

Investor Confidence Project

*Project Developer and Quality Assurance Assessor Training
May 9th 2018*

Presenters:

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Bethan Phillips, ICP Europe Technical Team



WELCOME

The word "WELCOME" is displayed in a playful, handcrafted style on a corkboard. Each letter is cut from a different colored piece of paper and is pinned to the corkboard with a matching colored pushpin. The letters are: 'W' (blue paper, white pin), 'E' (white paper, red pin), 'L' (red paper, blue pin), 'C' (yellow paper, yellow pin), 'O' (white paper, red pin), 'M' (light green paper, white pin), and 'E' (red paper, blue pin). The letters are arranged in a slightly staggered, horizontal line.

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

Bethan Phillips
ICP Europe Technical Team

- 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



European Commission Disclaimer



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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

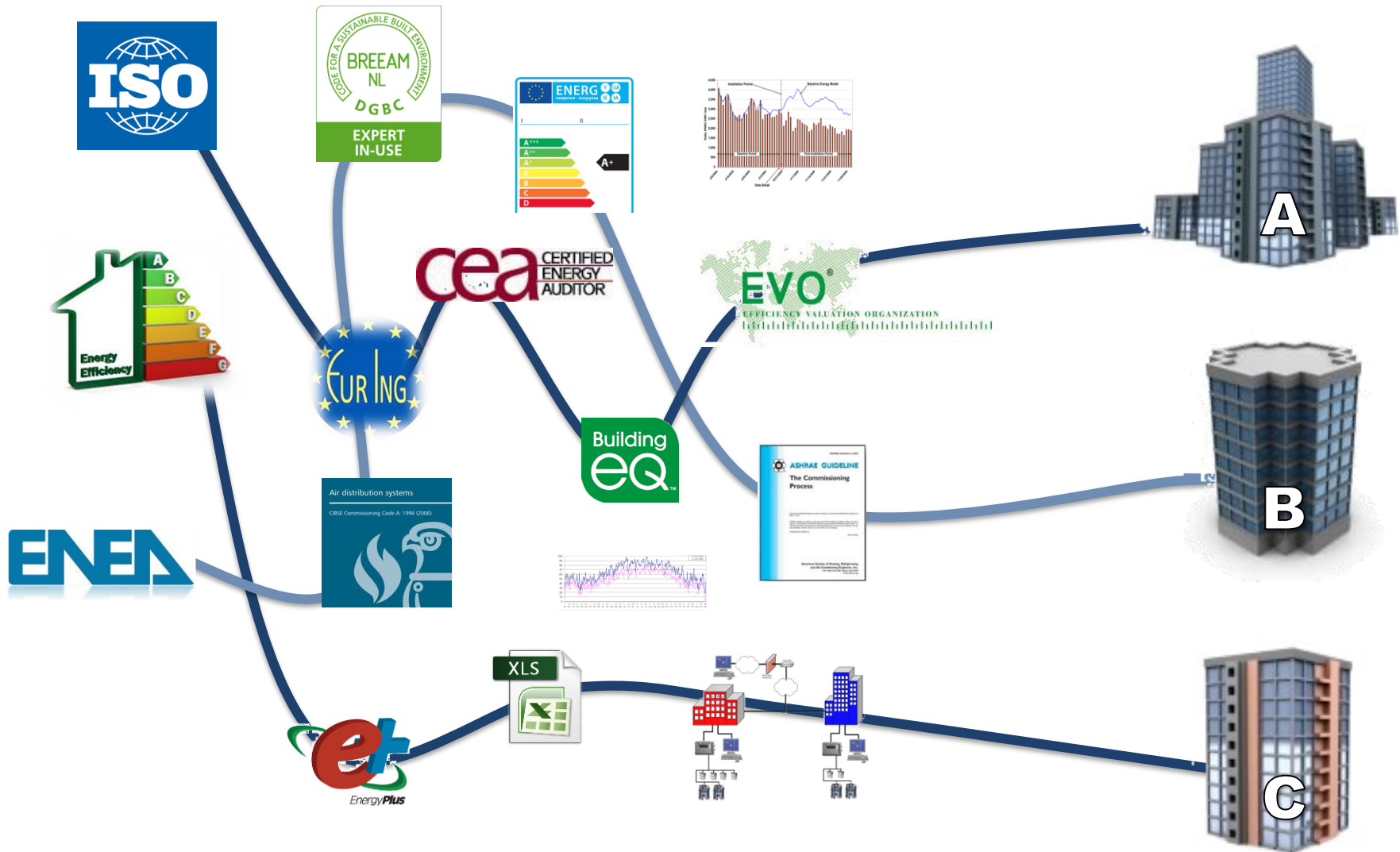
- You are all muted by default to minimize background noise, but we want your participation!
- You can ask questions either using the chat box or raising your hand on gotowebinar control panel anytime
- We will stop at the end of each section for QA
- We will use a poll facility to assess comprehension 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

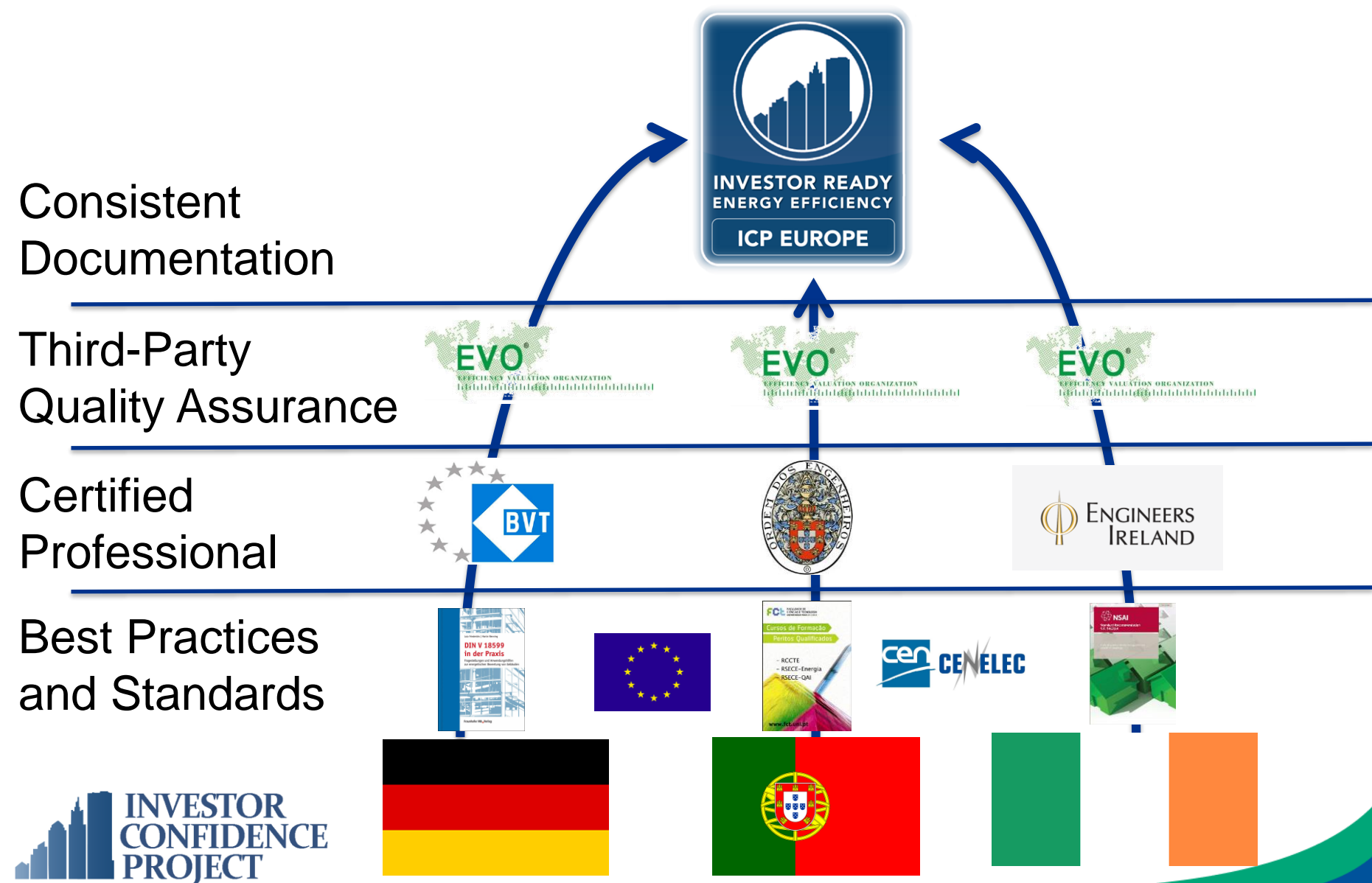
- All participants are knowledgeable and experienced professionals
- This training is only the beginning of a longer journey
- ICP Project Developers and Quality Assurance Assessors are crucial agents for the success of our scheme and the transformation of the Energy Efficiency market

What is the Investor Confidence Project?

Lack of Standardisation = Greater Risk



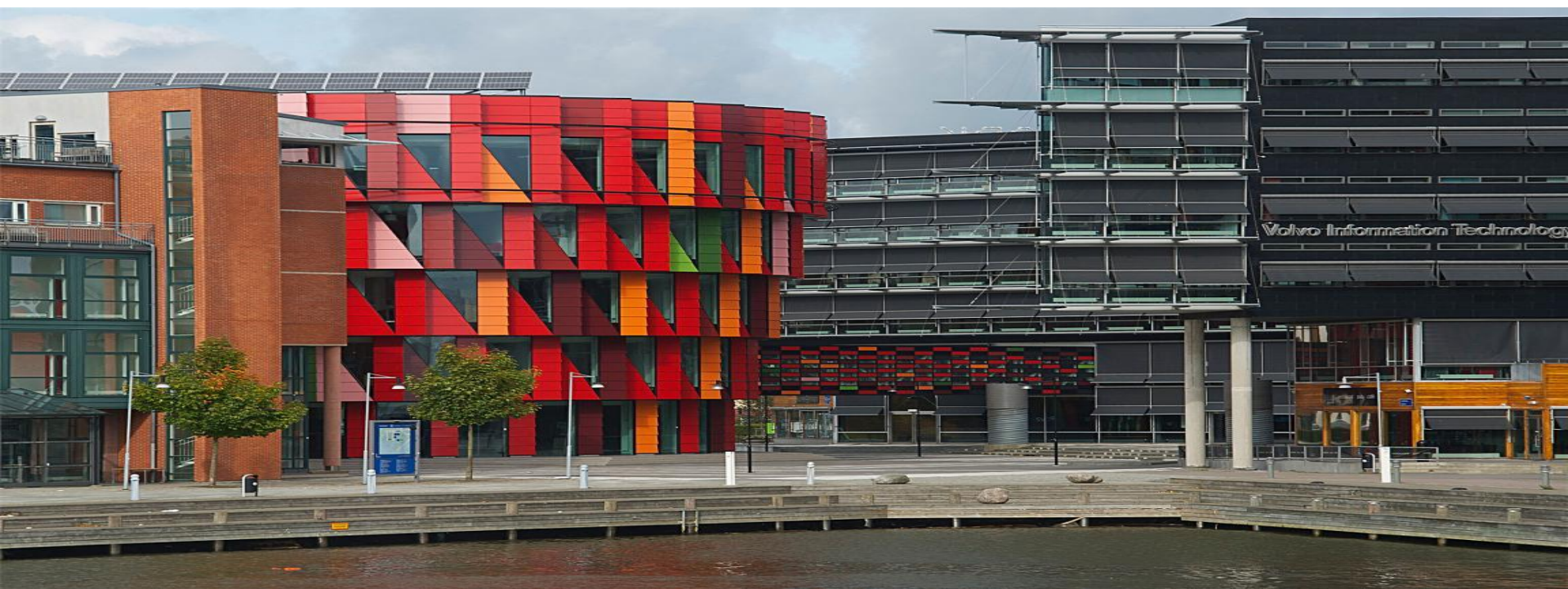
Investor Ready Energy Efficiency Project





Ensures transparency,
consistency and trust-
worthiness 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



What project types is IREE™ designed for?





Street Lighting

One Protocol



**Single protocol for all types of
street lighting energy efficiency
projects**



Street Lighting: European context

- 60-90m street lights across Europe
- 75% more than 25 years old
- Approx annual energy cost €3bn
- Energy saving potential from LED of 50-75% or €1.9bn



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 network requirements:
 - Qualifications
 - Experience
 - Professional insurance



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’

- 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:
 - 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 approach taken from the ICP Protocol*
- Validate that all necessary *documentation* is provided and complete
- Check methodologies, assumptions, and results (*technical review*)
- Complete the ICP Checklist

ICP QA Checklist Qualifier

“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

STAGE	Develop Baseline	Savings Calculations / Investment Package	Design, Construction & Verification	Operations, Maintenance & Monitoring	Measurement & Verification
PROJECT TASKS	Select a baselining approach	Develop initial savings estimates	Appoint an Operational Performance Verification Resource	Select and document ongoing management regime e.g. periodic inspection/aM&T	Develop an IPMVP based M&V plan
	Collect asset information, plans, drawings and utility asset registers	Establish preliminary cost estimates	Develop OPV plan	Develop OM&M plan	Appoint an M&V professional
	Work with the M&V specialist to define the measurement boundary	Ascertain preferred financial analysis metrics	Where appropriate, make provisions for the development and implementation of training	Where appropriate, make provisions for the development and implementation of operator training	Provide the M&V Plan, input data sets, assumptions and calculation to all parties
	Establish the baseline period	Develop a set of recommended ECMs	Make provisions for updating systems manual (if one already exists)	Make provisions for updating operator's manual (if one already exists)	Option A/B: Collect post-retrofit energy / performance data
	Collect hourly electricity consumption data, independent data, utility rate schedule, historical energy use data and independent variable data	Develop a project inventory for the proposed ECMs	If no systems manual exists, at minimum provide full inventory of installed equipment	Make provisions for the development and execution of instructions to notify affected stakeholders	Option A/B: Performance data analysis
	Define the project boundary	Estimate the total annual operational hours	Where appropriate, make provisions for a simple OPV report		Option A/B: Verified savings calculations
	Develop a project inventory	Calculate and document the estimated annual performance period energy consumption			Option C: Post-utility data
	Calculate estimated operational hours, power consumption and hence baseline energy consumption	Develop detailed energy savings calculations			Option C: Identify / quantify non-routine adjustments
	Cross-check the baseline energy consumption using spot measurements	Develop final investment package for ECMs			Option C: Regression based analysis
	Calendarise independent variable data	Prepare final report summarising ECMs			Develop a deemed savings plan
	Develop the baseline energy consumption model and test accuracy				
	Establish peak demand and pricing (where it is in effect)				
	Chart average daily demand (where demand charges or time-of-using pricing is in effect)				

Key

All approaches

Measurement based approach

Deemed savings approach

Quality Assurance Tasks

STAGE	Develop Baseline	Savings Calculations / Investment Package	Design, Construction & Verification	Operations, Maintenance & Monitoring	Measurement & Verification
QUALITY ASSURANCE TASKS	Review and approve selected baseline period	Review and approve credentials of individual responsible for energy model/savings calculations	Review and approve credentials of individual responsible for OPV	Review and approve OM&M plan, setting out procedures	If using a measurement based approach: Review and approve M&V plan
	Review and approve electricity data and rates, significant variable data and energy baseline	Review and approve credentials of individual responsible for designing the lighting system	Review and approve OPV plan	Review and approve selected ongoing management regime	Review and approve credentials of individual responsible for M&V
	Review and approve energy consumption model	Review and approve energy savings calculations, including supporting data	Review and approve systems manual/full inventory	Review and approve operator's manual (if one exists)	Review and approve the deemed savings plan
	Review and approve regression model when used	Review and approve annual operational hours and total annual post-retrofit energy consumption calculations	Review and approve training (interview system operators)	Review and approve training (interview system operators)	
		Review and approve project inventory			
		Review and approve investment package			
		Review and approve ECM report including final energy cost savings and pricing for each measure			

Key

All approaches

Measurement based approach

Deemed savings approach









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 Checklist v1.0		
<div>Client: XYZ Property LLC Project: 123 Main St Project Developer: Energy Efficiency Inc. QA Provider: Assured Quality Assurance</div>		Energy Performance Protocol Large Commercial v1.2a
<div> BASELINING CORE REQUIREMENTS</div> <ul style="list-style-type: none"><input checked="" type="checkbox"/> 14-36 months utility data<input checked="" type="checkbox"/> Utility baseline period<input checked="" type="checkbox"/> End-use energy use estimates<input checked="" type="checkbox"/> Weather data - related baseline<input checked="" type="checkbox"/> 12 mos occupancy - related baseline<input checked="" type="checkbox"/> Building asset data<input checked="" type="checkbox"/> Baseline operational/performance data<input checked="" type="checkbox"/> Normalized / regression-based baseline<input checked="" type="checkbox"/> Utility rate structure (if Demand Charges or Time of Use apply)<ul style="list-style-type: none"><input checked="" type="checkbox"/> Annual load profile<input checked="" type="checkbox"/> Average daily load profiles<input checked="" type="checkbox"/> Peak usage<input checked="" type="checkbox"/> TOU summary by month (if applicable)	<div> SAVINGS CALCULATIONS</div> <ul style="list-style-type: none"><input checked="" type="checkbox"/> Software type<input checked="" type="checkbox"/> Modeler credentials<input checked="" type="checkbox"/> Weather file<input checked="" type="checkbox"/> Model input files<input checked="" type="checkbox"/> Model output files<input checked="" type="checkbox"/> Model calibration<input checked="" type="checkbox"/> Model process description<input checked="" type="checkbox"/> Energy Efficiency Report<u>Energy Conservation Measures (ECMs)</u><ul style="list-style-type: none"><input checked="" type="checkbox"/> Investment criteria<input checked="" type="checkbox"/> ECM model variables<input checked="" type="checkbox"/> ECM results and package results<input checked="" type="checkbox"/> Cost estimates<input checked="" type="checkbox"/> Quality assurance statement	
<div> DESIGN, CONSTRUCTION, AND VERIFICATION</div> <ul style="list-style-type: none"><input checked="" type="checkbox"/> Operational Performance Verification plan<input checked="" type="checkbox"/> OPV authority credentials	<div> MEASUREMENT AND VERIFICATION</div> <ul style="list-style-type: none"><input checked="" type="checkbox"/> Measurement and Verification plan<input checked="" type="checkbox"/> M&V agent credentials	
<div> OPERATIONS, MAINTENANCE, AND MONITORING</div> <ul style="list-style-type: none"><input checked="" type="checkbox"/> Ongoing management regime	<ul style="list-style-type: none"><input checked="" type="checkbox"/> Project Developer Credential	
<div>QA Firm: Assured Quality Assurance Reviewer*: John Doe Date: 1/1/15 Signature: </div> <p><small>*Reviewer must be qualifying individual per ICP QA Application</small></p>		
<p><small>By signing this ICP QA checklist, the ICP Quality Assurance Provider attests to having reviewed the project development documentation and certifies that the project substantially follows the ICP Energy Performance Protocols and the ICP Project Development Specification. 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.</small></p>		

ICP Quality Assurance Checklists

- Specific to the protocol (one checklist)
- Focuses on underwriting phase
- Required components and documentation
 - Baselineing
 - Savings Calculations
 - OPV
 - OM&M
 - M&V



ICP Project Development Specification

- Supplements protocol
- More detailed guidance on requirements in protocol
- Additional resources
- Linked to protocol sections

ICP Project Registry

[ABOUT](#)[NEWS](#)[INVESTORS](#)[PROVIDERS](#)[PROJECT DEVELOPMENT](#)[PROJECT CERTIFICATION](#)[REGISTRY](#)

Project Name *

Protocol *

Large Commercial ▼

Protocol Version # *

Project Description * ?

Quality Assurance Provider * ?

QA Reviewer Name *

QA Reviewer Email *

Project Developer *

QA Reviewer Phone #

Project Developer ICP Credentialed?

☐ Yes

QA Reviewer ICP Credentialed?

☐ Yes

Building Owner Organization/Name *



Questions and polls



ICP Stages - Requirements

1. Baseline Development

2. Savings Calculations

3. Design, Construction & Verification

4. Operations Maintenance & Monitoring

5. Measurement & Verification



Protocol Approach and Documentation

Street Lighting Protocol

Measurement-Based Approach

- Direct monitoring of energy consumption
- IPMVP compliant
- Preferred approach: more robust

Deemed Savings Approach

- Estimations of consumption based on reliable asset information
- No requirement for when to use it, but generally when:
 - Billing based on deemed savings approach, and/or
 - No energy monitoring system installed

Street Lighting Project Development Specification

Baseline Development

Procedure	Measurement-based	Deemed Savings
Normalised baseline (energy consumption equation)	Maybe	-
Electricity consumption data	✓	-
System asset, operational, performance data	✓	✓
Retrofit isolation baseline	Maybe	-
Load shapes (when interval data available)	✓	-
Project Inventory	-	✓
Estimated annual baseline energy consumption	-	✓

Where relevant to the ECMs

Baseline Development

All approaches: System Asset, Operational, Performance Data

- Collect system asset, operational, and performance data
 - Drawings, equipment inventories, surveys, monitoring or measurements etc.
 - System performance tracking
 - Analysis of ECMs
 - ECM implementation
 - ECM performance tracking



- Provide a summary of activities and processes

Baseline Development

Deemed savings approach: Estimated baseline calculation

- Define project boundary
- Develop project inventory for fixtures and fittings undergoing replacement
 - Include fixtures which are not operational
 - Power consumption from manufacturer's data, national reference documents or on-site measurement (preferred option).
- Calculate estimated total annual operational hours
 - Account for effects such as local sunrise/sunset times and weather effects
 - Nationally recognised approach, or use on-site measurement (preferred option).
- Calculate estimated power consumption by fitting type and operating hours



Baseline Development

Deemed savings approach: Estimated baseline calculation

- Estimated annual baseline energy consumption = \sum power consumption x operating hours *(for each equipment category)*
- Cross-check with spot measurements (sampling) and/or comparing with national databases (e.g. inventory and charge code)
- Deviation >10%: written justification required
- Document all assumption, calculations, measurements



Baseline Development

Measurement-based approach: Data collection

- Collect historical energy use and cost data
 - Define measurement boundary/project boundary
 - At least one full energy-use cycle (for most street lighting systems this will be one year)
 - Electricity, renewable energy and any other resources consumed
 - Calendarise if necessary
 - Energy end-use breakdowns to create boundaries and reality checks associated with energy savings estimates

PDS section 4.2.1
Street Lighting PDS section 1.2

EN16247-1 Energy Audits – General requirements
ISO 5002 Energy Audits – Requirements with guidance for use

Baseline Development

Measurement-based approach: 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 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

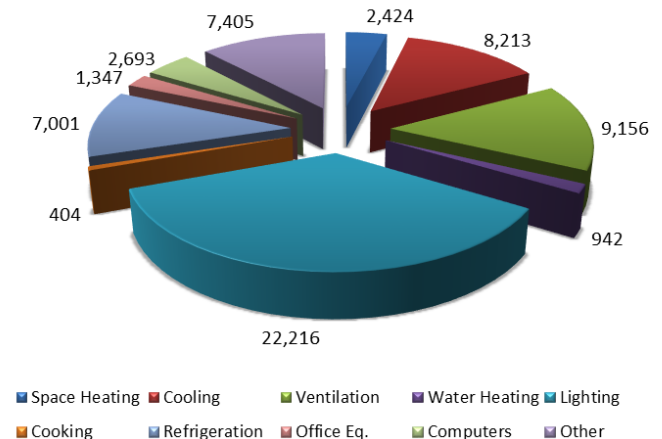
IPMVP: Statistics and Uncertainty for
IPMVP 2014 (section 1)

Baseline Development

Measurement-based approach: Energy end-use consumption / Weather

- Estimate or measure end-use energy use
 - Calibrate baseline energy model
 - Calibrate energy savings estimates
- Where relevant to ECMs, collect independent variables data corresponding to the baseline period (e.g. traffic)
 - At least one full energy-use cycle (for most street lighting systems this will be one year)
- Other independent variables
 - e.g. number of burn outs,
 - changes to illuminance levels etc.

EIA Based Electric Usage Allocation (kWh)



Baseline Development

Measurement-based approach: Retrofit isolation baseline

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

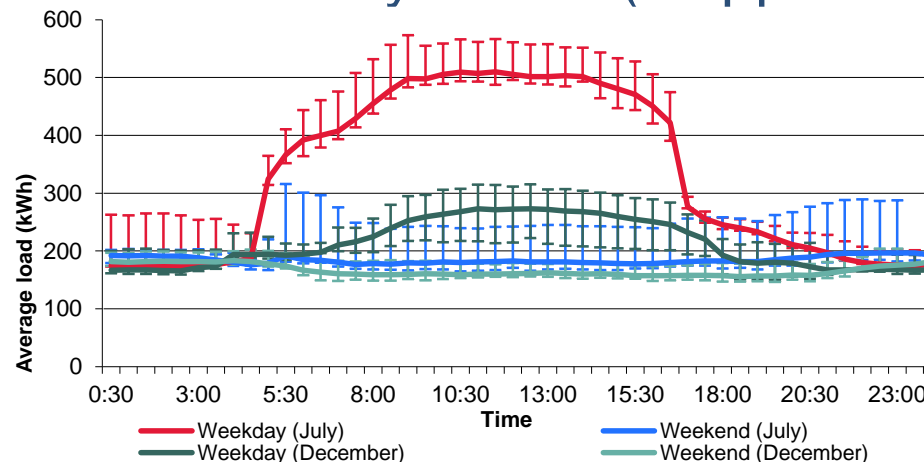
IPMVP Core
Concepts 2016
Section 5.1

Baseline Development

All approaches: 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 all four seasons
- Time of Use summaries by month (if applicable)



Baseline Development

Documentation

Baseline approach	Documentation
Both	Statement of basis for the baselining approach selected
Measurement-based	Baseline period (start and end dates)
Measurement-based	Energy data
Deemed Savings	Project inventory
Deemed Savings	Details of power consumptions of relevant equipment
Deemed Savings	Calculations relating to baseline energy consumption
Both	Access to all asset, operational and performance data
Both	Utility rate structure
If applicable:	
Measurement-based	Operational hours, weather and traffic data (if relevant to project)
Both	Interval data; sub-metered data; load profiles; monthly peak demand

Baseline Development

Questions and polls

QUESTIONS



1. Baseline Development

2. Savings Calculations

3. Design, Construction & Verification

4. Operations Maintenance & Monitoring

5. Measurement & Verification



Savings Calculations

Procedure	Measurement-based	Deemed Savings
ECM descriptions	✓	✓
ECM savings calcs – models/spreadsheets	✓	✓
Investment criteria	✓	✓
Fixed prices for each ECM	✓	✓
Investment package	✓	✓
Reporting	✓	✓

Savings Calculations

Deemed savings approach

- Repeat baselining process for proposed ECMs:
 - Project inventory including number of items and estimated power consumption
 - Estimate total annual operational hours for each piece of equipment
 - Calculate and document annual performance period energy consumption



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

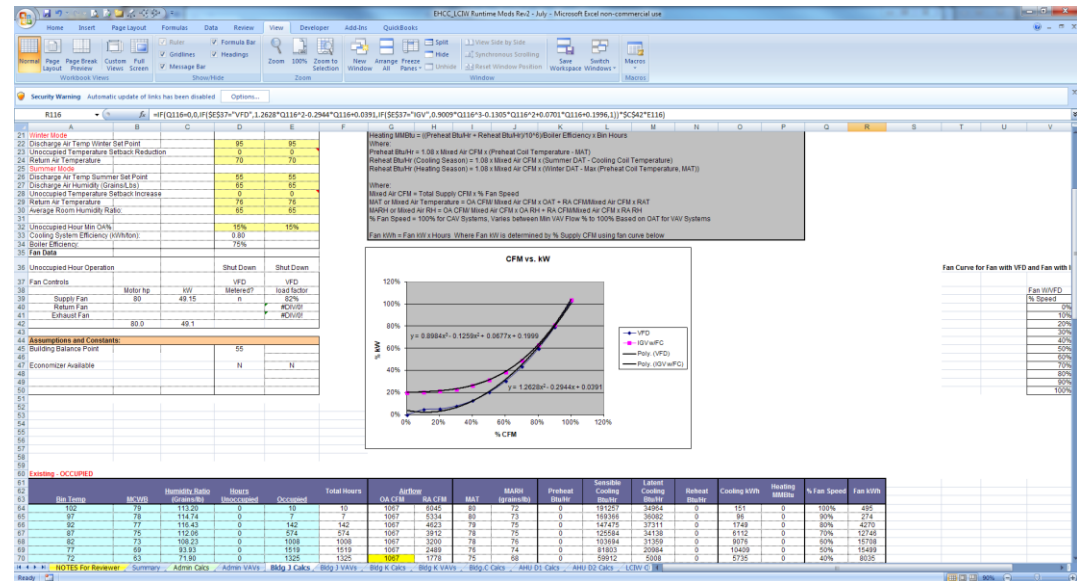
Investment Criteria

- 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
- Assumptions and inputs
 - Documented
 - Never embedded
 - Reasonable

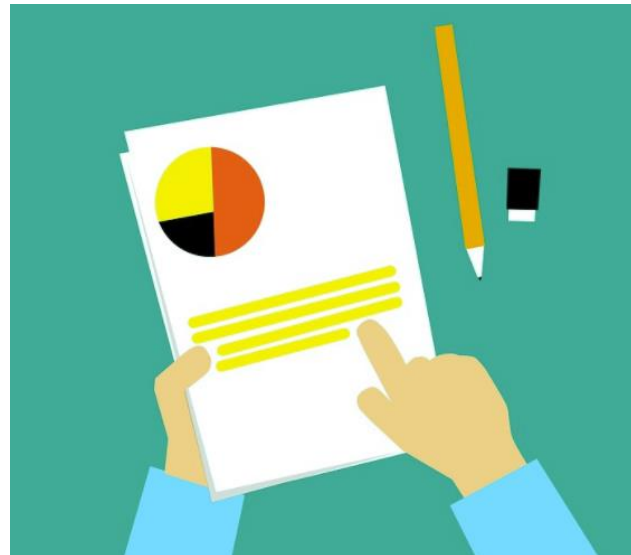


Savings Calculations

Report

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

EN 16247-1 Energy audits –
Part 1
Section 5.6



Savings Calculations

Documentation

Protocol	Documentation
Both	Energy modeller/consultant qualifications
Both	System designer qualifications
Both	Where proprietary or third-party software has been used: input files; output files; calculation descriptions
Both	Where open-book calculations have been used: calculation process description, workbooks, calculation tools
Both	Basis for ECM costs
Both	Summary report – including annual predicted energy savings by fuel type
Deemed Savings	Project inventory: all equipment within the project boundary
Deemed Savings	Calculations relating to: annual operational hours; total annual baseline energy consumption

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

Procedure	Protocol
Appoint an Operational Performance Verification (OPV) resource	✓
Operational Performance Verification (OPV) plan	✓
Operational Performance Verification (OPV) report	Maybe
Training	Maybe
Update Systems manual/full Inventory of the installed equipment	✓



Where appropriate to the nature of the ECMs/scale of the project

Design, Construction & Verification

Operational Performance Verification

Deemed savings approaches
Well-known ECMs, predictable or low savings

- 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
- *Targeted 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

ECMs with greater
savings/uncertainty



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

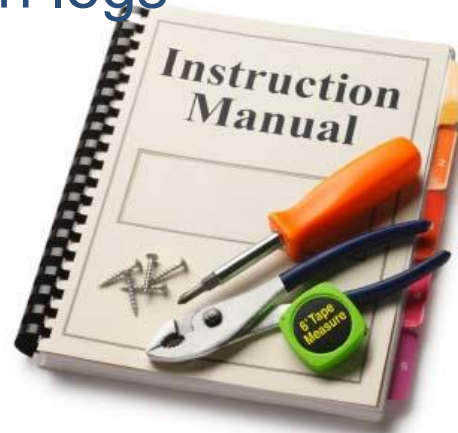
Operational Performance Verification

- OPV plan
 - Developed preconstruction
 - Verification activities: design review, etc...
 - Systems involved; roles and responsibilities
 - Target energy budget
 - Description of OPV report (where appropriate to nature/scale of project)
 - Provisions to:
 - Develop training plan for operators (ECM descriptions, target performance, etc.) (where appropriate to nature/scale of project)
 - Update Systems Manual, or
 - If no Systems Manual exists, provide a full inventory of the installed equipment, as a minimum

Design, Construction & Verification

Systems Manual – update if one exists

- Systems manual
 - System design and construction (owner's project requirements, current system 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

Approach	Documentation
Both	Qualifications of the OPV provider
Both	OPV Plan

Design, Construction & Verification

Questions and polls



1. Baseline Development

2. Savings Calculations

3. Design, Construction & Verification

4. Operations Maintenance & Monitoring

5. Measurement & Verification



Operations, Maintenance & Monitoring

Procedure	Protocol
OM&M plan (ongoing management regime)	✓
Training on OM&M procedures	Maybe
Update Operators manual (if one exists)	Maybe



Where appropriate to
the nature of the ECMs

Operations, Maintenance & Monitoring

OM&M Plan

- OM&M procedures
 - Continuous improvement and monitoring
 - Tracking, analyzing, diagnosing issues
 - Resolving issues
 - Maintain system performance
- Methods include:
 - Periodic inspections
 - Remote management and monitoring systems



Operations, Maintenance & Monitoring

OM&M Plan

- OM&M Plan: framework for ongoing management regime
 - Process and intent
 - Manual or automated tools or processes to use
 - Resources and established roles / responsibilities
 - Organisational chart
 - Technical qualifications for O&M
 - Provisions to:
 - Use approved installers (where national certification schemes exist)
 - Develop training plan for operators (ECM descriptions, target performance, issue resolution, etc.)(where appropriate to nature/scale of project)
 - Update Operator's Manual
 - Develop instructions to notify stakeholders of implemented ECMs

Operations, Maintenance & Monitoring

Operator's Manual – update if one exists

- 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
 - Equipment locations
 - Control system logic
 - O&M instructions
 - Training materials

Operations, Maintenance & Monitoring *Documentation*

Approach	Documentation
Both	OM&M Plan (ongoing management regime)
Both	Organisational chart

Operations, Maintenance & Monitoring

Questions and polls



1. Baseline Development
2. Savings Calculations
3. Design, Construction & Verification
4. Operations Maintenance & Monitoring
- 5. Measurement & Verification**



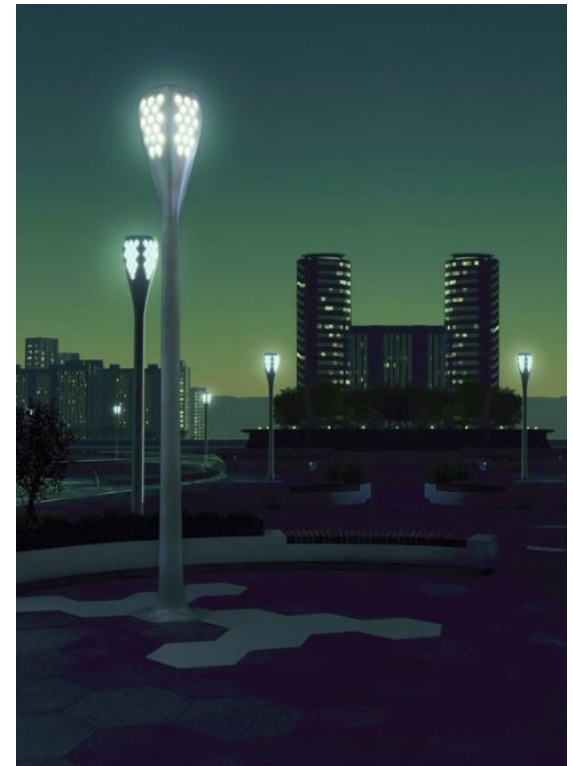
Measurement & Verification

Procedure	Measurement-based	Deemed Savings
Appoint an M&V resource	✓	
M&V Plan	✓	
Whole facility (Option C)	✓	
Retrofit isolation – all parameters (Option B)	✓	
Retrofit isolation – key parameters (Option A)	✓	
Deemed Savings Plan		✓
Collection of energy data	✓	✓
Verified calculations and report	✓	✓

Measurement & Verification

Deemed savings approach: Pre-construction

- Post-retrofit verification
 - Check asset information for each piece of installed equipment consistent with pre-retrofit assumptions
 - Power consumption
 - Operating hours
 - Not compliant with IPMVP
 - Does not need to be carried out by a qualified M&V professional



Measurement & Verification

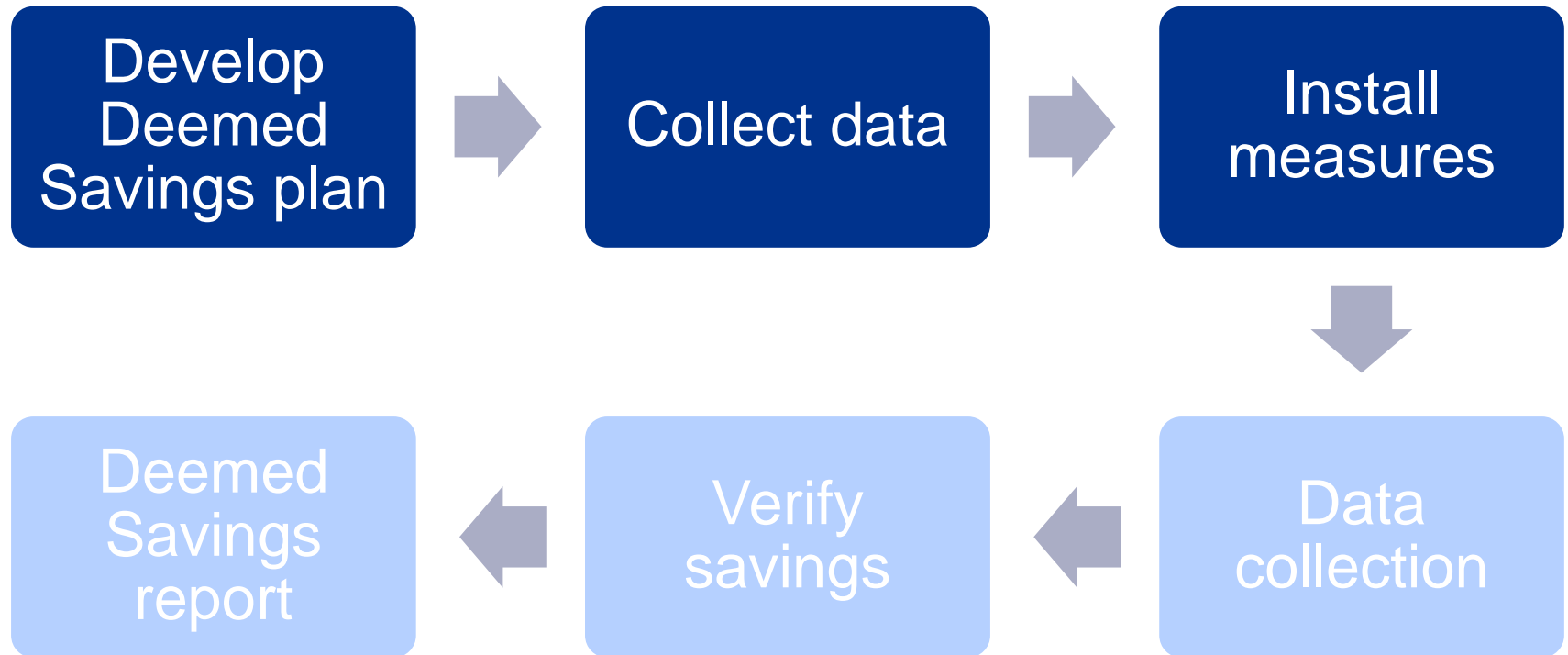
Deemed savings approach: Pre-construction

- Deemed Savings Plan
 - Develop pre-retrofit
 - Verify asset information
 - Define project boundary
 - Documentation of the planned process for establishing the deemed energy savings:
 - Collect estimated annual baseline energy consumption
 - Collect estimated post-upgrade energy consumption



Measurement & Verification

Deemed savings approach: Performance period efforts



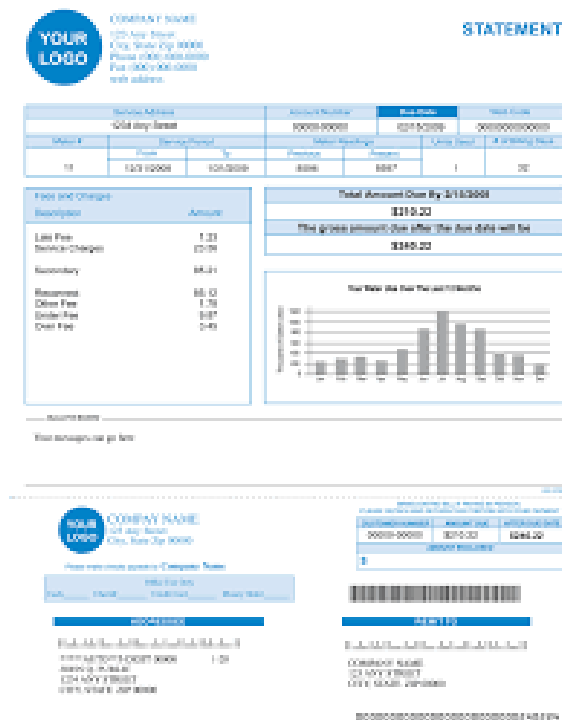
Measurement & Verification

Measurement-based approach: Option C

IPMVP Core Concepts 2016

- Whole Facility

- Option C: Utility bill analysis
- Savings estimates > 10% system energy use
- Energy use equation/regression analysis
- Routine and non-routine adjustments
- Statistical evaluation
 - $R^2 > 0.75$
 - $CV[RMSE] < 15\%$
 - $MBE \pm 7\%$
 - $T\text{-stat} > 2.0$



Measurement & Verification

Measurement-based approach: *Options A and B*

- Retrofit Isolation

- Option A: Key parameter measurement
- Option B: All parameter measurement

IPMVP Core Concepts 2016

- Specific to each ECM
- Develop measurement boundaries
- Estimated parameters

Measurement & Verification

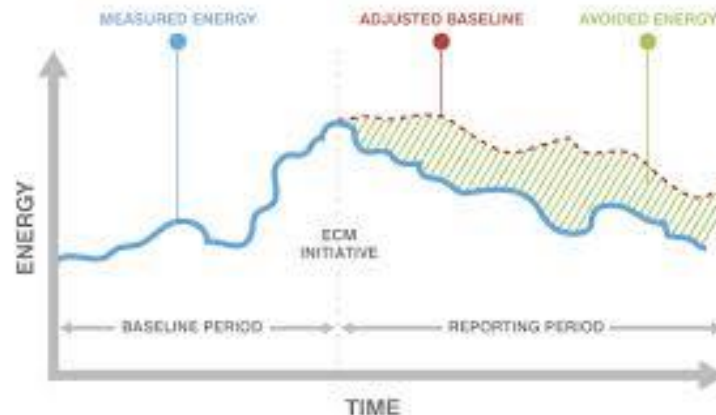
Measurement-based approach: Process

- 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-retrofit

Post-retrofit



Measurement & Verification

Measurement-based approach: M&V application – pre-construction

- M&V Plan

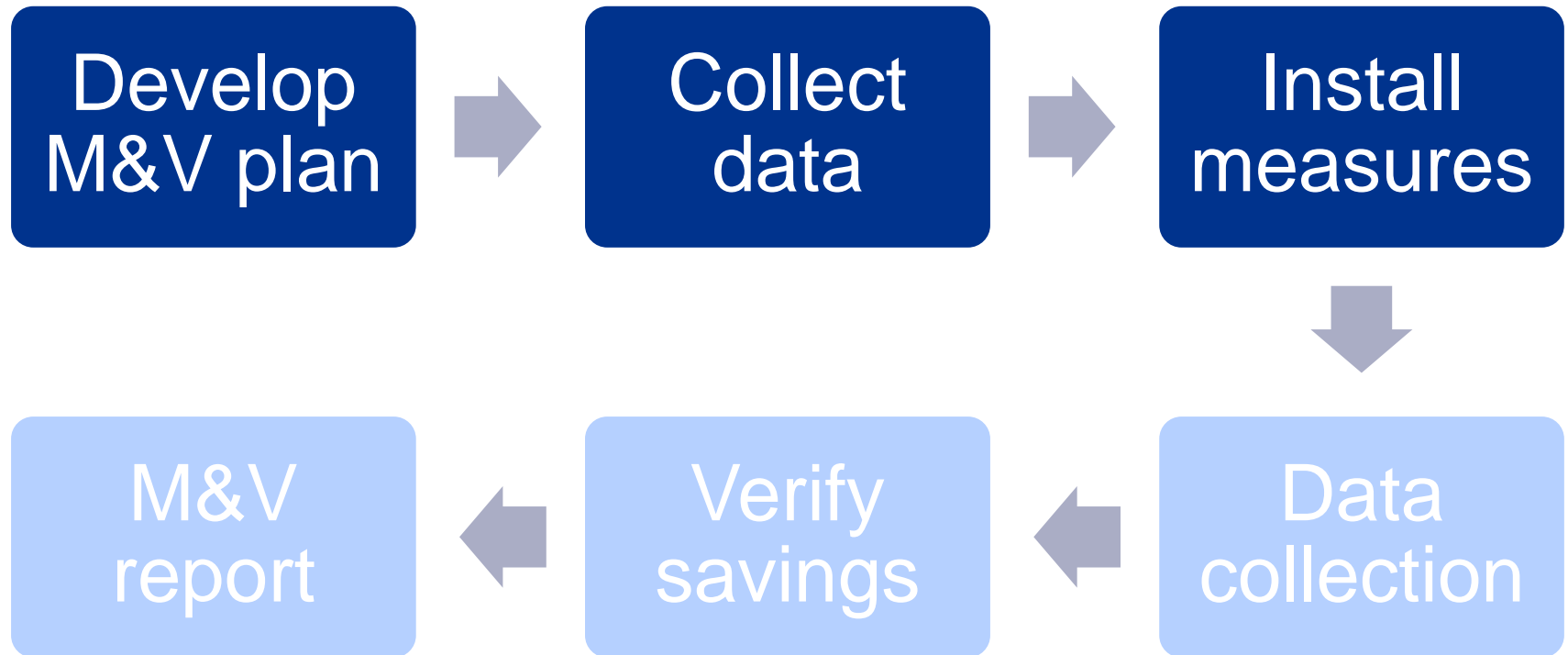
- Compliant with IPMVP
- Select appropriate Option(s)
- Define:
 - Routine and non-routine adjustments
 - Measurement boundary
 - Measurement period
- Meter locations, accuracy
- Collect baseline and post-construction data
- Option A: estimated parameters

Section 7.1
IPMVP Core Concepts 2016



Measurement & Verification

Measurement-based approach: Performance period efforts



Measurement & Verification

Documentation

Approach	Documentation
Measurement-based	Qualifications of the M&V provider
Measurement-based	M&V Plan
Measurement-based	Routine and non-routine adjustments
Deemed Savings	Deemed Savings Plan
Both	Pre-retrofit collected data (baseline period)

Measurement & Verification

Questions and polls



Worked examples

Example 1: Retrofit of LED luminaires

- Discrete measure
 - Simple to estimate savings
- Measurement/project boundary to be drawn around number of luminaires in system
- IPMVP Option A or B/Deemed Savings approach likely to be most appropriate
- A sampling approach can be adopted, provided a representative sample is selected
- Only the baseline associated with the luminaires needs to be developed (if other energy uses)

Example 2: Major street lighting upgrade

- ECMs consist of luminaire retrofit, installation of a new Central Management System and replacement of most 'at-risk' street lighting columns.
- Billing based on metered data
- Measurement boundary should include all energy using components – i.e. include the entire system.
- IPMVP Option C approach likely to be most suitable

Application Process



Application timeline

- A link to the PD and QAA applications will be sent to attendees of today's training
- A link to test for QAA applications will also be sent
- Applications must be submitted **by 23rd May**
- 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:
 - Baselineing
 - Savings calculations
 - Design, Construction and OPV
 - Operations, Maintenance and Monitoring
 - Measurement and Verification
- Proof of Professional Indemnity **insurance**
- **Acknowledge** ICP T&Cs and to information being correct
- **Company** logo and brief details

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
- Proof of Professional Indemnity **insurance**
- **Acknowledge** ICP T&Cs and to information being correct
- **Company** logo and brief details
- **Take QAA test – online, 40 questions, 30 mins**



ICP Europe Network Members



Investor Confidence Project

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