

**B=**YOND  
SMART CITIES



*wel come to*

**BEYOND SMART CITIES**

**BEYOND**  
SMART CITIES



# FUNCTIONALITY OF THE MEASUREMENT AND VERIFICATION SPECIALIST

ONLINE PROFESSIONAL COURSES LED BY THE WORLD'S TOP SPECIALISTS

**ONLINE TRAINING BY KRISHNAJI PAWAR**

**LEARN.BEYONDSMARTCITIES.IN**

# BEYOND

SMART CITIES

MODULE

17

## The Future of Measurement and Verification

KRISHNAJI PAWAR - CEO & FOUNDER

LEED AP(BD+C), GSAS CGP, GCP, ISO 14001

[WWW.BEYONDSMARTCITIES.IN](http://WWW.BEYONDSMARTCITIES.IN)



# FUNCTIONALITY OF THE MEASUREMENT AND VERIFICATION SPECIALIST

Measurement and verification (M&V) are critical processes in a range of sectors, including energy efficiency, environmental monitoring, and financial auditing. This chapter explores the evolving landscape of M&V methodologies, the influence of technology, and the implications for policy and practice. We will examine emerging trends, innovative tools, and the role of data analytics and artificial intelligence (AI) in shaping future M&V practices.

# Learning Objectives

- Instrument metering and calibration
- Fieldwork: formal accreditation, safety, OSHA, and NFPA
- Data accessibility, communication, and valuation
- Reporting on Measurement and Verification (M&V) Projects
- Definitions of IPMVP Options
- **The future of measurement and verification**
- Sample M&V Plan
- Sample M&V Report
- ESCO's Guide to Measurement and Verification
- Summary and Resources



# INTRODUCTION

- Measurement and verification (M&V) are crucial processes in sectors like energy efficiency, environmental monitoring, and financial auditing.
- M&V has traditionally relied on standardized protocols, but has faced challenges related to data availability, methodological rigor, and stakeholder trust.

# THE FUTURE OF ENERGY MANAGEMENT AND VULNERABILITY

- The current methods for M&V have been successful for the past three decades, but the world of energy and energy management are evolving.
- The energy transition, which includes renewable energy, energy storage, electric vehicles, real-time pricing, fuel switching, and carbon reduction, is causing a fundamental change in how energy is generated, distributed, and used.
- The energy transition presents new challenges to the M&V professional, including:
  - Changing energy mix: The variability and intermittency of renewable energy sources make it difficult to establish accurate baselines for the impacts of energy management activities.
  - Rapid technological change: New technologies like energy storage systems and smart grid technologies require new M&V protocols and tools to measure their impact on energy consumption.
  - Increased complexity: As energy systems become more complex, M&V professionals may face challenges in accurately measuring energy usage across multiple systems and components.
  - Data quality and availability: M&V relies heavily on analog and timoladata, which can be challenging, particularly in older buildings or regions with limited data infrastructure access.



## MODERN M&V, DEFINED IN "THE BIG THREAT" - FEMP M&V IPMVP AND ASHRAE GUIDELINE 1 - M&V GUIDANCE DOCUMENTS, IS NOW IN ITS FOURTH DECADE.

Technological advancements that have the potential to impact the field of M&V include:

- Internet of Things (IoT): This technology can help M&V professionals collect more accurate and timely data to improve energy performance and optimize operations.
  - Machine learning: These technologies enable M&V professionals to analyze and make sense of large amounts of data, developing more accurate models and predictions for energy performance.
  - AI: These technologies can help automate M&V processes and improve accuracy.
  - Digital twins: A digital replica of a physical asset can be created to create a digital twin of an energy system.
  - MeT networks: These technologies can simulate distant conditions and detect the immediacy of changes to the system before implementing them in the physical world.
  - Blockchain: This distributed ledger technology can securely and transparently track energy usage and transactions.
  - Smart contracts: These self-evidenced contracts with direct terms of agreement between buyer and seller are self-evidenced into a single agreement.
- Reliable calibration: This statistical technique is used to actuate uncertainty in model parameters.



# TECHNOLOGICAL ADVANCEMENTS IN M&V



- Internet of Things (IoT) allows for real-time data collection from various sources, enhancing the accuracy of M&V.
- Big Data and Analytics integrate into M&V processes, enabling the handling of vast datasets and yielding insights.
- Artificial Intelligence (AI) applications in M&V are expanding rapidly, offering predictive modeling and automated reporting.

# EVOLVING METHODOLOGIES IN M&V

- Real-time M&V allows for immediate feedback and adjustment of interventions, contrasting with traditional M&V.
- Remote Verification, facilitated by advancements in satellite imagery and drone technology, is emerging as effective methods for assessing environmental impacts.





# CHALLENGES AND CONSIDERATIONS

- Data Security and Privacy: Stakeholders must navigate the complexities of data governance to ensure compliance with regulations while maintaining trust.
- Standardization of Practices: Diverse approaches to M&V can lead to confusion and inconsistencies in results, necessitating the establishment of common frameworks.



# FUTURE OF M&V IN ENERGY EFFICIENCY AND CLIMATE POLICIES

## M&V's Future

- Performance targets are more straightforward and easier to communicate to stakeholders.
- Compliance with targets can be tracked through metrics like energy bills or emissions data.
- Performance targets like net zero emissions are becoming popular as a way to drive meaningful action on climate change.
- M&V could still play a role in verifying that a building has achieved its net zero energy or carbon target.





# ADDITIONAL TRAINING AND INFORMATION



- Advancing and implementing future energy and climate policies will require a range of skills and expertise.
- Technical skills: Understanding of energy systems, carbon accounting, and data analysis.
- Political analysis and development: Training in stakeholder engagement, policy design, and policy evaluation.
- Communication and advocacy: Training in messaging, media relations, and public speaking.
- Leadership and collaboration: Training in team-building, conflict resolution, and strategic planning.
- Cultural competency: Training in understanding of cultural norms, values, and beliefs.



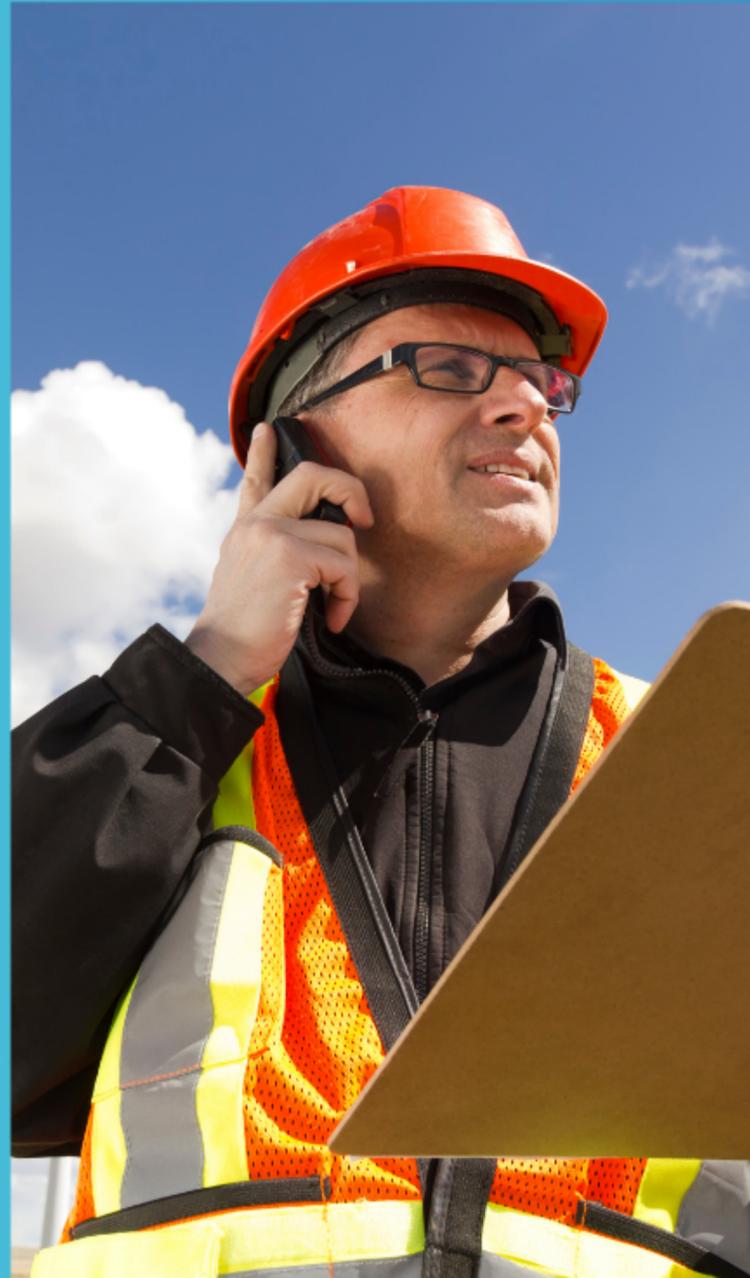
## A Global Guild

- The growth of an international community of M&V practitioners, a "global guild," is undeniable.
- Both academia and industry have valuable roles to play in the future of M&V.
- These organizations are actively involved in facilitating peer-to-peer learning and support.



## FLEX MARKETS AND INTEGRATED POLICY FRAMEWORK

- Flex markets manage variability and intermittency of renewable energy sources by enabling real-time buying and selling of flexible capacity and demand responses.
- The energy management industry is using sensors, meters, analytics, machine learning, and artificial intelligence for accurate and reliable data.
- M&V is developing new methods for measuring and verifying the performance of distributed energy resources (DERs) like solar panels, wind turbines, and energy storage systems.
- The development of flex markets presents an opportunity for M&V to innovate and adapt to the changing energy landscape.
- The role of M&V professionals is challenged and exciting in the years ahead due to the changing policies around grid integration and climate.



## Cost Categories in Energy Management

- M&V activities incur costs, especially with small projects.
- M&V activities need to be scaled to meet the needs and budget of each project.
- M&V costs may exceed the impacts of one project, but if used to extrapolate across a large project, it may be well worth the expense.



# BALANCING COSTS AND BENEFITS



- M&V can lead to improved operational performance through observation and feedback, detection and correction of faults, risk mitigation through observation, increased stakeholder confidence, and reduced uncertainty and increased confidence.
- Sharing costs with others is critical to avoid iust M&V.
- M&V costs can range from a few thousand dollars for a simple project to several hundred thousand dollars for a complex project demanding a high level of detail and rigor.

# OPTIMIZING M&V EXPENDITURES

- All energy management activities involve a degree of uncertainty.
- Risk premiums are an additional return or compensation that investors or participants demand in exchange for taking on a higher level of risk in an investment or financial transaction.
- M&V costs can be a necessary investment in risk reduction and uncertainty management.
- A risk assessment can help identify potential sources of error or bias in the M&V process.
- An uncertainty reduction algorithm can be used to predict the effect of various sources of uncertainty on the estimated impact of energy management activities and to identify the most effective strategies for reducing uncertainty.





## Using Monte Carlo

- Monte Carlo simulation is a valuable tool for identifying potential sources of error or uncertainty in M&V analysis.

# CONTACT US



+91 6363032722



info@beyondsmartcities.in



learn.beyondsmartcities.in



#55,HMR Layout ,Bengaluru ,India



# THANK YOU

