ComEd
Energy Efficiency Program

CALCULATING & DOCUMENTING ENERGY SAVINGS CUSTOM PROJECTS

These guidelines provide suggestions for submitting documentation to demonstrate that your ComEd Energy Efficiency Program project qualifies for custom measure(s), and that the savings estimates and incentive applied for are actually realized. This section provides information to assist you in calculating and measuring energy savings associated with your project.

The analysis methods and documentation details are recommendations, not requirements. Following these guidelines will help you meet the program requirements and speed our review of your project.

The incentives for custom projects are based on the normalized first-year kilowatt-hour (kWh) savings. To be accepted as a basis for the incentive, the savings calculations must be developed using acceptable engineering calculation techniques supported by site-specific operating and equipment performance data. The final incentive payment may be different from the reserved amount if the post-retrofit system operation or performance is not in agreement with the assumptions and models used to set the reserve amount.

Before submitting an application for a custom project, confirm that the measures are not listed as standard measures in the Standard / Custom Incentives fact sheet available at **ComEd.com/StandardCustomIncentives**. To facilitate your project's energy savings verification process, consider what key parameters can be readily measured before and after installation for analysis and final verification.

For certain custom projects: in addition to energy savings calculations, the program may require measurement and verification (M&V) in order to qualify for an incentive (M&V requirements are determined on a case-by-case basis). You are encouraged to review the International Performance Measurement and Verification Protocol (IPMVP) available at **evo-world.org**. Submit any operational data with your project application that support the energy usage claims and validate your savings calculations. If you need assistance identifying appropriate M&V procedures or have questions about your custom project, call us at 855-433-2700 or email **BusinessEE@ComEd.com**.

TABLE OF CONTENTS

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

OVERVIEW

	General Guidelines (needed in all applications)	Custom Lighting Measures	Custom HVAC/IT Projects	Custom Process and Refrigeration Measures
Name and contact information for the person(s) conducting energy savings calculations	Required			
Provide a concise before and after project description	Required			
Provide sketches, drawings, equipment lists, spec sheets and inventories before and after project to clarify scope of work	Required			
Describe facility operating hours before and after project completion	Required			
Provide equipment load profile for each operating condition	Required			
Provide quantity, make, model number, rated capacity, rated voltage and full load amps before and after project equipment installation	Required			
Provide relevant equipment location information before and after project completion	Required			
Provide invoices for all relevant new equipment	Required			
Detail existing and proposed lighting fixture wattages		Required		
Provide existing and proposed lighting fixture quantities		Required		
Detail existing and proposed lighting controls		Required		
Provide existing and proposed lighting operating hours		Required		
Detail space square footage, the type of space (interior/exterior) and floor plans		Required		
Provide electrical plans, ceiling plan and lighting fixture schedule		Required		
ASHRAE-based simplified calculation methodologies for weather-dependent projects			Choose one for projects ≤ $25,000 in incentives	
Simple spreadsheet analysis for carbon monoxide sensors in parking garages				Choose one for projects ≤ $25,000 in incentives
Executable engineering model such as Trane Trace, Carrier HAP, eQUEST, DOE2 and Energy Plus	Required if > $25,000 in incentives			
Provide Measurement and Verification data from before and after the project installation, parameters of interest; power, energy use, air flows, air temp, water flows, water temp, outdoor temp and humidity, building occupancy, production data	Required if > $25,000 in incentives		Required if > $25,000 in incentives	Required if > $25,000 in incentives
Marketing materials from the manufacturer or distributor, including case studies or savings claims (unless they are verified by a certified third party)	Not acceptable			
Vendor specific or proprietary analysis software (unless methods used are available for review, and input parameters are site specific)	Not acceptable			
Simple percent of total kWh savings on percent of end use energy savings	Not acceptable			

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

GENERAL GUIDELINES

To estimate first-year energy (kWh) savings for retrofit projects, calculate the difference between the pre-retrofit (or base case) system energy (kWh) use and the anticipated post-retrofit (or efficient case) system energy (kWh). It is essential to define and describe the base case and efficient case system as well as operating conditions. Listed below are the general requirements common to all custom projects:

1. For industrial equipment replacement past its end of useful life (EUL) (based on industry standards), baseline = theoretical or new standard efficient equipment.
2. For commercial equipment replacement regardless of EUL, baseline = minimum code requirement.
3. Provide the name and contact information of the person(s) conducting the savings calculations so that the project reviewers can discuss any questions.
4. Provide a concise project description: Describe the existing (pre-retrofit or base case) system and the proposed (post-retrofit or efficient-case) system. Be as precise, yet concise, as possible in the descriptions: include specific quantities and equipment descriptions.
5. ldentify equipment using the terminology or numbering system used by the customer. (e.g., “Replace compressor #3 with a new variable speed compressor” or “install a VFD on VAV AHU #3, 5, 7, 8, 9.”).
6. Provide copies of sketches. drawings, equipment lists or inventories that help to clarify the scope of the project.
7. Describe the facility operating hours (both existing and post implementation conditions) and the equipment operating schedule for each day of the week. Where equipment operation varies with days of the week or seasons, you must enter a description of the operation for all days of the week and all seasons.
8. Describe the equipment load profile during the equipment’s operating hours and at what percentage (%) load, if available (if not available, ComEd may require measurement).
9. If the equipment load profile is not constant (i.e., varies due to time of day/year, day of the week, shift, season, etc.), provide profile detail for each applicable condition.
10. Provide the quantity, make, model number and rated capacity (i.e., tonnage, horsepower, gpm) of the existing and the new equipment that is being installed. Also provide other nameplate information, such as rated voltage and full-load amps where appropriate. The scope of work is often helpful to describe the new equipment.
11. Describe the location(s) where the equipment is installed.
12. Provide copies of the manufacturer’s specification sheets and/or performance rating sheets and the website address where further technical information about the equipment performance might be found.
13. Use accepted engineering methodology from recognized technical organizations such as ASHRAE, SMACNA, ANSI, etc.
14. Annotate all assumptions or constants used in engineering calculations.
15. Use rated performance factors tested under accepted procedures specified by recognized rating agencies, such as ARI, AGA, ANSI, ASTM, etc. Provide an explanation when equipment performance rating conditions vary from standard conditions.

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

ACCEPTABLE CALCULATION METHODS

Equipment or Process Sub-Metering

When measures are installed that affect large individual systems or sets of equipment (e.g., an air-compressor, chiller, process blower or induction molding machine), sub-metering is the preferred method to document the savings.

This may require the installation of temporary monitoring equipment that measures and records the equipment power at short intervals over several days or weeks. When sub-metering is used, a method must be developed to extrapolate the savings for the measurement period to a full year of operation. Component sub-metering may often include observation of other variables such as outside air temperature, operating hours or production quantities during the measurement period to allow for this extrapolation.

Engineering Calculations

For projects impacting smaller, non-complex systems, sub-metering may not be feasible. For these projects, a theoretical engineering calculation method is best to document savings. For most equipment and efficiency projects, there are well-established engineering methods and a number of publicly available performance models to calculate existing (pre-retrofit or baseline) and post modification (post-retrofit or efficient case) energy use.

Whole Building Metering (Bill/Meter Analysis Method)

For projects in which the savings are a significant portion (10% or more) of the total monthly (or annual) kWh usage, a "utility bill analysis" approach may be used, duration of which will be determined on a hyphenate basis. Usually, a regression must be included in this approach to adjust for uncontrolled variables, such as weather, occupancy levels, production rates, operating hours, etc.

Whole Building Modeling

If a whole system or building model is used, be sure to provide sufficient documentation or annotation so that the differences between the base case and high-efficiency case can be understood and verified by the project reviewers. Executable whole building metering models must be calibrated to actual energy use (electric or natural gas bills) and be normalized for weather and other known variances.

For measures that have building-wide impact or effect a number of systems, the following executable engineering models are acceptable: Trane TRACE, Carrier HAP, eQUEST, DOE2 and Energy Plus. When using any model, you must provide a report showing both the pre- and post-upgrade input and output data in addition to an executable model of the building simulation. Models that do not reflect the actual systems and their operation (i.e., defaults instead of building-specific equipment) are not acceptable.

Initial savings estimates that are submitted based on manufacturers' proprietary performance models are not acceptable for initial estimates of savings. Additional information and actual on site operating data or measurements verifying the model assumptions will usually be required to confirm the final savings. If you are planning to use whole building models to estimate savings as a basis for the incentive, contact ComEd early in the project development process.

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

CUSTOM LIGHTING MEASURES

The following is an example of information to provide when submitting a custom lighting measure:

Description:

Existing Lighting System (Baseline)				
Type/ Description	**(A) Square Feet**	**(B) Fixture Wattage or Lighting Power Density**	**(C) Annual Hours of Operation**	**(A x B x C) / 1,000 Total Annual kWh***
New Construction Retail Store	100,000	1.06 (*Lighting Power Density* for Retail spaces per IECC 2018)	4,093	433,858
New Proposed Lighting System				
Type/ Description	**(A) Number of Fixtures**	**(B) Fixture Wattage**	**(C) Annual Hours of Operation**	**(A x B x C) / 1,000 Total Annual kWh***
LED High Bay (*Include model number here*)	1	10	4,093	40.93

Savings		
(A) Annual kWh Savings (Baseline kWh - Proposed kWh)	**(B) Waste Heat Factor and Heating Penalty** (WHF-IFkWh)**	**(A x B) Total kWh Savings**
433,817	(1 - 0)	433,817

Incentive
Final Incentive (Total kWh Savings x $0.07)
$30,367.19

** Where equipment operation varies with days of the week or seasons, you must enter a complete description of the operation for all the days of the week and all seasons.*

*** When heating type is Gas, there is no penalty for electric only gas. When heating type is non-conditioned, there is no heating penalty or waste heat factor.*

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

Provide a detailed lighting inventory that includes the following:

- Location (area, aisle #, etc.)
- Existing fixture description, new fixture description and model numbers
- Existing and new fixture wattage
- Existing and new fixture quantity
- Existing and new controls
- Annual operating hours
- Description of space type
- Square footage of space, backed up by floor plans
- Interior or exterior fixtures
- Provide the electrical plan sheet that shows the existing and proposed lighting layout or a reflected ceiling plan and the lighting fixture schedule, when available.
- The use of standard default fixture wattages is acceptable. Default fixture wattages for common fixture/lamp types are available in the lighting incentives worksheets or in the lighting incentives worksheets or upon request.
- Please note, lighting product must be DLC listed.

Other Guidelines

When preparing project information, consider:

- Operating hours may or may not always be the operating hours of the facility. Where equipment operation varies with days of the week or seasons, you must enter a description of the operation for all days of the week and all seasons.
- Exit signs, emergency lighting and many hallway and stairway fixtures are typically on 24 hours a day, 7 days a week; and therefore, are in use 8,760 hours per year.
- Installing a lower wattage lamp of the same type is NOT considered an eligible measure unless it can be established that the replacement fixture is more efficient (the lumens per watt must be the same or greater) than the fixture that it replaces.

NOTE: The project reviewer will check for inconsistencies between the quantity of fixtures used in the savings calculation shown in the invoice documentation and observed in the post-inspection.

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

CUSTOM HVAC PROJECTS

Note that many of the most common HVAC projects are included in the list of standard projects. These projects, including HVAC chiller or packaged AC unit replacement and variable frequency drives (VFDs or VSDs) for HVAC motors, should be applied for under the standard portion of the application. Common custom projects that may be applied for under the custom HVAC category might include:

- Water-side economizer (e.g, plate and frame heat exchanger, closed-loop tower or "dry-cooler")
- Exhaust heat recovery equipment (heat exchanger)
- Conversions from constant volume to variable volume for water or air distribution
- Adding variable-speed control to centrifugal equipment (other than HVAC fans or pumps) that is throttled by less efficient means
- Pumps / fans > 200 horsepower
- Controls enhancements such as air-side economizer, changeover temperatures and/or any of the listed standard EMS required control strategies

Most (but not all) HVAC system measures are weather-dependent. As such, the acceptable methods of estimating energy savings are building or system models that integrate local weather conditions with system loads and performance or "temperature bin" models. This section includes several acceptable methods for providing the savings analysis for HVAC measures.

In all cases, it is important to document the pre- and post-retrofit conditions thoroughly. For most projects, the analysis will need to be calibrated and adjusted to reflect the weather variances, occupancy variations and/or internal load changes.

The following techniques may be employed for calculating project savings:

- ASHRAE-based simplified calculation methodologies, including the "bin methods," are usually useful to estimate the savings of many weather-dependent strategies, such as economizer systems (water and air), heat recovery, ventilation control or even VAV conversions.
- Simple spreadsheet analysis may be used for certain stand-alone retrofits such as carbon monoxide sensors for parking garages.
- For projects that have building-wide impact or effect a number of systems, the following executable engineering models are acceptable: Trane Trace, Carrier HAP, eQUEST, DOE2 and Energy Plus.

These methods can be calculated in a spreadsheet format so that the underlying assumptions can be easily understood. In many retrofit projects, the existing building energy use and energy use patterns can provide the basis for calibration for these methods.

Depending on the energy savings and/or complexity, a monitoring/metering approach may be the best means to document savings. Although it is simpler to verify the post retrofit case, the base case condition requires documentation for verification. Be sure to consider pre-project measurements when planning a future project. The following are a few suggested parameters to measure pre- and post-retrofit:

- Power (kW), energy (kWh) use
- Air flows, temperatures, water flows
- Outdoor temperatures and humidity (may be available from other sources)
- Building activity (people, hours, etc.)
- Production data

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

CUSTOM PROCESS AND REFRIGERATION MEASURES

Typical measures include

- "Tower-free cooling" for process cooling (e.g., plate and frame heat exchanger, closed-loop cooling tower or "drycooler")
- Waste heat recovery equipment (heat exchangers)
- Constant volume to variable volume water or air distribution
- Upgrading a refrigeration compressor
- Certain air compressor improvements
- Compressor replacement > 200 horsepower
- VFDs / controls for process pumps / fans
- Electric process heating modifications

There are several methods that can be used to document energy savings for process measures. Nearly all process measures will require some degree of monitoring, measurement or hourly log observations to establish the load profile for the equipment, the energy use and the savings, which are then extrapolated to a full-year period. ln all cases, it is important to consider any seasonal, weekly or monthly variations in operation.

Short-term pre- and post-retrofit measurements extrapolated by production: Energy use for process systems can sometimes be correlated to production output. One method to document annual savings is to compare the pre- and post-retrofit systems over a representative production period (which may include multiple shifts) and then extrapolate the results to a full year.

The method is as follows:

- Determine the pre-retrofit system kWh per unit of production per shift, production run or equipment cycles, as appropriate.
- Determine the post-retrofit kWh per unit of production per shift, production run or equipment cycles, as appropriate.
- Adjust the baseline using the post-retrofit production levels.
- Extrapolate to a full year by multiplying the difference by the annual production.

Short-term measurements extrapolated by shifts or operating time: In some cases, the energy use does not relate to production, but to equipment operating time. ln this case, the savings are similar to the above except the time in days or number of shifts is the factor used to extrapolate the savings to the full year.

Short-term monitoring extrapolated to a full year: A short term pre- and post-monitoring (duration determined on a case by case basis) can be carried out and the results extrapolated to a full year based on time. The difference is then multiplied by the ratio of annual hours to the monitored hours.

CALCULATING & DOCUMENTING ENERGY SAVINGS
CUSTOM PROJECTS

CUSTOM PROCESS AND REFRIGERATION MEASURES (cont'd)

Post-retrofit energy monitoring and calculated base case energy, extrapolated to a full year: This method is useful when the performance or efficiency of the base case equipment is known, but the load profile was not monitored prior to the project. This method often applies to compressed air systems or large refrigeration systems. ln this case, the post-retrofit system power and output (Cfm or tons) is measured for a period to be determined on a case-by-case basis. The base case power for the same period is then calculated by multiplying the output by the base case equipment performance. The savings are then calculated to a full year by extrapolating based on the projected loading pattern.

UNACCEPTABLE DOCUMENTATION

The following methods are NOT acceptable for calculating the energy savings for custom projects:

- Vendor-specific or proprietary analysis software.
- Simple percent of total kWh savings or percent of end use energy savings.
- Factors or percentages of savings achieved at other sites unless there is an extensive body of statistically valid results.
- Using rules of thumb for calculating savings.
- Marketing materials from the manufacturer or distributor, their company's case studies or savings claims based on non-standardized methods. For example, a manufacturer or distributor product savings claim that has not been verified by a certified third party.
- Operating hours may or may not always be the operating hours of the facility. Where equipment operation varies with days of the week or seasons, you must enter a description of the operation for all days of the week and all seasons.

If documentation is not provided, technical reviewers will use conservative estimates. Spot measurements used as documentation of power or energy use are typically not acceptable for variable load equipment. Amperage can often be used as a proxy for true power (kW) measurements EXCEPT for systems where the power factor may vary significantly, as in variable speed drive situations (where the voltage may vary as well as the amperage). Contact the Program Team to verify monitoring needs where VSDs are installed.