LARGE APARTMENT BLOCK PROTOCOL

VERSION 2.0 –FEBRUARY 2018

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THE INVESTOR CONFIDENCE PROJECT

The Investor Confidence Project (ICP) is a global initiative that focuses on increasing energy efficiency deal flow by ensuring that projects are engineered robustly, financial returns are predictable, and project underwriting can be streamlined. The ICP system is comprised of the ICP Protocols and the Investor Ready Energy Efficiency™ Certification which offer a standardised roadmap for project developers, a market tested methodology for program administrators, and a certification system for investors and building owners to accurately and efficiently assess project risk.

ICP is administered by Green Business Certification Inc. (GBCI) and was conceived, incubated and developed by the Environmental Defense Fund (www.edf.org).

For more information, please visit:

ICP North American (www.eeperformance.org) or ICP Europe (europe.eeperformance.org)

Investor Ready Energy Efficiency™

Investor Ready Energy Efficiency™ (IREE) is a certification awarded to energy efficiency retrofit projects that conform to the requirements of the ICP Protocols, were originated under the direction of qualified providers, have been independently reviewed by an ICP Quality Assurance Assessor, and are certified by GBCI. IREE projects provide investors, building owners, and other stakeholders with an increased level of confidence in project quality.

Investor Ready Energy Efficiency™ Certification occurs after completion of project development and engineering, but prior to construction.

Development of an ICP compliant project includes the following two periods:

- **Certification Period** (pre-IREE Certification). The Certification Period includes all procedures and documentation elements associated with project development that occur prior to construction. This includes the development of plans (such as the OPV, OM&M, and M&V plans) that describe the tasks and documentation that will be performed during the Performance Period.
- **Performance Period** (post-IREE Certification). The Performance Period refers to the construction and post-construction (post-retrofit) period after IREE Certification is achieved. The ICP Protocols require certain procedures and documentation elements that occur during the Performance Period which are specified in various plans that are developed during the Certification Period. These plans, and the requirements identified in them, should be explicitly required by the investor or building owner to be included in the project developer's scope of work and contract. If necessary, the services of the Quality Assurance Assessor or other third parties may be retained during the Performance Period to oversee implementation.

ICP Large Apartment Block Protocol

To conform to the ICP Protocols, projects must meet the specified procedural and documentation requirements detailed in this document. In order to ensure the protocol requirements optimally fit the project, it is crucial that the developer selects the correct ICP Protocol. This protocol is intended for apartment block building retrofits and projects scopes that include:

- **Large Buildings**, where the cost of improvements and magnitude of energy cost savings justifies greater time and effort in pre- and post- development energy analysis
- **Whole Building Retrofits**, projects that typically involve multiple measures with interactive effects

Additional resources to this protocol include:

- **Project Development Specification** is the reference guide for all ICP Protocols and includes detailed explanations of the requirements as well as supporting references and tools.
- **ICP Protocol Glossary** defines industry terminology found in the ICP Protocols.
- **ICP Acronym Dictionary** defines the various industry acronyms.
- This document also makes use of tool-tips to provide context and information associated with various terms and requirements.

Global Standards And References

Throughout this document, reference is made to European and international standards, guidance and resources when relevant to protocol requirements. 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 the ICP Annex A, “Index of National Resources”.. 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 the Annex A.

ICP Project Framework

The ICP Protocols are structured based on five project lifecycle phases that represent the entire lifecycle of a well-conceived and well-executed energy efficiency project. For each phase, the protocol establishes minimum requirements for:

- **Procedures** - specific tasks to be performed during the certification period.
- **Documentation** - required documentation supporting procedures, calculations, models, as well as plans that specify procedures to be executed during the performance period.

1.0 BASELINING

The baselining efforts involve the development of a baseline and collection of all information needed to perform the tasks associated with the savings calculations, economic analysis, and development of plans for the performance period.

The baseline must establish how much energy a building can be expected to use over a representative 12-month period and include any energy sources that are generated and used onsite. The baseline model should be normalised by factoring in the impact of independent variables such as weather, occupancy, and operating hours of the building's energy use. Where demand charges or time-of-use pricing are in effect, load profiles must be provided to show the pattern of daily demand and incorporated annual adjustments.

Obtaining comprehensive utility billing information for a residential building can present challenges, since many owners of apartment blocks cannot legally access utility bills for their own properties due to tenant privacy laws. Acquisition of baseline utility data for residential properties typically falls into four categories, with associated ramifications that need to be considered and addressed:

Category	Baseline Situation	Baseline Development
Category 1	Owner occupied building with gross leases; building owner can access all building data and receives savings directly.	Baseline can be developed without issue, and would follow the whole-building protocol methods described here.
Category 2	Tenants pay utility bills; due to privacy laws, project/building owner cannot access the tenant data.	Methods to acquire tenant data should be pursued. If proposed energy conservation measures (ECMs) only affect non-tenant utilities, a retrofit-specific baseline can be developed (see Optional section).
Category 3	Tenants pay utility bills; some portion of tenant data can be acquired, through individual agreements / solicitation directly with the tenants.	Create a representative baseline using a statistically valid sample of tenant data.
Category 4	Tenants pay utility bills; but aggregate data can be obtained anonymously from the utility or in aggregate.	Baseline can be developed without issue, and would follow the whole-building protocol methods described here.

As demonstrated in the above table, tenant privacy laws represent a challenge to baseline development that needs to be considered. Methods to acquire tenant data, or a statistically valid representation of tenant data, are beyond the scope of this protocol. A growing number of utilities are now providing aggregated tenant consumption data to building owners on a monthly or yearly basis, a relatively new approach that can overcome this barrier to data access. However, if this approach is not available, other approaches to collect or access these data will need to be pursued, so that a valid baseline can be developed to support the energy efficiency project development efforts.

For cases in which tenants pay their own utility bills, savings will be distributed between the owner-paid utilities and the tenant-paid utilities. Subsequently, separate baselines should be developed for both the owner-paid and tenant-paid utilities.

1.1 Procedures

1. **Collect energy source data, independent data, and utility rate schedules** for all energy sources to inform baseline and savings calculations. Data to gather should include:
   a. **Historical Energy Use**: Collect a minimum of 12 months of energy use data (recommended 36 months of data if available when heating and cooling degree days are available for that period and the building's location). Collect energy use data for all meters and energy accounts for end-uses in all areas of the building subject to retrofit with a goal of accounting for 100% of energy sources. [PDS Section 1.2.1]
      i. Data should be used as the basis for an analysis that is compliant with IPMVP Option C.
      ii. For non-metered fuel types, either install sub-metering, utilise billing, or other final use data to estimate energy use.
      iii. The baseline period should be of sufficient duration to capture variations in relevant variables such as weather and building occupancy. Do not include, or adjust the baseline accordingly, to account for any data involving a renovation affecting greater than 10% of gross floor area or a change that affects estimated total building energy use by greater than 10% (i.e. "major renovation").
      iv. Cost data for electricity and each energy source should also be collected including unit and total annual costs.
      v. For electricity, monthly peak demand (in kW) should be recorded as well as the peak output from any on-site generation and the associated fuel source , if relevant to the ECMs.
   b. **Energy End-use:** Use energy end-use breakdowns to create boundaries and reality checks associated with energy savings estimates and total energy consumption of the baseline case. Sub-metering can be used to assess the energy consumption associated with each end-use and the anticipated ECMs, or calculations can be performed to estimate energy end-use. In place of sub-metering or calculations, national resources can be used to estimate energy end-use based on building characteristics and region, applied to the total historical energy consumption of the building - *Annex A* [2f]. In the absence of a national source of data, European resources such as the *EU Building Stock Observatory (see https://ec.europa.eu/energy/en/eubuildings)* should be used. [PDS Section 1.2.2]
   c. **Weather Data**: 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 for the time interval coinciding with the interval of the energy use. [PDS Section 1.2.3]
   d. **Occupancy Data**: Acquire vacancy rates, space uses and occupancy schedules for the defined baseline period from the tenant, building owner or building operator, following the requirements set out in *EN 16247-2 Energy audits – Part 2: Buildings (section 5.3.2)*. This should include the tenant information (e.g. the nature of their lease, type of business, occupancy times) where relevant as well as an assessment of how occupancy patterns affect energy consumption. [PDS Section 1.2.4]
   e. **Other Independent Variable Data:** Acquire other independent variables that significantly affect the energy use, such as sales or production volume, for the defined baseline period chosen or as otherwise needed for an accurate regression model. [PDS Section 1.2.1]
   f. **Baseline Operational/Performance Data:** Acquire system performance data used to inform the energy model (e.g. equipment efficiencies and capacities). These data need to include a comprehensive data set for all building systems and can be collected through interviews, reviews of

building documentation (as-built plans, controls sequences, etc.), observations, spot measurements, short-term monitoring, and functional performance tests. [PDS Section 1.2.5]

g. **Building Asset Data**: Acquire data including accurate total floor area (for conditioned and unconditioned spaces) 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) [2a]* and material specifications/inventories based on building drawings, following the requirements set out in *EN 16247-2 Energy audits – Part 2: Buildings (section 5.3.2 and Annex D) [2c]*. This information will be referenced in any future adjustments to the building asset that may be made. [PDS Section 1.2.5]

2. **Normalise the independent variable data** to the same time interval that aligns with the defined baseline period.
3. **Develop baseline regression model** using the methodology described in *ISO 50006:2014 Energy Management Systems – Measuring Energy Performance Using Energy Baselines and Energy Performance Indicators (Annex D) [2e]*.
4. **Perform model sufficiency test** to an accuracy of achieving an appropriate goodness of fit of energy data variability to independent variables according to IPMVP's Statistics and Uncertainty for IPMVP 2014. The 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, extenuating circumstances must be described and documented.
5. **Establish monthly peak demand and pricing** (where peak demand pricing is in effect) based upon the monthly bills. Where monthly data are not available, explain why, and describe any potential impacts this may have on the baseline and savings calculations as well as how these issues will be addressed. [PDS Section 1.5]
6. **Chart average daily demand** (where demand charges or time-of-use pricing is in effect) in 15-minute intervals (maximum available frequency if 15-minute 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. [PDS Section 1.6]

1.2 Documentation

- Full energy data as a computer-readable file, including:
  - Raw meter readings should include from-date and to-date, energy-unit value, energy use charges, demand quantities and demand charges. Energy sources must be consolidated to a set of 12 monthly periods common for all energy sources. Data may also include bulk-delivered fuel information, including units delivered and associated costs. Local currency should be used.
  - The dataset must cover all forms of purchased energy and energy produced on-site that are part of the baseline. Where applicable, this will include aggregated tenant data or an approximation of tenant energy use, descriptions of the metering and sub-metering of energy in the building, and an explanation of how energy costs are paid by building occupants.
  - Provide a brief description of how periods are consolidated to the integer years/months periods 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) [2d]* for guidance on partial month billing data normalisation/calendarisation.

- The start and end dates of the 12 month baseline period and why that period was chosen.
- Weather data used in the regression analysis corresponding to the baseline period (containing heating and cooling degree day and average daily temperature data for the site as described above).
- As appropriate for recommended upgrades, include building drawings, equipment inventories, system and material specifications, field survey results and/or CAD take-offs, observations, short-term monitored data, spot measurements, and functional performance test results.
- Utility rate structure as published by the utility and the commodity provider (if the two are separate) including a breakdown of distribution costs, commodity costs, demand charges, taxes, and time-of-day variability for each of these elements.
- Copies of at least one bill, or equivalent data, preferably in a machine-readable format for all energy sources consumed including the description of the tariff structure and any fixed charges. If tenants pay their bills directly, provide a breakdown by owner-paid and tenant-paid utilities.
- List of project-specific routine adjustment factors to be included in the M&V Plan.

Optional:

- Sub-metering data, including heating and cooling equipment and other major pieces of equipment.
- Building owner's rental information (showing occupancy and lease dates) 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.
- Monthly consumption load profile for each energy type.
- Multi-year, year-over-year plotting of monthly peak demand by energy type.
- 12 months of interval meter data for the relevant fuels (if interval metering exists) provided in spreadsheet format.

2.0 SAVINGS CALCULATIONS

Calculations of estimated savings for projects of the scale this protocol is designed for must be based on a dynamic calibrated building simulation that meets the procedural requirements outlined in this section and in any referenced standards. Once the simulation model is established and calibrated, iterative runs should be conducted for individual measures. The total package of all measures must be executed together for a final projection of packaged energy reductions to account for interactive effects between measures.

Apartment block projects may comprise a situation involving split incentives, which can potentially inhibit a building owner's incentive to invest in the energy efficiency project. A split incentive (or misaligned incentive) involves a transaction where the benefits do not accrue to the person who pays for the transaction. This occurs in situations involving tenant-paid utility bills - the building owner pays for the retrofits, but does not recover savings from reduced energy costs that accrue to the tenant. This situation warrants consideration and methods such as Green Leasing or other savings recovery methods to incentivise the building owner investment in the energy efficiency project. While critical to the financing component of project development, these considerations are beyond the scope of this protocol.

However, for these projects in which the tenants pay their own utility bills, savings estimates should be developed separately for those that accrue to the building owner, and those that accrue to the tenants, so that appropriate savings recovery efforts can be developed and potentially employed to incentivise the project. Additionally, investment costs should similarly be developed separately for those measures applicable to owner-paid utilities and tenant-paid utilities, such that methods can potentially be developed to pass on these capital expenses directly to the building tenants.

2.1 PROCEDURES

Develop Dynamic Calibrated Building Simulation [PDS Section 2.3]

1. **Choose dynamic building simulation software** that is public domain or commercially available software and meets *EN ISO 13790:2008 Energy performance of buildings – Calculation of energy use for space heating and cooling [4a],* is validated according to the criteria in *EN 15265:2007 Energy performance of buildings – Calculation of energy needs for space heating and cooling using dynamic methods – General criteria and validation procedures [4a],* and complies with current national standards for 8760-hour annual simulation of building energy use.
2. **Choose an individual to perform simulation development with one of the following:**
    a. Nationally/Internationally recognised building performance simulation certification (see *Annex A), or*
    b. Five or more years of energy modeling experience documented in the form of a CV outlining relevant project experience.
3. **Prepare and model input values** using on-site observations and measured data.
    - Prepare input files in a readily readable and usable form based on building documentation from plans, equipment schedules, field confirmations, observations and tests.
    - 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 use, cleaning schedules and practices.

- Disclose and describe inputs/outputs (identify and document defaults versus assumptions) including those from any companion tools (e.g. load calculators, field testing) used to create inputs for the simulation.

4. **Tune dynamic building simulation and input variables.** Investigate discrepancies between actual billing and model predictions. Dig deeper into areas of greatest discrepancy. Inform model tuning changes based on actual building data.

5. **Calibrate dynamic building simulation** such that the simulation monthly outputs for each energy type match the monthly energy baseline to within the tolerances specified in the calibration criteria. If calibration criteria are not met, reiterate calibration efforts. The following calibration requirements must be met:

   a. Follow IPMVP guidelines on modeling accuracy. Utilities may include electricity, natural gas, fuel oil, central plant chilled water, central plant steam, or any metered energy types.

   b. Use baseline monitored data (if available) to support the calibration of major energy end-uses, systems and equipment. Calibrated simulation must show a reasonable match (maximum 15%) to baseline monitoring data for major energy end-uses when monitoring data are used. The modeler must explain large variations.

   c. Ensure key metrics for the existing building simulation and the retrofit building simulation fall within expected ranges. If metrics fall outside the expected range, explanatory factors must be identified and provided.

Analysis of Energy Conservation Measures (ECMs) [PDS Section 2.4]

1. **Ascertain the preferred financial analysis metrics** and criteria of the investor (or owner) in order to evaluate ECMs. Metrics may include simple payback period (SPB), return on investment (ROI), internal rate of return (IRR), net present value (NPV), cash-flow analysis, and/or savings-to-investment ratio (SIR). [PDS Section 2.6]

2. **Develop a set of recommended ECMs** based on the energy audit and select ECMs that are 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 modeling, and contractor recommendations. [PDS Section 2.1]

3. **Establish preliminary cost estimates** for each ECM under consideration. [PDS Section 2.7]

   - At the feasibility stage, initial quotes may be obtained from the contractor(s). Alternatively, cost estimates may be based on the engineer's experience with previous projects, detailed conceptual estimates, nationally recognised sources of cost estimating data, general contractor quotes or other sources.

4. **Calculate energy savings performance** and cost effectiveness of each ECM individually using the dynamic calibrated building simulation. For each ECM provide a table showing the model variables changed and the basis for the change. [PDS Section 2.4]

   - If the simulation model is incapable of assessing a given measure, any separate calculations must be described and their incorporation into model results explained in detail.

5. **Provide a statement of the energy prices** used to establish the monetary value of the savings. This conversion from energy savings to cost savings 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. 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.

6. **Perform a model iteration** incorporating all selected measures in order to project the interactive effects of the full package of measures. Confirm that this package meets the owner and investor documentation requirements.
7. **Evaluate economics of each ECM** and package of ECMs with the owner in order to select a final list of ECMs to be included in the bid package.
8. **Develop final pricing for ECMs** selected to be included in the project scope including operation and maintenance costs. Finalise model-based analysis and recommendations based upon pricing from bids received.
   - The final documentation package must have pricing based on bids that represent the price for which a contractor has committed to make the improvements.
9. **Prepare a final report summarising ECMs** and compiling all required supporting data. The report must include a summary table with final energy cost savings, pricing for each measure and the package of measures.

2.2 Documentation

- Qualifications of the person(s) developing or supervising the calibrated building simulation development and performing the savings calculations.
- Calibration and ECM savings calculation results including a demonstration that the calibration criteria are met.
  - Description of inputs/outputs (identify and document defaults versus assumptions), including those from any companion tools (e.g. load calculators, field testing) used to create inputs for the simulation.
  - Building simulation process description that with the necessary input files would allow a reviewer to reconstruct the simulation including adjustments made for calibration and ECM savings calculations.
  - Building simulation input and output files together with information about the modeling software that has been used (including version number).
- Weather files that were used for simulation (model calibration weather file and ECM savings calculations weather file).
- Report: Use of an industry-accepted format for reporting of results and for compilation of methods and underlying data is recommended. Refer to *EN 16247-2 Energy audits – Part 2: Buildings (section 5.6) [4c]* for the industry standard for report presentation of ECM, building and energy use data.
  - Annual predicted energy savings by fuel type shall be documented in terms of energy units, a percentage of the total volume of each energy source and as cost savings using the correct marginal rate for that energy type. [PDS Section 2.8]
- Basis for cost estimates; if applicable include the scope of work upon which the bid packages are based and the bid packages.

3.0 DESIGN, CONSTRUCTION AND VERIFICATION

Design, construction and verification comprise the inter-related tasks associated with designing, installing, and verifying prescribed ECMs. The ICP Protocols do not address specific requirements associated with design and construction, but it is important that the teams involved commit to realising the intent of the recommended ECMs accepted by the project owner.

The ICP verification methodology utilises an Operational Performance Verification (OPV) approach to ensure that the individual implemented ECMs were installed correctly and are capable of achieving the predicted energy savings. OPV is a targeted process that focuses specifically on the ECMs involved in the project and differs from traditional Commissioning (Cx) which typically refers to whole building optimisation.

The OPV process involves various methods based on measure type, complexity and other factors. OPV processes may include visual inspection, targeted functional performance testing, spot measurements or short term monitoring of the installed systems and control sequences.

The OPV effort may be performed by an independent party or by the project developer as long as a Quality Assurance Assessor is providing oversight to these efforts. Procedures performed during the performance period should be specified in the OPV Plan and addressed in the proposal and contract.

3.1 Procedures

1. **Appoint an Operational Performance Verification Resource**: A specified OPV resource shall be named in the OPV Plan who has one of the following qualifications:
   a. Nationally/Internationally recognised commissioning certification (see *Annex A)*, **or**
   b. Five years or more of commissioning experience documented in the form of a CV outlining relevant project experience
2. **Develop an Operational Performance Verification Plan** (pre-construction) that includes:
   a. Procedures to consult with the project developer; monitor designs, submissions and project changes; and perform a visual inspection of the implemented changes.
   b. Procedures to verify that the ECMs have been implemented as designed and can be expected to perform as conceived and projected by the energy audit. This will include descriptions of operational performance verification activities to be performed on the installed measures and details regarding documentation of operational performance verification results as part of the building's permanent documentation following market-standard commissioning guidelines and standards. [PDS Section 3.2]
   c. Provisions for the development and implementation of a training plan for operators to be conducted at the conclusion of the OPV effort that will train them in the correct operation of all new systems and equipment including how to meet energy performance targets.
   d. Provisions for the development and implementation of a Systems Manual (or update existing Systems Manual) at the conclusion of the OPV effort to document the modified systems and equipment and the process and responsibilities for addressing any future operational issues, to be prepared following guidance set out in *EN 13460:2009 Maintenance – Documents for maintenance [5a]*. [PDS Section 3.4]
   e. Description of the process to develop target energy budgets and/or other key performance indicators for the modified building both as a whole and also down to the level of individual systems and major equipment where required.

f. Description of the OPV report to be developed at the conclusion of the OPV effort that will detail activities completed as part of the OPV process and include significant findings from those activities.

3.2 Documentation

- Qualifications of the Operational Performance Verification Resource.
- Operational Performance Verification Plan.

4.0 OPERATIONS, MAINTENANCE, AND MONITORING

Operations, Maintenance, and Monitoring (OM&M) is the practice of systematic monitoring of energy system performance and implementing corrective actions to ensure "in specification" energy performance of ECMs over time. Good OM&M processes involve a proactive strategy for achieving occupant comfort while optimising energy performance. Procedures performed during the performance period should be specified in the OM&M Plan and addressed in the proposal and contract.

4.1 PROCEDURES

1. **Select and document ongoing management regime** including either periodic inspection, Building Management System (BMS) reporting, software-based monitoring and fault detection, whole-building monitoring, periodic recommissioning, or a combination of these approaches. [PDS Section 4.2]
2. **Develop an Operations, Maintenance and Monitoring Plan** (pre-construction) that includes:
   a. A description of the OM&M management regime to be selected [PDS Section 4.2]. If a monitoring-based approach to OM&M is to be utilised, identify and document the number of points, interval and duration to be monitored by the building management system.
   b. Performance indicators at the component and/or system level that specify the acceptable performance bands outside of which corrective communication/response will be taken. These must be measurable and should be consistent with achieving close to desired building level energy performance as defined in the Operator's Manual.
   c. Defined roles and responsibilities of the OM&M staff and plans for issue resolution and preventative (or predictive) maintenance.
      - Develop an organisational chart establishing contact information for all personnel involved in ongoing commissioning process and clear internal responsibility for the monitoring and response activities.
   d. Provisions for the development of a training plan that will be conducted for facility staff and service providers on new/modified equipment, management and monitoring software, and reporting regime. This training is to be conducted at the conclusion of the OPV effort and can be combined with the training described in the OPV section. Refer to *EN 15331:2011 Criteria for design, management and control of maintenance services for buildings [6a]* for guidance. [PDS Section 4.4]
   e. Description of the process to develop performance verification criteria based on the OM&M regime(s) selected. This process should (when applicable):
      - Identify points, interval and duration to be monitored by the building management system.
      - Chart the data points to be monitored and their relationship to the performance of the new installations and modified equipment/systems.
      - Install and test fault detection functions for system malfunctions or substantial deviations.
      - Compare actual performance with savings projections for the same period given adjustment factors on a periodic basis.
      - Specify the process to create and collate periodic performance reports covering all specified points. Reports are to include all observed deviations from projected operation, an analysis of their cause, and any recommended/executed corrective actions.

f. Commitment to the development of an Operator's Manual (or updating of existing Operator's Manual) targeting the new systems and their operation including assignment of responsibilities for communication of performance issues and implementation of corrective action. [PDS Section 4.3]

g. Provisions for the development and execution of instructions to notify building tenants of the project's implemented building improvements and descriptions of any associated best practices or recommended behaviour modifications.

4.2 DOCUMENTATION

- Operations, Maintenance and Monitoring Plan.

5.0 MEASUREMENT AND VERIFICATION

Measurement and Verification (M&V) activities verify actual versus predicted performance and are crucial to understanding the efficacy of energy efficiency measures and projects. Prior to investment decision-making (e.g. as part of contract development and investment due diligence), an IPMVP-adherent M&V Plan for an energy efficiency improvement project must be developed and specified to ensure that reliable accounting methods for energy savings are in place.

The M&V procedures for this protocol are consistent with the methods outlined in IPMVP Core Concepts Option C (Whole Facility). In this approach, the pre-retrofit regression-driven baseline energy use that was developed in the Baselining section of this protocol is used as the starting point for M&V calculations. The approach requires the following adjustments be made as appropriate to the pre-retrofit baseline energy use:

1. **Routine adjustments**: Account for expected changes in energy use.
2. **Non-routine adjustments**: Account for unexpected changes in energy use due to factors other than the installed ECMs.

This adjusted baseline represents what the baseline energy use would have been if the project ECMs had never been installed, under the same set of post-retrofit conditions. Realised savings are then determined by comparing this adjusted pre-retrofit baseline energy use model with the actual post-installation energy use.

The M&V effort may be performed by an independent party or by the project developer as long as a Quality Assurance Assessor is providing oversight to these efforts.

5.1 Procedures

The M&V efforts must fully comply with applicable sections of IPMVP Core Concepts-2016 Option C. [PDS Section 5.0]

1. **Appoint an M&V Professional** during the certification period who has one of the following qualifications:
   - Association of Energy Engineers (AEE) 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
2. **Develop an IPMVP based M&V plan** as early in the project development process as possible that adheres to the IPMVP Core Concepts-2016, Section 7.1. This plan should be developed pre-construction.

5.2 Documentation

- M&V plan adhering to the IPMVP Core Concepts-2016, Section 7.1.

6.0 PROJECT DEVELOPER REQUIREMENTS FOR IREE CERTIFICATION

ICP's IREE certification is designed to ensure that projects are robustly engineered and their savings predictions are reliable. In order to support this goal, project developer firms who submit projects seeking IREE certification must meet a number of requirements to ensure that they possess adequate experience, credentials, training and other criteria. These qualifications will be verified during the IREE certification process.

IREE project certification requirements shall consist of:

- The Qualifying Individual (a licensed Professional Engineer or AEE Certified Energy Manager or approved national equivalent) who is associated with the project development firm must sign off on a project's compliance with the ICP Protocols in order to be certified.
- The qualifying individual or other employee of the project developer firm seeking IREE certification of a project must possess and demonstrate 5 years of relevant industry experience via a CV, project history, or other means.
- Firms must submit three example projects that demonstrate that the project developer seeking IREE certification of a project has experience performing, planning, or managing tasks associated with all five of the ICP Lifecycle Phases consisting of Baselining; Savings Calculations; Design, Construction & Verification; Operations, Maintenance & Monitoring; and Measurement & Verification.
- Project developer firms seeking IREE project certification must provide proof of insurance coverage for error and omissions / professional liability (or equivalent coverage) with a minimum of $1MM coverage per claim in the United States or appropriate coverage for other countries.

These requirements are meant to serve as minimum requirements to determine the experience and capability of project developer firms. There are cases where these qualities may be difficult to demonstrate and ICP will review and consider such cases when necessary. Please contact ICP with any questions or concerns.