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ONLINE TRAINING BY KRISHNAJI PAWAR

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MODULE 6

System Boundary in M&V

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The system boundary is a crucial concept in Measurement and Verification, ensuring the accuracy and reliability of energy savings claims. It enhances clarity, accountability, and consistency in M&V efforts, enabling stakeholders to assess the impact of energy efficiency initiatives and make informed decisions.

Learning Objectives

- Introduction and Course Outline
- Contexts and Concepts: The M&V Specialist's Function
- Standards of Practice
- Practical Considerations for M&V
- Physical and statistical models
- System boundary in M&V
- Baseline: Additional Considerations
- Special Baseline Considerations for Utility Programs
- Implementing the baseline model and data from the reporting period
- Granularity and load shapes
- Using Statistics to Communicate Uncertainty

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INTRODUCTION

- The system boundary is a fundamental theory of M&V, defining the limits of the system being evaluated for performance and/or "savings."
- It establishes what is included in the scope of the M&V plan and what is not.
- The system boundary can be defined in various ways, depending on the project and the goals of the M&V plan.
- Primary categories of system boundaries in M&V are: Whole facility, System-level, and Subsystem-level.
- The facility boundary is the most comprehensive and is typically used for complex retrofits with multiple Energy Conservation Measures (ECMs) or new construction projects.
- The system-level boundary includes a specific energy-using system, such as HVAC system, lighting system, or process equipment.
- The subsystem-level boundary includes a part or component of an energy-using system, used for projects involving upgrading or replacing individual components within an energy-using system.
- The FEMP and IPMVP "options" terminology arose from the awareness that M&V should comprise a range of approaches to develop an optimal plan for each project.

SYSTEM BOUNDARY IN MEASUREMENT AND VERIFICATION (M&V)

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Definition and Importance of System Boundary

- System boundary refers to the physical and operational limits that define which components, processes, or activities are included in the M&V analysis.
- It helps in determining the scope of the M&V efforts and clarifying which variables will be monitored, measured, and reported.

Importance of System Boundary

- Provides a clear framework for identifying what data needs to be collected and how it will be analyzed.
- Ensures accountability by specifying the components included within the system boundary.
- Allows for consistent application of M&V methodologies across similar projects.
- Helps in understanding the influences on energy performance, including operational practices and external factors.

DETERMINING THE SYSTEM BOUNDARY

- Involves defining the project scope, component identification, operational context, external factors, and stakeholder input.

Examples of System Boundaries

- Commercial Building Retrofit: System boundary may include all lighting fixtures, controls, and associated electrical systems within the building.
- Industrial Process Improvement: System boundary might encompass the motor, associated drives, and the equipment it powers.
- District Heating System: System boundary could include the central boiler plant, distribution infrastructure, and end-user buildings.

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WHOLE FACILITY STATISTICAL MODELS AND ESPC CONTRACTS

- Historical whole facility statistical methods relied on utility bills, but this is not always accurate due to potential ancillary loads and multiple metering.
- M&V professionals must study the facility's energy delivery systems to ensure data corresponds to the desired measurement boundary.
- ESPC contracts and utility programs often use the whole facility measurement boundary, but differ in their responsibility for project performance and operation.
- Utility programs often lack a method for accounting for non-routine events, while ESPC contracts include specific guidance.
- With the rise of "smart" meters and automated metering infrastructure, many utilities offer "pay for performance" programs, relying on agreed-upon algorithms and assuming non-routine events will "cancel out."
- Some programs use control groups to provide information on participant comparison to the population at large.

WHOLE FACILITY ENERGY/SIMULATION MODELS

- First principal energy models can be used for the whole facility method.
- A calibrated simulation model is the gold standard for M&V but is expensive.
- The "spherical cow" principle applies in implementing whole facility physical models.
- Sensitivity analysis is used to create Building Energy Model (BEM).
- Low fidelity model and high fidelity model are created.
- Emulator/surrogate is used to calibrate BEM.
- Model calibration is done through Meg drawines.
- The IPBSA site provides more information on energy modeling.
- New construction programs often use whole facility simulation models.
- The baseline is hypothetical, and design information is used to create a simulation model.

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RETROFIT ISOLATION IN ENERGY MANAGEMENT

- ASHRAE Guideline 14 defines retrofit isolation as an M&V approach that measures energy consumption and demand of a portion of a facility or system that has been retrofitted.
- This approach ensures data collection accurately reflects predicted impacts, but may introduce unquantified effects outside the system boundary.
- The need for dedicated metering equipment is a major issue, requiring cost, potential interruptions of facility operations, security concerns, and safety concerns.
- The most effective approach to verify the impact of energy management activities for a building retrofit project involves an assessment of the facility, identifying potential retrofit measures, and using modeling tools and historical energy data to estimate the quantified impact of each measure.
- If the impacts are not significant enough, retrofit isolation is recommended, implementing targeted retrofit measures in specific areas where the potential for impact is highest.
- The choice between a whole facility approach and retrofit isolation depends on the facility's size and complexity, available budget, potential energy management impacts, and the level of accuracy required for M&V.

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