

Commercial Energy Modeling Report

There are two Performance Compliance Paths with two approaches under each path in the 2019 Denver Building Code (DBC):

- IECC Section C407 Total Building Performance Energy Cost Approach
- IECC Section C407 Total Building Performance Site EUI Approach
- ASHRAE 90.1 Appendix G Performance Rating Method Energy Cost Approach
- ASHRAE 90.1 Appendix G Performance Rating Method Energy Source Approach

The requirements of these compliance paths are described in Section C401.2 of the DBC. This Energy Modeling Report serves as the template for all compliance path approaches.

Directions: Please complete this report, submit as a pdf file and include as part of the Energy Compliance Package with the construction documents as part of the permit application for commercial projects pursuing compliance with one of the performance path approaches identified above. If using a different form, please match the format and include each section. In addition, the appropriate Compliance Checklist must be completed and submitted with the permit application.

Please note some projects may be selected 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

1.1. 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.

1.2. Energy Model and Assumptions and Judgments:

Please provide a summary description of all professional assumptions and judgements used while preparing the Energy Modeling Report. Include reasoning behind the assumptions and judgements. Some examples are air infiltration, thermal bridging within design, assumptions for unregulated loads, and assumptions about future tenants and associated mechanical, service water heating, lighting, and power systems.

1.3. pEUI Values:

Please provide four separate pEUI values as listed below:

- Site pEUI including parking.
- Site pEUI excluding parking.
- Source pEUI including parking.
- Source pEUI excluding parking.

1.4. Top Energy Consumption items and Top Energy Conservation items:

Please provide a list of the top 3 items that increase the energy usage and the top 3 items that decrease the energy usage. Please discuss these items along with all assumptions and possible energy saving techniques that could be utilized.

1.5. pEUI vs. actual EUI:

Please provide a summary of how the design team will address factors that affect the actual EUI that are not accounted for in the Energy Model. Some examples are construction quality, occupant behavioral controls and operation of building, sophistication of facilities managers, maintenance of systems and equipment, training of facilities maintenance team, training of occupants along with use of systems and controls, hours of operation and system overrides, anticipated vs. actual impact of unregulated loads, reliability of input received from ownership team, and value engineering modifications made throughout the construction.

1.6. Expectations for Accuracy:

Please provide an estimate of how far off the pEUI might reasonably be expected to fall from the actual EUI based on the factors above.

1.7. Applicable Requirements:

Compliance Path	Requirement Summary
<input type="checkbox"/> IECC Section C407 Total Building Performance Energy Cost Approach	Comply with Total Building Performance Energy Cost Approach in IECC Section C407 and DBC Section C401.2.3.
<input type="checkbox"/> IECC Section C407 Total Building Performance Site EUI Approach	Comply with Total Building Performance Site EUI Approach in IECC Section C407 and DBC Section C401.2.3.
<input type="checkbox"/> ASHRAE 90.1 Appendix G Performance Rating Method Energy Cost Approach	Comply with Performance Rating Method Energy Cost Approach in ASHRAE Appendix G and DBC Section C401.2.1.c.1.
<input type="checkbox"/> ASHRAE 90.1 Appendix G Performance Rating Method Energy Source Approach	Comply with Performance Rating Method Energy Source Approach in ASHRAE Appendix G and DBC Section C401.2.1.c.2.

1.8. 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 (pEUI)	

1.9. Project square footage breakdown by usage type.

Please use space types as provided by [ENERGY STAR Portfolio Manager](#) when you fill in the usage types for the project.

Usage Types	Conditioned SF	% of Total Conditioned SF

2. 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 Light Transmittance		
Shading Devices		
Interior Lighting Power Density (W/sf)		
Daylighting Controls		
Other Lighting Control Credits		
Exterior Lighting Power (kW)		
Parking Lighting Power (kW)		
Process Lighting (kW)		
Receptacle Equipment Power Density (W/sf)		
Domestic Hot Water		
Cooking gas load (MBH)		
Primary HVAC System Type		
Other HVAC System Type		

Model Input Parameter	Proposed Design Input	Baseline Design Input
Fan Supply Volume		
Fan Power		
Economizer Control		
Demand Control Ventilation		
Unitary Equipment Cooling Efficiency		
Unitary Equipment Heating Efficiency		
Chiller parameters		
Chilled water loop & pump parameters		
Boiler parameters		
Hot water loop & pump parameters		
Cooling tower parameters		
Condenser water loop & pump parameters		
Energy Recovery		
Building Schedules (lighting, plug loads, occupancy)		
Renewables On-Site		
(ADD AS NECESSARY)		

3. SUMMARY OF RESULTS

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

3.1. 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)		

3.2. 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?)

Efficiency/Renewable Energy Measure	Drawing # from Plans	Notes (How does this save energy above baseline code?)

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

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 in Apartments	Electricity							
Interior lighting - process	Electricity							
Exterior lighting	Electricity							
Parking lighting	Electricity							
Space heating	Natural Gas							
Space heating	Electricity							
Heat Pump Supplementary	Electricity							
Space cooling	Electricity							
Space cooling	Natural Gas							
Pumps	Electricity							
Heat rejection	Electricity							
Fans - interior ventilation	Electricity							
Fans - parking garage	Electricity							
Fans - Kitchen Ventilation	Electricity							
Cooking	Natural Gas							
Cooking	Electricity							
Service water heating	Natural Gas							
Service water heating	Electricity							
Misc Equipment	Electricity							
Misc Equipment	Natural Gas							
IT equipment	Electricity							
Cooking	Electricity							
Refrigeration Equipment (Regulated)	Electricity							
Refrigeration Equipment (Unregulated)	Electricity							
Elevators and escalators	Electricity							
Building Transformers	Electricity							

3.4. Performance Cost Index Calculations

Proposed Building Performance before site-generated renewable energy and exceptional calculations	
Onsite Renewable Cost Savings, Site Energy	
Exceptional Calculations Cost Savings, Site Energy	
Proposed Building Performance including renewable energy and exceptional calculations	
Baseline Building Unregulated Energy Cost (BBUEC)	
Baseline Building Regulated Energy Cost (BBREC)	
Baseline Building Performance (BBP)	
Building Performance Factor (BPF)	
Target Performance Cost Index (PCIt)	
Performance Cost Index without renewables and exceptional calculations	
Performance Cost Index including exceptional calculations	
Performance Cost Index including exceptional calculations and renewables	
% Improvement Beyond IECC Section C407, excluding renewable and exceptional calculations	
% Improvement Beyond IECC Section C407, all included (MUST BE 24% TO COMPLY WITH 2019 DBC)	
% Improvement Beyond ASHRAE 90.1 2016 Appendix G, excluding renewable and exceptional calculations	
% Improvement Beyond ASHRAE 90.1 2016 Appendix G, all included (MUST BE 15% TO COMPLY WITH 2019 DBC)	

4. **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.**

5. 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	
Architect	(print name)	(company)
		(date)
Mechanical Engineer	(print name)	(company)
		(date)
Electrical Engineer	(print name)	(company)
		(date)
Energy Consultant	(print name)	(company)
		(date)
Building Owner	(print name)	(company)
		(date)

The Lead Design Professional (Architect) must stamp and provide electronic signature.

(Stamp and electronic signature)