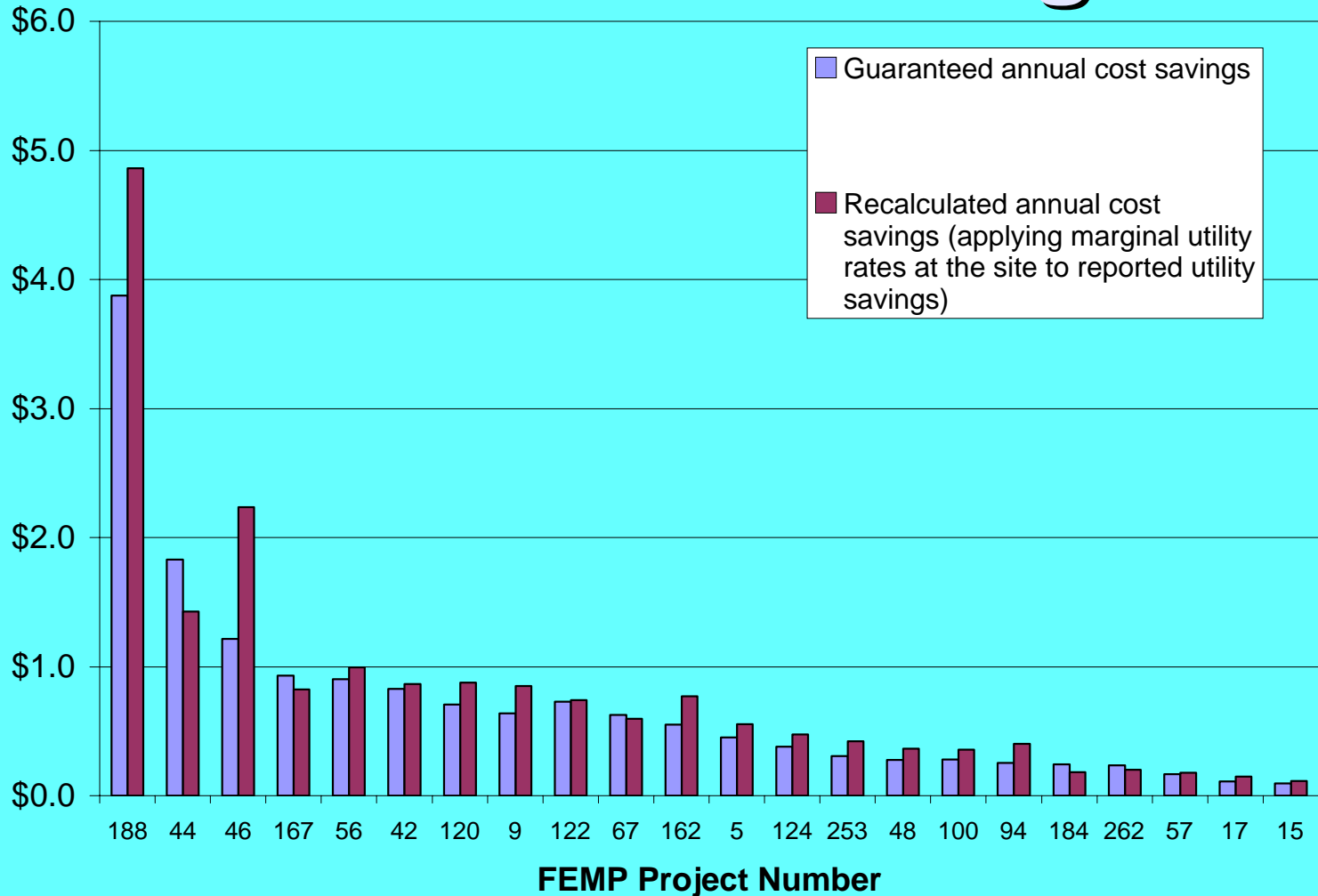
Electricity prices



Reported and Recalculated Annual Cost Savings



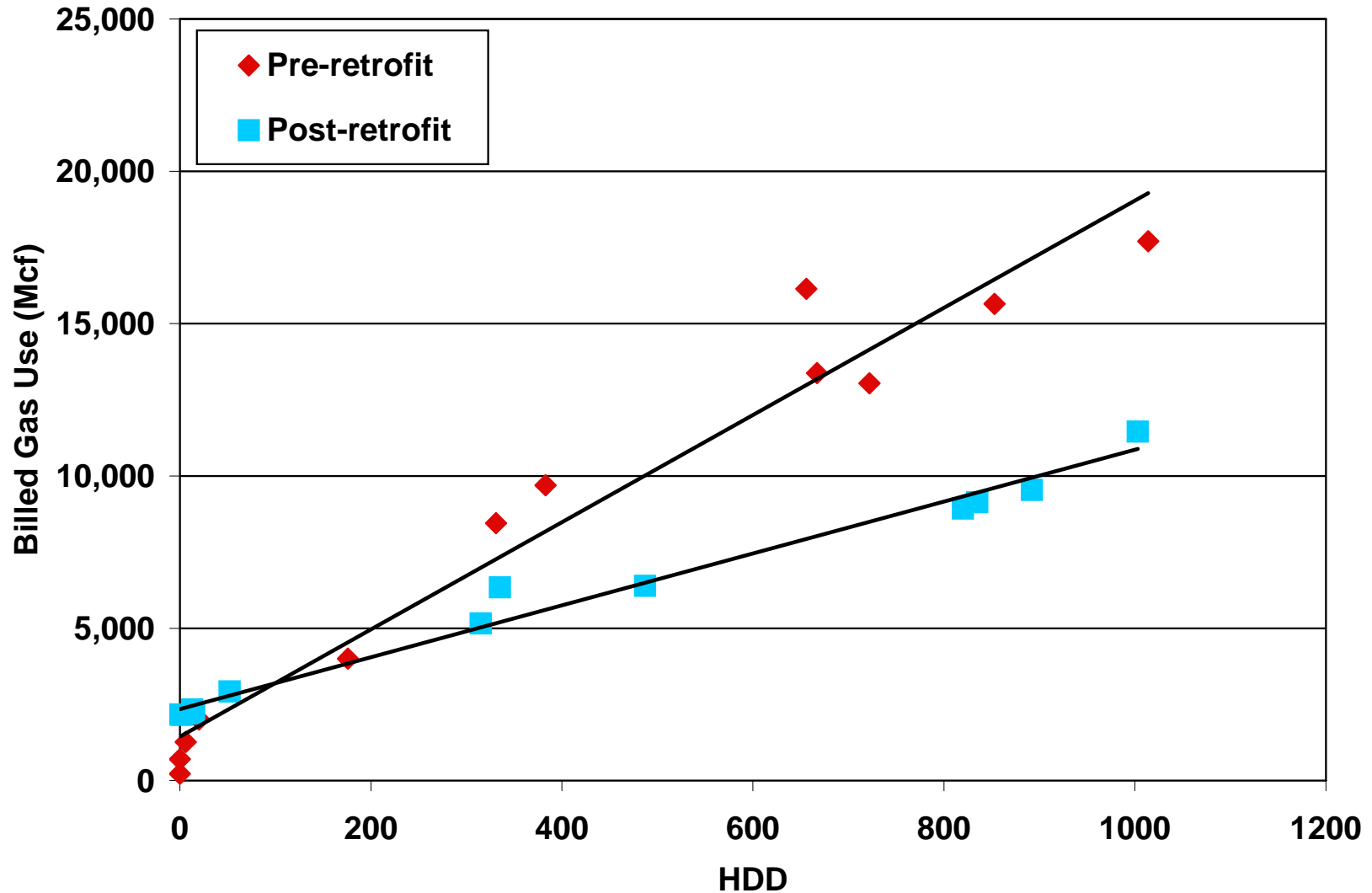
Guaranteed and Recalculated Annual Cost Savings



Level 3 analysis

- Based on subsample of projects from the level 2 sample
 - Only ESPCs meeting validity criteria for whole-building or facility data analysis can be selected
- Savings verified based on analysis of pre- and post-retrofit energy use
 - Utility or other pre/post site metering
 - Data source independent of the project's M&V
- Objective is to determine ratio of verified to recalculated savings

Example of utility bill analysis



Preliminary Level 3 Results

- Has been able to verify cost and energy savings in three cases, but this method has some limitations
 - Savings must be large compared to utility bills
 - Federal sites presently do no submetering
 - This will change as metering provisions of EPC Act are put in place
 - Analysis must be performed soon after retrofits
 - New construction, demolition of buildings, load creep make it difficult to “see” savings after a time
 - Cannot address long-term duration of savings

Conclusions

- Level 1 of Super ESPC evaluation has been completed
- Reported cost savings are 108% of guaranteed savings
- Preliminary Level 2 results show recalculated savings to be about 110% of reported, when actual utility rates are used
- Government realizing $(108\%)(110\%) = 119\%$ of guaranteed savings

Conclusions

- A great deal of data have been collected, providing the framework for institutionalization of the process
- A small number of annual M&V reports do not measure up, and lack key information
- The broad range (300 to 1) in the size of ESPC project investment and savings means that averages are dominated by what happens in large projects