Appendix D: TECHNICAL STANDARDS

Energy Efficiency and Charging Infrastructure

Contents

Article 1 - Overview

This appendix is a supplemental program document used by Green Bank in the implementation of the C-PACE Program Guidelines[1] and may be modified or amended by Green Bank, in its sole discretion, from time to time. Capitalized terms used herein which are not otherwise defined shall have the meaning ascribed to them in the Program Guidelines.

These Technical Standards provide the complete description of energy audit requirements, technical review methodology and standards, and eligible and ineligible measures for Qualifying Projects. All Qualifying Projects must conform to these standards and undergo a technical review by the Technical Administrator or Technical Reviewer to confirm compliance with these standards and the Program Guidelines. The Green Bank may periodically audit project reviews conducted by the Technical Administrator and Technical Reviewers to ensure compliance. A technical review report prepared by a Technical Administrator or Technical Reviewer must be submitted to and approved by the Green Bank before a project can receive Green Bank approval.

Qualifying Projects generally fall into the following categories: retrofits (efficiency or renewable energy alterations to an existing building), New Construction (as defined below), and Zero-Emission Refueling Infrastructure. Technical standards and requirements for new construction, major renovations involving building system replacements, and repurposing (collectively being "New Construction") are in Appendix N. Renewable energy generation standards and requirements are in Appendix E. Energy efficiency retrofits and Zero-Emission Refueling Infrastructure standards and requirements follow in this Appendix. Green Bank reserves the right, in its sole discretion, to make any final determination regarding whether a certain project must meet the New Construction or the retrofit standards.

Pursuant to the Program Guidelines, Projected Total Cost Savings for all Energy Improvements except Zero-Emission Vehicle Refueling Infrastructure must exceed the Projected Financing Cost. In other words, the Savings-to-Investment Ratio (SIR) of the project must be greater than one.

The technical methodology incorporated into the SIR review process relies upon three established industry protocols:

a. ASTM E2797-15, Building Energy Performance Assessment ("BEPA") Standard directed at data collection and baseline calculations for the energy audit.
b. American Society of Heating, Refrigerating and Air-Conditioning Engineers ("ASHRAE") Level I, Level II, and Level III Energy Audit Guidelines.
c. International Performance Measurement and Verification Protocol ("IPMVP") for measurement and verification of the energy savings.

Article 2 – Audit Reports

All energy efficiency retrofit projects and Zero-Emission Refueling Infrastructure projects require an energy audit conducted by a Qualified Contractor. Audits can range from a simple walkthrough of a

[1] See www.cpace.com/guidelines

building to an investment grade audit (see section 3.3). A Qualified Contractor determines the level of audit required. The Green Bank Technical Administrator or an Approved Technical Reviewer reviews the audit results, validating the scope of work meets technical standards, C-PACE program eligibility requirements, and the SIR requirement if there is one.

Section 1. Energy Efficiency Audit

An energy efficiency audit must:

a. Identify an energy usage baseline consistent with ASTM E2797-15. (See Article 2, section 3).
b. Identify and recommend C-PACE-eligible Energy Improvements.
c. Identify the Effective Useful Life (EUL) of each Energy Improvement consistent with industry best practice.
d. Estimate the total installed cost of each Energy Improvement.
e. Estimate the total project cost, which can include equipment costs, installation costs, and costs related to the Energy Improvement(s).
f. Estimate the energy savings/changes that can confidently be achieved (energy savings should be determined by finding the difference between projected energy use after the Energy Improvements are installed and the projected baseline energy use under similar conditions, e.g., average (normalized) weather, etc.
g. Determine the project's key financial metrics, including cash flow and payback time. The financial analysis performed should reflect any rebates or incentives.

Section 2. Zero-Emission Vehicle Refueling Infrastructure Audit

A Zero-Emission Vehicle Refueling Infrastructure audit must:

a. Identify energy usage of existing meter unless installing new dedicated service.
b. Identify the charger type and make/model.
c. Identify the existing or new electric meter, include meter type.
d. Identify software vendor if different from hardware vendor.
e. Identify charger power level or rated volts and amps.
f. Identify number of stations and ports.
g. Identify the Effective Useful Life (EUL) of each Energy Improvement consistent with industry best practice.
h. Calculate the weighted average EUL for equipment, if installing multiple chargers of different make or model.
i. Estimate total equipment, installation, and supporting infrastructure costs.
j. Identify rebates/incentives.
k. Provide utility rate from utility bill or an explanation of utility rate.

Section 3. ASHRAE Audit Levels

The Green Bank reserves the right, in its sole discretion, to require a particular ASHRAE audit level for any project, depending upon the nature of the proposed project and supporting information. All audits must meet Green Bank criteria. A summary of the ASHRAE audit levels is provided below.

3.1 ASHRAE Level I Energy Audit

An ASHRAE Level I energy audit consists of a:

a. Walk-through analysis to assess a building's energy cost.
b. Utility bill analysis to assess its efficiency (using ASTM BEPA Methodology to establish the building's baseline energy use).
c. Brief on-site survey of the building.

The walk-through may be targeted at a specific building component that is intended to be replaced, upgraded, or added, or may include checking all major energy-using systems. Operational metrics of building equipment are typically limited to data collection of nameplates but may be more detailed if that data is readily available. Level I energy analysis should, at minimum, identify Energy Improvements and the associated potential energy savings, the estimated cost of the Energy Improvements, and specify where further consideration or more rigorous investigation is warranted.

3.2 ASHRAE Level II Energy Audit

An ASHRAE Level II energy audit is a more detailed investigation and includes a more comprehensive building survey and energy analysis than a Level I audit. It also includes more detailed financial analysis. In addition to nameplate data collection, empirical data may also be acquired through various field measurements using handheld devices.

The Level II audit should at the minimum identify and provide the investment and cost savings analysis of all recommended Energy Improvements, along with a discussion of any changes to operation and maintenance procedures. It should determine the project's key financial metrics, including SIR, cash flow and payback time. The financial analysis performed should reflect any rebates or incentives.

3.3 ASHRAE Level III Energy Audit

The ASHRAE Level III energy audit (often referred to as an "investment grade audit") is generally applicable to projects that are capital intensive and demand more detailed data collection and rigorous engineering analysis. The Level III energy audit provides more comprehensive project investment and cost savings calculations that may be required for major capital investment decisions. Data collection may involve field measurements acquired through data loggers and/or an existing energy management system.

Article 3 - Setting the Energy Use Baseline

Section 1. ASTM BEPA – Standard Methodology

The ASTM BEPA protocol establishes a standardized methodology for building energy use data collection, compilation, and analysis. The methodology is intended to fill data collection and analysis gaps in the ASHRAE energy audit guidelines and establish a sound, representative building energy use baseline. The ASTM BEPA methodology standardizes several major variables associated with data collection and analysis. This overarching methodology dictates the data and history that should be collected at each site.

To meet **ASTM E2797-15** requirements, the preferred length of time that baseline building energy consumption data should be collected is three years, assuming it is available, or back to the last major renovation if completed in less than three years, with a minimum of one year of data collection. A major

renovation is defined in the standard as any change that either involves expansion (or reduction) of the building's gross floor area by 10% or more or impacts total building energy use by more than 10%.

Section 2. Methodologies for Unique Building Scenarios

For buildings or equipment where it is impossible or prohibitively difficult to obtain the required historical energy consumption data, the following methodologies may be utilized for establishing baseline building energy use.

2.1 Fully or partially vacant existing building whose use is not expected to change. If an existing building is partially vacant and the use is not expected to change (e.g., office space stays as office space, etc.), it may be possible to use the utility data from the occupied space and extrapolate energy consumption to the full space, as if it were 100% occupied. A building energy use simulation model may then be used to estimate the energy use after the Energy Improvements are installed and compare this to the extrapolated baseline.

2.2 If the existing building is currently vacant and has been vacant for some time. If there is no utility data available, then the existing space may be modeled (building energy use simulation model, such as eQUEST, EnergyPlus, or equivalent) with the existing equipment (e.g., HVAC, windows, etc.), but operating how it would be operating under the expected use (the number of people occupying the building, the hours of operation, etc.). This would establish the baseline energy use. The model can then be used to project energy use after the Energy Improvements are installed and compare this to the baseline to project the energy savings.

2.3 Multi-tenant buildings, such as retail, office residential, etc. where the tenants are sub-metered and pay their own electricity. In multi-tenant buildings where it is prohibitively difficult to obtain the electricity meter data of all tenants, C-PACE applicants may use the building's aggregate energy use, which may be supplied by the utilities via a signed waiver from the property owner. This would represent the building's pre-Energy Improvement baseline. The alternative is to collect whatever tenant energy use data is voluntarily offered and use this to model the building's energy use. To use this option, a minimum of 10% of the tenants must contribute energy use data. Once the baseline is established, a calibrated building energy use simulation model can then be used to project energy use after the Energy Improvements. The difference (energy improvement) between the two scenarios would be the "energy savings." Tenants may be willing to authorize the building owner to access their energy use because they would be getting the benefits of the Energy Improvements and be receiving lower energy bills.

2.4 New equipment is proposed where there is no existing equipment, or the existing equipment is not operational. If equipment is proposed to be installed where there is no pre-existing equipment or the pre-existing equipment has been non-operational for at least one year, C-PACE applicants may use the appropriate code-compliant equipment as the baseline. If the equipment is partially operational or became inoperative within the last year, the pre-existing equipment may be modeled as the baseline per its cutsheet specifications.

Article 4 – Eligible and Ineligible Energy Improvements

Section 1. Eligible Energy Improvements

The list below includes some examples of eligible Energy Improvements. It is not a complete list. If a measure is not included on this list, the Green Bank will review proposed Energy Improvement(s) and accept them on a case-by-case basis. For measures not included on this list, Green Bank reserves the right to require a project review by the Technical Administrator.

a. High efficiency lighting.
b. Heating, ventilation, and air conditioning (HVAC) upgrades.
c. New automated building and HVAC controls.
d. Zero-Emission Refueling Structures.
e. Variable speed drives (VSDs) on motors, fans and pumps.
f. High efficiency chillers.
g. High efficiency boilers and furnaces.
h. High efficiency hot water heating systems.
i. Combustion and burner upgrades.
j. Water conservation measures to the extent they save energy.
k. Heat recovery and steam traps.
l. Building enclosure/envelope improvements.
m. Building automation (energy management) systems.
n. High efficiency air compressors with heat recovery.
o. Participation in a District Heating and Cooling System.
p. Participation in a microgrid, as defined in Section 16-243y of the Connecticut General Statutes, including any related infrastructure for such microgrid.
q. New automated process controls.
r. Heat recovery from process air and water.
s. Cogeneration used for peak shaving.

Section 2. Eligible Associated Costs

Associated Costs may, subject to Green Bank approval, be included in the Financed Amount. The list below includes some examples or eligible Associated Costs. It is not a complete list. If a cost is not included on this list, the Green Bank may review proposed Associated Cost and may approve them on a case-by-case basis for any project.

a. Capital expenditures associated with an Energy Improvement (i.e., roof replacement for solar, or improvements that are part of a LEED certification project).
b. Utility service upgrade costs (i.e., gas line expansion required by a fuel conversion, or electric interconnection costs).
c. Energy/water audit costs.
d. Engineering and design costs.
e. Construction costs (i.e. installation, labor, and equipment).
f. Commissioning costs.
g. Prepaid operation and maintenance costs for a period of up to five years, including measurement and verification costs incurred.

h. Costs of an extended warranty covering the full finance term for equipment financed.
i. Any capital provider fees and /or required prepaid interest.
j. Program and permit fees.
k. Leadership in Energy and Environmental Design (LEED) certification and consulting fees.

Section 3. Ineligible Improvements

The list below includes some examples of measures which are not Energy Improvements. It is not a complete list.

a. Appliances, e.g., refrigerators, dishwashers, etc.
b. Plug load devices.
c. Vending machine controls.
d. Any measure that is easily removed from the property or not permanently installed.

Article 5 – Commissioning

All projects are required to include a commissioning plan prepared by a Qualified Contractor, Technical Reviewer, or the Technical Administrator. Such commissioning plan is necessary to confirm that the measures were properly installed and that the project is operating as intended.

Article 6 - Performance Measurement & Verification of Energy Savings

The Green Bank encourages C-PACE applicants to develop an M&V plan consistent with guidance provided by the International Performance Measurement and Verification Protocol (IPMVP) or an alternative methodology as appropriate for the project size and Energy Improvements installed.
The IPMVP guidance provides four options for determining energy savings. These include:

a. Retrofit Isolation: Key Parameter Measurement.
b. Retrofit Isolation: All Parameter Measurement.
c. Whole Facility.
d. Calibrated Simulation.

Options A and B focus on the performance of specific Energy Improvements that can be measured in isolation from the rest of the building. In Option A, the key energy use parameter is measured, but other minor effects can be estimated. For example, Option A might include a lighting retrofit, where an electric meter can isolate and measure electricity use for the lighting, but where the relatively minor interactive effect of less cooling in summer and more heating in winter is estimated. Reduced lighting loads will reduce air conditioning energy consumption (a cooling bonus) but increase heating consumption (a heating penalty). In Option B, all parameters necessary to evaluate energy use are measured. This might, for example, be the case with installation of a variable speed drive and controls to a motor, with a power meter installed on the electrical supply to the motor.

Options C and D are used when energy use of the Energy Improvements installed is not easily measured in isolation from the rest of building operations, or there is little measured baseline energy data, among other reasons. The Option C approach assesses savings at the whole facility level. The measured and verified energy savings in the desired reporting period (e.g., 12 months after the Energy Improvements

have been installed) is determined from the difference between the actual (measured) energy use in the reporting period and the projected energy use in this same reporting period assuming the Energy Improvements had not been installed. The analysis reflects changes in the independent variables impacting building energy use (such as weather, occupancy, operating hours, etc.) for each month in reporting period as compared to the baseline. Option C is commonly applied for whole building retrofits involving multiple Energy Improvements that may be interactive. Option D uses computer simulations and building modeling (e.g., U.S. DOE 2.2- based software such as eQuest or EnergyPro) and is usually applied when baseline year energy data are not available or considered reliable.

An M&V plan should determine if and with what frequency energy consumption and/or clean energy production data will be collected for measurement purposes. An M&V plan should also determine how data will be tracked and collected as well as what party is responsible for data collection.

The Green Bank may elect to facilitate M&V on projects submitted to the Green Bank for financing. Property owners and/or qualified Approved Capital Provider (ACP)may request M&V services from the Green Bank, see Third-Party Capital Provider Term Sheet (Appendix F). M&V activities may be financed as an eligible measure under the C-PACE program.

Article 7 - Data Management, Program Information Management, Reporting and Analytics

Green Bank reserves the right to collect project data on all projects, regardless of the Capital Provider. C-PACE ACP will be required to submit data regarding project characteristics and project energy savings in a standard format to be determined by the Green Bank in its sole discretion. The Green Bank issues quarterly reports on the C-PACE Program that include aggregated data across all closed and completed transactions. For more information, visit our Quarterly Dashboard.