INVESTOR CONFIDENCE PROJECT

ENERGY PERFORMANCE PROTOCOL

TARGETED TERTIARY

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Finding the ways that work

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1.0 INVESTOR CONFIDENCE PROJECT

The Investor Confidence Project (ICP) Europe, is an Energy Efficiency (EE) initiative addressing investment market barriers, which have been repeatedly identified as the main impediments to mass scaling of EE investments in Europe, by the International Energy Agency, the Buildings Performance Institute Europe, the Energy Efficiency Financial Institutions Group, as well as other relevant EE stakeholders in Europe.

The initiative builds on the successful experience of its United States counterpart, which has been pointed out as a best-practice approach by the Energy Efficiency Financial Institutions Group and the International Energy Agency.

The project is supported by the Horizon 2020 European Research and Innovation Programme and by the Stiftung Family Foundation and aims to establish itself as an EU-wide, open access system, to provide more stable, predictable, and reliable savings outcomes and to enable greater private investment through a more efficient transparent marketplace.

At the core of the system are ICP Europe protocols which provide comprehensive and robust guidance for project development at a European level, allowing market entities to dramatically streamline project underwriting processes related to project performance.

This is the Targeted Tertiary protocol, one of the six that comprise the ICP Europe system, along with the Project Development Specification document which compiles all relevant and supporting information and best-practices for system application, which will also be supported by a suite of tools, resources and software products facilitating system application.

1.1 ENERGY PERFORMANCE PROTOCOL – TARGETED TERTIARY

This protocol focuses on tertiary buildings, which are among the most energy use-intensive structures and because they tend to exhibit relatively consistent usage patterns. The protocol is intended for **Targeted Projects**, including single or smaller sets of energy conservation measures (ECMs) applied to one or a number of buildings that focus on only one or a handful of building end-uses, such as lighting, controls, or HVAC replacement. There should be no interactive effects between measures. The exception to this is for lighting projects where there may be interactions between the lighting measures, and heating and cooling loads – that is, a significant improvement in lighting efficiency in a building will reduce heat gains and therefore potentially reduce cooling loads but increase heating loads. This protocol is not intended for whole building renovations.

The Targeted Tertiary Protocol allows for the use of various open-book calculation methods, and relies on partial or full measurement and verification of the energy use and system(s) to which an ECM is applied (IPMVP Option A: Retrofit Isolation: Key Parameter Measurement and Option B: Retrofit Isolation: All Parameter Measurement). However, these approaches may not be appropriate for buildings requiring a more holistic approach that may require the use of an energy model to determine energy savings, as well as an IPMVP Option C: Whole Facility approach for measurement and verification of savings. In the case of a building requiring such a holistic approach, the M&V protocols found in the EPP - Large Tertiary Protocol should be used.

The Energy Performance Protocols are intended as minimum requirements for an investment quality analysis and best practices to maintain, measure and verify the energy savings, not an exhaustive treatment of all possible techniques. Each section of the document establishes these minimum requirements and offers additional methods and tools that can be used to improve the reliability of savings estimation and measurement. A checklist provided in section 10 of this document is intended for inclusion in project documents. Providers are asked to self-certify that they have fulfilled the requirements listed and to indicate what additional methods they applied. A glossary of key terms used in this protocol is also provided in section 9.

This document will evolve over time. Some methods may move from an "additional" or "recommended" category to a standard requirement. Members of the ICP invite engineers, building owners, software developers, prospective lenders and investors, and others to participate in testing and improving these protocols by applying them to retrofit projects and sharing their results.

Throughout this document, reference is made to European and international standards, guidance and resources which are relevant to the requirements of the protocol. Where a relevant national standard, guidance or resource is available, this may be used as an optional alternative resource to the European or international standard. Relevant national standards are shown in Annex A. Resource references are shown in *italics*, followed by a specific reference number in square brackets (e.g. "*[2a]*") which can be used to locate it in Annex A.

As results justify and resources allow, the ICP will expand to develop protocols for additional building types and use cases.

1.2 ENERGY EFFICIENCY PROJECT FRAMEWORK

The EEP Framework is divided into five categories, which together are designed to represent the entire lifecycle of a well-conceived and well-executed energy efficiency project:

1. **Baselining**
    a. Core Requirements
    b. Rate Analysis, Demand, Load Profile, Interval Data
2. **Savings Calculation**
3. **Design, Construction, and Verification**
4. **Operations, Maintenance, and Monitoring**
5. **Measurement and Verification (M&V)**

For each category, the protocol establishes minimum requirements, including:

- **Elements**
- **Procedures**
- **Documentation**

2.0 BASELINING – CORE REQUIREMENTS

A technically sound energy usage baseline provides a critical starting point for accurate projection of potential energy savings as well as for measurement after retrofits and/or retro-commissioning. Under an IPMVP Option A or B approach, a retrofit isolation baseline is developed which is specific to the proposed ECMs. The baseline must establish how much fuel and electricity a building system or end-use can be expected to use over a representative period (refer to 'Measurement Period' in section 2.1 below), as well as any renewable energy that is generated and used on site. It should also factor in the impact of independent variables such as weather, occupancy, and operating hours on the baseline energy use, where these have an impact on the baseline energy consumption.

2.1 ELEMENTS

- **Retrofit Isolation Baseline**: The baseline(s) is specific to the proposed ECMs. It forms the basis for savings estimates under IPMVP Option A or B (refer to IPMVP (section 4.7.1) for guidance), and is used subsequently to verify achieved energy savings. The baseline should be compared to simple estimation efforts or previous energy savings estimates to ensure reasonability. [PD Sec 4.2.6]
- **ECM Characteristics:** For the proposed ECMs, load and hours-of-use components, and whether these components are constant or variable should be documented. The developed baseline(s) should be informed by all available information, including equipment inventories and operating performance, and should be consistent with calculated energy end-use consumption. [PD Sec 4.2.6]
- **Measurement Boundary:** A clear definition of the measurement boundary should be provided. The boundary can be defined around a specific piece of equipment, a combination of equipment comprising a building subsystem, or a specific end-use. The measurement boundary should also account for whether the equipment or end-use is a constant or variable load, or a constant or variable schedule. [PD Sec 4.2.6 and 9.2.1]
- **Interactive Effects (Lighting ECMs Only)**: As described in section 1.1 of this document, this protocol is intended for projects with no interactive effects. The exception to this is for lighting ECMs where there may be interactions between heating and cooling loads. Where this type of project is planned, either:
    a. The impact on heating and cooling loads must be estimated for each season of the year, using conventional heating and cooling calculations. The result should be presented as a proportion of the lighting energy savings; or
    b. The measurement boundary should be expanded to include the interactive effects.
- **Measured and Estimated Parameters:** Sub-metering is an accurate method to measure end-use energy use. However, Option A can be applied to "simpler" measures where at least one of the parameters is expected to be fairly constant or consistent, and can therefore be estimated. When considering an Option A approach, and what variables to estimate, consideration should be given to the amount of variation in baseline energy consumption or the energy impact that variables have on the ECMs before establishing which variables to estimate. Estimates should be based on reliable, documentable sources, with a high degree of confidence. These estimates should never be based on "rules-of-thumb," proprietary sources ("black box"), or "engineering estimates." Key parameters that are not consistent (and should therefore not be estimated), must be measured. This typically includes parameters such as capacity, efficiency, or operation - essentially, any parameters that represent a significant portion of the savings uncertainty. Where multiple versions of the

same ECM installation are included within the measurement boundary, spot sampling is permitted (see IPMVP section 4.7).

- **Measurement Period:** The baseline period should fairly represent all operating conditions of a normal operating cycle for parameters relevant to the ECM (see IPMVP section 4.5.2). Parameters may be continuously measured or periodically measured for short periods. The frequency of measurement will be determined by the expected variation in the parameter. For weather dependent end-uses, or end-uses that vary based on other independent variables, the metering period should cover a period that will capture both minimum and maximum loads. [PD Sec 9.2.1]
- **Weather Data:** Where this affects the baseline energy consumption, for the defined baseline period, acquire weather data (at least degree-days for heating and cooling) from the closest weather station, or on-site measurement, at the time interval coinciding with the interval of the energy usage. [PD Sec 4.2.3]
- **Occupancy Data**: Where this significantly affects the baseline energy consumption, for the defined baseline period, acquire from the tenant and/or building owner or operator vacancy rates, space uses and operating schedules, following the requirements set out in *EN 16247-2 Energy audits – Part 2: Buildings (section 5.3.2) [2b]*. This should include tenant information (e.g. the nature of their lease, type of business, occupancy times) where relevant, and an assessment of how occupancy patterns affect energy consumption. [PD Sec 4.2.4]
- **Building Asset Data**: This data will be specific to the ECM(s) and systems involved in the project, and therefore do not necessarily need to include a comprehensive data set for all building systems. Accurate total useful floor area (for conditioned and unconditioned space) following the guidance provided by *EN ISO 13790:2008 Energy performance of buildings – Calculation of energy use for space heating and cooling (section 3.2.6) [2c]*, and system and material specifications/inventories relevant to the ECM(s) based on building drawings (for example, details of HVAC equipment), following the requirements set out in *EN 16247-2 Energy audits – Part 2: Buildings (section 5.3.2 and Annex D) [2d]* methodology. This information is needed as a reference for any future adjustments to the building asset that may be made. [PD Sec 4.2.5]
- **Accuracy**: Where normalisation of baseline energy data is required, achieve an appropriate goodness of fit of energy data variability to independent variables, following the IPMVP methodology (see Appendix B). Adjusted R^2 value shall be at least 0.75 and a CV[RMSE] shall be less than 0.2, subject to extenuating circumstances; in the event that the fit is outside the range, such extenuating circumstances must be described.

2.2 PROCEDURES

1. Gather energy data, operational/performance data, and building asset data specific to the ECM(s) and systems included in the project. Identify which independent variables are considered the most important, based on the building type and space uses.
2. For lighting ECMs, identify whether there are any interactive effects on heating and cooling loads, and if these are significant, either estimate them as described in section 2.1, or expand the measurement boundary to include them.
3. If required, calendarise the independent variable data to the same time interval that aligns with the defined baseline period.
4. Normalise baseline data against the variables identified above to develop retrofit isolation baseline model(s), using the methodology described in *ISO 50006:2014 Energy Management*

Systems – Measuring Energy Performance Using Energy Baselines and Energy Performance Indicators methodology *(Annex D) [2e]*.

5. Develop the baseline energy use characteristics of the equipment or end use broken down into load and hours-of-use components, and whether these components may be considered constant or variable. This will inform the measurement and verification process.
6. Create a list of specific routine and non-routine adjustment factors to be taken into account during the measurement and verification process, noting also the types of potential non-routine adjustments that may be required.

2.3 DOCUMENTATION

The following information is required for all projects:

- The start and end dates of the retrofit isolation baseline period and why that period was chosen.
- Building drawings, equipment inventories, system and material specifications, field survey results and/or CAD takeoffs, observations, short-term monitored data, spot measurements, and functional performance test results as appropriate to recommended upgrades. This data will be specific to the ECM(s) and systems involved in the project, and therefore does not necessarily need to include a comprehensive data set for all building systems.

The following requirements are dependent on the ECMs proposed and are therefore optional, providing sufficient justification is provided for not including them:

- Weather data (containing heating and cooling degree day and average daily temperature data for site as described above).
- Energy data as a computer-readable file, including:
    - Raw meter readings: from date and to date, in energy-unit value, energy usage charges, demand quantities and demand charges. Local currency should be used.
    - Dataset must cover all forms of purchased energy and energy produced on-site where these are relevant to the baseline(s). Where applicable this will include aggregated tenant data or an approximation of tenant energy use, as well as descriptions of the metering and sub-metering of energy in the building, and how energy costs are paid by building occupants.
    - Provide a brief description of how periods are consolidated to the baseline period applied. Dates of meter reading periods will vary from one energy source to another. Refer to *ISO 16346:2013 Energy Performance of Buildings – Assessment of Overall Energy Performance (section 8.2.2) [2f]* methodology for guidance on partial month billing data "calendarisation."
- Utility rate structure as published by the utility and the commodity provider (if the two are separate) with a breakdown of distribution costs, commodity costs, demand charges, and taxes as well as any time-of-day variability in each of these elements. Statement of how the facility currently purchases energy is included in the next section.

Optional:

- Sub-metered data, including heating and cooling equipment and other major pieces of equipment or end-uses.

- Copies of most recent calibration certificates for all utility meters or data logging equipment, stating the standards to which they are calibrated.
- Building owner's rental information (showing occupancy and lease dates for each tenancy) for the relevant period and description of types of space use by tenants; if details are viewed as confidential, general descriptions of end use will suffice. Auditor shall note particularly energy-intensive uses including restaurants and data centres.

3.0 BASELINING - RATE ANALYSIS, DEMAND, LOAD PROFILE, INTERVAL DATA

Depending upon the location of the building in question, the time of day at which energy is saved can have a significant impact on the monetary value of the savings achieved. Where demand charges are in effect or time-of-use pricing and these have an impact on anticipated savings, load profiles must be provided to show the typical pattern of daily demand of measured parameters.

3.1 ELEMENTS

- **Energy Purchasing**: Description of how the facility purchases energy and the pricing that applies to peak and off-peak energy for all energy sources affected by any proposed ECMs.
- **Load Profile**: Load profiles for all measured parameters for the duration of the measurement period showing any variability and peaks in consumption.
- **Time-of-Use**: Time-of-use summary by month if the site is under a time-of-use or real-time rate for fuels which are relevant for the proposed project.

3.2 PROCEDURES

1. Establish monthly peak demand and pricing based upon the monthly bills for the fuels relevant to the proposed project. Where monthly data is not available, explain why, and describe any potential impacts this may have on the baseline and savings calculations, and how these issues will be addressed.
2. Where demand charges or time-of-use pricing is in effect, for the measured parameters and the duration of the measurement period, chart average daily demand in half hourly intervals (maximum available frequency if half hourly is not available) with time on the x axis and kW on the y axis for typical weekday and weekend days in the spring, autumn, winter, and summer. [PD Sec 5.2.1]

3.3 DOCUMENTATION

- Where relevant to the proposed project, copies of at least one bill for electricity and each fuel. If tenants pay their bills direct, provide a breakdown by owner-paid and tenant-paid utilities. Copies of commodity purchase contracts and/or utility rate sheets or relevant language describing peak and off-peak rates, demand charges, time periods, seasonality.

Optional:

- Monthly consumption load profile for each energy type.
- 12 months of interval meter data for the relevant energy end-uses (if interval metering exists), provided in spreadsheet format.

4.0 SAVINGS CALCULATION

Calculations of estimated savings for projects of the scale anticipated must be based on "open-book" calculation methods or tools. The calculations must be based on sound engineering methods and consistent with the IPMVP approach (refer to IPMVP section 4.5), and the results calibrated to estimated or known energy end-use consumption. These same calculations will be used to perform verified savings calculations as part of the M&V effort, using post-retrofit monitored data.

Use of proprietary "closed book" calculation methods is not recommended. However, if proprietary tools are used for measure savings calculations, they must be well documented. The documentation must include history of previous use, detailed description of the calculation methodologies and assumptions used by the tool, as well as papers, studies or documentation demonstrating the technical rigour of the tool and methodologies employed.

4.1 ELEMENTS

- **Calculation Tools:** Open-book spreadsheet methods or other non-energy modelling methods, either commercially available or developed in-house, should be used to develop energy savings estimates for the ECMs.
- **Credentials**: Savings calculation development and/or review by an individual with:
    a. Professional engineering accreditation, **or**
    b. Five years (minimum) of demonstrated experience calculating energy savings, documented in the form of a CV outlining relevant project experience.
- **Energy Conservation Measure Descriptions:** Descriptions of the existing conditions, proposed retrofit, and potential interactive effects for each lighting measure. [PD Sec 6.2.1]
- **Calculation Data**: Disclosure and description of inputs (defaults versus assumptions), including those from any supporting tools (e.g. load calculators, field testing) used to create inputs for the calculations.
- **Measure Calibration**: Measured parameters associated with the pre-retrofit energy consumption for the project must be compared to simple estimation efforts or previous energy consumption figures to ensure they are reasonable.
- **Calculation Process Description**: Sufficient description of the calculation processes such that (with the necessary input information) a reviewer can reconstruct the calculations. This description should include documentation of the formulas used, as well as assumptions used and their sources. Calculations must be transparent, such that constants or assumption values are not "embedded" within formulas, but are referenced within the spreadsheet and documented with source, value, and units. [PD Sec 6.2.4]
- **Interactions (Lighting ECMs Only)**: Calculations should take into account measure interactions with building heating and cooling loads.
- **Reporting**: Use of an industry-accepted format for reporting of results and for compilation of methods and underlying data used for individual ECM calculations as well as for the package of recommended measures. At present, the industry standard for report presentation of ECM, building, and energy use data is *EN 16247-2 Energy audits – Part 2: Buildings (section 5.6) [2c].* Additionally, annual energy savings by fuel type shall be documented in terms of energy units, a percentage of the total volume of each fuel, and as cost savings using the correct marginal rate for that energy type.

4.2 PROCEDURES

1. **Inform calculation input values** with on-site observations and measured data.
    - Prepare transparent calculations in a readily readable and usable form based on building documentation from plans, equipment schedules, field confirmations, observations and tests.
    - Document calculation processes, formulas, as well as assumptions used and their sources.
    - Where inputs must assign efficiencies, rates, and other values that are not readily measurable, the basis of such assignments must be clearly stated.
    - Identify equipment part-load profiles, operating conditions, and associated efficiencies.
    - Confirm operating schedules for seasonal variations, zone variations, overtime usage, cleaning schedules and practices.

2. **Inform and tune.** Compare measured parameters associated with pre-retrofit energy consumption for each system involved in an ECM to estimates or previous energy consumption figures to ensure that they are reasonable. Compare estimated energy savings to “rules of thumb” or “back-of-the-envelope” calculations, and previous estimates from similar past projects.

3. **For lighting projects only, account for any interactive effects** with building heating and cooling loads, as well as interactions between the lighting measures themselves (e.g. changing lamps, together with installing lighting controls).

4. **Use findings to determine whether project objectives are met (e.g. energy saving targets).**

Analysis of Energy Conservation Measures (ECMs)

1. Ascertain and record the return on investment criteria of the investors, which could include both landlord and tenant, best expressed for simplicity as a simple payback period, or as an internal rate of return (IRR), net present value (NPV), cash-flow analysis or savings-to-investment ratio (SIR). [PD Sec 6.2.6]
2. Prepare a set of ECMs likely to achieve the investment criteria, based on the experience of the engineers involved, building owner preferences, observed condition and operation of existing systems, preliminary calculations, and contractor recommendations. [PD Sec 6.2.1]
3. Establish a preliminary cost estimate (see Pricing / Cost Estimation below).
4. Evaluate savings performance and cost effectiveness of each ECM individually. Utilise calculation methods such as regression analysis. For each ECM clearly document the calculation methodology, formulas, inputs, assumptions and their sources. [PD Sec 6.2.4]
    a. References such as IPMVP (section 4.7) and *EN 16212:2012 Energy Efficiency and Savings Calculation, Top-down and Bottom-up Methods (section 6) [4d]* provide detailed guidelines for calculation methods and best practices.
    b. Vetted calculation tools can be used or referred to as models for calculation methods.
    c. Screening tools are an acceptable method for preliminary consideration of measure applicability, but must not be used as a substitute for detailed calculation methods.

d. Note: If third-party proprietary calculation tools are used, sufficient documentation must be included to validate unbiased assessment of energy savings estimates.

5. Provide a statement of the energy prices used to establish monetary value of the savings. Provide this for both building owner and tenants if the savings are to be shared. This conversion from energy usage to cost must be based on the appropriate local utility rate schedule in effect at the time or, if the facility is purchasing from an independent vendor, the commodity price and the utility distribution schedule of charges. The marginal rate must be used as the cost of the next unit of energy used or saved. Utilise the *European Central Bank's Harmonised Index of Consumer Prices* (*https://www.ecb.europa.eu/stats/prices/hicp/html/index.en.html*) or *source of national data forecasts [4e]* for inflation values if applied in the analysis. Where relevant, details of any demand-side management tariffs/payments should be provided.
6. For lighting ECMs only, account for interactions between measures and potential reductions and increases in building heating and cooling loads.
7. Perform a Quality Control review of recommended measures and overall projected savings based on experience, and data from comparable projects such as estimated or sub-metered energy end-use.
8. Develop pricing for ECMs including operation and maintenance costs, and finalise spreadsheet-based analysis and recommendations based upon estimated pricing.
9. Prepare a final report in an industry-standard format summarising ECMs and compiling all required supporting data.

Pricing / Cost Estimation [PD Sec 6.2.5]

The final investment-grade package should have pricing based upon bids that represent the price for which a contractor has committed to make the improvements.

If that pricing is not available for the economic evaluation of ECMs, the calculations must be based on a minimum of three general contractor quotes. If this is not available, utilise cost estimates based upon the engineer's experience with comparable previous projects (details of how these projects are comparable must be submitted).

Estimates so developed can be used to rank improvements and determine those for inclusion in a final bid package. Cost estimates at the calculation phase must include:

- A construction feasibility review indicating what has to be done, that it can be done, allowable working hours, impacts on the facility, access points for bringing in any large equipment, major removals (demolition), permits required and environmental issues (i.e., asbestos, hazardous materials, or other issues that impact indoor air quality).
- Categories and multiple line items for all necessary trades, i.e., civil (structural and site work, demolition, rigging), mechanical, plumbing, electrical, architectural (finishes), environmental (hazardous material mitigation), provision of temporary services as necessary. Underlying lists or spreadsheets with major pieces of equipment must back up trade categories.
- All lines by trade must include labour and materials. "Labour" can be specified by budgetary allowance rather than hours and hourly rates.
- Operation and maintenance costs.

- Line items for professional fees, engineering, commissioning, construction management, permitting, measurement & verification, contractor overhead & profit, and contingency. These are percentages of the total from above.
- Cost estimates may need to be split into total cost and incremental cost, depending on the audience and the financing contemplated. The incremental cost is the additional cost of installing the energy efficient system or piece of equipment compared to the baseline cost, or non-energy-related investment. For example, utility incentives are often based on incremental cost.
- Lifecycle Cost Analysis (LCCA) is not required, but may be included where there are benefits of the proposed retrofit other than energy cost savings. Refer to *ISO 15686-5:2008 Buildings & constructed assets – Service life planning - Part 5: Life cycle costing [4f]*.
- Estimated equipment useful life expectancy and equipment degradation are not required (although some projects may require this when assessing the financing term), but may be included to assess the overall economic performance of proposed retrofits. These estimates should be conservative (i.e. using the lower end of lifespan ranges provided) and based on accepted values – refer to *EN 15459:2007 Energy performance of buildings – Economic evaluation procedure for energy systems in buildings (Annex A) [4g]* for lifespan data.

Quality Control Process

1. Compare calculation outcomes to comparable projects, and simple estimation methods for reasonableness. If not consistent with comparable projects, provide reasons why the project under consideration is different.
2. Clearly document all sources used for inputs and assumptions, formulas, and methodology.

4.3 DOCUMENTATION

- Qualifications of the person(s) performing the savings calculations.
- Documentation must include all factors that were considered to create the savings calculation estimates.
- Specific documentation requirements include, without limitation:
    - Workbooks, spreadsheets and other calculation tools used for the savings estimates.
    - Weather file that was used for temperature bin calculations or regression analysis, if relevant.
    - Basis for cost estimates, including, if applicable, scope of work upon which bid packages are based, and bid packages.
    - If applicable, bids by trade with the breakouts described in pricing (above).
    - Savings calculation results.
    - A quality control statement indicating the findings of a review of calculation results against data from comparable projects. Savings should be expressed as a percentage of energy end-use consumption.

5.0 DESIGN, CONSTRUCTION AND VERIFICATION

The design and construction team must commit to realising the intent of the energy audit recommendations – that is, the ECMs - accepted by the Project Owner. As part of this effort, the design and construction team is required to perform operational performance verification on the measures implemented as part of the project.

Unlike a full commissioning effort, this process does not involve assessment of all of the systems and controls. Instead, it is targeted at ensuring that the implemented ECMs have the ability to achieve the predicted energy savings, and involves verification that the measures were implemented properly and have the capability to perform.

At a minimum, the operational performance verification process involves visual inspection of the installed systems and control sequences to ensure that they were implemented as intended. For more complex measures or those with higher implementation costs and predicted energy savings, this may also involve targeted functional performance testing, spot measurements or short term monitoring.

5.1 ELEMENTS

- **Operational Performance Verification Specialist**: Appointment of a qualified third party Operational Performance Verification Specialist as manager of the performance verification process is required.
- **Operational Performance Verification Plan**: Development of an Operational Performance Verification plan (pre-construction) that describes the verification activities, target energy budgets and key performance indicators. [PD Sec 7.2.1]
- **Design and Construction**: The Specialist must ensure that the ECMs have been implemented as designed and can be expected to perform as conceived and projected during the energy savings calculation phase. This will include consultation with the project team, monitoring of designs, submittals and project changes, and inspections of the implemented changes. The Specialist must have the responsibility and means of reporting deviations from design and projected energy savings to the Project Owner in an issue log. [PD Sec 7.2.1]
- **Training**: Training of building operators in operation of the new systems/equipment, including their energy performance targets and key performance indicators. [PD Sec 7.2.2]
- **Operational Performance Verification Report:** Concise documentation shall be provided that details activities completed as part of the operational performance verification process and significant findings from those activities, which is continuously updated during the course of a project.

5.2 PROCEDURES

1. Appoint a qualified Operational Performance Verification Specialist (‘the Specialist’) with at least five years of demonstrated operational performance verification experience, documented in the form of a CV outlining relevant project experience.
2. Develop an Operational Performance Verification plan (pre-construction) that describes the verification activities, target energy budgets and key performance indicators.

3. Consult with the project team, monitor designs, submittals and project changes, and visual inspection of the implemented changes.
4. The Specialist should perform operational performance verification activities, and document operational performance verification results as part of the building's permanent documentation.
5. Train operators in the correct operation of all new systems and equipment, including meeting energy performance targets.
6. Develop a Systems Manual, documenting the modified systems and equipment, troubleshooting procedures, and the process and responsibilities for addressing issues.
7. Develop target energy budgets and other key performance indicators for the modified ECMs.

5.3 DOCUMENTATION

- Qualifications of the Operational Performance Verification Specialist.
- Statements by the Specialist that the project, first as designed and, subsequently, as built conforms with the design intent and scope of the energy savings calculations and has the ability to achieve predicted energy savings.
- A concise Operational Performance Verification Report, which is a record of operational performance verification results. The report should include photographs, screen captures of the Building Management System (BMS) if relevant, copies of invoices, testing and data analysis results as appropriate.
- Training materials and record of training.

Optional:

- **Operational Performance Verification Plan**: A concise Operational Performance Verification Plan specified for all new systems and/or major pieces of equipment in the project. The Plan will define all of the procedures, tests to be performed and a performance checklist.
- **Test Requirements**: System and equipment test requirements must include specific tests and documentation that relate to the energy performance of the new and modified systems and/or equipment, conducted over a suitable range of operating (or simulated operating) conditions, and time period.
- **Project and Equipment Documentation**: Full documentation of all new and modified systems and equipment in the form of Systems Manuals, to be prepared following the guidance set out in *EN 13460:2009 Maintenance – Documents for maintenance [5a]*.
- **Energy Performance Reporting:** Documentation must include (monthly where possible) target energy budgets and other key performance indicators for the modified systems and major equipment.

6.0 OPERATIONS, MAINTENANCE AND MONITORING

Operations, Maintenance, and Monitoring is the practice of systematic monitoring of energy system performance and implementing corrective actions to ensure "in specification" energy performance (often referred to as Ongoing Commissioning, Monitoring-based Commissioning, Performance-based Monitoring, and Building Re-tuning).

6.1 ELEMENTS

- **Operation**: Development of a concise, targeted Operator's Manual discussing the new ECMs or systems, including assignment of responsibilities for communication of performance issues and implementation of corrective actions.
- **Training**: Training of building operators in proper maintenance best-practices for the new and modified systems/equipment.
- **Outreach:** Notifying building tenants of the improvements performed in the building as part of the project, and descriptions of any behaviour modifications or best practices recommended as part of the energy efficiency efforts.

6.2 PROCEDURES

1. Development of a concise Operator's Manual targeting the new systems and their operation, including assignment of responsibilities for communication of performance issues and implementation of corrective action. This should include details of how the systems should be used and operated, as well as KPIs, benchmarks and any additional goals or success criteria. In many cases, the Operator's Manual and Systems Manual can be combined into one document to be used by the operations and maintenance personnel. [PD Sec 8.2.2]
2. Train operators in proper maintenance best-practices for all new systems and equipment (refer to the Operator's and Systems Manual(s) and, *EN 15331:2011 Criteria for design, management and control of maintenance services for buildings [6a]* for guidance). [PD Sec 8.2.3]
3. Notify building tenants of the improvements performed in the building as part of the project, and descriptions of any behaviour modifications or best practices recommended as part of the energy efficiency efforts.

6.3 DOCUMENTATION

- Operator's Manual describing the new systems and their proper operational performance, as well as an organisational chart establishing contact information for all personnel involved in ongoing system operation and responsibilities for corrective action.
- Maintenance plans and service response log, including warranties for any new equipment.
- Training curriculum.

Optional:

- Follow-up monitoring or evaluation to assess effectiveness of actions taken.

7.0 MEASUREMENT AND VERIFICATION

The following overarching principles should govern any Measurement and Verification (M&V) Plan:

- **Transparency**: all input data, baseline calculations, and variable derivations must be made available to all parties and any authorised reviewers.
- **Reproducibility**: given the same source data and a description of the adjustment methodology, any competent practitioner must be able to produce identical or nearly identical results.
- **Fairness**: baseline adjustments must show no meaningful statistical bias toward a positive or negative outcome.

The methods outlined in IPMVP Options A (Retrofit Isolation: Key Parameter Measurement) and B Retrofit Isolation: All Parameter Measurement must be followed, supported by the data collection methodology described in *EN 16247-2 Energy Audits – Part 2: Buildings*. Particular reference should be made to IPMVP Appendix B which describes uncertainty analysis. Prior to investment decision-making (e.g. as part of contract development and investment due diligence), an M&V Plan for an energy efficiency improvement must be designed to ensure that reliable accounting methods for energy savings are in place.

Note IPMVP Option C (Whole Building Comparison) is not presented as an option under this Targeted Tertiary Protocol. However, it may be applicable for some projects with scope and energy savings that represent a significant impact on the building's overall energy usage. If an Option C approach is deemed appropriate, the EPP-Large Tertiary or Standard Protocols should be used.

Standard M&V Method

Quantifying the savings reliably from energy conservation projects (or individual ECMs) requires the comparison of established baseline and post-installation energy performance and use normalised to reflect the same set of conditions. For the purposes of this protocol, the pre-retrofit energy usage baseline that was developed in the Baselining section of this protocol is the starting point for measurement and verification. The standard method is to measure the pre- and post-retrofit energy use of the components affected by an ECM. In the case of IPMVP Option A, some of these parameters are estimated rather than measured. The energy savings are verified through comparison of the pre- and post-retrofit energy performance of the system(s).

Selection of an Option A (Retrofit Isolation: Key Parameter Measurement) or Option B (Retrofit isolation: All Parameter Measurement) approach should depend on the level of energy savings and confidence / variability associated with each ECM and the parameters associated with the energy savings. Guidance regarding which option is most appropriate for a measure can be found in IPMVP Volume III 2006, Table 1 in Section 4.1, Section 4.2.9 (Option A: Best Applications) and Section 4.3.1 (Option B: Best Applications), as well as in IPMVP Volume I 2012, Section 4, Table 3 and Figure 4.

Savings are determined by comparison to the monitored baseline energy and post-installation energy use, adjusted to the same set of conditions (loads). The approach requires adjustments to baseline energy use as follows:

1. **Routine adjustments**: Account for expected changes in energy use.
2. **Non-routine adjustments**: Account for unexpected changes in energy use not due to installed ECMs.

Routine adjustments typically include those for changes in weather. Non-routine adjustments typically include changes in occupancy, type of space use, equipment, operating hours, service levels (e.g. a new tenant requires colder air), and utility rates (where the difference in cost and not usage is the desired outcome).

The equation for an adjustment takes the general form:

$$EnergyUsage_{New} = EnergyUsage_{Baseline} +/- Adjustments$$

For example, an engineer may estimate the impact of a change in occupancy on the energy usage of a system. The adjustment factor to be applied may be derived from a comparison of actual usage data for periods of lower or higher occupancy.

7.1 ELEMENTS

- Appointment of a third-party measurement and verification professional with Certified Measurement & Verification Professional (CMVP) certification or at least five years of demonstrated M&V experience, documented in the form of a CV outlining relevant project experience, to provide M&V services, or to provide oversight to the M&V process.
- M&V plan adhering to the IPMVP (see Chapter 5). This is the foundation of the M&V activities, and should be developed as early as possible in the project. [PD Sec 9.2.1 provides a list of what this should include.]
- Definition of the baseline and post-retrofit periods.
- All baseline energy use and cost parameters (the dependent variables in an adjustment calculation).
- Definition of the baseline values of routine adjustment parameters which are relevant to the project (the independent variables, such as external temperature).
- For IPMVP Option A, definition of the estimated parameters, including their overall significance relative to the total expected savings. [PD Sec 9.2.4]
- Utility rates applicable to the baseline values.
- List and describe all methods for routine adjustments, relevant to the project.
- List and describe all known or expected non-routine adjustments, relevant to the project.
- Provide all adjustment parameters and formulas for routine and known or expected non-routine adjustments.
- Define the principles upon which any unknown non-routine adjustments will be based.
- Input data sets, assumptions and calculations should be made available to all parties in an efficiency project and any commissioned or independent reviewers. [PD Sec 9.2.5]
- Technical identification of the boundaries of savings determination (e.g. piece of equipment, system). The nature of any energy effects beyond the boundaries must be described and their possible impacts estimated.
- Specification of metering points, equipment, equipment commissioning and calibration, and measurement protocols, including expected accuracy.
- Specification of the methods used to deal with missing or lost metered data. [PD Sec 9.2.2]

- Specification of the set of conditions used for any weather adjustments, including the period and/or weather data used, and any assumptions or interpolations made in the case of missing or incomplete data.
- Description of Quality Control procedures applied to the M&V process.
- Specification for reporting format of the results (M&V Report format).

7.2 PROCEDURES

This involves planning and coordinating M&V activities. Comply with applicable sections IPMVP Options A and B. [PD Sec 9.2.1]

1. M&V plan.
2. Gather data – before and after the planned retrofit. [PD Sec 9.2.2]
3. Verify savings for the projects, as set out in section 7.1 above. This involves consideration of the measurement boundaries, any interactive effects (for lighting projects only), selection of appropriate measurement periods, and basis for adjustments. The following should be taken into account during the reporting period:
   - Routine Adjustments:
     - See IPMVP Options A and B.
   - Non-Routine Adjustment Procedures:
     - To the extent possible, ongoing commissioning processes should be used to reduce the need for non-routine adjustments. Equipment failures and other anomalies should be identified and addressed before non-routine adjustments must be applied. Nevertheless, during the post-installation period, unexpected changes may take place in buildings. For a 'like for like' comparison with the baseline, the impact of these unexpected changes must be quantified and adjusted for.
   - Uncertainty: while uncertainty does not necessarily need to be quantified, quality assurance activities should be employed to minimise uncertainty and risk throughout the energy efficiency project development process.
4. Verify savings for the entire project.
5. Report results.

7.3 DOCUMENTATION

- Measurement and Verification plan.
- Justification for the IPMVP option(s) applied to the measures.
- Data collected and used in the analysis.
- Revisions to calculations as a result of the M&V effort, including all assumptions and documentation.
- Routine adjustments.
- Non-routine adjustments.
  - Description of cause or source of unexpected changes.

- Impact.
  - Temporary or permanent.
  - Constant or variable impact.
  - Amount of energy affected.
- Measurements made to quantify non-routine adjustments.
- Description of baseline adjustment procedure.

8.0 ENGINEERING CERTIFICATION

I hereby certify that the engineering design used in preparation of this application, attachments and supplements were performed by me or under my direct supervision. I further certify to the best of my knowledge that, with respect to the project described herein, the elements listed below have been performed in accordance with the protocols specified as part of the **Energy Performance Protocol – Targeted Tertiary**:

- ○ BASELINING ENERGY USAGE
  - ○ RATE ANALYSIS
  - ○ DEMAND
  - ○ LOAD PROFILE
- ○ SAVINGS CALCULATION
- ○ DESIGN, CONSTRUCTION AND VERIFICATION
- ○ OPERATIONS, MAINTENANCE, AND MONITORING
- ○ MEASUREMENT AND VERIFICATION
  - ○ M&V METHODOLOGY
  - ○ BASELINE ADJUSTMENT FACTORS IDENTIFIED
  - ○ CONTRACT PROVISIONS FOR M&V

____________________ Name	____________________ Title
____________________ Address	____________________ Registration / Licence Number
____________________ Phone Number	____________________ State
____________________ Signature	____________________ Date

9.0 GLOSSARY

Building simulation model – computer-based modelling used to assess the energy performance of a building dynamically i.e. over the course of a whole year.

Energy conservation measure (ECM) – measure implemented in order to reduce primary energy consumption. This can include energy efficiency measures, such as variable speed drives and lighting controls, and also low and zero carbon measures, such as Combined Heat and Power, and solar photovoltaic panels.

Energy end-use – energy consumed by system or equipment, classified according to type of load e.g. internal lighting, cooling, process, pumps etc.

Energy use baseline – energy consumption over a specified period providing a basis for comparison of energy performance, before and after implementation of ECMs. The baseline is usually normalised against variables affecting energy consumption.

Green leasing – a standard lease which includes additional specific obligations and targets to ensure the building is operated sustainably and efficiently.

Interactive effects – secondary energy effects occurring as a result of ECMs, usually associated with heating and cooling. For example, a significant improvement in lighting efficiency in a building will reduce heat gains and therefore potentially reduce cooling loads but increase heating loads.

International Performance Measurement and Verification Protocol (IPMVP) - standardised approach to energy efficiency M&V, developed by Efficiency Valuation Organization.

Measurement and verification – process used to quantify the actual savings achieved, following the implementation of ECMs, and to determine whether they meet the predicted savings targets.

Measurement boundary – under IPMVP Options A and B, this is a boundary drawn around all significant energy requirements of the systems and equipment associated with the ECMs.

Non-routine adjustments – adjustments made to the baseline to account for unexpected changes in energy use not due to installed ECMs, such as changes in occupancy, type of space use, equipment, operating hours, service levels, and utility rates.

Operators manual – document targeted at operations and maintenance personnel, and containing all the information required for the correct use and operation of ECMs or systems, such as as-built drawings, equipment location and training materials. In many cases, this is a section within the Systems Manual.

Operational performance verification – process used to ensure that the implemented ECMs have been implemented properly and will have the ability to achieve the predicted energy savings during the operational phase.

Project Development Specification - document which compiles all relevant and supporting information and best-practices for system application.

Retrofit Isolation Baseline – a baseline specific to the proposed ECMs, and most appropriate when applying an IPMVP Option A or B IPMVP approach.

Routine adjustments – adjustments made to the baseline to account for expected changes in energy use, typically include those for weather.

Spot measurements – statistically valid samples used as valid measurements of the total parameter.

Submittals – these are submissions from contractors for approval (e.g. drawings or equipment details).

Systems manual - document describing the modified systems and equipment, intended to support building operations and maintenance, and to optimize the facility systems over their useful lives. It contains information and documentation regarding building design and construction, commissioning, operational requirements, maintenance requirements and procedures, training, and testing.

10.0 QUALITY ASSURANCE CHECKLIST

ICP Quality Assurance Checklist v1.0

Client:
Project:
Project Developer:
QA Provider:

Energy Performance Protocol
Targeted Tertiary v1.0

BASELINING CORE REQUIREMENTS

- ☐ 12-36 months utility data
- ☐ Utility baseline period
- ☐ Energy end-use estimates
- ☐ Weather data - related baseline
- ☐ 12 mos occupancy - related baseline
- ☐ Building asset data
- ☐ Baseline operational/performance data
- ☐ Normalised / regression-based baseline
- ☐ Utility rate structure

(if Demand Charges or Time of Use apply)

- ☐ Annual load profile
- ☐ Average daily load profiles
- ☐ Peak usage
- ☐ TOU summary by month *(if applicable)*

SAVINGS CALCULATIONS

- ☐ Energy Analyst credentials
- ☐ Weather file
- ☐ Energy Efficiency Report

Energy Conservation Measures (ECMs)

- ☐ ECM calculations
- ☐ ECM variables and assumptions
- ☐ ECM results
- ☐ Cost estimates
- ☐ Investment criteria
- ☐ Quality assurance statement

DESIGN, CONSTRUCTION, AND VERIFICATION

- ☐ Operational Performance Verification plan
- ☐ OPV authority credentials

MEASUREMENT AND VERIFICATION

- ☐ Measurement and Verification plan
- ☐ M&V agent credentials

OPERATIONS, MAINTENANCE, AND MONITORING

- ☐ Ongoing management regime

- ☐ Project Developer Credential

QA Firm:
Reviewer*:
Date:
Signature:

* *Reviewer must be qualifying individual per ICP QA Application*

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.