**ASHRAE Level II Energy Assessment Report**

for

**Building Name**

**Address**

*Draft (template)*

**Preparation date:**

Date of report

**Prepared for:**

Company Name

Contact Name, Title

Address

**Prepared by:**

Energy Assessment Firm

Contact Name, Title

Address

*For Compliance with City of Boulder Building Performance Ordinance*

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# Executive Summary

This section should summarize the findings of the energy assessment including the rating and reporting results, the list of practical[[1]](#footnote-1) energy measures with estimated costs and benefits, and the potential energy and cost savings with key financial indicators. This section should also include the summaries of the City Manager Rule requirements of retrocommissioning and lighting evaluations.

A sample table of practical energy efficiency measures (EEMs) is provided below.

Table 1. Practical Measure Energy and Cost Savings

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***EEM #*** | ***Measure Name*** | ***Energy Saved (energy unit/yr)*** | ***Energy Cost Savings ($/yr)*** | ***Maintenance Cost Savings ($/yr)*** | ***Measure Cost ($)*** | ***Rebates and Incentives ($)*** | ***Simple Payback (years)*** |
| *1 (low/no cost measures)* | *B-1 OAT Lockout* | *504 therms* | *$585* | *$0* | *$480* | *$240* | *<2 yrs* |
|  |  |  |  |  |  |  |  |
| **Subtotal** |  |  |  |  |  |  |  |
| *3 (Capital Measures)* | *Replace Lobby T-8 with LED Fixtures* | *7,711 kWh* | *$925* | *$1,440* | *$4,500* | *$900* | *>2 yrs, but < EEM life* |
|  |  |  |  |  |  |  |  |
| **Subtotal** |  |  |  |  |  |  |  |
| **Total** |  |  |  |  |  |  |  |

## Retrocommissioning Evaluation Results

This section should summarize the evaluation of the costs and benefits of implementing the retrocommissioning requirements in the Building Performance Ordinance. If retrocommissioning is not recommended, please justify. (Note: This will be the high level executive summary of Section 5.7 below).

## Lighting Evaluation Results

This section should include a statement of whether the building’s lighting systems and controls meet the lighting requirements in the Building Performance Ordinance. (Note: This will be the high level executive summary of Section 5.8 below).

# Introduction

This section introduces the scope of the project, what will happen and when, and provides contact information for the key team members.

## Assessment Scope

Provide a scope for the energy assessment process including all the major steps and clarification as to what is included in each step along with deliverables.

Please provide an estimate of what percentage of total energy use comes from process loads. If the facility includes industrial processes that account for over 25% of total energy use, then those must be included in the scope of the assessment and energy efficiency measures evaluated for these processes.

## Key Dates

Provide important dates for items such as preliminary walkthrough, staff interviews, testing, logging or trending intervals, preliminary measure selection meeting, final presentation or other important dates.

## Contact Information

Provide contacts for energy assessment contractor and client team members.

# Facility Description

This section describes the building as it exists at the time of the assessment. Provide general building information such as age, gross floor area in square feet, building orientation, space use, construction types and any major retrofits. For building envelope, domestic hot water, electrical, lighting, HVAC, plug loads, process loads, vertical transportation, and control systems include major equipment types, how they are managed, when they are used, and discuss how you differentiate between these different systems. Also, in the “other applicable information” section provide information on any special events or facility requirements which may affect energy use overall, such as historic landmark status. Include pictures of key areas and/or systems when applicable.

* General building information
* Building envelope
* Domestic hot water systems
* Electrical systems
* Lighting systems
* HVAC systems
* Plug loads
* Process loads
* Vertical transportation
* Control systems
* Other applicable information

# Historical Utility Data

This section is meant to provide the client with a breakdown of historical energy demand, use and cost data in order to highlight trends, identify opportunities, and show the relationship between weather, processes, occupancy, any other factors, and energy use. It can also serve to show the relative importance of different fuels. Include information on how energy is purchased, peak and off-peak pricing, load profiles of consumption and peak demand, graphs of peak usage, and a monthly summary if on a time-of-use schedule. Include cost saving utility rate analysis recommendations.

## Monthly energy data summary for two to three years

ENERGY STAR Portfolio Manager requires at least twelve consecutive months of utility data for benchmarking. Two to three years is preferred to identify weather related bias in the energy data. Also provide purchasing and rate structure for each type of energy (including demand and time-of-use for electricity).

## Energy benchmarking

Include load profiles, heating and cooling degree days to heating and cooling energy comparisons, and energy use profile comparison by fuel and peak electricity demand.

## Energy target index and savings estimate

Provide energy use intensity (EUI) for the facility and estimated available savings based on EUI comparison with similar facilities in the same climate zone. Provide the ENERGY STAR score if applicable.

## End-use breakdown

Provide end-use energy breakdown by total energy, cost, and fuel.

# Energy Savings Opportunities

This section provides the findings of the energy assessment in detail, presenting the energy efficiency measures (EEMs) organized in a manner that allows the owner to select the package best suited to their needs and budget.

## Practical energy efficiency measures

This is the list of practical[[2]](#footnote-2) measures evaluated. If the facility includes industrial processes that account for over 25% of total energy use, then those must be included in the scope of the assessment and energy efficiency measures evaluated for these processes. Practical EEMs are composed of two primary types, capital measures and low-cost/no-cost measures.

The primary difference between these two types of practical measures is that capital measures include significant capital investment in physical plant that will have a simple payback longer than two years, while low-cost/no-cost measures have a simple payback period of two years or less and don’t require large capital investments.

For each practical measure provide the following detailed information.

1. **Description of current situation**

Describe current situation the equipment, schedule or operation including all pertinent information leading to the recommendation.

*Sample capital measure: The existing fire tube boiler B-1 is 23 years old, 6,000 MBH capacity, is likely oversized since windows were upgraded in 2008, and has a no turn-down or staging capability. It is estimated at about 72% efficient due to corrosion from age and poor heating hot water loop maintenance.*

*Sample low-cost/no-cost measure: The boiler B-1 runs 24 hours per day, 7 days per week, all year round with a heating hot water set point of 180 degrees F.*

1. **Recommended changes**

Describe the EEM and why it is being proposed, in other words how it will save energy.

*Sample capital measure: The boiler B-1 will be replaced by two new 2,000 MBH two-stage condensing boilers with efficiency ratings of over 92%, placed on a weekly lead-lag schedule to match operating hours, and staged to run only one boiler unless heating load is great enough to require both boilers. Energy savings will result from increased efficiency and the ability to better match boiler energy output to load.*

*Sample low-cost/no-cost measure: Reduce boiler schedule to only run from October 1 to June 1 each year and add hot water reset schedule that lowers heating hot water supply set point (120°F to 180°F) to match outdoor air temperature. Savings will accrue from reduced runtime and reduced energy output with temperature following load.*

## Potential Rebates:

*Sample capital measure: Utility Company has a commercial condensing boiler prescriptive rebate of $3,500 per million Btuh.*

*Sample low-cost/no-cost measure: Recommend a full RCx study. 75% of study costs and up to 50% measure cost can be reimbursed by the Utility Company.*

## Savings Summary:

Table 2. EEM-N Savings Summary

|  |  |
| --- | --- |
| **Component** | **Value** |
| Electricity Consumption Savings (kWh/yr) |  |
| Electricity Demand Savings (kW/yr) |  |
| Gas Consumption Savings (therms/yr) |  |
| Annual Utility Savings ($/yr) | $ |
| Estimated Implementation Costs ($) | $ |
| Potential Incentives ($) | $ |
| Simple Payback without Incentives (yrs) |  |
| Simple Payback with Incentives (yrs) |  |
| Estimated Maintenance Savings ($) | $ |

## Other Notes:

Include additional information such as evaluation methods.

*Sample capital measure: Contact Utility Company prior to equipment change for existing equipment verification required for prescriptive rebate.*

*Sample low-cost/no-cost measure: The RCx study trending should indicate the best method for annual lock out, whether this is date based or outside air temperature based. Engineering firm to calculate boiler temperature reset based on new calculated load, selected equipment, and overall control strategy.*

Table 3. Practical Measure Timeline and Evaluation Method Recommendations

|  |  |  |
| --- | --- | --- |
| **EEM #** | **Implementation Timeline** | **M&V Method** |
| *Sample* | *After Utility RCx study, before summer* | *Pre/post annual gas use weather normalized* |
| *Sample* | *Boiler update next fiscal year, summer* | *Ongoing Cx* |
|  |  |  |
|  |  |  |
|  |  |  |

Please refer to Appendix H: Detailed Specifications for Practical EEMs for detailed specifications for each practical EEM.

## Summary of applicable rebates, incentives and financing options

Provide a summary of the various ways to reduce and finance the capital costs of the measures.

## Retrocommissioning evaluation

Per the Building Performance Ordinance, an RCx potential assessment is required in the scoping phase of the energy assessment. Summarize the need and opportunities for RCx, including identification of operations and maintenance problems and needs. Provide justification if there is clearly no anticipated benefit from the required RCx scope.

## Lighting upgrade assessment

Per the Building Performance Ordinance, a lighting upgrade assessment must be included as part of the energy assessment. This section highlights the findings of whether the building’s lighting systems and controls meet each lighting requirement in the ordinance. If the assessment concludes that the ordinance lighting requirements are already met, please convey to the owner that compliance must be reported through a professional that can calculate the lighting power allowances, run a COM*check*™[[3]](#footnote-3) report and use City of Boulder compliance spreadsheets, and submit compliance to the city.

If the existing lighting does not meet the ordinance requirements, please convey to the owner that a professional must implement all needed lighting upgrades to meet requirements, calculate the lighting power allowances, run a COM*check*™ report and use City of Boulder compliance spreadsheets, and submit compliance to the city. Include a statement of any situation or instance in the building where in your opinion the IECC 2012 and COBECC 2017 requirements are impractical for the space.

## Capital energy measure descriptions

Capital energy measures are those measures which require a capital investment to implement. Capital measures are a type of Practical measure that typically has a simple payback of greater than 2 years.

Include major assumptions, savings calculations methodology, existing conditions, proposed retrofit, significant impacts on health, comfort and safety, recommended options for measure savings verification, expected new equipment life, training requirements, operations and maintenance changes and potential interactive effects for each recommended measure.

If the facility includes industrial processes that account for over 25% of total energy use, then those must be included in the scope of the assessment and energy efficiency measures evaluated for these processes.

## Measures considered but not evaluated

This section is a listing of measures that were considered but not evaluated. Include assumptions and the reasons why these possible measures were not included.

# Special Conditions

Discuss any special conditions such as specific timing or pre-requisites for implementing measures, for example required repairs prior to implementing given measures.

# Appendix A: Utility Data for Evaluation Period

Provide monthly utility data for the evaluation period, and for each energy utility provider.

The evaluation period is the one to three-year period of utility data that will be utilized to benchmark and estimate such aspects as energy use breakdown or specific equipment energy use. Provide a period starting and ending month as well as number of days per month.

# Appendix B: Utility Rate Schedules

Provide all pertinent utility rate schedules for all energy utility providers here.

# Appendix C: Calculation Methodology

Provide detailed information about your calculation methodologies and assumptions here. For calculation data provide description of inputs, defaults, assumptions and sources. Please provide the general construction of your calculations, outline how you have handled interactions between measures, and provide calculation accuracy estimates (i.e. +/- 15%) as well.

*For example: Boiler Part Load Efficiency Curve[[4]](#footnote-4)*

This image shows mathematical equations and definitions for calculating fuel consumption in heating systems.
The main equation at the top states: Fuel_partload = Fuel_design × FHeatPLC(Q_partload, Q_rated)
Below that is the FHeatPLC equation: FHeatPLC = a + b × (Q_partload/Q_rated) + c × (Q_partload/Q_rated)²
The image includes a definitions table with the following variables:

FHeatPLC: The Fuel Heating Part Load Efficiency Curve
Fuel_partload: The fuel consumption at part load conditions (Btu/h)
Fuel_design: The fuel consumption at design conditions (Btu/h)
Q_partload: The boiler capacity at part load conditions (Btu/h)
Q_rated: The boiler capacity at design conditions (Btu/h)
a: Constant
b: Constant
c: Constant

The equations appear to be technical specifications for calculating how fuel consumption varies with boiler load conditions.

# Appendix D: EEM Savings Calculations

Provide copies of your savings calculations here. PDFs or graphics files are acceptable.

The savings calculations need to **clearly** show how current and proposed cases were calculated, the assumptions used, and any caveats or estimated variance to the values provided. List all variables that went into the calculation.

*For example: Annual lighting electricity usage = watts per fixture X number of fixtures X annual hours of operation.*

# Appendix E: Cost Estimates

Provide details of your cost estimates here including sources and what services are included in the price such as equipment, installation, commissioning, etc. Also provide your estimated cost accuracy (i.e. +/- 25%).

# Appendix F: Equipment Inventory Tables

Include the inventory of existing equipment here. This information is typically broken up between major categories such as HVAC, lighting, plug load and process equipment. As a minimum this should include tag number, location, area served, age, capacities, efficiencies, electrical data, refrigerant type if applicable, fuel, and control type.

# Appendix G: Operations & Maintenance Logs

Provide any pertinent operations and maintenance logging and trending information that is used to inform any of the measures.

# Appendix H: Detailed Specifications for Practical EEMs

Provide energy measure minimum equipment specifications including items such as capacity, voltage, minimum efficiency, control requirements, etc. if they are known and may impact the installation, operations and maintenance, health and safety, or efficiency of the measure.

* A more detailed description of the EEM including the following: (not every upgrade will be a piece of equipment, but might be an envelope retrofit or controls strategy, etc.)
  + The existing conditions
  + The proposed upgrades
  + Why it is recommended
* Picture/visual
* Capacity
* Efficiency
* Weight, size (i.e. roof, ceiling, closet considerations including maintenance access)
* New requirements such as condensate disposal, fusing/breaker changes, water requirements for evaporative pre-cooling
* Other related changes due to installation (i.e. limited to time of year, access, temporary air quality monitoring, etc.)
* Simple diagrams/plans if applicable (i.e. reflected ceiling plans for lighting or sensor locations for daylighting retrofits)
* Required controls changes or updates
* Operations and maintenance notes

# Appendix I: Internal Reviews and Quality Control

Provide information here on your methodology for internally reviewing your data, calculations, assumptions, and document quality. This should include as a minimum internal review of calculations and owner/operator meetings to review assumptions.

1. A “practical measure” is an Energy Efficiency Measure (EEM) that is determined by the energy assessor to be technically feasible and have a simple payback that is less than the anticipated lifecycle of the measure. [↑](#footnote-ref-1)
2. A “practical measure” is an Energy Efficiency Measure (EEM) that is determined by the energy assessor to be technically feasible and have a simple payback that is less than the anticipated lifecycle of the measure. [↑](#footnote-ref-2)
3. [COM*check*](https://www.energycodes.gov/comcheck)™ is a Dept. of Energy tool that simplifies the process of determining whether a building meets IECC requirements, as well as other code requirements. [↑](#footnote-ref-3)
4. California Energy Commission, *2013 Nonresidential Alternative Calculation Method Reference Manual*, (CEC 2013). [↑](#footnote-ref-4)