NEW JERSEY'S CLEAN ENERGY
PAY FOR PERFORMANCE PROGRAM

New Construction Program Guidelines

January 2012

Version 3.0

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Notable Changes between v2.0 and v3.0

1. **Expanded Section 2**, including Program Overview (2.1) and Tools & Resources (2.2).
2. **Changes to Section 2**, including:
    a. Removal of **SmartGrowth Area** requirement
    b. Removal of **Combined Heat & Power and Fuel Cells** from Pay for Performance. It will be a standalone program in 2012.
    c. Changes to **Incentive Structure** (2.4)
    d. Changes to **Submittal Requirements and Timelines** (2.6)
    e. Addition of guidelines for requesting **Extensions** (2.6.1)
3. Revised/Expanded **Section 3**, including the addition of **Measure Evaluation** (3.4)
4. **Incremental Cost** Guidelines moved to Section 3.5
5. **Financing Cost** Guidelines moved to Section 3.6
6. **Implementation Plan** Guidelines moved to Section 3.7
7. **Commissioning Plan** Guidelines moved to Section 3.8
8. **Simulation Guidelines** re-labeled Section 4.0 and **revised/expanded**, including Overview (4.1), Simulation Requirements (4.3), Infiltration/Ventilation modeling guide (4.4), multi-building modeling guide (4.4), Documenting Model Inputs (4.7), and As-Built modeling guide (4.8).
9. **As-Built Energy Reduction Plan Guidelines** re-labeled Section 5.0 and **revised** to include information on System Changes (5.2.1), Invoices (5.2.2.) and Inspection (5.2.3).
10. Former **Combined Heat & Power** Section 8 deleted.
11. Addition of **Appendix B Minimum Performance Standards**

1 Introduction

New Jersey's Clean Energy Pay for Performance **New Construction** Program ("Program") comprehensively addresses the energy efficiency needs of the Commercial and Industrial ("C&I") sector by working with building owners and their representatives ("Participants") to improve the energy efficiency of new commercial and industrial buildings with 50,000 square feet or more of planned gross heated space.

This Program relies on a network of contractors who have demonstrated their experience and expertise in commercial and industrial energy efficiency projects. These entities are identified as Pay for Performance Partners ("Partner"), and are afforded the privileges outlined in the Partnership Agreement and its Attachments. The Program will work to achieve the following goals:

1. Create a market-based network of energy efficiency professionals capable of delivering comprehensive services to developers, building owners and their representatives;
2. Facilitate access to capital for comprehensive energy and energy-related improvements;
3. Reach significant numbers of commercial and industrial customers with comprehensive, cost effective scopes of work;
4. Reduce the C&I sector's contribution to the system peak demand;
5. Package energy efficiency with other types of improvements, such as combined heat and power and renewable energy systems;
6. Improve the profitability of Participants by implementing cost effective energy efficiency measures which lower energy consumption and costs.

The New Construction component of the Program is open to new commercial and industrial buildings with 50,000 sq. ft. or more of planned gross heated space. Participants will be required to work with an approved Pay for Performance Partner to develop an Energy Reduction Plan ("ERP") and facilitate the incorporation of the recommended energy efficient design features. In order to receive incentives offered through the Program, the submitted ERP must include a package of energy efficiency measures that achieve the minimum performance requirement of energy costs 15% below the ASHRAE 90.1-2007 Appendix G requirements. In addition, the ERP must include a comprehensive mix of measures; lighting cannot make up more than 50% of

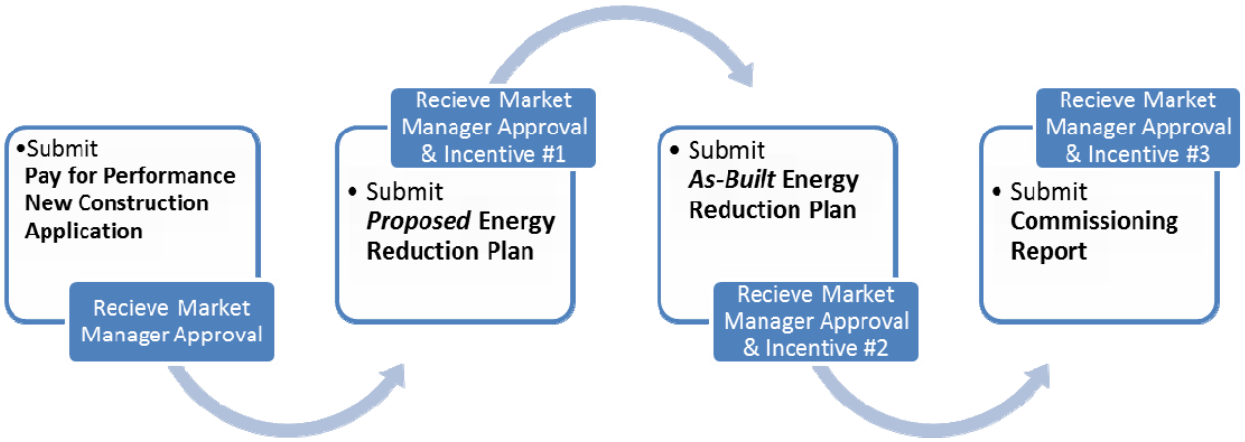
the total projected energy cost savings. Projects that cannot identify efficiency improvements that meet this minimum performance level will be referred to the appropriate NJ SmartStart Buildings Program(s).

This document presents guidelines and requirements for the development of an ERP as required by the Program.

2 General Requirements

2.1 Program Overview

The Pay for Performance New Construction Program ("Program") has four main deliverables that are submitted in the order shown below:



1. **Application:** Initial application form must be submitted and approved by Market Manager prior to beginning work on the Energy Reduction Plan. This is to ensure the facility is eligible to participate. Please refer to Instructions on the Application, which can be downloaded from the New Jersey's Clean Energy website.

2. **Proposed Energy Reduction Plan (Section 3):** Summary report of proposed building that achieves the minimum performance requirement of energy costs 15% below the ASHRAE 90.1-2007 Appendix G. Submitted at the onset of the project, preferably at the Design Development stage, or well enough before construction to allow for review and approval by the Market Manager.

3. **As-Built Energy Reduction Plan (Section 5):** Proposed Energy Reduction Plan that is updated to incorporate all changes that occurred during construction. Submitted once construction is completed and all recommended energy-efficiency measures, as outlined in the approved Proposed Energy Reduction Plan, are implemented.

4. **Commissioning Report (Section 6):** Completed by pre-approved Commissioning Authority. Must ensure that all energy-efficiency measures are installed and operating as outlined in the approved Proposed Energy Reduction Plan (or as modified in the approved As-Built Energy Reduction Plan).

2.2 Tool and Resources

In addition to the Program Guidelines, the following tools must be used when completing program deliverables:

1) Energy Reduction Plan report template
2) Energy Reduction Plan commissioning plan template
3) Energy Reduction Plan Excel tables

These documents, as well as other helpful resources, such as instructions on uploading documents to the FTP site, modeling help sites, etc. can be downloaded from the *Partner Portal:*

URL: http://www.njcleanenergy.com/p4p-portal-login
Case sensitive password is: **tRP47px**

2.3 Eligibility Requirements

Participation in the Program is based on the following criteria – payment of the Societal Benefit Charge, project size, construction type, and location.

Societal Benefits Charge – Participants will be electric and/or gas customers of the following regulated New Jersey utilities:

- Atlantic City Electric
- Elizabethtown Gas
- Jersey Central Power & Light
- New Jersey Natural Gas
- PSE&G
- Rockland Electric Company
- South Jersey Gas

Participants must pay a monthly Societal Benefits Charge, which can be found as a line item on their utility bills. For buildings which will use fuels other than those provided by the utilities listed above (e.g., fuel oil), the 15% minimum performance requirement will apply to total energy cost and at least 50% of the reductions must come from electricity and/or natural gas that is provided by regulated NJ utilities.

Project Size – The project must have 50,000 square feet or more of planned gross heated space.

Construction Type – The new construction component will accept both new construction and substantial renovation, or gut rehabilitation, as defined below:

New Construction: Defined as a new building, or portion within a new building where a licensed professional architect or engineer has prepared and certified the building plans.

Substantial Renovations (Gut Rehab): Defined as one of the following types of projects where a licensed professional architect or engineer has prepared or certified the building plans:

- Change of use and reconstruction of an existing building or space within;
- Construction work of a nature requiring that the building or space within be out of service for at least 30 consecutive days;
- Reconstruction of a vacant structure or a space within.

Additionally, the Program will serve Multifamily Buildings that are 7 stories or greater, or 4-6 stories with central heating and/or cooling, or projects of any size that do not meet the qualifications of ENERGY STAR Homes Program® and/or ENERGY STAR Multifamily High Rise Program®.

Location in a SmartGrowth[1] Area –New construction projects will only be eligible for incentives if they are located in areas designated for growth in the New Jersey State Plan. However, the following exceptions do apply:

- The replacement or expansion of buildings in an area not designated for growth, on a single parcel by the current owner who has owned the property for at least one year would be eligible for program incentives, provided that such replacement or expansion will result in structures that, in total no more than double the amount of square footage of the original building prior to expansion, and provided that the original building was built before March 4, 2003. New construction outside an area designated for growth that does not expand or replace an existing structure will remain ineligible for program benefits.
- Municipally owned buildings, hospitals, and/or military facilities in areas not designated for growth are also eligible for program benefits, provided they meet the same requirements noted in the preceding paragraph.
- Exceptions to the SmartGrowth requirements may be granted by the BPU. Refer to Board Order dated April 3, 2006, Docket No. EO02120955 for the criteria to qualify.

[1] SmartGrowth areas can be found using the SmartGrowth Locator at the following website: http://njgin.state.nj.us/OIT_BusinessMap/index.jsp

2.4 Incentive Structure

Table 2-1. P4P New Construction Incentive Structure

Incentive #1: Proposed Energy Reduction Plan			
Minimum Performance Requirement:		**15%**	**Cost reduction over baseline**
Incentive Amount:		$0.10	per gross heated square foot
Maximum Incentive:		$50,000	
This incentive is used to offset the cost of services associated with the development of the Proposed Energy Reduction Plan and design fees. Projects must identify energy-efficiency improvements that meet the minimum performance level in order to become eligible for Incentive #1. Incentive #1 is payable upon approval of Proposed ERP, receipt of signed contract between Participant and Partner, receipt of project Sheet Index and the table of contents from the Specification Booklet, documentation that Participant has paid 75% (minimum) of the A/E design fees for construction documents, and is contingent upon moving forward with construction.			
Incentive #2: As-Built Energy Reduction Plan			
Minimum Performance Requirement:		**15%**	**Cost reduction over baseline**
Incentive Amount:		$1.00	per gross heated square foot
This incentive is used to offset the costs associated with the implementation of recommended energy-efficiency measures as outlined in the approved Proposed ERP. Incentive #2 is payable upon construction completion, approval of As-Built ERP, and a successful post-installation inspection by Market Manager.			
Incentive #3: Commissioning Report			
Minimum Performance Requirement:		**15%**	**Cost reduction over baseline**
Performance Requirement	15%-17%	$0.35	per gross heated square foot
	18%-20%	$0.45	
	> 20%	$0.65	
This incentive will be based on confirmation that the performance level indicated in Proposed and/or As-Built Energy Reduction Plan is met. Final savings projections will be calculated using energy simulation rounded to the nearest percent based on installed and commissioned energy-efficiency measures as outlined in the Proposed and/or As-Built ERP. Incentive #3 is payable upon approval of Commissioning Report.			

2.5 Incentive Caps

Incentives will be capped at the lesser of:

1. Project Cap- Total of Incentives #2 and #3 is capped at 75% of total incremental project cost over baseline. Total project cost includes materials, labor, design fees, construction management fees, and Partner fees.
2. Project Cap- Total of all incentives is capped at $1 million per electric and gas account, not to exceed $2 million per project, assuming both electric and gas measures are implemented.

3. Entity Cap- The participating customer's entity will be subject to an Entity Cap of $4 million per calendar year (Definition of an Entity can be found in the Board Order Docket No. EO07030203). This cap is raised to $5 million if a CHP project is implemented.

2.6 Submission Guidelines and Timelines

Initial submittal documents, as listed in Table 2-2 below, should be submitted to the Market Manager at the very beginning of the project to verify that project meets minimum eligibility criteria. Work on the ERP should not begin until the Application Approval letter is issued stating that the project is eligible to participate in the Program. Make sure the most recent versions are used.

Incentive #1 submittal documents, including the Proposed ERP should be submitted within six (6) months of Application approval AND if the scope of work changes, such that the energy savings are significantly affected. Savings are considered to be significantly affected if the changes in the scope of work could result in the project no longer meeting the stated Program Rules. For example, if a project estimates exactly 15% energy cost savings, even slight changes to the scope could put the project at risk of not meeting the minimum savings criteria. Other trigger events for re-submitting an ERP include changes in estimated savings that exceed 10% of original estimates and/or the removal or addition of an entire measure. No measures may be implemented until the Proposed ERP is approved, the incentives are committed, and ERP Approval letter is issued. Make sure the most recent versions of tools and templates are used.

Incentive #2 submittal documents, including the As-Built ERP should be submitted within twelve (12) months of Proposed ERP approval or upon construction completion, whichever comes first. Make sure the most recent versions of tools and templates are used.

Incentive #3 submittal documents, including the Commissioning Report should be submitted within six (6) months of As-Built ERP approval. Make sure the most recent versions of tools and templates are used.

During the term of the Participation Agreement, a Partner must notify the Market Manager in a timely manner of any changes that significantly affect energy savings (i.e., plus or minus 10%). All submittals, changes to submittals, and approvals must be in writing and signed by an authorized party, as indicated in the Participation Agreement. Any changes must be authorized by the Market Manager in writing. The project work scope, proper measure selection, and

successful project implementation are the Partner's sole responsibility.

2.6.1 Extensions

Incentive #1 Submittal: The Market Manager may grant an extension of up to SIX months past the Proposed ERP submittal deadline provided the following conditions are met:

- Partner must provide evidence that the final design or construction documents for the project were not completed in time to successfully develop and submit the Proposed ERP by the original submittal deadline. This evidence will include a statement from the designer/architect/engineer indicating the final design or construction documents have not been completed, the reason for such delay(s), and an estimated date of receipt.

Incentive #2 Submittal: The Market Manager may grant a project a *first extension*, not to exceed SIX months past the As-Built submittal deadline, and a *second extension* up to an additional SIX months, provided the following conditions are met:

- The Market Manager will consider extensions in cases where significant progress has been made toward completion of the projects, and where the delay was unavoidable and unforeseeable at the time of the upfront incentive application. Approval of any extension will depend on the totality of circumstances related to project progress the reason why the delay was unavoidable and unforeseeable as demonstrated through documentation provided with the extension request.

Incentive #3 Submittal: The Market Manager may grant an extension of up to SIX months past the Commissioning Report submittal deadline provided the following conditions are met:

- Partner must provide a statement from pre-approved Commissioning Authority indicating the degree to which the commissioning has been completed, the amount remaining, the reason for the extension, and the estimated date of completion.

The following steps must be followed to request an extension to the above deadlines:

1. Partner must submit the request for an extension in writing prior to the expiration date.
2. Request must identify the reason for the request and a schedule that identifies how much extra time is needed to complete the project.
3. Approval of a request for extension will not change or modify any other program terms and conditions

Table 2-2. P4P Program Submission Guidelines and File Naming Conventions

Initial Submittal	**P4P New Construction Application:** Submit as a PDF file (*.pdf) or hard copy
	Signed W9 form: Submit as a PDF file (*.pdf) or hard copy
	Brief project description: Submit as a PDF file (*.pdf) or hard copy

Incentive #1 Submittals	**Proposed Energy Reduction Plan:** Submit as a PDF file (*.pdf) File Name: Project Name – Proposed ERP_rev0.pdf Example: New Jersey Retail – Proposed ERP_rev0.pdf
	Commissioning Plan: Submit as a PDF file (*.pdf) File Name: Project Name – CxPlan_rev0.pdf Example: New Jersey Retail – CxPlan_rev0.pdf
	Proposed Energy Reduction Plan Tables: Submit as an Excel file (*.xls) File Name: Project Name – Proposed ERP Tables_rev0.xls Example: New Jersey Retail – Proposed ERP Tables_rev0.xls
	Modeling Software file(s): Submit as electronic files (see Section 4.7.1)
	Installation Agreement: Submit as a PDF file (*.pdf) *Document must be signed by both parties.* File Name: Project Name – Installation Agreement.pdf Example: New Jersey Retail – Installation Agreement.pdf
	Partner-Participant Contract: Submit as a PDF file (*.pdf) *Document must be signed by both parties.* File Name: Project Name – Partner Contract.pdf Example: New Jersey Retail – Partner Contract.pdf
	Evidence of 75% Design Completion: Submit as a PDF file (*.pdf) File Name: Project Name – 75Design Evidence.pdf Example: New Jersey Retail – 75Design Evidence.pdf
	Drawing Sheet Index and the Specification Booklet table of contents: Submit as PDF File Name: Project Name – Index and Specs.pdf Example: New Jersey Retail – Index and Specs.pdf
	Request for Incentive #1: Submit as PDF file (*.pdf) *Document must be signed by both parties.* File Name: Project Name – Request for Incentive 1.pdf Example: New Jersey Retail – Request for Incentive 1.pdf

Incentive #2 Submittals	**As-Built Energy Reduction Plan:** Submit as a PDF file (*.pdf). File Name: Project Name – As-Built ERP_rev0.pdf Example: New Jersey Retail – As-Built ERP_rev0.pdf
	As-Built Energy Reduction Plan Tables: Submit as an Excel file (*.xls) File Name: Project Name – As-Built ERP Tables_rev0.xls Example: New Jersey Retail – As-Built ERP Tables_rev0.xls
	Modeling Software file(s): Submit as electronic files (see Section 4.7.1).
	Invoices: Submit as PDF file (*.pdf) *Must support installed project cost, broken down by materials and labor, and show energy-efficiency measure specifications.*
	Request for Incentive #2: Submit as PDF file (*.pdf) *Document must be signed by both parties.* File Name: Project Name – Request for Incentive 2.pdf Example: New Jersey Retail – Request for Incentive 2.pdf

Incentive #3 Submittals	**Commissioning Report:** Submit as a PDF file (*.pdf). File Name: Project Name – Commissioning Report_rev0.pdf Example: New Jersey Retail – Commissioning Report_rev0.pdf
	Request for Incentive #3: Submit as PDF file (*.pdf) *Document must be signed by both parties* File Name: Project Name – Request for Incentive 3.pdf Example: New Jersey Retail – Request for Incentive 3.pdf

2.7 Miscellaneous

A valid Tax Clearance Certificate from the State of New Jersey, Division of Taxation is required before any incentives can be released to the customer. No incentive will be paid without receipt of a valid Tax Clearance Certificate. A Tax Clearance Form will be attached to your ERP Approval Letter. Certificates are valid for 90 days but may be renewed for up to 1 year. If the Trade Name listed on your Tax Clearance Form does not match the Company Name on your application, please notify the Market Manager, otherwise, your Tax Clearance Certificate will not be matched with your application and will not be processed. For questions regarding Tax Clearance Applications, please contact NJ Division of Taxation at 609-242-6400.

The Market Manager will submit Incentive Invoices to the State of New Jersey twice each month for payment of approved incentives. Upon receipt of wire transfer of payment from NJ Treasury Department, the Market Manager will issue incentive checks to Participants and/or their designated payee within approximately five business days.

NJ law P.L 2009, c. 203: As of January 14, 2010, the prevailing wage rate shall be paid to workers employed in the performance of any construction undertaken in connection with Board of Public Utilities financial assistance programs. This law applies to contracts greater than $14,187.

3 Proposed Energy Reduction Plan Development

3.1 Overview

The Proposed Energy Reduction Plan ("ERP") report provides a roadmap for developing and implementing a comprehensive energy efficiency improvement work scope in new C&I projects. The process of creating an ERP involves assisting the design team in developing an energy efficient design and evaluating potential energy savings of the proposed design. The ERP includes simulation results, a financing plan, a construction schedule, and a commissioning plan. The ERP must be developed in consultation with the Participant and must be adhered to closely throughout construction in order to ensure that the energy efficiency measures are installed in such a way as to realize the intended energy savings.

The Proposed Energy Reduction Plan shall include the following necessary components:

- Project Description
- ENERGY STAR Benchmark (Section 3.3)
- Recommended Energy Efficiency Measures, including:
    - Description of measure (Section 3.4)
    - Corresponding incremental costs (Section 3.5)
    - Estimated energy savings (Section 5)
    - Baseline and proposed or as-built Simulation Results (Section 5)
- Financing Plan (Section 3.6)
- Plan Implementation and Schedules (Section 3.7)
- Commissioning Plan (Section 3.8)

In addition, the appendices shall include additional documentation, model simulation reports and assumptions, as well as any other analyses completed for the energy efficiency measures.

3.2 Rules and Requirements

The ERP details the specific energy efficiency measures that will be implemented to achieve the 15% performance requirement, identify the sources of funding that will pay for these measures, and outlines their construction schedule. The following are Program rules which must be adhered to by all projects participating in the Program. This list focuses on programmatic requirements

relating to the ERP and is not intended to cover all Program eligibility requirements as listed in the Application, the Participation Agreement and/or the Partnership Agreement.

1. The ERP will summarize the proposed design and construction plan developed by the Partner and must be completed prior to the start of construction.
2. When assembling the set of measures to be included in the ERP, the following criteria must be met:
    a. A minimum performance requirement of energy costs 15% below ASHRAE 90.1-2007 Standards must be achieved in order to participate. Projects that cannot identify efficiency improvements that meet this minimum will be referred to the appropriate NJ SmartStart Buildings Program(s).
    b. The 15% minimum is based on reducing the total energy cost for the facility. For all projects, 50% of the energy cost reduction must come from electric and/or gas utilities which pay into the Societal Benefits Charge[2]. For projects where either the primary heating fuel or electricity is not from one of New Jersey's investor-owned utilities, Program Incentives (1, 2, and 3) will be reduced by 50%.
    c. No more than 50% of the total energy cost reduction may be derived from lighting measures.
    d. The total energy cost reduction necessary to meet the Program performance requirement of 15% may not come from a single measure.
    e. The *total package* of measures as presented in the ERP must have at least a 10% internal rate of return (IRR) based on incremental cost over the baseline.
    f. Participants must clearly identify any additional incentives being pursued with the New Jersey investor-owned utilities. Such information should be included in the Financing Plan section of the Energy Reduction Plan.
3. Any modifications in the work scope that change the overall project cost reduction must be submitted as a revision to the ERP. The project must still achieve the 15% minimum reduction in estimated annual energy cost after this revision. The project can proceed prior to receiving approval from the Market Manager, but the Participant cannot

[2] Eligible customers are those non-residential electric and/or gas services customers of the New Jersey investor-owned utilities, which include: Atlantic City Electric, Jersey Central Power & Light, Rockland Electric, New Jersey Natural Gas, Elizabethtown Gas, PSE&G and South Jersey Gas.

start/continue work on the revised measure(s) until they receive approval from the Market Manager.

4. After construction is complete, the As-Built ERP (Section 5) and model must be submitted. The As-Built ERP and model serve as a "revision" to the approved Proposed ERP and will incorporate any changes that occurred during construction.

3.3 ENERGY STAR'S Target Finder

Simulation of the proposed building will be performed following ASHRAE 90.1- 2007 Appendix G, which requires the comparison of a proposed design to an averaged baseline model. This evaluation includes the energy usage, demands and utility costs associated with building systems such as envelope, interior and exterior lighting, plug loads, HVAC, fans, service water heating, and other equipment. The Baseline model is derived from the proposed design, but modified to incorporate criteria defined in Appendix G and minimum prescriptive requirements within ASHRAE 90.1. Section 4 describes simulation requirements.

Simulation does not provide benchmarking in relation to other similar facilities. Therefore EPA's Target Finder[3] will be employed for initial building benchmarking. The EPA Target Finder rating, the EUI (energy use index), is a performance measurement based on the distribution of energy usage in commercial buildings taken from DOE's 2003 Commercial Building Energy Consumption Survey (CBECS). The Target Finder rating system provides a percentile rating for a facility in a specific location given specific programmatic requirements, relative to a large population of operating buildings.

The building information required for input into Target Finder includes zip code, city, state, information on generic space types (i.e. floor area, operating hours, number of workers, percent heated), energy reduction target, estimated energy use from building simulation and utility cost. The "Target Energy Performance Results" report must be included in the ERP, along with the full facility summary. Buildings currently included in the database and eligible for an energy performance rating are:

- Bank/Financial Institutions
- Courthouses
- Offices
- Residence Halls/Dormitories

[3] http://www.energystar.gov/index.cfm?c=new_bldg_design.bus_target_finder

- Hospitals (Acute and Children's)
- Hotels and Motels
- K-12 Schools
- Warehouses (refrigerated and non-refrigerated)
- Retail Stores
- Supermarkets
- Medical Offices
- Wastewater Treatment Plants

For building types that are not addressed specifically by Target Finder, the performance measurement will be reviewed on a case by case basis using additional categories within the 2003 CBECS database. Data similar to that required for Target Finder must be submitted. Other general categories (non-location specific) included in CBECS database include:

- College/University
- Convenience Store
- Restaurant/Cafeteria
- Fast Food
- Fire Station / Police Station
- Vehicle Repair / Service
- Public Assembly Entertainment / Culture
- Self-storage Warehouse
- Retail (non-mall Stores, Vehicle Dealerships)
- Healthcare Inpatient (Specialty Hospitals)
- Healthcare Long Term Care (Nursing Home, Assisted Living)
- Lodging
- Mall (Strip or Enclosed)
- Public Library
- Public Recreation
- Public Social / Meeting
- Postal Service
- Non-refrigerated Warehouse
- Distribution / Shipping Center
- Healthcare Outpatient
- Healthcare Clinic / Other

It should be noted that there is no direct correlation between the EPA rating and ASHRAE 90.1.

After construction is completed, it is recommended that energy usage be monitored using post-construction utility billing data and EPA's Portfolio Manager. The information required by Portfolio Manger includes at least one (1) year of post-construction utility bills and information on each of the different spaces in the building (e.g. floor area, operating hours, number of workers, percent heated, etc.) and utility costs.

Energy performance is rated on a scale of 1 to 100 relative to statistically similar buildings based on the CBECS survey conducted every four years by the U.S. Department of Energy's Energy Information Administration. This energy performance rating system accounts for the impact of weather variations as well as changes in physical and/or operating characteristics of the building.

3.4 Measure Evaluation

The calculation of energy savings must follow the Simulation Guidelines (Section 4). For any measure affecting equipment that cannot be directly modeled in the simulation software, detailed energy savings calculations with analytical and methodological information and assumptions used in estimating the energy savings must be included in the ERP.

The total work scope must be cost effective, thus a project-level internal rate of return (IRR) must be greater than or equal to 10%. The IRR shall be calculated using the ERP Tables for New Construction and based on the incremental project costs and savings of each measure. There is no measure-specific IRR requirement.

For each proposed measure, a narrative description of the measure and the baseline component is required, along with the estimated incremental hard cost (Section 3.5).

The appropriate lifetime for each measure must match those given in New Jersey's Clean Energy Program Protocols (Appendix A).

3.4.1 Minimum Performance Standards

All recommended energy efficiency measures must:

- Meet or exceed minimum efficiencies and/or requirements as listed within Appendix B, OR
- Exceed ASHRAE 90.1-2007, OR
- Exceed minimum efficiencies as established by law, code, or standard practice

…whichever is more stringent.

Additionally, all applicable equipment must be listed by UL or other OSHA approved Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable US standards. Manufacturer's specification sheets may be requested by Market Manager to confirm performance.

3.4.2 Measure Interactivity

Individual measures aggregated into a proposed work scope will often interact with each other and impact the anticipated savings performance. For instance, analysis may indicate that installing new windows in an existing building might save 50 MMBtu/year. Or, installing a new boiler in the same building might save 25 MMBtu/year. However, if you install the boiler first, careful analysis will show that the windows, installed second, might save only 40 MMBtu/year. Conversely, you could install the windows first, saving 50 MMBtu/year, but then the boiler would only save 15 MMBtu/year, since in either case the boiler/window combination must

correspond to the same savings, 65 MMBtu/year.

The savings attributable to a package are almost always less than the sum of the savings each measure would produce if implemented in the original building. These interactive effects must be included in estimating the savings attributable to a recommended package of measures. These interactions will be taken into account when the building is modeled following the Simulation Guidelines in Section 5. All measures that can be represented in the simulation software must be included in the model.

3.4.3 Non-Energy Savings

Energy saving measures included in the work scope can occasionally provide cost savings through saving water (and associated sewer charges) and/or providing cost savings in the form of reduced equipment maintenance.

Cost savings associated with reduced Operation and Maintenance (O&M) expenses can be very difficult to predict and quantify and should be claimed only in cases where solid documentation can be provided to substantiate the savings estimate.

An example might involve the removal of a central boiler plant and replacement with decentralized boilers in each building. If the central plant involved underground distribution of heated water or steam and the underground piping was in a deteriorated condition, annual repairs could be regular and expensive. In such a case, it may be reasonable to quantify the savings associated with no longer needing to maintain the underground distribution piping, based on historical costs for such maintenance and repair.

When determining cost savings from the recommended scope of work, the Partner should use a marginal rate analysis that includes consideration of demand charges and ratchet clauses, per the applicable utility rate tariff. Projects subject to a block rate structure by their local utility will realize cost savings based upon which block the energy savings occur within. As a result, a marginal rate analysis produces a more accurate cost savings projection than a straight blended rate analysis and is therefore preferred when preparing the ERP.

3.4.4 Non-Eligible measures

The Pay for Performance program will only provide incentives for eligible energy-efficiency equipment. Renewable energy technologies that generate power cannot be included in the Energy Reduction Plan, such as:

- Solar panels
- Wind turbines
- Biogas

- Hydro power

Power generating technologies may be included as part of the project, as long as they are not included in the ERP. In which case, they must be separately metered so that they can be separated from the savings figures claimed under the Pay for Performance program.

The following technologies are not considered to be power generating, and may be included in the ERP work scope:

- Geothermal heat pumps
- Thermal storage
- Solar water heaters

Most energy-efficient technologies will qualify under the Pay for Performance program. If the work scope recommends new or emerging technologies it is recommended that the Market Manager is contacted to verify eligibility.

When in doubt, please contact the Market Manager for clarification.

3.4.5 Combined Heat and Power & Fuel Cells

Combined Heat and Power and Fuel Cell Systems cannot contribute to the 15% energy cost savings requirement. A separate program for CHP and fuel cell incentives is provided by the New Jersey Clean Energy Program. Please visit www.njcleanenergy.com/ssb for more information.

3.4.6 Materials and Installation Standards / Specifications

It is the responsibility of the Partner to ensure that all performance assumptions reflected in the ERP are translated into bid and design documents. A work scope should contain performance specifications or references to the specifications for the materials and equipment to be installed. Additionally, the work scope should include enough information about installation standards to ensure that competitive bidding is fair in scope and pricing and that potential contractors understand the importance of following the performance specifications.

3.5 Incremental Cost Guidelines

This section is meant to assist the Partner in calculating the incremental costs of the project's recommended measures. The guidelines present a comprehensive methodology to determine the incremental costs between the proposed design and the established baseline using generally accepted costing approaches. The difference in material and labor costs between the baseline equipment or system and the proposed improvement is the Estimated Incremental Hard Cost for that Energy Efficiency Measure (EEM). The Simulation Guidelines are used to determine equipment requirements for the baseline and proposed designs. This section provides guidance on how to determine the cost of installing each EEM, which is presented to the customer as part of the Energy Reduction Plan. The Incremental Cost guidelines may be shared with the developers, if requested.

The objectives of this section are to:

1. Develop a comprehensive methodology to determine the incremental costs of the proposed design compared to the baseline using generally accepted costing approaches (e.g. cost-estimating manuals such as RS Means).
2. Provide a procedure to reconcile costs that are prepared by the Design Team, if these differ from the Partner's cost estimate.
3. Ensure that the process developed is fair and equitable among all types of EEMs, and replicable between projects.
4. Ensure that the procedure can be considered objective to all parties.

3.5.1 Overview

Any proposed design component with an energy consumption impact that differs from the baseline component is considered to be an EEM, and shall be provided with an Estimated Incremental Hard Cost. If an EEM cost is determined to be less than its respective baseline component's cost, then the Estimated Incremental Hard Cost will be a negative value, representing the cost decrease. This negative cost should be included in the summation of the project's Estimated Incremental Hard Costs.

Many of these EEMs will arise out of consultation between the developer/design team and the Partner, working together to improve the energy efficiency of the proposed design. Some proposed design building components that result in reduced energy usage when compared to the baseline may have been included in the initial set of plans. All such building components are

included as EEMs, even though they were part of the original design.

These EEM distinctions are pointed out to ensure that all components that are an improvement over the baseline are recognized, in order to provide a fair and equal evaluation of all projects in the Program. If the developer is a not-for-profit company, no sales tax should be included for materials; otherwise the sales tax should be included. Partners should be aware that even if the project delivery method for a project is a guaranteed maximum price bid, all incremental costs shall be determined for each EEM in the project.

3.5.2 Cost Estimating Procedures

Once the EEMs have been determined for the project, the price of both the baseline and proposed measures must be calculated to determine incremental costs and IRR for the project.

To do so, the Partner shall first determine all building components associated with a specific EEM that would differ from the baseline. For example, if an EEM specifies that R-20 continuous exterior wall insulation be installed in the proposed design, the only difference between the proposed and baseline would be the insulation cost itself. The baseline cost would include the cost of the insulation that was determined to be the appropriate baseline wall insulation, and the proposed cost would include the cost of the actual specified insulation.

In other cases, this is not always so straightforward. For example, when the wall in the proposed design is a different construction type than specified in the baseline, the total price of the wall construction, including the insulation, should be accounted for in the cost analysis. Therefore, Partners shall include in their Energy Reduction Plan, a description of the items that were included in the hard costs for both the baseline and proposed designs.

Once the components required for the cost analysis of each measure are identified, the Partner shall determine the cost estimation method. The Partner may estimate costs through the use of cost estimation manuals, vendor quotes, design team calculations, or other reasonable methods – including online pricing. For each calculated hard cost, the method chosen to estimate this value shall be documented in the report.

3.5.2.1 Estimating By Cost Estimation Manuals

One method for estimating measure costs is to use cost estimation manuals, such as RS Means. The cost estimation procedure using these manuals is as follows:

1. Determine the costs for materials and labor using the initial "Bare Costs" or "Raw" value derived from the manual.
2. Multiply these raw costs by correction factors to accurately estimate the total material and labor costs, which include taxes, overhead, profit, and regional fluctuations in prices.
3. The correction factors, also included in the cost estimation manual, should be applied to any construction costs assessed using a cost estimation manual such as RS Means.
    a. The markup labor and markup material values are percentages that represent the national average for overhead and profit charged for the material and labor associated with construction.
    b. The constant associated with the zip code of the project is a regional correction factor that takes into account the local area cost variations in labor and materials within New Jersey.

3.5.2.2 Estimating By Vendor Quotes

When using vendor supplied quotes, it is necessary that the Partner document in the in the ERP which material and labor costs are taken into account in the quote.

Example 1

If the building was designed to be heated by a high-efficiency non-condensing boiler, and the vendor's quote did not include the material and labor cost associated with the hot water loop piping, it would be incorrect to compare that quote to the baseline cost assessment that did include pricing for the hot water loop piping. In this case it would be appropriate to leave out the pricing for the piping system assuming a similar system type for both baseline and proposed.

Example 2

If the building was designed to be heated by individual furnaces, then it would be appropriate to compare a vendor's quote for the furnaces and any associated ductwork, etc., to the baseline cost including the piping, as this is an actual difference in the cost of the systems.

Additionally, it is important to verify which type of price a vendor is providing, since this can be a source of confusion and have a large impact on the price. Vendor prices can be given as a contractor's (or trade) cost or a retail (or budget) cost. The Partner should apply an appropriate contingency/markup for these prices accordingly and document this in the ERP.

3.5.2.3 Estimating By Design Team Calculations

Similar to vendor quotes, design team calculations must specify which items they are pricing for each EEM to ensure an accurate comparison between the baseline and proposed measures.

3.5.2.4 Estimating By Online Pricing

Online pricing is permitted, but the source of the quote must be justified and included in the report.

3.5.3 Example Cost Estimation Procedures

Documentation in the ERP should include:

Baseline design components

Provide estimated installed costs for other equipment with the minimum efficiency required as detailed in the Simulation Guidelines or ASHRAE 90.1-2007.

Proposed design components

Provide installed costs for other equipment that have the efficiency in accordance with their actual properties using one of the estimating methods listed above.

3.5.3.1 Building Envelope: Vertical Fenestration Procedure

Baseline design components

The window area used to calculate the baseline cost shall be equal to the amount in the proposed design or 40% of the total gross above grade wall area, whichever is smaller.

Prepare cost estimates for windows that comply with ASHRAE 90.1-2007 requirements, using one of the estimating methods listed above.

Proposed design components

The actual properties of fenestration planned in the proposed design shall be used for cost estimating. The proposed cost should be based on the actual amount of fenestration in the proposed design using one of the estimating methods listed above. For projects with excessive windows, this will likely result in a significant increase in incremental cost for the project.

3.5.3.2 Interior Lighting: Power Density Reductions and Bi-level Fixtures

This would apply to interior lighting EEMs related to reductions in lighting power density (W/SF), and installation of bi-level lighting fixtures (fixtures with manufacturer integrated

occupancy controls for high-low switching).

The Estimated Incremental Hard Cost for this EEM is the sum of the results from all the following steps:

1. Determine the *labor cost* portion of the Estimated Incremental Hard Cost by one of the estimating methods listed above. In most cases the incremental labor costs will be $0.
2. Determine the *material cost* portion of the Estimated Incremental Hard Cost as follows:
    a. Determine the total proposed design material cost using one of the estimating methods listed above;
    b. Determine the total baseline design material cost. The Partner may calculate baseline material costs for fixtures of similar quality as the proposed design fixtures, but with a power usage that approximates the W/SF lighting power density (LPD) value of the baseline.
    c. Subtract the total baseline material cost from the total proposed design material cost. This is the materials portion of the Estimated Incremental Hard Cost for these fixtures.
3. Add the material cost and labor cost to get the total incremental hard cost for this measure

3.5.4 Assessing Costs for Gut Rehab Projects

For gut rehabilitation projects, the Baseline design of the envelope shall reflect existing conditions prior to any revisions that are part of the scope of work being evaluated, as described in building envelope section of Table G3.1 of Appendix G. However, all other components of the building (HVAC, DHW, lighting, appliances, etc.) shall follow the same design guidelines of non-gut rehab projects.

As such, the baseline cost for all gut rehab envelope components shall be $0. Costs of envelope components in the proposed design shall be estimated in accordance with their actual properties, using one of the estimating methods listed above. The baseline and proposed design costs of all other components of the building shall be calculated using the guidance listed above.

3.6 Financing Plan

The scope of the financing plan will vary in complexity depending on the anticipated sources of funding for the energy efficiency work scope. For Program Participants who have sufficient funds in reserve to cover the construction costs of the project, the financial plan will be very simple. Conversely, for Participants who are planning to include public funding, the financing plan will be more complex.

The objective of the financing plan is to clearly present a detailed description of how the proposed energy efficiency work scope is intended to be financed. The plan is seen as a critical component of a well prepared project and illustrates that the Participant, in collaboration with the Partner, as necessary, has considered how the proposed construction project will be financed. The plan should provide enough detail to ensure that all parties (Participant, Partner, and the Market Manager) are aware of the intended sources of funding for the energy efficiency project.

The Financing Plan table contains total construction costs, including the recommended EEMs, as well as the total Partner fees for the project. The table must delineate all sources of financing for the project, including the Pay for Performance Program Incentives. Make sure you've determined that the Pay for Performance incentives do not exceed the incentive caps as discussed in the Program Requirements (Section 2). If the incentive does exceed the cap, then enter the Pay for Performance Program incentive as equal to the incentive cap.

3.7 Implementation Plan

The implementation schedule should include a detailed description of the proposed construction schedule for the project, including a timeline for regulatory approvals, system design, and bid document preparation, as applicable. The plan should provide enough detail to ensure that all parties (Participant, Partner, and the Market Manager) are aware of construction schedule.

Estimated Construction Start of measures should not begin prior to ERP approval. Estimate Completion Date should be within the program allowances, as described in Section 2.

3.8 Commissioning Plan

A detailed Cx Plan, utilizing the Cx Plan template, will be submitted as part of the Proposed ERP and shall include the following items:

1. Identification of the CxA and documentation of experience;
2. A narrative describing the activities to be accomplished during each phase of Cx, including identification of the responsible party and how they will be completed;
2. Proposed operation of control systems;
3. Equipment and systems to be tested, including the extent of tests;
4. Functions to be tested (calibration, economizer control, etc.);
5. Conditions under which the test shall be performed (winter and summer design conditions, full outside air, etc.);
6. Measurable criteria for acceptable performance;
7. Method for reporting and resolving any deficiencies discovered.
8. Timeline/Schedule for commissioning activities

The Partner and CxA should work together in developing the Cx Plan to ensure key performance assumptions used in energy savings calculations are translated into the Cx Plan as parameters for acceptable performance. Details of the Cx Plan must be clearly documented in the Proposed ERP. For more information on Commissioning requirements, please see Section 6.

4 Simulation Guidelines

4.1 Overview

In order for the project to qualify for incentives under this Program, the Partner must calculate the project's *performance rating* (i.e. minimum 15% energy costs below current energy code). The performance rating is calculated as a percentage improvement in the Proposed design compared to a Baseline designed to comply with ASHRAE Standard 90.1-2007 Appendix G. Throughout this document, Appendix G terminology will be used. Thus, "Proposed" will refer to actual building design as specified in drawings and specs, and "Baseline" will refer to the design modified per Appendix G to reflect a minimally code compliant version of the building. The Simulation Guidelines are intended to assist the Partner in developing these models and is meant to:

1) Facilitate consistent modeling among different modelers,
2) Facilitate consistent modeling of Baseline components not mentioned in Appendix G,
3) Establish modeling protocols for measures
4) Ensure that these modeling results are used to drive the energy-efficient design process.

For any measure included in the model that is not addressed in the Simulation Guidelines or ASHRAE 90.1-2007 Appendix G, the Partner must include all modeling assumptions and calculations used for that measure in the Energy Reduction Plan for approval. Any calculations performed outside the modeling software and not specified in the Simulation Guidelines must also be included in the Energy Reduction Plan for approval.

4.2 Software Requirements

Modeling software used to determine the performance rating for projects in the New Construction component must satisfy the requirements outlined in ASHRAE 90.1-2007 Appendix G simulation and documentation requirements, as modified in these Simulation Guidelines. Examples of allowed tools include eQUEST, HAP, EnergyPlus, Trane Trace, and DOE 2.1. Approval for use in LEED and Federal Tax Deductions for Commercial Buildings program may serve as the proxy to demonstrate compliance with the requirement.

If the approved simulation tool used for the project cannot adequately model a design, material,

or device, then the energy savings associated with this component may be calculated using an external calculation method such as custom spreadsheets, proprietary software, or a thermodynamically-similar component model that can approximate the expected performance of the particular component that cannot be modeled explicitly in the approved software tool. The resulting savings may then be subtracted from the usage projected by the Proposed model. External calculation methods must include detailed documentation and require prior approval by the Market Manager.

Partners or software vendors who believe that they have an analytical tool that satisfies the requirements above but that is not yet approved for use in the program should submit a P4P Modeling Software Application to the Market Manager describing the tool capabilities and demonstrating compliance with the listed program requirements. Based on the Market Manager's review, the tool may be accepted for use on one or several pre-approved pilot projects. After successful completion of the pilot project(s), the tool will be included in the list of approved software.

Energy Reduction Plans for projects that are not identified as pilot projects prior to preparing the comprehensive energy assessment and that utilize software not approved for use in the program will not be accepted.

4.3 Simulation Requirements

4.3.1 General Requirements

1. Buildings shall be simulated per Appendix G and as described in this document. Addenda to ASHRAE 90.1- 2007 may be used, but must be explicitly listed in the submittals. In addition to the ASHRAE Standard 90.1, the 90.1 User's Manual is a good reference for interpretation of the Standard.
2. When modeling the proposed design, all recommended energy-efficiency measures must be modeled incrementally (additional guidance in Section 4.3.5).
    a. For example, in eQuest the "parametric runs" function must be used to model all energy reduction measures where possible. In TRACE 700, the "Alternates" function must be used. Keep in mind that TRACE 700 only allows up to four (4) Alternates; therefore if modeling more than three (3) measures, Alternate-4 should be 'saved as' Alternate-1 and additional measures modeled as subsequent Alternates. ***Model submissions that do not incorporate parametric runs [eQuest], alternates [TRACE], or an equivalent process will not be accepted.***

3. If there are no changes to the HVAC system type, only one model shall be submitted. In cases that the HVAC system type changes from the baseline to proposed design, two models may be submitted. The first model shall only include the baseline building components. The proposed model shall initially be a copy of the baseline model. Changes to the HVAC systems shall be made in the detailed interface [eQuest]. Other than the change in systems, there shall not be any other changes between the two models. Once the proposed systems are included in the proposed model, each of the measure improvements shall be modeled as a separate parametric run/alternate added to all the previous parametric runs/alternates. The compare documents feature of Microsoft Word or other word processor may be used to compare the .inp files of the baseline and proposed models [eQuest] to identify any unintended differences between the two models.
4. All differences between the baseline and proposed models shall be documented in the Energy Reduction Plan including any energy penalties to the building (e.g. electric resistance heaters in the proposed design).
5. Baseline and Proposed design models shall include all the energy costs within and associated with the building project.
6. Any modeling assumptions that are outside the scope of ASHRAE 90.1-2007 and Program Guidelines must be documented in the Energy Reduction Plan. Energy savings calculations performed outside of the simulation tool must be documented and submitted to the Market Manager for approval.
7. For performance rating calculations, both Baseline and Proposed design performance must be expressed as annual energy cost (additional guidance in Section 4.3.4).

4.3.2 Baseline Design

The Baseline design –

- shall comply with prescriptive requirements of ASHRAE Standard 90.1-2007;
- shall be modeled as described in ASHRAE 90.1-2007 Appendix G modeling protocol; *and*
- shall not include end uses that do not exist in the Proposed building. For example, if the parking lot in the Proposed design is not lit, then the parking lot lighting power allowance cannot be added to Baseline energy consumption. Space cooling is excluded from this requirement, as per Appendix G, and shall be modeled in all conditioned spaces.

4.3.3 Proposed Design

The Proposed design –

- must reflect the actual building components specified;
- must comply with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in ASHRAE Standard 90.1-2007;
- must include all energy costs within and associated with the building project; *and*
- must include heating and cooling in all conditioned spaces, even if no cooling is specified for the project.

4.3.4 Performance Rating Calculations

A summary of performance rating calculation requirements are listed below

1. *Performance rating* is defined as follows:

   Performance rating = 100(Baseline Building Performance -Proposed Building Performance)/(Baseline Building Performance).*

   Both the Baseline and Proposed building performance are expressed as *energy cost*. If performance credit is claimed for demand reduction, its impact on energy cost must be calculated hourly within the simulation tool.

2. *Baseline Building Performance* shall be determined as follows:

   a. Export into a spreadsheet file all total electricity and fuel usages from the simulation software, for each of the four Baseline runs (actual orientation and 90, 180, and 270 degree rotations, per Table G3.1 of Appendix G). *Exception:* Baseline building performance may be based on the actual building exposure if it is demonstrated that the building orientation is dictated by site conditions or for gut rehabilitation projects.

   b. Average the results of the four building orientations, for each fuel and per each usage component.

   c. Adjust the result to include *approved* calculations performed outside of the simulation tool (if any).

   d. Show energy consumption broken down into at least the following components: lights, internal equipment, service water heating, space heating, space cooling and heat rejection, fans, and other HVAC (such as pumps).

   e. If the energy consumption inputs in steps a-d above were expressed in units other than dollars, then after adjusting the simulation outputs as described above, multiply the result by the appropriate fuel rates. This dollar value ($) is the

Baseline Building Performance.

3. *Proposed Building Performance* shall be determined as follows:

    a. Export into a spreadsheet file all total electric & fuel usages from the simulation software (only the actual building orientation is required; no rotations).

    b. Adjust the result to include the *approved* calculations performed outside of the simulation tool (if any).

    c. Show energy consumption by end use.

    d. If the energy consumption inputs in steps a-c above were expressed in units other than dollars, then after adjusting the simulation outputs as described above, multiply the result by the same fuel rates as used for the Baseline simulation. This dollar value ($) is the *Proposed Building Performance*.

4.3.5 Simulating Measure-Level Savings

In addition to reporting electricity and fuel usage for the Proposed design and four Baseline runs (one per exposure), Partners must submit incremental savings for each individual measure.

The savings achieved by the package of measures Proposed or installed in a building are usually different from the sum of savings that may be achieved had each measure been implemented individually. For example, the savings realized by the motor retrofit will be lower if the variable speed drive is included as a separate measure. In turn, the variable speed drive savings vary depending on whether it is controlling the old inefficient motor or the new premium motor. To account for interactive effects and to allocate them among measures, the measures must first be ranked. The order may be based on cost-effectiveness of each measure, or the sequence in which measures would likely have been implemented had they been implemented individually. The measures are then added sequentially based on the established ranking as follows:

Step 1 Add the highest ranking measure (M1) to the Baseline design to calculate usage of the Baseline with Measure #1.

Step 2 The savings associated with Measure #1 are estimated by comparing the usage of the Baseline Design to the Baseline + M1 Model from the previous step.

Step 3 The Baseline+M1 model is then modified to include the measure that was ranked the second (Measure #2) to obtain the Baseline+M1+M2

Step 4 The savings associated with Measure #2 are estimated by comparing the Baseline +M1 model to Baseline+M1+M2 model.

Step 5 Repeat with the remaining measures until the model includes all the measures and is equivalent to the Proposed Design.

The model files submitted to Market Manager must allow review of savings projected from individual measures as described above.

4.3.6 Measure Granularity

Multiple components or systems may be grouped and reported as a single measure provided that these components/systems belong to the same end use. Distinct energy efficiency measures should not be combined if individual components have separate baselines OR if individual components improve efficiency, reduce flow rates, and/or reduce hours of operation. For example, different types of lighting fixtures may be modeled and reported as a single measure, but lighting fixtures and occupancy sensors cannot be combined. Similarly, lighting and HVAC system upgrades cannot be combined. Measure granularity is defined by the available measures in the ERP template.

4.4 Additional Simulation Guidelines

The following general guidelines outline principles to be used in modeling different systems in the Proposed and Baseline designs using the Appendix G method:

a) **Schedules of operation** in the model must be the same in the Baseline and Proposed models, except to model non-standard energy efficiency measures such as demand control ventilation. In such cases, documentation must be provided in the ERP justifying the assumptions.

b) **Heating and cooling** must be modeled in all *conditioned* spaces of both the Proposed and Baseline design, even if no heating or cooling system is specified. If no heating or cooling system is specified, minimally code complaint systems of type determined per Appendix G tables 3.1.1A and G3.1.1B must be included in both the Baseline and Proposed models. With proper documentation, the requirement to model cooling may be waived for industrial facilities that do not have a specified cooling system and are unlikely to have cooling installed in future.

c) Baseline **Building envelope** must be modeled using light-weight assembly types for all above-grade walls, roofs, and floor assemblies using the ASHRAE Standard 90.1-2007 prescriptive maximum U-factors for the building's climate and space type (residential, non-residential, semi-heated). The Proposed building envelope must be modeled as

shown on drawings. The exception is for gut rehab projects, in which case the envelope must be modeled as the existing condition.

d) The percentage of vertical **Fenestration** in the Baseline shall equal that of the Proposed design or 40%, whichever is less, and must be modeled using ASHRAE Standard 90.1-2007 prescriptive requirements for the building's climate zone. Proposed fenestration must be modeled as specified.

e) **Lighting** for the Baseline must be modeled using either the building or space by space methods described in ASHRAE Standard 90.1-2007 sections 9.5 and 9.6. Lighting for the Proposed design should include all task, ambient, and exterior lighting. Lighting energy savings credit may be claimed only for hardwired lighting fixtures, unless otherwise specified in Appendix B Minimum Performance Standards.

f) **Lighting Controls** credit can only be taken for spaces where such controls are not required ASHRAE 90.1-2007, but not where they are prohibited by state or local building or safety code. Some example of spaces that require controls per ASHREAE include, but are not limited to, janitor closets, laundry rooms, community rooms, offices, public restrooms, and refuse rooms.

g) **HVAC system types** will often vary between Proposed and Baseline models. Proposed model must reflect actual specified HVAC system, while the Baseline system type must be determined following ASHRAE Standard 90.1-2007 tables G3.1.1A and G3.1.1B.

h) **Other systems** regulated by ASHRAE Standard 90.1-2007 include parking garage ventilation; freeze protection and snow/ice melting systems; exhaust air energy recovery for service water heating; kitchen hoods; laboratory fume hoods; swimming pools; all building power distribution systems; exit signs; parking garage lighting; exterior lighting power; and permanently wired electric motors. For all systems regulated by ASHRAE Standard 90.1-2007, the Proposed model must reflect actual specified systems and the Baseline must comply with the standard.

i) **Process energy** includes office and general miscellaneous equipment, computers, elevators and escalators, kitchen, laundry, lighting exempt from the lighting power allowance, and other loads not regulated by ASHRAE Standard 90.1-2007. All process energy must be included in the simulation. Process energy typically accounts for 25% or more of the total Baseline energy cost. If actual process loads are less than 25% of the total Baseline energy cost, the Partner must provide justification to the Market Manager. Process energy must be the same in both the Baseline and Proposed models unless claimed savings are documented by the Partner with justification for all assumptions

submitted to the Market Manager for approval (e.g. claiming savings for ENERGY STAR appliances, versus standard-efficiency appliances). For facilities where process energy accounts for more than 25% of the Baseline, as may be the case for some industrial facilities, the actual process energy must be modeled but may be capped at 25% of Baseline energy cost in performance rating calculations with prior approval from Market Manager.

j) **Infiltration and Ventilation** is not regulated by ASHRAE 90.1-2007. Therefore, infiltration rates must be the same in the Baseline and Proposed design. Process-related exhaust ventilation may be combined with infiltration to determine the combined rate to be entered in the model. The mechanical ventilation schedule may differ between Baseline and Proposed design when necessary to model non-standard efficiency measures, provided that the revised schedules are approved by the Market Manager. Measures that may warrant use of different schedules include Demand Control Ventilation (DCV), as described in Appendix G.

k) **Energy rates** shall be used from the local utility schedule. If unavailable, the most recent average rates for the applicable rate class and location posted by DOE Energy Information Administration (EIA) at www.eia.doe.gov may be used. Energy cost reduction due to decrease or shift in peak demand in the Proposed design compared to the Baseline may contribute to the *performance rating* if local utility rates include demand and/or time of use charges.

l) **On-Site Renewable Energy** shall not be included in the Proposed building performance model.

m) Proposed **Non-standard energy efficiency measures** must be clearly documented by the Partner and submitted to the Market Manager for approval.

n) **Multiple building modeling.** Sometimes projects include several buildings that have identical characteristics, such as garden-style multifamily buildings, in which case a simplified modeling approach may be used with prior approval from Market Manager. The buildings involved must have *similar envelopes and mechanical systems* as described below:

   - Buildings are considered to have similar envelopes if all of the following conditions are met:
     - Building geometries are similar
     - Total conditioned building area differs by no more than 20%
     - Percentage of area taken by common spaces differs by no more than 20

percentage points.
- Spaces in buildings are of a similar occupancy type
- Areas of surfaces of each type (exterior and below grade walls, windows, roof, slab) differ by no more than 20%
- Thermal properties of envelope components are similar
- Infiltration rates are similar.

- Buildings are considered to have similar mechanical systems if *all* of the following conditions are met:
  - HVAC or domestic hot water equipment in buildings is of similar type
  - Overall plant efficiency varies by no more than 5 percentage points.
  - Mechanical ventilation rates are similar.

4.5 Alternative Modeling Protocols

Projects attempting LEED 3.0 certification or documentation of the EPAct Tax Deduction may follow modeling guidelines set forth by those rating authorities to participate in the Program assuming the following conditions are met:

1. Proof of intended participation in the relevant program;
2. Completion of all necessary Program documentation described in this document and in other application materials, including energy cost reported by end use;
3. Inclusion of all the energy costs within and associated with the building project, including process loads.[4]

The baseline used for LEED 2.2 is based on the prescriptive requirements of ASHRAE 90.1 2004. The baseline used for EPAct Tax Deductions is based on the prescriptive requirements of ASHRAE 90.1-2001. To account for difference in the baseline stringency, the following adjustment[5] must be made to the performance rating calculation described in Section 4.3.4 when LEED 2.2 or EPAct Tax Deduction protocols are used:

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[4] Particularly relevant for projects documenting EPAct Tax Deduction, which does not include process loads when calculating the performance rating.

[5] The purpose of the adjustment is to normalize for differences in ASHRAE 90.1 2001, 2004, and 2007. Adjustment based on "Comparison of Codes" ASHRAE Journal January 2008 (18).

EPAct Tax Deduction

Performance rating = 100(Baseline Building Performance*N*
*-Proposed Building Performance)/(Baseline Building Performance*N).*

N=0.838 for non-residential

N=0.862 for residential

LEED 2.2

Performance rating = 100(Baseline Building Performance*K*
*-Proposed Building Performance)/(Baseline Building Performance*K).*

K=0.95 for non-residential buildings

K=0.977 for residential buildings

4.6 Model Result Validation

The Partner must review and verify the projected usage of the *Baseline* and *Proposed designs* and measure-level savings before submitting the results to Market Manager.

Verification may include the following steps:

1. Verify that un-met load hours (e.g. hours when spaces in a building are under-heated or under-cooled) reported by the simulation tool are within the limits allowed by Section G3.1.2.2 of ASHRAE 90.1-2007 Appendix G.
2. Verify realistic monthly load distribution. For example, simultaneous heating and cooling may indicate incorrectly modeled controls.
3. Verify that incremental savings for individual improvements are realistic in magnitude and impact various end uses as expected.

Compare modeled energy consumption by end use to the available usage statistics for similar building types. The 2003 CBECs survey data presented in **Table 4 1. 2003 CBECs Survey Data** may be used for this comparison. Areas where model results significantly differ from average are a red flag and should be investigated.

Table 4-1. 2003 CBECs Survey Data

3.1.13 2003 Commercial Buildings Delivered Energy End-Use Intensities, by Building Activity (Thousand Btu per SF) (1)

	Education	Food Sales	Food Service	Health Care	Inpatient	Outpatient	Lodging	Mercantile	Service
Space Heating	39.4	28.9	43.1	70.4	91.8	38.1	22.2	24	35.9
Cooling	8	9.8	17.4	14.1	18.6	7.2	4.9	9.9	3.8
Ventilation	8.4	5.9	14.8	13.3	20	3.3	2.7	6	6
Water Heating	5.8	2.9	40.4	30.2	48.4	2.5	31.4	5.1	1
Lighting	11.5	36.7	25.4	33.1	40.1	22.6	24.3	27.5	15.6
Cooking	0.8	8.6	63.5	3.5	5.6	N/A	3.2	2.3	N/A
Refrigeration	1.6	94.8	42.1	2.6	2	3.5	2.3	4.4	2.1
Office Equipment	0.4	1.6	1	1.2	1.1	1.3	N/A	0.7	0.3
Computers	4	9.1	9.5	16.1	18.1	13.2	7	10.3	11.4
Other	3.4	1.9	1.4	3.4	3.9	2.6	1.3	1.1	1
Total	83.1	199.7	258.3	187.7	249.2	94.6	100	91.3	77

	Retail (No Mall)	Enclosed and Strip Malls	Office	Public Assembly	Public Order and Safety	Religious Worship	Warehouse and Storage	Other	Vacant
Space Heating	24.8	23.6	32.8	49.7	49.9	26.2	19.3	79.4	14.4
Cooling	5.9	12.4	8.9	9.6	8.9	2.9	1.3	10.5	0.6
Ventilation	3.7	7.5	5.2	15.9	9.5	1.4	2	6.1	0.4
Water Heating	1.1	7.7	2	1	14	0.8	0.6	2.1	0.1
Lighting	25.7	28.6	23.1	7	16.5	4.4	13.1	34.1	1.7
Cooking	0.6	3.4	0.3	0.8	1.3	0.8	N/A	N/A	N/A
Refrigeration	5	4	2.9	2.2	2.9	1.7	3.5	6	N/A
Office Equipment	0.6	0.8	2.6	N/A	0.6	0.1	0.2	N/A	N/A
Computers	5.6	13.2	9	6.5	10.6	4.9	4.8	18.9	3.1
Other	1	1.1	6.1	N/A	1.6	0.3	0.6	3	N/A
Total	73.9	102.2	92.9	93.9	115.8	43.5	45.2	164.4	20.9

(1) Due to rounding, end-uses do not sum to total

Source: EIA, 2003 Commercial Building Energy Consumption Survey, Energy End-Uses, Oct 2008, Table E.2A

4.7 Documenting Model Inputs

All measure descriptions in the "Recommended Measures" section of the Energy Reduction Plan shall include all key model inputs for all measures. Any input used in the simulation software that corresponds to an energy reduction measure shall be included with the description of the measure. Key model inputs include but are not limited to the following: equipment capacity, equipment size, equipment efficiency, appliance and lighting power density, R-values, U-factors, SHGC, etc. Energy Reduction Plans missing a significant number of key model inputs will not be accepted.

Example:

DHW: Install Direct-fired Boiler

Description of Energy Efficiency Recommendation

- One central DHW natural gas boiler located on the 1st floor; 1.4 MMBtu/hr.
- Size of boiler tank: 200 gallons
- Storage Tank: 1000 gallons
- Thermal Efficiency: 85%
- Energy Factor: 0.765
- Proposed storage tanks have R-12.5 insulation and temperature set point of 120ºF
- Estimated cost: $50,000

Baseline Component

- One 1.4 MMBtu/hr natural gas domestic hot water boiler
- Size of boiler tank: 200 gallons
- Storage Tank: 1,000 gallons
- Thermal Efficiency: 80%
- Energy Factor: 0.72
- Baseline storage tanks have R-12.5 insulation and temperature set point of 120ºF
- Estimated cost: $40,000
- Estimated Incremental Hard Cost $10,000

In addition to the key modeling inputs mentioned above, the description of the proposed measure must also include quantity, model numbers (where available), and equipment location (where applicable). This information must be included for all measures, including not only equipment and appliances, but also any envelope measures. For example, the number of windows and square footage of wall insulation should be included with the description of the corresponding energy efficiency measures for windows and walls. For any lighting measures, descriptions must

include a schedule of the proposed lighting including fixture types by space, as shown on lighting plans for the project. HVAC measure descriptions should include system type, size, manufacturer/model (if available) and efficiency in the appropriate units. This is necessary for facilitating post-installation inspections.

4.7.1 Modeling File Submittal

The following modeling files and reports shall be submitted along with the Proposed Energy Reduction Plan. Reports should be in data PDF format. Additional files and reports may be requested by Market Manager:

eQuest

Modeling files: **.pd2, *.inp, *.prd*

Reports: *Monthly Energy Consumption by Enduse (Baseline and each EEM)*

Monthly Utility Bills-All Rates (Baseline and each EEM)

Trane Trace 700

Modeling files: *.TAF

Reports: *System Checksums (major HVAC systems)*

Monthly Equipment Energy Consumption (Baseline and each EEM)

Monthly Energy Consumption (Baseline and each EEM)

Monthly Utility Costs (Baseline and each EEM)

Entered Values (Baseline and each EEM)

All Other Simulation Platforms

Check with Market Manager

4.8 As-Built Model

Unless otherwise noted in this document, components in the As-Built Building model must reflect the actual building components, as verified or measured during inspections. At the completion of the project, these same guidelines can be used to calculate the performance rating for the As-Built model, by substituting "As-Built" where you find "Proposed". Please see the following Section 5 for additional information on As-Built Energy Reduction Plan.

5 As-Built Energy Reduction Plan Development

5.1 Overview

After construction is complete, the As-Built Energy Reduction Plan and model must be submitted to the Market Manager. This submission will incorporate any changes that occurred during construction from what was originally approved in the Proposed Energy Reduction Plan.

5.2 Rules and Requirements

5.2.1 Incorporating Equipment and System Changes

The As-Built ERP must verify that the equipment specified in the final Proposed ERP was installed, and identify any deviations in equipment, systems, and/or operating schedules. The Partner must update the model, as appropriate, to incorporate these changes and obtain revised energy savings estimates.

For each measure with significant changes, the As-Built ERP must include:

1. Initial equipment/assumptions used in the Proposed ERP
2. Actual equipment and operating conditions
3. Method followed to update building model, or justification that energy savings were not significantly affected
4. Initial and as-built energy savings

5.2.2 Invoices

In addition to the As-Built ERP and model, the Partner must also submit invoices/purchase orders/etc. for the installed energy efficiency measures in order for the Market Manager to verify project costs. Invoices for all measures should include a description of the equipment installed, quantity, and unit price (e.g. material price per fixture, motor, etc.). Material and labor should be indicated separately.

5.2.3 Inspections

Market Manager will visit a project site to verify that the information provided in the As-Built

ERP and/or invoices is accurate with regard to project equipment, site conditions, and monitoring configurations. These inspections may occur at any time after project installation. Should the Market Manager decide to inspect a site, the Market Manager, or its Technical Consultant, may or may not contact the Partner to schedule the inspection. In other words, an inspection may occur without advance notice given to the Partner. If the conditions are found to be different from those represented in the Proposed and/or As-Built ERP, the Market Manager may refuse any further incentive payments.

6 Commissioning Guidelines

6.1 Overview

Commissioning (Cx), as a systematic process, verifies and documents the performance of new facility equipment. Cx is intended to confirm that building equipment and systems meet the design intent and operational needs of the owner, developer, and occupants. Cx shall also confirm the system performance assumptions documented in the Proposed ERP, ensuring the facility achieves the projected energy savings. Efficient new buildings will fall short of the energy savings potential without an effective Cx program.

The Cx process must be overseen by a qualified Commissioning Authority (CxA). The CxA is a person or team with extensive building design and construction experience, generally retained at the onset of the project-design phase. Early involvement of the CxA is necessary in order to guide the design process Cx elements. The intent is to ensure new construction projects funded through the Program are correctly designed, constructed, and yield the highest industry standard performance.

6.2 Rules and Requirements

Once energy efficiency measures are installed, the Cx process can begin and shall follow the outline of the *Cx Plan* submitted with the Proposed ERP. If the measure installed is consistent with the Proposed ERP, then the commissioning of that particular equipment can begin prior to As-Built ERP approval. Measures that have deviated from the Proposed ERP must first be approved under the As-Built ERP prior to being commissioned.

Partners, CxA's, and sub-contractors involved in Cx activities shall observe industry best practices. The Cx Plan, testing procedures, and reporting need to reference ASHRAE Guideline 0-2005. These guidelines contain information on best practice procedures and documentation for Cx, which are an example of typical Cx tasks. Additional references for industry *best practices* and guidelines for Cx and functional testing have been provided in Section 6.5.

The CxA should be independent from the design and construction teams, and must have the proper credentials and industry experience. Documented CxA experience in at least two (2) building projects of similar technical complexity is required. The CxA may be a qualified staff member of the Partner, a consultant retained by the Partner, or a Participant's consultant to the project.

The CxA shall be involved at the beginning of the design process to ensure Cx components,

specifications and responsibilities are defined and in place prior to bid and construction. As an example, subcontractor contracts must contain appropriate direction, defining their responsibilities during the Cx activities. In addition to verifying the installation and operation of building systems, the CxA must work with the Partner to ensure assumptions used in energy savings calculations are incorporated into the Cx Plan and to identify any discrepancies between system operation and modeling assumptions.

The focal point of the Cx process shall be the Energy Management System (EMS), which should be designed to serve as the means to quantify and confirm energy efficient operation. The EMS shall trend-log process variables to demonstrate stable control and intended sequences. Performance graphs developed within the EMS to demonstrate performance and can also be used in subsequent years as a benchmark for comparison purposes.

Figure 6-1 contains a list of common deficiencies often missed during initial Cx, leading to underperforming buildings. Particular care should be taken by the CxA, to ensure each of these potential issues is addressed.

Figure 6-1. Commissioning Findings

Top Ten Deficiencies Discovered by Commissioning New and Existing Buildings

1. Incorrect scheduling of lighting and HVAC equipment
2. Incorrect cooling and heating sequences of operation
3. Incorrect calibration of sensors and instrumentation
4. Lack of control strategies for optimum comfort and efficient operation
5. Malfunctioning air and water side
6. Underutilized computer based control systems
7. Short cycling of HVAC equipment
8. Lack of design intent and building documentation
9. Lack of training for building operators on complex systems

6.2.1 Commissioning Report

Once the Cx process is complete, the Partner or pre-approved Commissioning Authority (CxA) must complete a *Cx Report* to verify and/or identify the following:

1. Measures are the same as originally planned, or at least equivalent or better, in their energy savings than the Proposed ERP and/or As-Built ERP.

2. Nameplate data, such as model number, size, power rating, energy efficiency rating, etc. are the same as those in the Proposed ERP and/or As-Built ERP.
3. Actual energy consumption or equipment output matches assumptions in the Proposed ERP and/or As-Built ERP model and energy savings calculations.
4. Control systems are set and functioning such that they match the assumptions used in the Proposed ERP and/or As-Built ERP energy savings calculations.
5. Measures are likely to achieve (or exceed) their expected energy savings, or if not, that all reasonable corrective measures have been undertaken and that final savings have been accurately re-estimated, as necessary.

The Report, including guidelines for functionality to achieve continued energy savings and any other O&M requirements, should also be provided to the building owner, along with system maintenance manuals.

6.3 Commissioning Team Responsibilities

1. **Owner and/or Partner**. Provides definition and support of project and Cx goals. Empowers the CxA to participate in construction activities within the Plan boundaries. Provides discretionary decision making based on input from Cx team members and others. Defines communication protocols, assures CxA is included in applicable document distribution and present at relevant project meetings.
2. **Commissioning Authority (CxA)**. Organizes and leads the Cx team, develops and coordinates execution of the Cx Plan. Provides services as the energy efficiency advocate, manages preparation and organization of Cx documents, and participates during key construction startup, testing, training and closeout. The CxA facilitates problem resolution where appropriate.
3. **General Contractor (GC).** Assigns a Cx coordinator, whom will proactively participate in the Cx process. Facilitates execution of Cx plan and associated activities. Coordinates and ensures sub-contractor participation and cooperation while integrating Cx into the construction, startup, and testing and closeout process. Provides scheduling, preparation and/or compilation of related record documents.
4. **LEED Consultant**. Retained to facilitate achievement of credits and submittal requirements for targeted certification level if LEED goals are a part of the project goals.
5. **Architect**. Primary architectural design responsibility and associated authority. Prepares

architectural plans, specifications, reviews and approves applicable submittals and shop drawings. Supports Cx Plan strategies and participates in select Cx tasks. Performs periodic site inspections, prepares punch lists, advises on acceptance and supports project closeout.

6. **Mechanical & Electrical Engineers**. Have primary engineers-of-record responsibility and design authority. Prepares engineering plans, specifications and Basis of Design (BOD), reviews and approves equipment submittals and shop drawings. Supports Cx Plan strategies and participates in select Cx related tasks. Performs periodic site inspections, prepares punch lists, advises on Owner acceptance and supports project closeout.
7. **Mechanical & Electrical Contractors**. Assigns a Cx coordinator, who will participate in the Cx process. Participates in Cx and related tasks.
8. **EMS Controls Contractor**. Assigns a Cx coordinator, who will participate in the Cx process. Participates in Cx and related tasks, including preparation of EMS trending data, which demonstrate properly operating system sequences and performance.

6.4 Commissioning Process

For the purposes of the Program, the Market Manager will focus the review on components of the building design that are affected by the proposed energy efficiency measures.

6.4.1 Design Phase

The Cx objectives during the design phase include introducing the Cx process to the design team and other stakeholders. The CxA will initiate meetings and establish the Cx role, provide Cx-focused design review, comment, and recommendations. The CxA will coordinate Cx activity and related tests and inspections, and make sure other QA/QC requirements are clearly specified and organized.

6.4.2 Construction Phase

1. **Construction Phase Scoping Meeting:** The introductory Cx meeting will be organized by the CxA with the appropriate team members. Topics of the scoping meeting include:
    a. Establish team introductions, roles, responsibilities and expectations.
    b. Review Cx Plan review, Cx process interpretation and focus.
    c. Establish Pre-testing documentation responsibilities and expectations.

d. Define testing responsibilities and expectations.
e. Schedule highlights.
f. Obtain consensus by team members on Cx plan strategy.

2. **Regular Meetings and Job Walks:** The CxA will schedule, meet and walk the project periodically to:
    a. Facilitate the Cx progress, including general coordination and other meetings.
    b. Observe construction, startup, testing, inspections and other field activities.
    c. Coordinate EMS controls sequence of operation implementation and trending of system point data for demonstration of system acceptance.

    The CxA will also provide appropriate meeting minutes, memorandums, or field observation reports using standard forms, as applicable.

3. **Control System Cx:** Controls coordination meetings will be periodically held to track the following topics for primary and third party furnished controls.
    a. Construction shop drawings and equipment submittals.
    b. Final sequences of operation, advanced energy management features, manual and automatic setpoint adjustment strategies.
    c. Application, work station graphic screen and process software development including operator interface optimization.
    d. Sensor and device calibration plan.
    e. Pre-functional checklists.
    f. Functional performance test plan.
    g. Trend logging and report generation.

4. **Pre-Functional Testing Checklists:** These checklists will be generally provided by the GC with CxA oversight.
    a. Pre-functional checklists (PFCL's) include a combination of:
        i. In-house developed checklists,
        ii. Manufacturer start-up checklists, and/or
        iii. Field technician furnished startup checklists.
    b. CxA will help develop, review, and provide comments on proposed PFCL's.
    c. The CxA will organize and produce a binder of PFCL's for equipment and systems in preparation for startup and testing.

5. **Functional Performance Testing (FPT) Plans:**
    a. Functional performance tests demonstrate operation of:
        i. EMS communications infrastructure and operator work station.
        ii. EEM Equipment operation
        iii. Sequences of operation including system scheduling, mode and process loop control, alarm reporting, failure operation and data logging.
    b. FPT plans will include table summaries describing equipment testing, observed discrepancies and corrective actions.
    c. The CxA will incorporate key performance parameters used in the building energy simulation by the P4P Partner into the FPT plans.
    d. The CxA will prepare the FPT plan forms and will incorporate them into a binder in preparation for actual testing.

6. **Resolving and Reporting Deficiencies:** The CxA will develop procedures to be followed in cases where deficiencies are found during pre-functional and functional testing activities, including:
    a. Methods for both reporting and resolving the deficiency.
    b. Determination of effect on expected building performance, as reported in the Proposed ERP.
    c. Communication and decision requirements for Project Team, Owner, Partner, and Market Manager.

6.4.3 Startup, Testing, and Optimization Phase

1. **Pre-Functional Startup, Checkout**
    a. GC will confirm completion of construction and pre-startup activities, including permanent power, natural gas, domestic cold water, fire protection water and other utilities. Duct and piping systems are tested and cleaned, water treatment and filtration systems are in place and other pre-conditions for startup are in completed and operational.
    b. CxA will observe and provide comments during startup/checkout for each piece of primary equipment, unless there are multiple units, where a sampling strategy will be used. Observed discrepancies will be corrected.

2. **Functional Performance Testing (FPT)**
    a. Functional performance testing will include execution of FPT plans and documentation of results. Execution will be achieved by using a combination of

the following strategies:

i. Manual observation, testing and reporting.
ii. EMS Control system trend log reporting and analysis.

b. Testing will proceed from components to subsystems to systems and finally to interlocks and connections among systems, including life safety.

6.4.4 Closeout

1. **Closeout meeting.** This meeting will be held strategically and/or in association with a regular Cx meeting near project completion. Relevant closeout items include:
   a. Completion of functional performance testing. Closeout will not occur until after successful completion of testing has occurred, unless agreed to otherwise by the project team.
   b. Record documentation**.** GC will receive and distribute record documents and other information representing the constructed condition. The Architect will submit record documentation as appropriate.

2. **Training.** CxA and GC will confirm that training has been completed and will issue applicable documentation, including training activity, attendees, outline of reference material, and schedule. CxA will participate in training summary by integrating energy management, continuous Cx and other design intent features with training syllabus.

3. **Warranties.** GC will compile warranties, including milestone dates, inclusions, exclusions, contacts, procedures and other relevant items.

4. **LEED documentation.** CxA will compile information, and prepare and upload LEED prerequisite and credit documentation, if applicable.

5. **Final Commissioning Report.**
   a. CxA will aggregate relevant data and information collected throughout the project cycle.
   b. CxA will prepare written text summarizing the Cx activity. The CxA will also identify relevant data and other information collected where legacy value can be accrued by permanent building operations teams.
   c. CxA will produce Final Cx Report and electronically and in paper form for submission to Owner and P4P Partner.
   d. Partner will submit Final Cx Report to P4P Market Manager for approval.

6.5 Additional Resources for Commissioning Best Practices

For further references on Cx and functional testing procedures that meet P4P Program requirements, please consult ASHRAE Guideline 0-2005 and related documents.

The following resources contain additional information on current industry best practices for design, implementation, and documentation of Cx plans for commercial new construction. This list is provided as a supplemental reference to ASHRAE Guideline 0-2005, to aid in preparation of Cx Plans and design of functional testing procedures:

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): http://www.ashrae.org/publications/

California Commissioning Guide for New Buildings: http://www.cacx.org/resources/documents/CA_Commissioning_Guide_New.pdf

Portland Energy Conservation, Inc. (PECI) - Model Commissioning Plan and Guide Specification: http://www.peci.org/CxTechnical/mcpgs.html

National Institute of Building Sciences - Whole Building Design Guide: http://www.wbdg.org/project/doc_comp.php

Building Commissioning Association (BCI) - Commissioning Process Templates: http://www.bcxa.org/resources/templates/index.htm

Appendix A

NJCEP Measure Lives

The measure lives listed below should be used for all recommended measures included in the Energy Reduction Plan.

NEW JERSEY STATEWIDE ENERGY-EFFICIENCY PROGRAMS
Measure Lives Used in Cost-Effectiveness Screening
July 2001

PROGRAM/Measure	Measure Life
Residential Programs	
Energy Star Appliances	
ES Refrigerator post 2001	17
ES Refrigerator 2001	17
ES Dishwasher	13
ES Clotheswasher	20
ES Dehumidifier	11
ES RAC	10
Energy Star Lighting	
CFL	6.4
Recessed Can Fluourescent Fixture	20
torchiere residential	10
Fixtures Other	20
Energy Star Windows	
WIN-heat pump	20
WIN-gas heat/CAC	20
WIN-gas No CAC	20
Win-elec No AC	20
Win-elec AC	20
Refrigerator/Freezer Retirement	
Refrigerator/Freezer retirement	8
Residential New Construction	
SF gas w/CAC	20
SF gas w/o CAC	20
SF oil w/CAC	20
SF all electric	20
TH gas w/CAC	20
TH gas w/o CAC	20
TH oil w/CAC	20
TH all electric	20
MF gas w/AC	20
MF gas w/o AC	20
MF oil w/CAC	20
MF all electric	20
ES Clotheswasher	20
Recessed Can Fluor Fixture	20
Fixtures Other	20
Efficient Ventilation Fans w/Timer	10

PROGRAM/Measure	Measure Life
Residential Electric HVAC	
CAC 13	15
CAC 14	15
ASHP 13	15
ASHP 14	15
CAC proper sizing/install	15
CAC QIV	15
CAC Maintenance	7
CAC duct sealing	15
ASHP proper sizing/install	15
E-Star T-stat (CAC)	15
E-star T-stat (HP)	15
GSHP	30
CAC 15	15
ASHP 15	15
Residential Gas HVAC	
High Efficiency Furnace	20
High Efficiency Boiler	20
High Efficiency Gas DHW	10
E-Star T-stat	15
Low-Income Program	
Air sealing electric heat	17
Duct Leak Fossil Heat & CAC	15
typical fossil fuel heat	17
typical electric DHW pkg	10
typical fossil fuel DHW pkg	10
screw-in CFLs	6.4
high-performance fixtures	20
fluorescent torchieres	10
TF 14	20
TF 16	20
TF 18	20
SS 20	20
TF 21	20
SS 22	20
TF 25	20
audit fees	20
Attic Insulation- ESH	17
Duct Leak - ESH	15
T-Stat- ESH	5
HP charge air flow	8
electric arrears reduction	1
gas arrears reduction	1
Home Performance with ENERGY STAR	
Blue Line Innovations – PowerCost MonitorTM	5

Non-Residential Programs

C&I Construction

PROGRAM/Measure	Measure Life
Commercial Lighting — New	15
Commercial Lighting — Remodel/Replacement	15
Commercial Custom — New	18
Commercial Chiller Optimization	18
Commercial Unitary HVAC — New - Tier 1	15
Commercial Unitary HVAC — Replacement - Tier 1	15
Commercial Unitary HVAC — New - Tier 2	15
Commercial Unitary HVAC — Replacement Tier 2	15
Commercial Chillers — New	25
Commercial Chillers — Replacement	25
Commercial Small Motors (1-10 HP) — New or Replacement	20
Commercial Medium Motors (11-75 HP) — New or Replacement	20
Commercial Large Motors (76-200 HP) — New or Replacement	20
Commercial VSDs — New	15
Commercial VSDs — Retrofit	15
Commercial Comprehensive New Construction Design	18
Commercial Custom — Replacement	18
Industrial Lighting — New	15
Industrial Lighting — Remodel/Replacement	15
Industrial Unitary HVAC — New - Tier 1	15
Industrial Unitary HVAC — Replacement - Tier 1	15
Industrial Unitary HVAC — New - Tier 2	15
Industrial Unitary HVAC — Replacement Tier 2	15
Industrial Chillers — New	25
Industrial Chillers — Replacement	25
Industrial Small Motors (1-10 HP) — New or Replacement	20
Industrial Medium Motors (11-75 HP) — New or Replacement	20
Industrial Large Motors (76-200 HP) — New or Replacement	20
Industrial VSDs — New	15
Industrial VSDs — Retrofit	15
Industrial Custom — Non-Process	18
Industrial Custom — Process	10
Small Commercial Gas Furnace — New or Replacement	20
Infrared Heating	17
Small Commercial Gas Boiler — New or Replacement	20
Small Commercial Gas DHW — New or Replacement	10
C&I Gas Absorption Chiller — New or Replacement	25
C&I Gas Custom — New or Replacement (Engine Driven Chiller)	25
C&I Gas Custom — New or Replacement (Gas Efficiency Measures)	18
Building O&M	
O&M savings	3
Compressed Air	
Compressed Air (GWh participant)	8
Refrigeration	
Evaporator Fan Control	10
Cooler and Freezer Door Heater Control	10
Polyethylene Strip Curtains	4
Food Service	
Fryers	12

PROGRAM/Measure	Measure Life
Steamers	10
Griddles	12
Ovens	12

Appendix B

Minimum Performance Standards

This appendix contains information on minimum performance standards for measures included in the project workscope (derived from the NJ SmartStart Buildings Program).

Proposed measures must:

- Meet or exceed minimum efficiencies and/or requirements as listed within this Appendix, OR
- Exceed ASHRAE 90.1-2007, OR
- Exceed minimum efficiencies as established by law, code, or standard practice

…whichever is more stringent.

Additionally, all applicable equipment must be listed by UL or other OSHA approved Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable US standards. Manufacturer's specification sheets may be requested by Market Manager to confirm performance.

B-1. Chillers

Electric Chillers

	<150 tons	**150 to <300 tons**		**≥300 tons**	
	Full Load	**Full Load**	**Part Load**	**Full Load**	**Part Load**
Water-Cooled	0.75 kW/ton	0.56 kW/ton	0.50 kW/ton	0.47 kW/ton	0.46 kW/ton
Air-Cooled	1.20 kW/ton				

Gas Absorption Chillers

Gas absorption chillers must have a full load efficiency ≥ 1.1 COP.

B-2. Electric Unitary HVAC

Unitary HVAC/Split Systems*	
< 5.4 tons	14.0 SEER
≥5.4 to < 11.25 tons	11.5 EER
≥11.25 to < 20 tons	11.5 EER
≥20 to 30 tons	10.5 EER

Air-to-Air Heat Pump Systems	
< 5.4 tons	14.0 SEER & 7.8 HSPF
≥5.4 to < 11.25 tons	11.5 EER
≥11.25 to < 20 tons	11.5 EER
≥20 to 30 tons	10.5 EER

Packaged Terminal Systems	
< 9000 BTUH	12.0 EER
≥9,000 BTUH to 12,000 BTUH	11.0 EER
> 12,000 BTUH	10.0 EER

Water Source Heat Pumps	
All size	14.0 EER

Central DX AC Systems	
> 30 tons	≥9.5 EER

*Both indoor and outdoor components of a Split System must be replaced to qualify for the Program.

B-3. Ground Source Heat Pumps

Ground Loop & Ground Water Heat Pumps	
Type	Qualifying Efficiency Level
Closed Loop	≥ 16 EER* ENERGY STAR rated equipment only
Open Loop	Not permitted

*Performance ratings (EER, Btuh) for qualifying closed loop Ground Source Heat Pump equipment are calculated at 77 °F entering water temperature per test procedure ISO-13256-1.

B-4. Variable Frequency Drives

- The VFDs must be installed in a system that incorporates pressure sensors (or other applicable sensor devices) in the flow stream.
- The VFD must have either an input line reactor or isolation transformer.

B-5. Gas Water Heating

	≤ 50 Gallons	>50 Gallons	
		≤ 1500 MBH	>1500 MBH
Gas Water Heater	67% energy factor	85% AFUE	84% AFUE

Tankless Water Heater

Tankless Water Heaters must have a minimum energy factor of 82% or thermal efficiency of 90%.

B-6. Gas Heating

Gas-Fired Boilers	
Capacity, MBH	**Minimum Efficiency**
< 300 MBH	85% AFUE
≥300 - 1500 MBH	85% AFUE for Hot Water boilers 84% AFUE for Steam boilers
>1500 MBH	84% AFUE for Hot Water boilers 83% AFUE for Steam boilers

Gas Furnaces	
Capacity	**Minimum Efficiency**
All size	95% AFUE

B-7. Refrigeration Covers/Doors

- Doors must have either heat reflective treated glass, be gas filled, or both.
- Aluminum night curtains only applicable for refrigerated cases, used for non-frozen products which do not have doors or other means of full or partial closure to reduce cold air loss to ambient room air.

B-8. Premium Motors

	Open Drip-Proof (ODP)				Totally Enclosed Fan-Cooled (TEFC)		
	Speed (RPM)				Speed (RPM)		
	1200	1800	3600		1200	1800	3600
Size HP	NEMA Nominal Efficiency						
1	82.5%	85.5%	77.0%		82.5%	85.5%	77.0%
1.5	86.5%	86.5%	84.0%		87.5%	86.5%	84.0%
2	87.5%	86.5%	85.5%		88.5%	86.5%	85.5%
3	88.5%	89.5%	85.5%		89.5%	89.5%	86.5%
5	89.5%	89.5%	86.5%		89.5%	89.5%	88.5%
7.5	90.2%	91.0%	88.5%		91.0%	91.7%	89.5%
10	91.7%	91.7%	89.5%		91.0%	91.7%	90.2%
15	91.7%	93.0%	90.2%		91.7%	92.4%	91.0%
20	92.4%	93.0%	91.0%		91.7%	93.0%	91.0%
25	93.0%	93.6%	91.7%		93.0%	93.6%	91.7%
30	93.6%	94.1%	91.7%		93.0%	93.6%	91.7%
40	94.1%	94.1%	92.4%		94.1%	94.1%	92.4%
50	94.1%	94.5%	93.0%		94.1%	94.5%	93.0%
60	94.5%	95.0%	93.6%		94.5%	95.0%	93.6%
75	94.5%	95.0%	93.6%		94.5%	95.4%	93.6%
100	95.0%	95.4%	93.6%		95.0%	95.4%	94.1%
125	95.0%	95.4%	94.1%		95.0%	95.4%	95.0%
150	95.4%	95.8%	94.1%		95.8%	95.8%	95.0%
200	95.4%	95.8%	95.0%		95.8%	96.2%	95.4%

- Qualifying Premium Motors that operate at least 2000 run hours annually.

B-9. Lighting - Fixtures

Applicant and/or partner shall be responsible for maintaining and confirming adequate light levels. Lighting installed should comply with the following minimum lighting levels:

- Lighting level requirements as specified by New Jersey's nonresidential construction code, or
- For publicly supported schools, minimum lighting levels as specified in the New Jersey Administrative Code Title 6-NJAC 6:22-5.4, g1-h1.

Linear Fluorescents:

- All new linear T-5 and T-8 fluorescent fixtures must be installed with new electronic ballasts.
- All electronic ballasts must have a Total Harmonic Distortion of ≤ 20%.

Compact Fluorescents:

- Fixtures must be new, hard-wired and ENERGY STAR qualified.
- Total Harmonic Distortion (THD) must not exceed 33%.
- Power factor of the ballast must be no less than 90%.
- Only PAR 38 or PAR 30 screw-in CFLs are permitted. Lamps must be ENERGY STAR qualified or must be warranted by the manufacturer for 8,000 hours.

LED:

- LED fixture must be listed on ENERGY STAR or Design Lights Consortium qualified products list.

B-10. Lighting - Controls

Occupancy Sensor Controls:

- In general, sensors must control only eligible energy efficient lighting fixtures.
- Occupancy sensors must not allow manual override to the "ON" position.

High-Low Controls (OHLF and OHLH):

- The program does not condone high-low controls on eligible fluorescent fixtures where daylight dimming controls can be effectively employed.
- The program does not condone high-low controls in spaces smaller than 250 square feet.
- "Low level" must be less than 60% of "high level."
- The program does not condone high-low controls for the following spaces: stairways, elevators, corridors/hallways, or lobbies.
- OHLF will control fixtures that have a ballast factor less than 1.0 for T-5s and 1.14 for T-8s.
- OHLH will control fixtures that have a ballast factor greater than or equal to 1.0 for T-5s and 1.14 for T-8s.

Daylight Dimming Controls for Eligible Fixtures:

- Daylight dimming controls must operate at least 4 eligible ballasts with a minimum total connected load of 240 watts.
- Dimming shall be continuous or stepped at 4 or more levels.
- Daylight dimming control systems must be designed in accordance with IESNA practice as delineated in "RP-5-99, IESNA Recommended Practice of Daylighting."
- DLD will control fixtures that have a ballast factor less than 1.0 for T-5s and 1.14 for T-8s.
- DDH will control fixtures that have a ballast factor greater than or equal to 1.0 for T-5s and 1.14 for T-8s.