Investor Confidence Project

Project Developer and Quality Assurance Assessor Training: Industry
17th July 2018

Presenters:
Luís Castanheira, ICP Europe Technical Director
Bethan Phillips, ICP Europe Technical Team
WELCOME
Your Presenters

- 20 years in Sustainable Energy
- Energaia – Energy Management Agency
- Porto Polytechnic Engineering School
- EU Commission Expert
- CMVP and IPMVP Technical Committee Member
- Energy auditor, BREEAM, EPBD building energy assessor

Luís Castanheira
ICP Europe Technical Director
Your Presenters

- 15+ years in low energy building design and sustainable energy solutions
- Principal consultant at Verco
- Building services engineering, mechanical engineer
- CMVP accredited, ISO 50001 lead auditor
- Energy audits, feasibility studies (CHP, district heating, etc), sustainability assessments
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Agenda

• Housekeeping
• Strategic approach
• What is the Investor Confidence Project?
• Roles and responsibilities
• Process and tools available
• ICP Stages – requirements
• Worked examples
• Application process

This webinar will be recorded
Housekeeping

• You are all muted by default to minimize background noise, but we want your participation!

• You can ask questions either using the chat box on the gotowebinar control panel anytime

• We will stop at the end of each section for QA

• We will use a poll facility to assess comprehension and guide interaction

• At the end we will have an open QA session

• We will get back to you if there is any question we cannot answer in the course of this training session

• Training should take a maximum of 2 hours + QA
Strategic approach

• All participants are knowledgeable and experienced professionals

• This training is only the beginning of a longer journey

• ICP Project Developers and Quality Assurance Assessors are crucial agents for the success of our scheme and the transformation of the Energy Efficiency market
What is the Investor Confidence Project?
Lack of Standardisation = Greater Risk
Investor Ready Energy Efficiency Project

Consistent Documentation

Third-Party Quality Assurance

Certified Professional

Best Practices and Standards

ICP EUROPE

EVO

BVT

Engineers Ireland

INVESTOR CONFIDENCE PROJECT
Ensures transparency, consistency and trustworthiness through **best practice** and independent verification.
An international framework for reducing owner and investor risk, lowering due diligence costs, increasing certainty of savings achievement and enabling aggregation.
Baselining

Savings
Projections

Design,
Construction,
Verification

Operations,
Maintenance,
Monitoring

Measurement
& Verification
(M&V)

Procedures

- Best Practice Workflow
- Standard Industry Practices

Documentation

- Standard Documentation Package
- Itemized Outputs Required
The IREE™ Certification is delivered prior to investment decision.

**Development Period**

- **Project Development**: Certified Project Developer develops and documents projects according to ICP Protocols.

**Certification**

- **Certified Quality Assurance Provider**: Reviews project for ICP compliance and certifies qualifying projects as Investor Ready Energy Efficiency™.

**Investment**

- **Investment**: Building owners and investors can make investment decisions with increased confidence based on predicted savings.

**Performance Period**

- **Performance**: Building's energy performance is optimized and energy savings from retrofit are measured and verified according to ICP Protocols.
What project types is IREE™ designed for?

- Buildings
- Industry
- District energy systems
- Street lighting upgrades
Industry Types

Complex

Installation of new technology types or capacities/ECMs with variable loads

Targeted

Installation of simple technologies/ECMs which are like-for-like replacement
Important FACTS to remember

- Any EE project that follows state of the market origination processes already does “everything ICP requires” – ICP is an overarching standardizing layer to the process

- ICP supports best practices standards, tools or engineering methodologies already in the market place

- ICP is flexible and adaptable to different project complexity and investment levels

- There is nothing like ICP in the global market – relevance of the Performance Period for persistence of savings
Roles and responsibilities
ICP Project Developer

- Attend training
- Meet qualification and experience requirements
- Insurance must meet needs of project owner (reviewed by QAA on per project basis)
- Where projects include process-specific ECMs:
  - Demonstrate experience in similar process/technology
  - Involve an experienced specialist
Third Party

• Someone who may be indirectly involved with, but is not a principal party to, an arrangement, contract, deal, or transaction

• ICP requires third-parties for:
  – Measurement and Verification
  – Quality Assurance
ICP Quality Assurance

• Energy efficiency investors lack expertise

• Multiple investors separately evaluating a project = time and money wasted

• QA Assessor
  – Independent
  – Represent the investor’s interests
  – Ensures project conforms to ICP protocols
  – Can also be an ICP Project Developer
Quality Assurance ‘Specialists’

- Bespoke process ECMs
- Spreadsheet calculations
- Implementation costs / investment criteria
- Commissioning (OPV)
- Measurement and verification
Project Developer Responsibilities

• Represents project owner’s interests

• Components clearly identified and organised

• Available to QA Assessor and others as appropriate

• Develop and assemble documentation (investment) package:
  – Select the correct protocol
  – Submit all documentation required by protocol
  – Ensure calculations are fully transparent, and all assumptions documented and explained
QA Assessor Responsibilities

• Ensure project was developed in accordance with the **most appropriate ICP Protocol**

• Validate that all necessary *documentation* is provided and complete

• Check methodologies, assumptions, and results (*technical review*)

• Complete the ICP Checklist
By signing the ICP QA checklist, the ICP Quality Assurance Assessor attests to having reviewed the project development documentation and finds that the project is consistent with the ICP Protocol as deemed applicable to the project based upon the data that are available. *This Quality Assurance review and signature does not constitute a guarantee of energy savings performance, nor does it signify that the reviewer is taking professional responsibility for the required documents and engineering produced by the credentialed Project Developer.*
Project Team Communication

• Involve QAA early on in project development
• Maintain professional perspective and independence
• Collaborative approach
• Ask for clarifications
Process and tools available
# Project Development Tasks

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>PROJECT TASKS</strong></td>
<td>Work with the M&amp;V specialist to define the measurement boundary</td>
<td>Develop a set of recommended ECMs</td>
<td>Appoint an Operational Performance Verification Resource</td>
<td>Select and document ongoing management regime e.g. SCADA / aM&amp;T</td>
<td>All Options: Develop M&amp;V plan</td>
</tr>
<tr>
<td></td>
<td>Establish the baseline period</td>
<td>Perform model / spreadsheet calculations</td>
<td>Develop OPV plan</td>
<td>Develop OM&amp;M plan</td>
<td>Option A/B: Collect post-retrofit energy / performance data</td>
</tr>
<tr>
<td></td>
<td>Collect energy source data, production, weather and other significant variable data, and utility rate schedules</td>
<td>Develop costs / constructability</td>
<td>Develop systems manual (if one does not exist)</td>
<td>Develop operator's manual (if one does not exist)</td>
<td>Option A/B: Performance data analysis</td>
</tr>
<tr>
<td></td>
<td>Develop energy balances</td>
<td>Develop investment package</td>
<td>Update systems manual (if one already exists)</td>
<td>Update operator's manual (if one already exists)</td>
<td>Option A/B: Verified savings calculations</td>
</tr>
<tr>
<td></td>
<td>Calendarise the independent variable data</td>
<td>Develop ECM report</td>
<td>Perform facility operators training</td>
<td>Develop and perform facility operators training</td>
<td>Option C: Post-utility data</td>
</tr>
<tr>
<td></td>
<td>Establish the energy-use characteristics of the equipment or system which are within the measurement boundary</td>
<td></td>
<td></td>
<td></td>
<td>Option C: Identify / quantify non-routine adjustments</td>
</tr>
<tr>
<td></td>
<td>Develop the baseline energy consumption model and test accuracy</td>
<td></td>
<td></td>
<td></td>
<td>Option C: Regression based analysis</td>
</tr>
<tr>
<td></td>
<td>Establish peak demand and pricing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chart average daily demand</td>
<td></td>
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</tbody>
</table>

**Key**
- **All protocols**
- **Targeted protocol has adapted / less stringent requirements as detailed in the protocol document**
- **Complex protocol only**
- **Applicable for targeted protocol. Only applicable for complex protocol if IPMVP Option B is selected.**
## Quality Assurance Tasks

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<thead>
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</thead>
<tbody>
<tr>
<td></td>
<td>Review and approve selected baseline period</td>
<td>Review and approve ECM report including baseline, facility/systems and ECM descriptions, savings calculations, performance and cost analysis</td>
<td>Review and approve credentials of individual responsible for OPV</td>
<td>Review and approve OM&amp;M plan, setting out procedures</td>
<td>Review and approve credentials of individual responsible for M&amp;M plan</td>
</tr>
<tr>
<td></td>
<td>Review and approve utility data and rates, significant variable data and energy baseline</td>
<td>Review and approve savings spreadsheet calculations</td>
<td>Review and approve OPV plan</td>
<td>Review and approve selected ongoing management regime</td>
<td>Review and approve M&amp;M plan</td>
</tr>
<tr>
<td></td>
<td>Review and approve energy consumption model</td>
<td>Review and approve savings spreadsheet calculations, including supporting data</td>
<td>Review and approve systems manual (if one exists)</td>
<td>Review and approve operator’s manual (if one exists)</td>
<td>Option C: Review and approve performance-period utility data (12 months), regression based model, and adjustment calculations</td>
</tr>
<tr>
<td></td>
<td>Review and approve energy balances</td>
<td>Review and approve supporting costs / constructability information</td>
<td>Review and approve training (interview facility operators)</td>
<td>Review and approve training (interview facility operators)</td>
<td>Option A/B: Review and approve monitored data files, data analysis results, and revisions to savings calculations</td>
</tr>
<tr>
<td></td>
<td>Review and approve load profiles and interval data</td>
<td>Review and approve investment package</td>
<td>Option A/B: Ensure pre-retrofit energy / performance data collected</td>
<td>Review and approve adjustments and proper application</td>
<td></td>
</tr>
</tbody>
</table>

### Key

- **All protocols**
- **Targeted protocol has adapted / less stringent requirements as detailed in the protocol document**
- **Complex protocol only**
- **Applicable for targeted protocol. Only applicable for complex protocol if IPMVP Option B is selected.**
Project Acceptance

• Descriptions of deficiencies and issues
  – Documentation requirements
  – Methodologies, assumptions, and results

• Reasonableness
  – Document how items were resolved, or why they were left open

• Complete and sign the QA Checklist

• Project certified as IREE™
Quality Assurance Tools

- ICP QA Checklist
- ICP PD Specification
- Project Registry
ICP Quality Assurance Checklists

• Specific to each protocol (two checklists)
• Focuses on underwriting phase
• Required components and documentation
  – Baselining
  – Savings Calculations
  – OPV
  – OM&M
  – M&V
ICP Project Development Specification

- Supplements protocols
- More detailed guidance on requirements in protocols
- Additional resources
- Linked to protocol sections
Questions and polls
ICP Stages - Requirements
1. Baseline Development
2. Savings Calculations
3. Design, Construction & Verification
4. Operations Maintenance & Monitoring
5. Measurement & Verification
# Baseline Development

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Complex</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normalised baseline (energy consumption equation)</td>
<td>✓</td>
<td>Maybe</td>
</tr>
<tr>
<td>Energy end-use consumption</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Weather data</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Production data</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Site asset, operational, performance data</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Retrofit isolation baseline</td>
<td>-</td>
<td>Maybe</td>
</tr>
<tr>
<td>Load shapes (when interval data available)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Interactive effects</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Where relevant to the ECMs
Baseline Development

**Data collection**

- Collect historical energy use and cost data
  - Define measurement boundary
  - At least one full energy-use cycle (where Option C is used, usually minimum 12 months)
  - Electricity, on-site fuel for heating and cooling, district steam, and hot water or chilled water, renewable energy
  - Calendarise if necessary
  - Energy balances for systems associated with proposed ECMs

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**PDS section 4.2.1**

**EN16247-3 Energy Audits – Processes**

ISO 5002 Energy Audits – Requirements with guidance for use

**PDS section 4.2.5**
Baseline Development
Regression-based model

• Develop an energy-use equation
  – Achieve an appropriate goodness of fit of energy data variability to independent variables
  – Perform regression analysis
    • Initial check on R-squared – in some industrial cases it may be hard to achieve a high R-squared value
  – Model should be evaluated on the basis of predicted savings: must be greater than twice the standard error of the baseline value
  – Uncertainty analysis not required, but recommended
  – Proprietary tools may be available

IPMVP: Statistics and Uncertainty for IPMVP 2014 section 1
Baseline Development
Energy end-use consumption / Weather / Production

• Estimate or measure end-use energy use
  – Calibrate baseline energy model
  – Calibrate energy savings estimates

• Collect weather data and production data corresponding to the baseline period
  – At least one full energy-use cycle (where Option C is used, usually minimum 12 consecutive months)
  – e.g. production quantities, production rate, raw material composition

• Other independent variables
  e.g. raw material moisture content
Baseline Development
Facility Asset, Operational, Performance Data

• Collect facility asset, operational, and performance data
  – Drawings, equipment inventories, surveys, tests, etc
  – Facility performance tracking
  – Analysis of ECMs
  – ECM implementation
  – ECM performance tracking

• Provide a summary of activities and processes
Baseline Development

Retrofit Isolation Baseline

• ECM specific baseline
  – IPMVP Option A or B M&V approach
  – Same approach as whole-facility baseline development
  – Define measurement boundary
    • Specific piece of equipment
    • Facility subsystem
    • End-use
  – Define
    • Constant / variable load
    • Constant / variable schedule

IPMVP Core Concepts 2016
Section 5.1
Baseline Development

Load Profiles – if demand charges/time of use pricing are in effect

• Determine impact on monetary savings

• Annual load profile - showing monthly consumption and peak demand

• Average daily load profiles - use 15-minute interval data (if available), to develop profiles for weekday/weekend day types, all four seasons

• Time of Use summaries by month (if applicable)
Baseline Development

*Interactive effects*

- **Secondary energy effects occurring as a result of ECMs** – usually associated with heating and cooling

- **Estimate interactive effects** with ECMs and between measures where significant compared to ECM energy savings, and either:
  - Adjust savings; or
  - Expand measurement boundary

PDS Section 2.4
## Baseline Development

### Documentation

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Baseline period (start and end dates)</td>
</tr>
<tr>
<td>All</td>
<td>Energy data</td>
</tr>
<tr>
<td>All</td>
<td>Access to all facility asset, operational and performance data</td>
</tr>
<tr>
<td>All</td>
<td>Utility rate structure</td>
</tr>
<tr>
<td>If applicable:</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Production &amp; weather data (if relevant to project)</td>
</tr>
<tr>
<td>All</td>
<td>Interval data; sub-metered data; load profiles; monthly peak demand</td>
</tr>
</tbody>
</table>
1. Baseline Development

2. Savings Calculations

3. Design, Construction & Verification

4. Operations Maintenance & Monitoring

5. Measurement & Verification
## Savings Calculations

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Complex</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM descriptions</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ECM savings calcs – models/spreadsheets</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Investment criteria</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Interactive effects</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fixed prices for each ECM</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Investment package</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reporting</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Savings Calculations

ECM Descriptions; Cost Estimates

• ECM descriptions
  – Present condition, proposed measure

• Cost estimates
  – At the feasibility stage, direct quotes or past experience can be used
  – **Final investment package must be based on contracted price**
  – Must include:
    • Construction feasibility review
    • Labour and materials
    • Line items for professional fees, engineering, commissioning, construction management, permitting, M&V, overhead and profit, contingency

• Long term financial analysis is optional
Savings Calculations

**Investment Criteria**

- Programmes and projects have individual criteria
  - ICP does not specify investment criteria to be used
  - Job of PD is to ascertain and inform preferred financial metrics
    - Implementation costs
    - Estimated savings
    - Available incentives
    - Effective useful life
    - Escalation rates
    - Interest rates
    - Discount rates
    - Cost of capital
    - Lease terms
    - Other appropriate financial inputs
Savings Calculations

Spreadsheets and tools

• Analysis methods
  – Spreadsheet-based
  – Regressions analysis
  – Proprietary tools

• Interactive effects

• Weather file

• Assumptions and inputs
  – Documented
  – Never embedded
  – Reasonable
Savings Calculations

• Summary report: industry-accepted format
  – Results
  – Methods used
  – Data
  – Pricing for each ECM and package of ECMs
  – Predicted energy savings by fuel type: energy consumption, % volume, cost savings

EN 16247-3 Energy audits – Part 3
  Section 5.6
## Savings Calculations

**Documentation**

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Energy modeller/consultant qualifications</td>
</tr>
<tr>
<td>All</td>
<td>Process specialist experience</td>
</tr>
<tr>
<td>All</td>
<td>Where proprietary or third-party software has been used: input files; output files; weather file</td>
</tr>
<tr>
<td>All</td>
<td>Where open-book calculations have been used: calculation process description, workbooks, calculation tools; weather file</td>
</tr>
<tr>
<td>All</td>
<td>Basis for ECM costs</td>
</tr>
<tr>
<td>All</td>
<td>Summary report – including annual predicted energy savings by fuel type</td>
</tr>
</tbody>
</table>
Savings Calculations

Questions and polls
1. Baseline Development
2. Savings Calculations
3. Design, Construction & Verification
4. Operations Maintenance & Monitoring
5. Measurement & Verification
## Design, Construction & Verification

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Complex</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appoint an Operational Performance Verification (OPV) resource</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Operational Performance Verification (OPV) plan</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Operational Performance Verification (OPV) report</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Training</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Systems manual</td>
<td>✓</td>
<td>Maybe</td>
</tr>
</tbody>
</table>
• OPV approaches
  – *Visual inspection* - verify the physical installation of the ECM
  – *Spot measurements* - measure key energy-use parameters for ECMs or a sample of ECMs
  – *Pre-functional checklist / functional performance testing* - test functionality and proper control
  – *Trending and data logging* - setup trends or install data logging equipment and analyse data, and/or review control logic
Design, Construction & Verification

Operational Performance Verification

• OPV effort
  – Consultation with energy auditors
  – Monitoring of designs, submittals and project changes
  – Inspections of implemented changes
  – Means of reporting deviations from design
    • Help the client / PD team *fully install the measure properly* and then re-verify its performance; or
    • Work with the PD team to *revise the ECM savings estimates* using the actual post-installation data and associated inputs.
Design, Construction & Verification

Operational Performance Verification

- OPV plan
  - Developed preconstruction
  - Verification activities: design review, etc...
  - Systems involved; roles and responsibilities
  - Target energy budget
  - Description of OPV report (Targeted: where appropriate to nature/scale of project)
  - Provisions to:
    - Use approved installers (where national certification schemes exist)
    - Develop training plan for operators (ECM descriptions, target performance, etc)
    - Update or develop Systems Manual
• Systems manual
  – Facility design and construction (owner’s project requirements, current facility requirements, basis of design, construction/project record documents)
  – Operational requirements
  – Maintenance requirements and procedures
  – Commissioning process report: OPV plan, testing reports, issue and resolution logs
  – Training
Design, Construction & Verification Documentation

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Qualifications of the OPV provider</td>
</tr>
<tr>
<td>All</td>
<td>OPV Plan</td>
</tr>
</tbody>
</table>
Design, Construction & Verification

Questions and polls
1. Baseline Development
2. Savings Calculations
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4. Operations Maintenance & Monitoring
5. Measurement & Verification
# Operations, Maintenance & Monitoring

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Complex</th>
<th>Targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td>OM&amp;M plan (ongoing management regime)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Training on OM&amp;M procedures</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Operators manual</td>
<td>✓</td>
<td>Maybe</td>
</tr>
<tr>
<td>Staff outreach</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Operations, Maintenance & Monitoring
OM&M Plan

• OM&M procedures
  – Continuous improvement and monitoring
  – Tracking, analyzing, diagnosing issues
  – Resolving issues
  – Maintain production levels

• Methods include:
  • Periodic inspections
  • Automatic Monitoring and Targeting Reporting
  • Automated fault detection and diagnostic tools
  • Periodic data analysis
  • Supervisory Control and Data Acquisition (SCADA)
  • Periodic Recommissioning
OM&M Plan: framework for ongoing management regime

- Process and intent
  - Manual or automated tools or processes to use
- Resources and established roles / responsibilities
  - Organisation chart
  - Technical qualifications for O&M
- Quantifiable performance goals (based on performance indicators)
- Provisions to:
  - Develop training plan for operators (ECM descriptions, target performance, issue resolution, etc)
  - Update or develop Operator’s Manual
  - Develop instructions for facility staff on ECMs
• Operator’s Manual
  – Often combined with Systems Manual
  – Photographs
  – Reduced-size as-built drawings and schematics
  – List of major equipment
  – Invoices for major equipment purchases and repairs
  – Balance reports
  – Equipment locations
  – Control system logic
  – O&M instructions
  – Training materials
# Operations, Maintenance & Monitoring Documentation

<table>
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<tbody>
<tr>
<td>All</td>
<td>OM&amp;M Plan (ongoing management regime)</td>
</tr>
<tr>
<td>All</td>
<td>Organisational chart</td>
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</table>
Operations, Maintenance & Monitoring

Questions and polls

Any Questions
1. Baseline Development
2. Savings Calculations
3. Design, Construction & Verification
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# Measurement & Verification

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<tr>
<td>Appoint an M&amp;V resource</td>
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<td>✓</td>
</tr>
<tr>
<td>M&amp;V Plan</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Whole facility (Option C)</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Retrofit isolation – all parameters (Option B)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Retrofit isolation – key parameters (Option A)</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Collection of energy data</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Verified calculations and Report</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Measurement & Verification

**Option C**

- **Whole Facility**
  - Option C: Utility bill analysis
  - Complex protocol
  - Savings estimates > 10% facility energy use
  - Whole facility; interactions
  - Energy use equation/regression analysis
  - Routine and non-routine adjustments
  - Statistical evaluation
    - $R^2 > 0.75$
    - $CV[RMSE] < 15\%$
    - $MBE +/- 7\%$
    - $T$-stat > 2.0
Measurement & Verification

Options A and B

• Retrofit Isolation
  – Option A: Key parameter measurement
  – Option B: All parameter measurement
  – Targeted protocols, and sometimes Complex using Option B
  – Specific to each ECM
  – Develop measurement boundaries
  – Estimated parameters
Measurement & Verification

Process

• Follow IPMVP M&V process

  1. Document baseline
  2. Plan and coordinate M&V activities
  3. Verify operations
  4. Gather data
  5. Verify savings
  6. Report results

Pre-construction

Post-construction
Measurement & Verification

M&V Application – Pre-construction

• M&V Plan
  – Compliant with IPMVP
  – Select appropriate Option(s)
  – Define routine and non-routine adjustments
  – Define measurement boundary
  – Define measurement period
  – Meter locations, accuracy
  – Collect baseline and post-construction data
  – Option A: estimated parameters

Section 7.1
IPMVP Core Concepts 2016
Measurement & Verification
Performance Period Efforts

Develop M&V plan → Collect data → Install measures

M&V report → Verify savings → Data collection
## Measurement & Verification Documentation

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Qualifications of the M&amp;V provider</td>
</tr>
<tr>
<td>All</td>
<td>M&amp;V Plan</td>
</tr>
<tr>
<td>All</td>
<td>Routine adjustments</td>
</tr>
<tr>
<td>All</td>
<td>Pre-retrofit collected data (baseline period)</td>
</tr>
</tbody>
</table>
Measurement & Verification
Questions and polls
Worked examples
Example 1: Motor replacements on packaging lines in manufacturing plant

- Discrete measure
  - Simple to estimate savings

- ECM is not bespoke, process-specific

- Measurement boundary to be drawn around each motor

- IPMVP Option A or B likely to be most appropriate

- **Targeted Industry protocol**

- A sampling approach can be adopted to energy audit, provided representative sample is selected

- Only the baseline associated with the motors needs to be developed
Example 2: Industrial site upgrade

- ECMs consist of lighting retrofit, upgrades to BMS, air handling unit improvements, installation of variable speed drives

- IPMVP Option C likely to be most suitable

- Complex Industry Protocol
Application Process
Application timeline

• A link to the PD and QAA applications will be sent to attendees of today’s training

• Applications must be submitted by 31st July

• We will contact you if we require additional information or clarifications on your submission

• Once our review is complete, we will notify you to confirm your official status as a member of the ICP PD/QAA network
Project developer requirements

• List of individuals who will oversee ICP projects and their credentials - option 1 (professional engineer) or option 2 (engineering/science degree plus additional certification) – describe relevance of qualification

• Sign Declaration of Honour confirming PD experience across 5 ICP stages:
  • Baselining
  • Savings calculations
  • Design, Construction and OPV
  • Operations, Maintenance and Monitoring
  • Measurement and Verification

• Acknowledge ICP T&Cs and to information being correct

• Company logo and brief details

• Insurance on a per project basis
QA assessor requirements

- List of individuals who will oversee ICP projects and their credentials - option 1 (professional engineer) or option 2 (engineering/science degree plus additional certification) – describe relevance of qualification

- Sign Declaration of Honour confirming QA experience across 5 ICP stages:
  - Baselining
  - Savings calculations
  - Design, Construction and OPV
  - Operations, Maintenance and Monitoring
  - Measurement and Verification

- Acknowledge ICP T&Cs and to information being correct

- Company logo and brief details

- Take QAA test – online, 40 questions, 30 mins

- Insurance on a per project basis
ICP Europe Network Members
Investor Confidence Project

europe.EEperformance.org

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