INVESTOR CONFIDENCE PROJECT

STANDARD TERTIARY PROTOCOL

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ENVIRONMENTAL DEFENSE FUND
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 Standard Tertiary protocol, one of the six that compose the ICP Europe system, along with the Project Development Specifications document which compiles all relevant information for system application, which will also be supported by a suite of software products facilitating system application References to relevant sections in the Project Development Specification are provided throughout this document, indicated as [PD Sec X.X].

The 2010 Energy Performance of Buildings Directive and the 2012 Energy Efficiency Directive are the EU's main legislation related to reducing the energy consumption of buildings (see section 4.2.5 of the Project Development Specification). All methodologies and procedures across all ICP protocols have taken into consideration the requirements of these key laws.

1.1 STANDARD TERTIARY PROTOCOL

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 protocols are intended for:

- **Standard Projects**, multiple measure projects costing which do not require building simulation modelling

The Standard Tertiary Protocol allows for the use of various open-book calculation methods, and relies on partial and full measurement and verification of the energy use and system(s) to which an energy conservation measure (ECM) was 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 IPMVP Option C*: Whole Facility* for measurement and verification of savings. In the case of a building requiring such a holistic approach, the M&V protocols found in the Large Tertiary Protocol should be used for these specific components of project development, or in its entirety.

The 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 as part 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.

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 PROTOCOL FRAMEWORK

The ICP protocol 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**

The following table provides an overview of the requirements at each stage of the ICP process. In order to fully comply with ICP requirements, the table should not be used in isolation to develop compliant projects, but in conjunction with the entire protocol and relevant supporting sections of the Project Development Specification.

Table 1 Protocol Summary: Standard Projects

Phase	Objective	Task	Description
Baselining	Establish current energy consumption, which will form the basis for savings calculations	Collect energy source information	Collect **energy source data and rates** for all energy sources to inform baseline and savings calculations. Collect **energy consumption data** associated with proposed ECMs. Develop **load shapes** if demand charges or time-of-use pricing are in effect to establish the impact on potential monetary savings.
		Estimate energy end-use consumption	Develop **energy end-use consumption breakdown** to help develop retrofit isolation baseline, and to create boundaries and reality checks, using sub-metering, calculations or nationally recognised benchmarks.
		Develop energy consumption equation	Identify **independent variables** that affect energy consumption (e.g. weather, occupancy) and calendarise data to match baseline period. Establish any **interactive effects** that may affect the energy savings. Normalise baseline data against independent variable data, and establish accuracy in order to validate the robustness of the data.
		Carry out energy audit to identify ECMs	Collect **building asset, operational and performance data**, to be used to inform the energy calculations. Identify baseline energy use characteristics of equipment (load, hours-of-use, constant/variable) to help determine the savings and the Measurement & Verification (M&V) approach. Create a list of **routine adjustments** (expected changes in energy use) and **non-routine adjustments** (unexpected changes e.g. change in type of space use) which will be used to adjust the baseline during the M&V process. Develop **Energy Conservation Measures (ECM) descriptions.**
Savings Calculations	Produce valuation of proposed projects	Carry out spreadsheet calculations on whole building retrofit	Prepare **calculation inputs** based on on-site observations and measured data. Develop 'open book' **savings calculations**, carried out by suitably qualified individual; account for any **interactive effects** in the calculations. **Calibrate** savings to energy end-use estimates or consumption. **Document** calculation processes, formulas and assumptions.
		Develop investment package	Establish the investor's required **investment criteria**, and prepare an initial set of ECMs. Prepare comprehensive **preliminary cost estimate** to rank ECMs (the final investment package should be based on contracted bids), and establish the financial performance of each measure individually and then as a **package.** Prepare **final report** summarising ECMs, constructability, projected savings and all supporting data.
Design, Construction & Verification	Ensure ECMs are implemented correctly and that savings can be realised	Perform Operational Performance Verification (OPV) activities	Appoint qualified **OPV specialist**. The specialist will develop the **OPV plan** (pre-construction), which describes verification activities, target energy budgets and key **performance indicators**, and then perform **OPV tasks** (monitor designs, submittals and project changes, and carry out visual inspections and functional performance tests of the ECMs). Document results in the form of an **OPV report**, with a statement of conformity.
		Provide guidance on ECMs	Develop **Systems Manual** on modified systems and equipment. **Train** building operators in how to operate new systems and equipment, and on energy performance targets.
Operations ,Maintenance & Monitoring	Ensure in-specification performance	Develop Operations Maintenance & Monitoring (OM&M) procedures	Select **ongoing management regime**, including plan for fault detection and remediation. Set up fault detection and diagnostics, develop retro- or re-commissioning plan, or other **monitoring method**. Collate **quarterly performance reports** to compare actual performance with regular savings projections.
		Provide guidance on operation of ECMs	Develop **Operator's Manual**, which can be part of Systems Manual – this should include assignment of responsibilities for performance issues/corrective actions, maintenance plans and service response log, warranties for new equipment, and any KPIs or targets. **Train** building operators in supporting OM&M programme and conduct **tenant outreach** if appropriate.
Measurement & Verification	Validate savings and effectiveness of the ECMs, post-installation	Comply with IPMVP Option A or B (or C if considered appropriate)	Appoint suitably qualified **third-party M&V professional** and develop **M&V plan** pre-construction**.** Gather **pre- and post-retrofit data**, and **verify savings** for the energy efficiency projects and the whole building, based on predicted savings, and taking into account routine and non-routine adjustments. Document analysis and results in the form of an **M&V report**.

2.0 BASELINING – CORE REQUIREMENTS

A technically sound energy usage baseline and a project-specific energy baseline provide critical starting points for accurate projection of potential energy savings as well as for measurement after retrofits and / or retro-commissioning. The baseline must establish how much fuel and electricity a building can be expected to use over a representative 12-month period, 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 building's energy use.

In addition to the whole-building energy usage baseline, a project-specific baseline, developed from the retrofit isolation baseline analysis, will illustrate a comparison of the projected energy savings versus the annual energy usage of the affected systems. This retrofit isolation baseline will subsequently be used for the IPMVP Option A or B effort.

2.1 ELEMENTS

- **Historical Energy Usage**: Collect 36 months (or a minimum of 12 months of energy usage data when heating and cooling degree days are available for that period and the building's location) for all meters and energy accounts for end-uses to be retrofitted in the building, with a goal of accounting for 100% of energy sources. This should be used as the basis for all M&V analysis. For non-metered fuel types, either install sub-metering, or utilise billing or other usage data to estimate energy use. The baseline period should be of sufficient duration to capture variations in relevant variables, such as weather and building occupancy. Note any 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." Cost data for electricity and each fuel consumed (including low and zero carbon energy sources) should also be collected, including unit and total annual costs. For electricity, peak demand (in kW) should be recorded as well as the peak output from any on-site generation and the associated fuel source e.g. gas, solar, wind etc. [PD Sec 4.2.1]
- **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 performed to estimate energy end-use. In place of sub-metering or calculations, national resources should be used to estimate energy end-use consumption, based on building characteristics and region, applied to the total historical energy consumption of the building – refer to Annex A. In the absence of a national source of data, European resources such as the *Buildings Performance Institute Europe's Data Hub for the Energy Performance of Buildings [2f] (see* *http://www.buildingsdata.eu/*) should be used. [PD Sec 4.2.2]
- **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, at the time interval coinciding with the interval of the energy usage. [PD Sec 4.2.3]
- **Occupancy Data**: 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]
- **Baseline Operational/Performance Data:** System performance data used to inform the energy savings calculations. This data can be collected through interviews, review of building documentation (as-built plans, controls sequences, etc.), observation, spot measurements, short-term monitoring, and functional performance tests. [PD Sec 4.2.5]

- **Building Asset Data**: 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 (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) [2c]*. 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**: Achieve an appropriate goodness of fit of energy data variability to independent variables, following the IPMVP methodology (see IPMVP Volume I 2012, 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.
- **Retrofit Isolation Baseline**: 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. Refer to *IPMVP (section 4.7.1)* for guidance. The impact of the ECM is used to determine the expected post-installation energy-use characteristics. [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]

2.2 PROCEDURES

1. Gather energy data, operational/performance data, and building asset data. Identify which independent variables are considered the most important, based on the building type and space uses.
2. Calendarise the independent variable data to the same time interval that aligns with the defined baseline period.
3. Normalise baseline data against the variables identified above to develop the baseline, using the methodology described in *ISO 50006:2014 Energy Management Systems – Measuring Energy Performance Using Energy Baselines and Energy Performance Indicators (Annex D) [2e]*. Where it is deemed that the independent variables do not have a significant effect on the baseline, then normalisation is not required. However, clear justification for this approach should be provided, including an estimate of the impact on energy savings.
4. 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.
5. Create a list of project-specific routine adjustment factors to be taken into account during the future measurement and verification process, noting also the types of potential non-routine adjustments that may be required.

2.3 DOCUMENTATION

- Weather data (containing heating and cooling degree day and average daily temperature data for site as described above).
- The start and end dates of the baseline period and why that period was chosen.
- Full 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; energy sources must be consolidated to a set of 12 monthly periods common for all energy sources. May also include bulk-delivered fuel information, including units delivered and associated costs. Local currency should be used.
    - 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, 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 12 monthly 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]* methodology for guidance on partial month billing data "calendarisation."
- Use energy end-use breakdowns to create boundaries and reality checks associated with energy savings estimates and total energy consumption of the baseline case.
- 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 as appropriate to recommended upgrades.
- 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:

- Interval data used for review of daily consumption and demand profiles.
- Sub-metering data, including heating and cooling equipment and other major pieces of equipment or end-uses.
- On-site weather data coincident with the metered utility data.
- 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 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, load profiles must be provided to show the pattern of daily demand. An annual electrical load profile must be constructed for peak demand (kW) as recorded and billed by the utility. Where there are charges for a minimum proportion of annual peak demand throughout the year, these must be identified. The same procedure must be followed for any other energy source that is sold with a peak demand charge separate from energy use.

3.1 ELEMENTS

- **Energy Purchasing**: Description of how the facility purchases energy and the pricing that applies to peak and off-peak energy.
- **Load Profile**: Annual load profile showing monthly consumption and peak demand.
- **Peak Usage**: Graphic presentation of peak usage if interval data are available.
- **Time-of-Use**: Time-of-use summary by month if the site is under a time-of-use or real-time rate.

3.2 PROCEDURES

1. Establish monthly peak demand and pricing based upon the monthly bills. 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, chart average daily demand 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. [PD Sec 5.2.1]

3.3 DOCUMENTATION

- Copies of at least one bill for electricity and each fuel. 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.
- 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.

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.

For more complex projects, use of a calibrated building simulation may be warranted. If this calculation method is selected, the Large Tertiary Protocol should be used for the project in place of this protocol.

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 measure under consideration. [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 spreadsheet calculations.
- **Measure Calibration**: The pre-retrofit energy consumption estimated for each system involved in an ECM must be compared to the estimated or measured energy end-use, to ensure that the estimated energy end-use consumption is in line with baseline estimates. Similarly, estimated energy savings should be compared to simple estimation efforts or previous energy savings estimates.
- **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:** Calculations should take into account measure interactions with building heating and cooling loads (e.g. lighting retrofit), as well as interactions between measures. 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. Interactive effects may be ignored where the estimated adjustment required for each measure can be shown to be less than 5% of the predicted saving for the measure. This should be clearly

documented, including a description of each interactive effect and how the estimated impact has been made. [PD Sec 6.2.5]

- **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) [4c]*. Additionally, annual energy savings by fuel type shall be documented in terms of energy units, a percentage of the total consumption of each fuel, and as cost savings using the correct marginal rate for that energy type. [PD Sec 6.2.8]

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.** Calibrate pre-retrofit energy consumption estimated for each system involved in an ECM to the estimated or measured energy end-use consumption. Compare estimated energy savings to “rules of thumb” or “back-of-the-envelope” calculations, and previous estimates from similar past projects. Inform inputs based on actual building data.
3. **Account for interactive effects** with building heating and cooling loads, as well as interactions between measures where required.
4. **Use findings to meet project objectives and provide added value.**

Analysis of Energy Conservation Measures (ECMs)

1. Ascertain and record the return on investment criteria of the investor, 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 6.2.7]
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 temperature bin analysis and 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. 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. Account for interactions between measures and potential reductions and increases in building heating and cooling loads. Interactions between measures, such as schedule changes, should also be accounted for when appropriate.
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 end-use energy usage.
8. Develop pricing for ECMs including operation and maintenance costs, and finalise spreadsheet-based analysis and recommendations based upon bids received or estimated pricing.
9. Prepare a final report in an industry-standard format summarizing ECMs and compiling all required supporting data.

Pricing / Cost Estimation [PD Sec 6.2.6]

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

At the feasibility stage, initial quotes may be obtained from the contractor, provided a minimum of three are used. It is recommended that the project use any contractors familiar to the building owner. Alternatively, cost estimates may be based upon the engineer's experience with previous projects.

Either of these approaches can be used to rank improvements and determine which measures will be included in a final bid package. Cost estimates at the calculation phase must include:

- A construction feasibility review indicating which measures will be included, description of construction methods, allowable working hours, impacts on the facility, access points for bringing in any large equipment, major removals (demolition), permits required, and possible 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 which include cost information must be submitted.
- All lines by trade must include labour and materials. "Labour" can be specified by budgetary allowance rather than by hours and hourly rates.

- Operation and maintenance costs throughout the life of the project.
- Line items for professional fees, engineering, commissioning, construction management, permitting, measurement & verification, contractor overhead and profit (O&P), and contingency. These are typically estimated as percentages of the total implementation costs.
- Cost estimates may need to be split into total cost and incremental cost, depending on the audience and the investment 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, simple estimation methods, and energy end-use consumption for reasonableness. Assess that outcomes are consistent with data from comparable projects. If not consistent with comparable projects, provide reasons why the project under consideration is different.
2. Compare calculation outcomes based on experience (including, for example, benchmarking data capturing the performance of reasonably comparable buildings) for individual measures and for the project as a whole. These guidelines must be expressed in terms of savings as a percentage of building energy use and system-level energy usage.
3. 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.
    - 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 (see 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.

The operational performance verification process involves visual inspection of the installed systems and control sequences to ensure that they were implemented as intended, as well as targeted functional performance testing, spot measurements or short term monitoring.

5.1 ELEMENTS

- **Operational Performance Verification Specialist**: Appointment of a qualified 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 by the energy audit. This will include consultation with the energy audit 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. [PD Sec 7.2.1]

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 energy audit 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, and the process and responsibilities for addressing issues. [PD Sec 7.2.3]
7. Develop target energy budgets and other key performance indicators for the modified building as a whole and down to the level of systems and major equipment where required.

5.3 DOCUMENTATION

- Qualifications of the Operational Performance Verification Specialist.
- 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 and tests to be performed and a performance checklist.
- 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.
- 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 Automation System (BAS), copies of invoices, testing and data analysis results as appropriate.
- Statements by the Specialist that the project, first as designed and, subsequently, as built conforms with the intent and scope of the energy audit and has the ability to achieve predicted energy savings.
- Training materials and record of training.
- 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]*.
- Documentation must include (monthly where possible) target energy budgets and other key performance indicators for the modified building as a whole and down to the level of systems and major equipment where required.

6.0 OPERATION, 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

- **Performance Indicators**: Establishment of key performance indicators at component and/or system level - the performance bands outside which corrective communication/response will be taken – consistent with achieving close to desired building level energy performance defined in the Operator's manual (see section 6.3). Key performance indicators must be measurable.
- **Monitoring**: Identification of points, interval and duration to be monitored by the building management system.
- **Operation**: Assignment of responsibilities for communication of performance issues and implementation of corrective actions. 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. Select ongoing management regime, such as Building Management System (BMS) report review by staff, software-based monitoring and fault detection, whole-building monitoring, periodic recommissioning, or a combination of these approaches. [PD Sec 8.2.1]
2. Train facility staff and service providers on new equipment, management and monitoring software and reporting regime. Training must incorporate understanding, skills, and procedures necessary to support the operations, maintenance, and monitoring program. [PD Sec 8.2.3]
3. Chart the data points to be monitored and their relationship to the performance of the new installations and modified equipment/systems.
4. Install and test fault detection functions for system malfunctions or substantial deviations.
5. Compare actual performance with savings projections for the same period given adjustment factors on a (minimum) monthly basis.
6. Collate periodic performance reports covering all monitored points including all observed deviations from projected operation, analysis of cause, and corrective actions taken or recommended.
7. 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]

8. Train operators in proper maintenance best-practices for all new systems and equipment (refer to *EN 15331:2011 Criteria for design, management and control of maintenance services for buildings [6a]* for guidance). [PD Sec 8.2.3]
9. 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. [PD Sec 8.2.4]

6.3 DOCUMENTATION

- Points list of key variables to be monitored in the BMS.
- Plan for fault detection and remediation – may be fully automated, a combination of automation and active response by commissioning and building personnel, or periodic recommissioning. The plan should indicate the intervals for measurements and the duration within which performance will be measured, or a schedule and plan for periodic recommissioning.
- Organisational chart establishing contact information for all personnel involved in ongoing commissioning process and clear internal responsibility for the monitoring and response activities. If ongoing commissioning is outsourced to a third-party provider, the chart must clarify its relationship to the property's operating staff and senior management personnel, reporting processes and responsibilities for corrective action.
- 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:

- Upgrade monthly monitoring, fault detection, correction and system tuning to weekly, daily or real-time.
- Follow-up monitoring 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), supported by the data collection methodology described in *EN 16247-2 Energy Audits – Part 2: Buildings [2c]*, should be followed. 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 that while IPMVP Option C (Whole Facility) is not presented as an option under this Standard Tertiary Protocol, 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 by a project using this protocol, the Measurement and Verification section of the Large Tertiary Protocol should be used in place of this section.

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 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 from the energy use of the rest of the building. In the case of 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 come from a whole building simulation that estimates the impact based upon the existing systems and their ability to modulate to respond to higher or lower occupancy, or a spreadsheet calculation method. Alternatively it might 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 (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.
- List and describe all known or expected non-routine adjustments.
- 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 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 Assurance 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. This should be developed pre-construction.
2. Gather data – before and after the planned retrofit. [PD Sec 9.2.2]
3. Verify savings for the EE projects, as set out in section 7.1 above. This involves consideration of the measurement boundaries, interactive effects, 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.
4. Verify savings for the entire facility.
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.

Optional:

Option C Approach (refer to the Large Tertiary Protocol).

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 **Standard Tertiary Protocol**:

- ○ 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 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.

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.

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.

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 M&V phase.

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

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

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.

Tertiary building – ICP Europe defines tertiary buildings as offices, educational buildings, hospitals, hotels, restaurants, sports facilities, wholesale and retail trade services buildings and institutional buildings.

10.0 QUALITY ASSURANCE CHECKLIST

ICP Quality Assurance Checklist v1.0

Client:
Project:
Project Developer:
QA Provider:

Energy Performance Protocol
Standard 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.