Protocol for M&V

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Purpose of Performance Verification-- Obtain the Most Accurate and Unbiased Estimate of Savings

- "Savings" are relative to a Baseline

International Performance Measurement & Verification Protocol (USDOE, 2000)

The IPMVP protocol presents four Measurement and Verification (M&V) options:

- Option A: Mutual agreement based on spot measurements and calculations.
- Option B: Engineering calculations based on short-term monitoring, statistical sampling.
- Option C: Billing analysis at the whole-building level using statistical techniques.
- Option D: Calibrated engineering simulation models.

Accuracy of the Savings Estimate

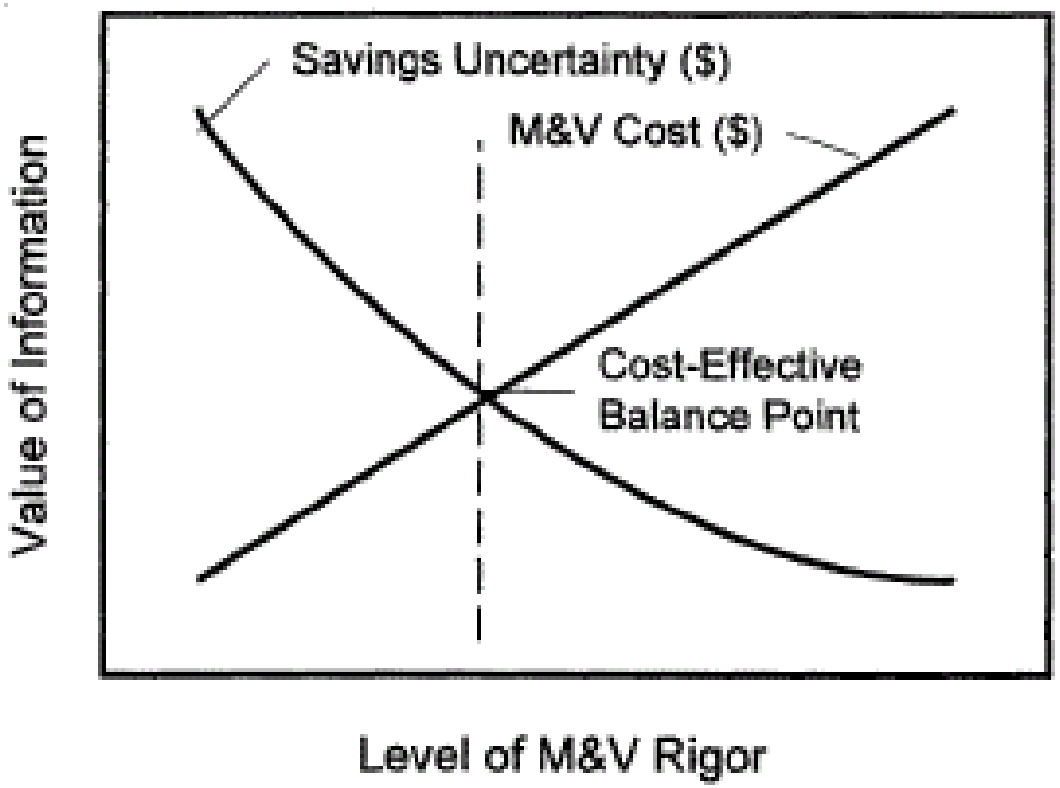
A savings estimate must include a statement of the accuracy (relative precision and statistical confidence) of the estimate.

Example: savings are 100,000 kWh

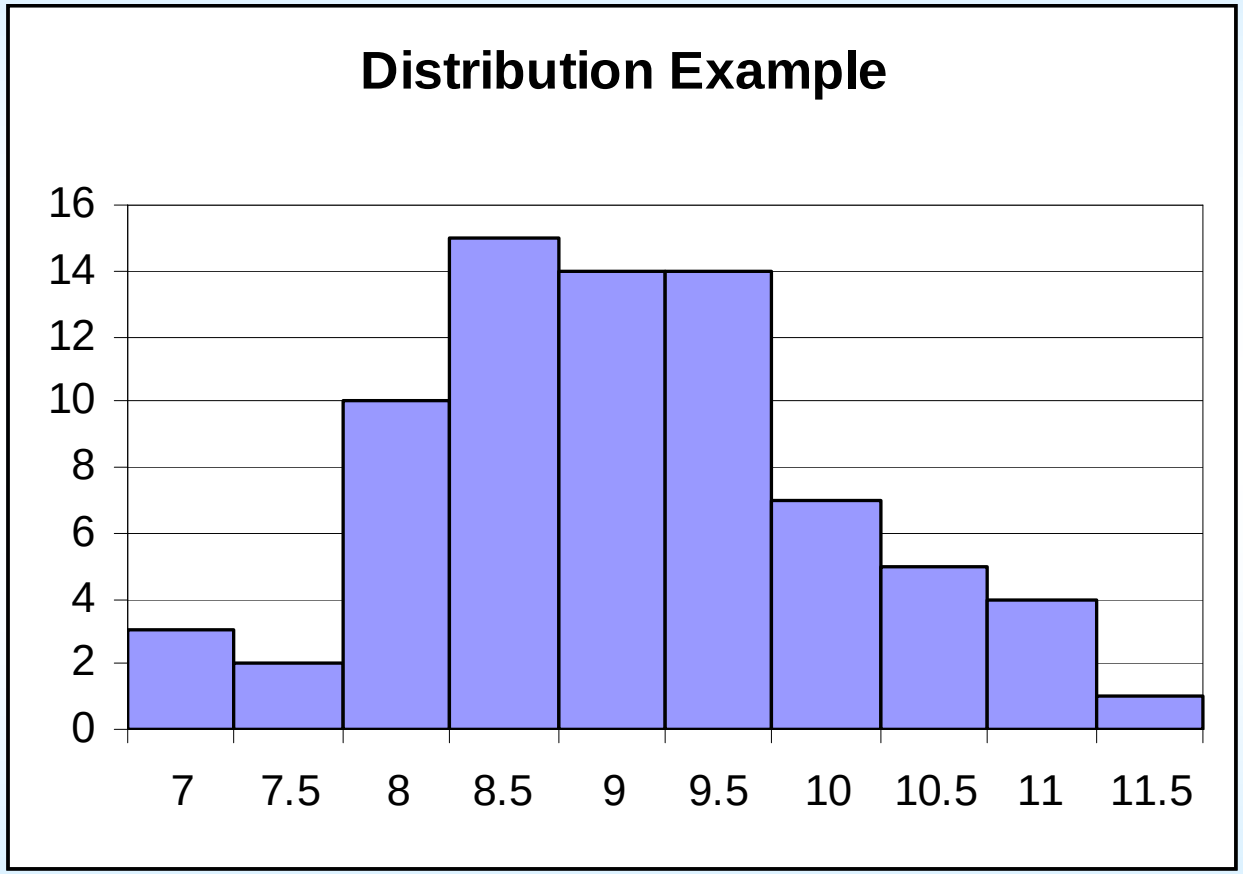
plus/minus 20,000 kWh

at 90% Confidence Limit

Cost/ Uncertainty Tradeoff: The Theory

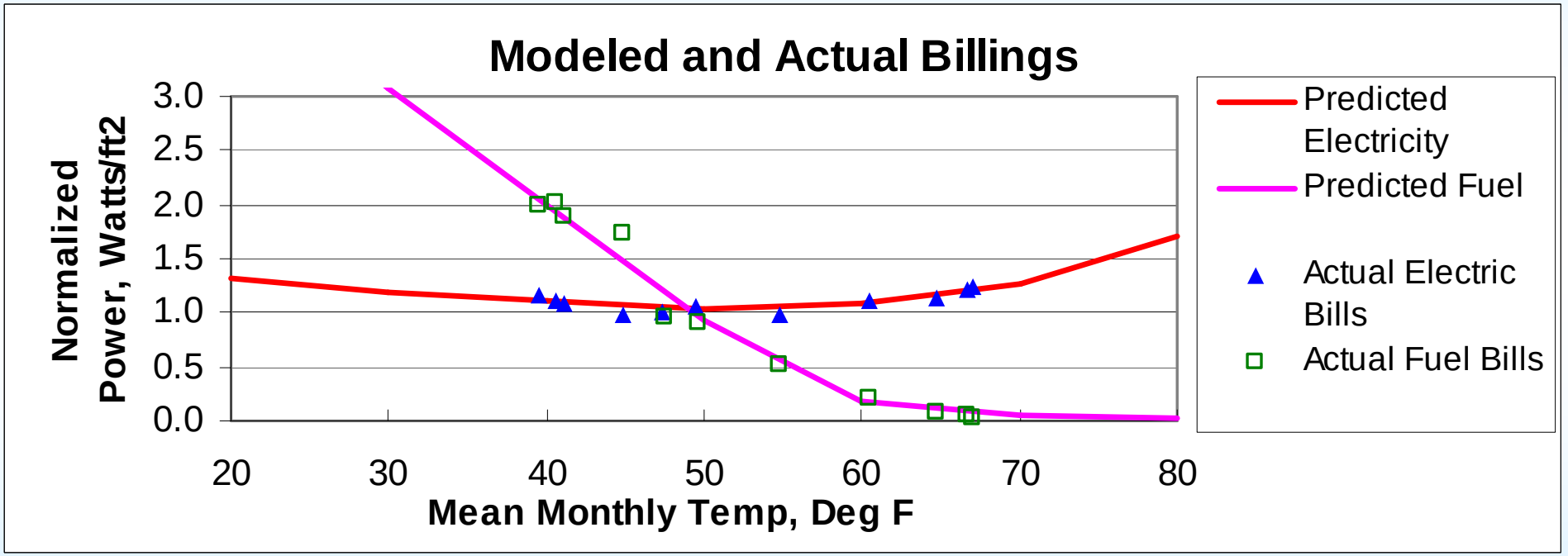


Why is Option B Such Bad News?



For variance of .7, even an 80/20 sample requires 86 cases

Assessing Estimation Error



Error based on how good a curve fit.

Error Estimate with a Good Fit

	Annual energy, kWh/year
Basecase	96,281
Relative SE	1%
Compcase	81,543
Relative SE	2%
Savings	14,738
SE/Annual	2%
SE Savings	12%

Cost/ Uncertainty Tradeoff: The Reality

◆Method	◆Saved kWh	◆Uncertainty*	◆Uncertainty Cost**	◆Verification Benefit	◆Verification Cost	◆BCR	◆Incr BCR
Initial Estimate	◆71,341	◆60%	$10,835				
◆Bill analysis	◆71,341	◆50%	$9,029	$1,806	$100	18.1	18.1
◆Sample 80/20	◆71,341	◆21%	$3,792	$7,043	$9,000	0.8	0.6
◆Sample 90/10	◆71,341	◆11%	$1,986	$8,849	$14,400	0.6	0.3
◆Submeter all	◆71,341	◆2%	$361	$10,474	$58,806	0.2	0.0

* Uncertainty is primarily due to sampling error, but also includes measurement precision

** Uncertainty cost = 10 years at level of probable error X $0.075/kWh

What's It All Mean?

- No one is going to pay for a rigorous study based on sampling (Option B).
  - Whole-building analysis may be less focused on a specific end-use, but is hard to beat for cost-effectiveness.
- Decisions will be based on mythology.
  - No one can be proven wrong.
  - If it sounds good, it is good.