**2024 Commercial Energy Modeling Report**

There are three Performance Compliance Paths in the 2024 City of Boulder Energy Conservation Code:

* Fixed Target Performance Path
* Modeled Baseline Performance Path
* Measured Performance Outcome Path

These compliance paths are described in Section C407 of the energy code. All new construction with construction values greater than $500,000 must use one of these paths. Additionally, Level 3, including Level 3 with substantial mechanical and Level 3 with substantial envelope. Alterations as defined in the code must also use one of the performance paths to comply with the energy code. This Energy Modeling Report serves as the template for all three energy code compliance paths. If using the Fixed Target or Measured Outcome Performance Paths, the Baseline Inputs may be left blank.

**Directions:** Please complete and submit this report with permit application for commercial projects pursuing compliance with the 2024 City of Boulder Energy Conservation Code Performance Path. In addition, the Mandatory Measures Checklist must be completed and submitted with the permit application.

Projects pursuing LEED certification and using the Modeled Baseline Performance Path can alternatively submit the LEED version 5 Minimum Energy Performance Calculator to document compliance with the City of Boulder’s code. Projects must still demonstrate a Performance Index (PIsite) 15% for mixed fuel buildings and 10% for all-electric buildings below the Performance Index Site Target (PItsite) calculated in accordance with Appendix CA of the 2024 City of Boulder Energy Conservation Code.

*Please note some projects may be requested to provide more detail on the modeling inputs and outputs. These projects will be notified by the plans’ examiner through the permit application review process.*

1. **INTRODUCTION**
	1. Background on the Project:

Please provide a summary description of the nature of the project, and the key energy aspects of the design. Include summary of mechanical systems and energy saving strategies.

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* 1. Applicable Requirements:

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| --- | --- |
| **Compliance Path** | **Requirement Summary** |
| ¨ New Construction > $500,000Fixed Target Performance Path | Comply with Fixed Target Performance in Section C407.3.2 |
| ¨ New Construction > $500,000Modeled Baseline Performance Path | Comply with Modeled Baseline Performance Path in Section C407.3.1 |
| ¨ New Construction > $500,000Measured Performance Outcome Path | Comply with Measured Performance Outcome Path in Section C407.3.3 |
| ¨ Level 3 Alteration | Performance Path, Target X 125% |
| ¨ Level 3 with Substantial Mechanical and Substantial Thermal Envelope Alteration |  Performance Path, Target X 125% with primary space conditioning fueled by an energy source other than fossil fuels. |

* 1. Project Summary Table:

| **General Info** | **Response/Comments** |
| --- | --- |
| Conditioned square footage (SF) |  |
| Unconditioned SF |  |
| Renovated SF |  |
| Estimated occupancy date |  |
| List other green building certifications being pursued by the project |  |
| Utility rates used in energy model (including demand charges) |  |
| **Energy Model Info** |  |
| Energy Modeler |  |
| Simulation Program |  |
| Simulation Weather File |  |
| Climate Zone  |  |
| Target EUI (for projects using the Fixed Target Performance Path) |  |
|  |  |

* 1. Project square footage breakdown by usage type.

Please use space types as provided by [ENERGY STAR Portfolio Manager](http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/identify-your-property-type) when you fill in the usage types for the project.

| **Usage Types** | **Conditioned SF** | **% of Total Conditioned SF** |
| --- | --- | --- |
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1. **comparison of proposed design versus baseline design**

Summarize modeling inputs for the Baseline and Proposed models. Highlight where models differ and clearly identify where the proposed model is less efficient than the baseline model.

| **Model Input Parameter** | **Proposed Design Input** | **Baseline Design Input** |
| --- | --- | --- |
| Exterior Wall Construction |  |  |
| Roof Construction |  |  |
| Floor/Slab Construction |  |  |
| Window-to-gross wall ratio |  |  |
| Fenestration type |  |  |
| Fenestration U-factor |  |  |
| Fenestration SHGC - North |  |  |
| Fenestration SHGC - Non-North |  |  |
| Fenestration Visual LightTransmittance |  |  |
| Shading Devices |  |  |
| Interior Lighting Power Density(W/sf) |  |  |
| Daylighting Controls |  |  |
| Other Lighting Control Credits |  |  |
| Exterior Lighting Power (kW) |  |  |
| Process Lighting (kW) |  |  |
| Receptacle Equipment PowerDensity (W/sf) |  |  |
| Domestic Hot Water |  |  |
| Primary HVAC System Type |  |  |
| Other HVAC System Type |  |  |
| Fan Supply Volume |  |  |
| Fan Power |  |  |
| Economizer Control |  |  |
| Demand Control Ventilation |  |  |
| Unitary Equipment CoolingEfficiency |  |  |
| Unitary Equipment HeatingEfficiency |  |  |
| Chiller parameters |  |  |
| Chilled water loop & pumpparameters |  |  |
| Boiler parameters |  |  |
| Hot water loop & pumpparameters |  |  |
| Cooling tower parameters |  |  |
| Condenser water loop & pumpparameters |  |  |
| Energy Recovery |  |  |
| Building Schedules (lighting, plug loads, occupancy) |  |  |
| Renewables On-Site |  |  |
| (ADD AS NECESSARY) |  |  |

1. **Summary of results**

Please complete the tables below. Applicants are also encouraged to submit graphic representation of the results generated by the modeling software.

* 1. Baseline and Proposed Model Comparison Table

| **Description** | **Proposed Model**  | **Baseline Model (based on the average of the 4 baseline model orientations required by ASHRAE 90.1)** |
| --- | --- | --- |
| Annual Utility Cost (electric, $/year) |  |  |
| Annual Utility Cost (gas, $/year) |  |  |
| Total Utility Cost ($/year) |  |  |
| Annual Electricity Purchased from Utility (kWh/year) |  |  |
| Annual Natural Gas Purchased from Utility (therms/year) |  |  |
| **Site Energy Use Intensity (kBtu/SF-year)** |  |  |
| Peak Electric Demand (kW) |  |  |
| Number of unmet load hours total (i.e. # of hours per year that any zone cannot meet the heating or cooling setpoint) |  |  |
| Annual Production of On-Site Renewables (kWh/year) |  |  |

* 1. Description of energy efficiency or renewable energy measures implemented in this project.

Please list the drawing number in the plan set that shows this measure, and a brief description of how it saves energy above the baseline code in the “Notes” column. For all measures that use the Exceptional Calculation Method, please describe how savings were calculated.

| **Efficiency/Renewable Energy Measure** | **Drawing # from Plans**  | **Notes (How does this save energy above baseline code?)** |
| --- | --- | --- |
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* 1. Proposed energy summary by end use

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **End Use** | **Energy Type** | **Units of Annual Energy and Peak Demand** | **Baseline** | **Proposed Design** | **Energy / Demand Savings per End-Use** | **End Use Percent Contribution to Total Energy Savings** | **End Use Percent Contribution to Total Cost Savings** | **Percent of Total Proposed Site Energy Consumption** |
| Interior lighting | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Lighting -Apartments | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Interior lighting -process | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Exterior lighting | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Space heating | Natural Gas |   |   |   |   |   |   |   |
|   |   |   |   |
| Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Heat Pump Supplementary | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Space cooling | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Natural Gas |   |   |   |   |   |   |   |
|   |   |   |   |
| Pumps | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Heat rejection | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Fans – ventilation, space conditioning | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Fans -parking garage | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Fans - Kitchen Ventilation | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Service water heating | Natural Gas |   |   |   |   |   |   |   |
|   |   |   |   |
| Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Misc Equipment | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Natural Gas |   |   |   |   |   |   |   |
|   |   |   |   |
| IT equipment | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Cooking | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Refrigeration Equipment (Regulated) | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Refrigeration Equipment (Unregulated) | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Elevators and escalators | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |
| Building Transformers | Electricity |   |   |   |   |   |   |   |
|   |   |   |   |

* 1. Performance Cost Index Calculations

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| --- | --- |
|  |  |
| Proposed Building Performance before site-generated renewable energy and exceptional calculations |  |
| Onsite Renewable Site Energy Savings |  |
| Exceptional Calculations Site Energy Savings |  |
| Proposed Building Performance including site-generated renewable energy and exceptional calculations |  |
| Baseline Building Unregulated Site Energy (BBUE) |  |
| Baseline Building Regulated Site Energy (BBRE) |  |
| Baseline Building Performance (BBP) |  |
| Building Performance Factor (BPFsite) |  |
| Performance Index Target, Site Energy (PItsite) |  |
| Performance Index Site Energy excluding renewables and exceptional calculations |  |
| Performance Index Site Energy including exceptional calculations |  |
| Performance Index Site Energy including exceptional calculations and renewables |  |
| % Improvement Above ASHRAE 90.1 2022 Appendix G as modified by Appendix I for Site Energy, excluding renewable and exceptional calculations |  |
| % Improvement Above ASHRAE 90.1 2022 Appendix G as modified by Appendix I for Site Energy including renewable and exceptional calculations |  |

1. **performance feedback**

Projects using the performance path are required to submit an analysis comparing design modeling to actual energy use for a consecutive 12-month period within two years of project occupancy. This analysis should use billing data and sub-metered data from the building to identify the accuracy of the energy model and any areas of performance divergence from predicted energy use. All projects are required to provide a narrative summary describing areas of alignment and misalignment of predictive modeling with actual energy use patterns, including modeled EUI and metered EUI. **Please include with this report a copy of the signed contract for this work to be completed by the firm responsible for code compliance energy modeling.**

1. **design TEAM SIGNATURES**

Demonstrating energy code compliance via the performance path requires the modeling inputs to be accurate and well specified in the construction documents. By signing below, the design team and building owner verify that the modeling inputs accurately capture the architectural, mechanical, electrical, plumbing design. Additionally, the building owner agrees that the schedules and building occupancy accurately depict how the building is intended to be used.

|  |  |  |
| --- | --- | --- |
| **Professional** | **Signature** | **Company / Date** |
| Architect |  | (company) |
| (print name) | (date) |
| Mechanical Engineer |  | (company) |
| (print name) | (date) |
| Electrical Engineer |  | (company) |
| (print name) | (date) |
| Building Owner |  | (company) |
| (print name) | (date) |

**2024 city of boudler energy conservation code**

**appendix ca**

**(Helpful formulas and table g1.2)**

**Mixed Fuel Buildings:**

 **PItsite** = 0.85 × (BBUE + (BPFsite × BBRE) **(Eq. G1.2.2.1.1)**

 BBP

**All Electric Buildings:**

 **PItsite** = 0.90 × (BBUE + (BPFsite × BBRE) **(Eq. G1.2.2.1.2)**

 BBP

where:

PItsite = The maximum Performance Index (Site Energy) for the *proposed design* to comply with the Boulder Energy Code

BBUE = Baseline Building Unregulated *Site Energy*, the portion of the annual site energy of a *baseline building design* that is due to

 *unregulated energy use*.

BBRE = Baseline *Building* Regulated *Site Energy*. The portion of the annual *site energy* of a *baseline building design* that is due to

 *regulated energy use*.

BPFsite = *Building* Performance Factor (BPF) from Table G1.2 below. For *building* area types not listed in the table, use “All Others.”

 Where a *building* includes multiple *building* area types, the required BPF shall be equal to the area-weighted average of the

 *building* area types. (Table G1.1 replaces Table 4.2.1.1 in 90.1- 2022)

BBP = *Baseline Building Performance*. The annual site energy of the baseline building design including both regulated and

 unregulated energy use.

 Level 3 Alterations

**Eq. G1.2.2.1.1** x 1.25

**PItsite** =  or

 **Eq. G1.2.2.1.2** x 1.25

**TABLE G1.1**

**BUILDING PERFORMANCE FACTORS FOR SITE ENERGY USE**

**(BPFSITE)**

|  |  |
| --- | --- |
| **Use Type** | **BPF** |
| Office | 0.52 |
| Retail | 0.47 |
| School | 0.50 |
| Healthcare | 0.63 |
| Restaurant | 0.69 |
| Hotel | 0.66 |
| Warehouse | 0.45 |
| Apartment | 0.67 |
| All Others | 0.50 |