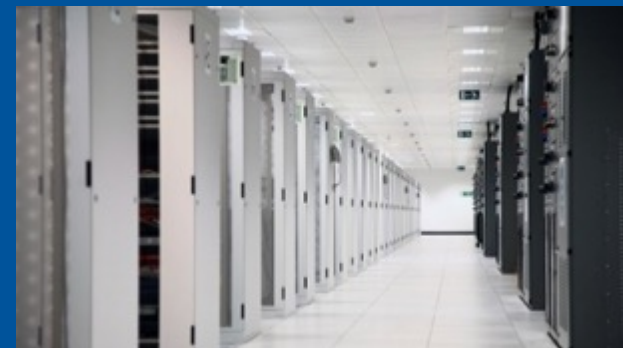
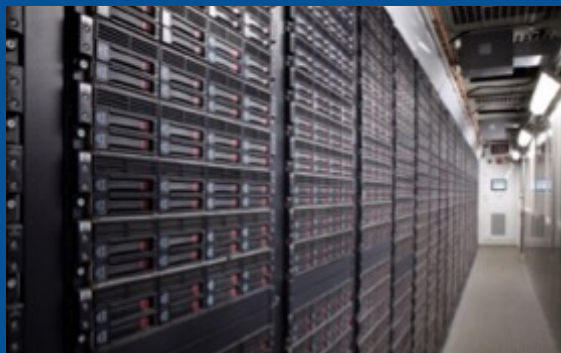




# Selecting M&V Options..... Issues to Consider



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**April 11, 2017**

Innovating to Transform America's Energy Future

- › According to the FEMP M&V Guide, the goal of M&V is to determine the energy, water, and cost savings that result from installation of efficiency measure, and can achieve the following:
  - Allocate risks between the contractor and the customer
  - Accurately assess energy savings and persistence of savings for a project
  - Reduce uncertainties to reasonable levels
  - Aid in monitoring equipment performance
  - Identify additional savings
  - Improve operations and maintenance (O&M)

# M&V Manages Risks

- › Reduce the risk of nonperformance to an acceptable level
- › *Risk refers to the uncertainty that the expected savings will be realized, and includes:*
  - Use risk
  - Performance risk



# Risk & Responsibility Matrix

## › Financial

- Interest rates, Energy prices, Construction costs, Measurement and verification confidence, Energy-related cost savings, Delays, and Major changes in facility

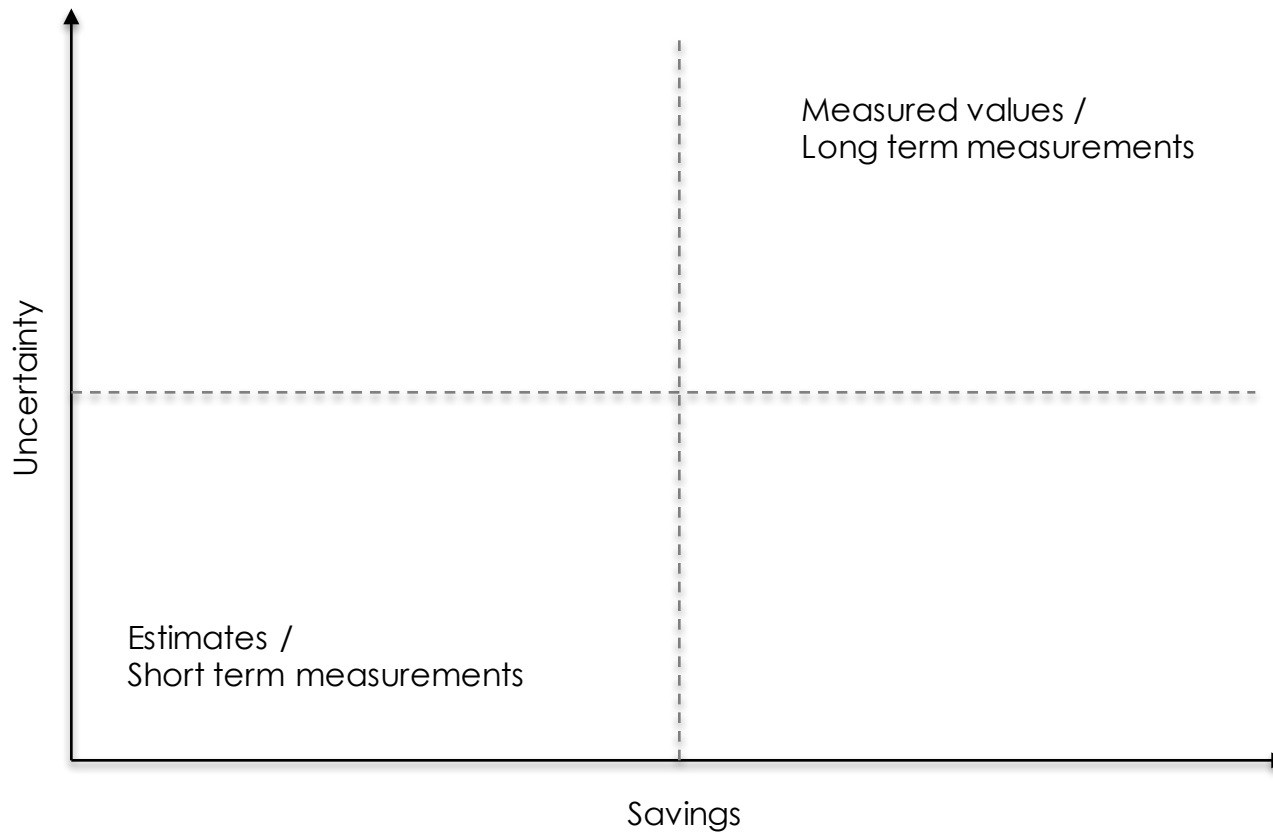
## › Operational

- *Operating hours, Load, Weather, and User participation*

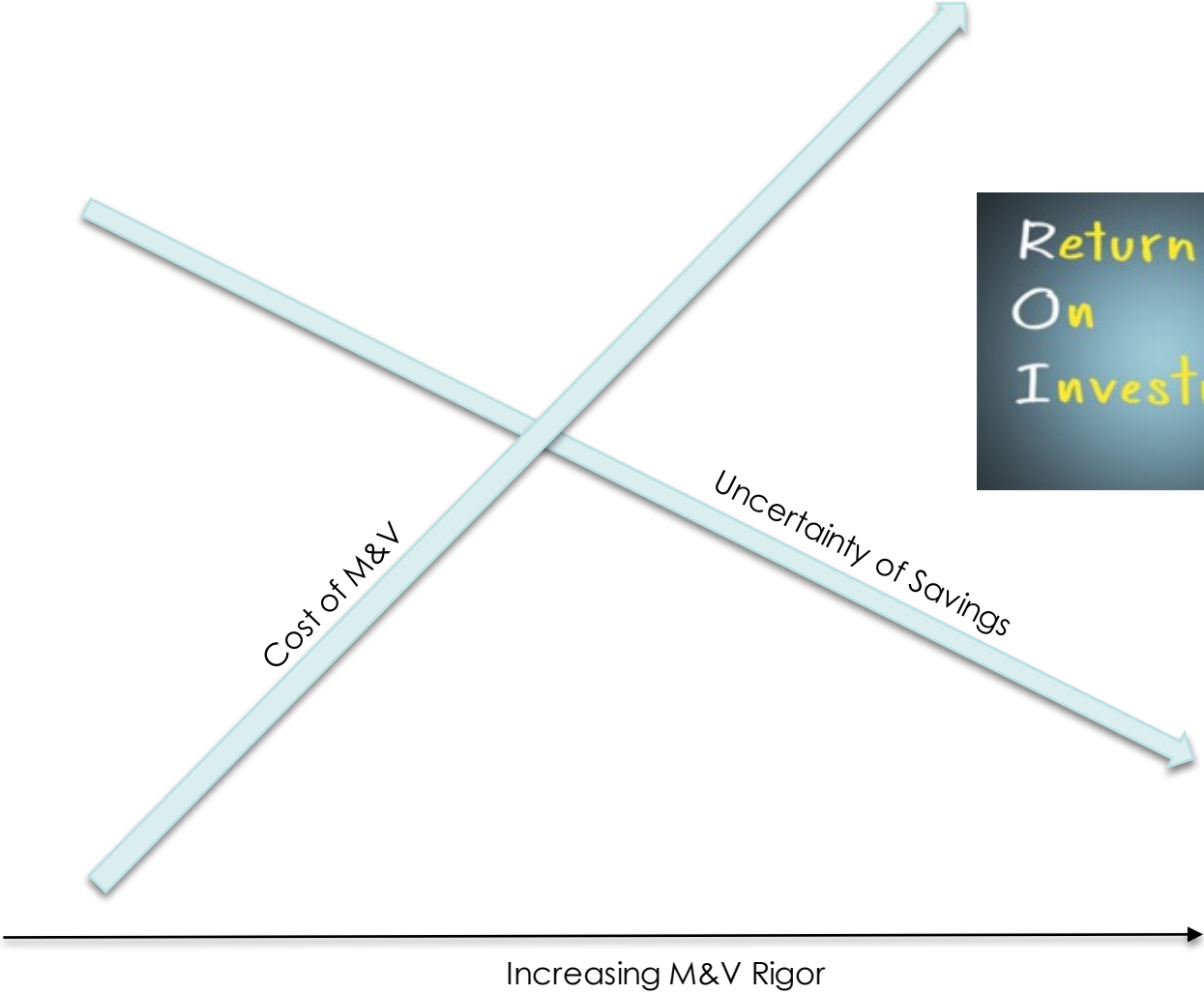
## › Performance

- **Equipment performance**, Operations, Preventive maintenance, and Equipment repair and replacement

# Savings and Uncertainty



# Diminishing Returns

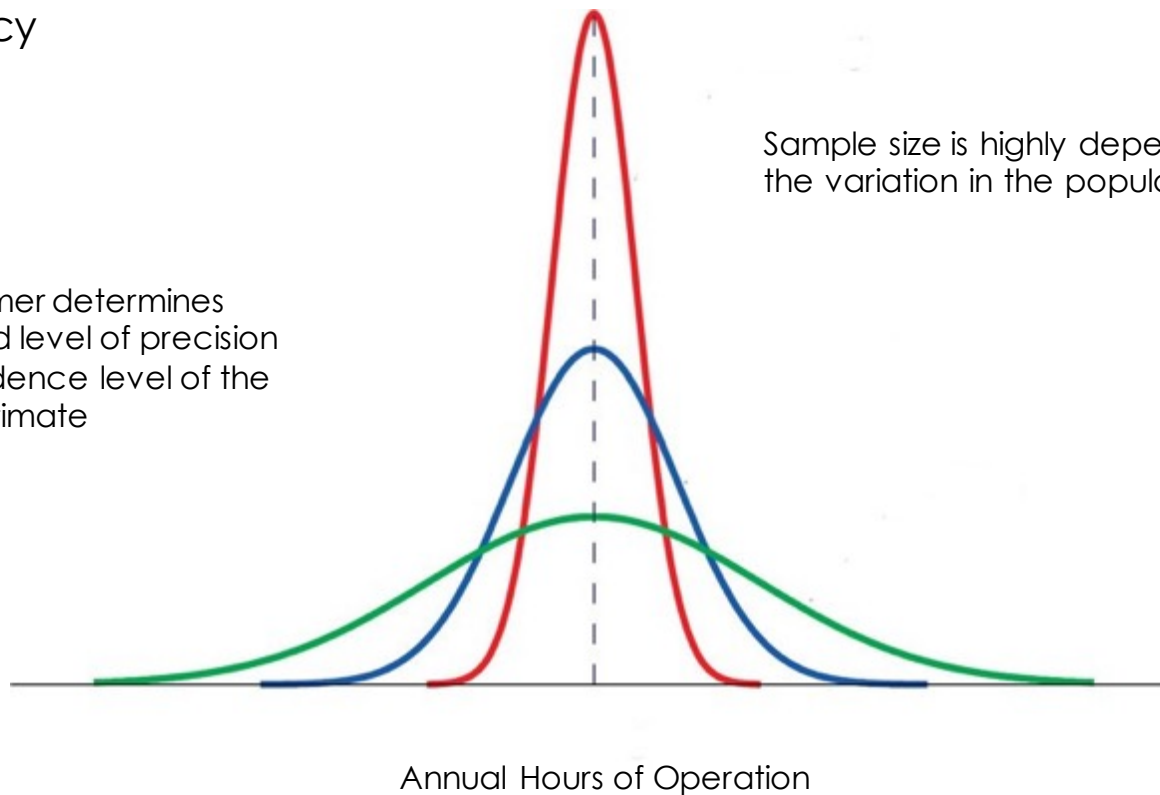


# Sampling Accuracy

Sampling reduces M&V costs while maintaining accuracy

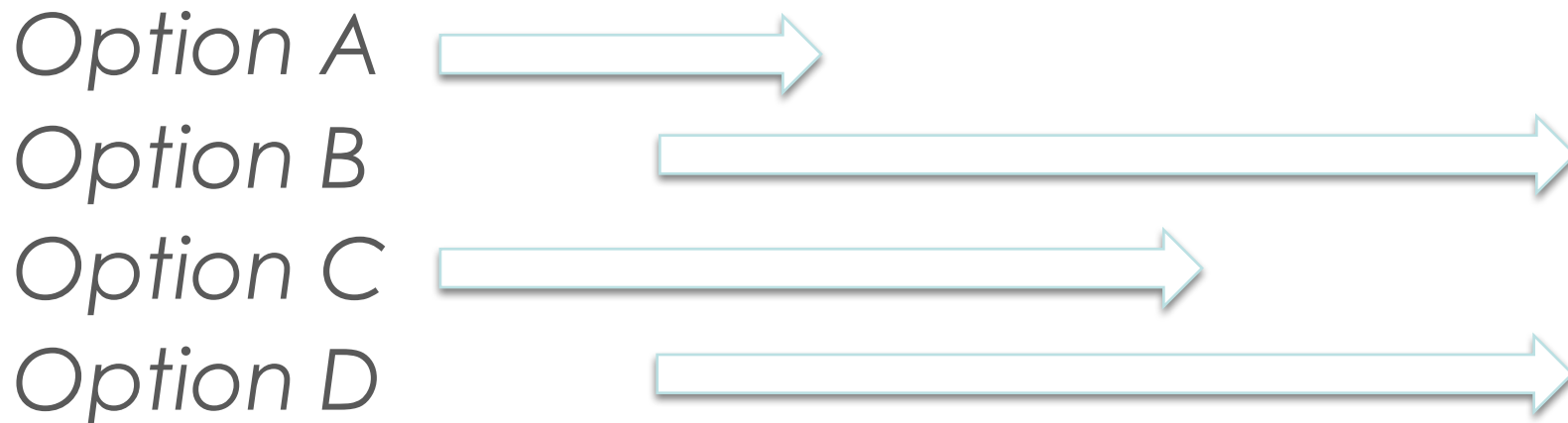
The customer determines the desired level of precision and confidence level of the savings estimate

Sample size is highly dependent on the variation in the population



# M&V Costs

› For federal ESPC projects, average annual M&V costs range from about 2% ~ 5%, but costs vary by approach...





- › Option A – Retrofit Isolation with Key Parameter Measurement
  - Engineering calculations using measured and estimated data
- › Option B – Retrofit Isolation with All Parameter Measurement
  - Engineering calculations using measured data
- › Option C – Whole-Facility Measurement
  - Analysis of utility meter data
- › Option D – Calibrated Computer Simulation
  - Comparing different models

# “Simple” Lighting Example

- › QUESTION - What option should be selected for a lighting project?



(answer – it depends...)

# Lighting Example - M&V Option A

- › Fixture retrofit that reduces the power without impacting the operating hours
  - Engineering calculations using estimated operating hours and measured power draw
- › Controls retrofit that reduces operating hours without impacting power
  - Engineering calculations using measured operating hours and estimated power draw

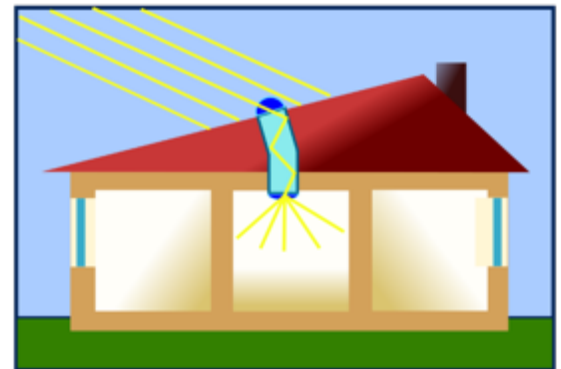
# Lighting Example - M&V Option B

- › Lighting conservation measure that reduces both power and operating hours and where neither power or operating hours are well known
  - Engineering calculations using measured load and measured operating hours



# Lighting Example - M&V Option C

- › Lighting retrofit of an unconditioned warehouse that includes fixture retrofits, controls retrofits, and daylighting (resulting in a reduction in power and operating hours)
  - Analysis of utility meter data



# Conclusion

- › When properly applied, and with due consideration to balancing M&V costs with the value of the increased certainty in savings, M&V can allocate risks between the ESCO and the client and reduce uncertainties to acceptable levels

