



How Denver's Buildings Achieve Climate Action New Construction – Net Zero Energy

Taylor Roberts, PE, BEMP, LEED AP
troberts@group14eng.com

group14eng.com



Introduction & Goals

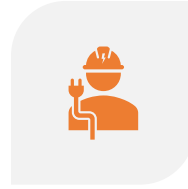


- 1 Denver Current Code Highlights
- 2 2021 Denver Code Look Ahead
- 3 Denver Green Building Ordinance
- 4 Net Zero & Electrification

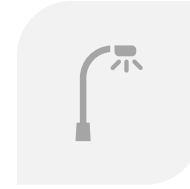
- Thermal Envelope Performance
 - Sealing details and review are required!
 - Testing is required! 0.4 cfm/ft² at 0.3 in of wc
- EV Charging stations are required
 - Multifamily – 5% installed, 15% ready, remainder capable
 - All other – 5% installed, 10% ready, 10% capable



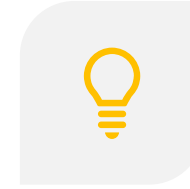
- Prescriptive pathway
 - 2018 IECC - COMcheck + TWO efficiency packages from C406
- Performance pathway
 - C407 + mandatories + energy costs or EUI 76% of reference design
 - 9% increased savings required



MORE EFFICIENT
HVAC (10%)



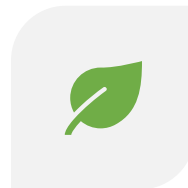
REDUCED LIGHTING
POWER DENSITY
(70% OR LESS THEN
ALLOWED)



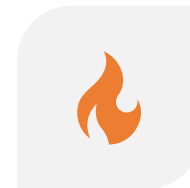
ENHANCED
LIGHTING
CONTROLS



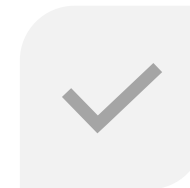
ON-SITE
RENEWABLE
ENERGY



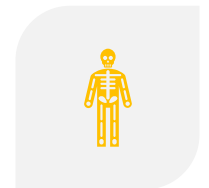
DEDICATED
OUTDOOR AIR
SYSTEM WITH
ENERGY RECOVERY



WASTE HEAT
RECOVERY FOR
SERVICE HOT
WATER



ENHANCED
ENVELOPE
PERFORMANCE
(15% BELOW THE
TOTAL ALLOWED
UA)



REDUCED AIR
INFILTRATION – 0.25
CFM/FT² AT 0.3 IN
OF WC

Denver's 2021 Commercial Energy Code

Commercial	2021	2024	2027	2030
HIGHLY EFFICIENT				
Prescriptive Path	Add renewables	Add renewables	Small/remodel projects only	Small/remodel projects only
Performance Target	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year	Meet EUI targets by type & year
Energy Modeling Accuracy	Report on discrepancy in disclosure data	Within 15% of target	Within 10% of target	Achieve target
Energy Modeling Normalization	Report on discrepancy	Document use changes in model	Document use changes in model	Document use changes in model
Energy Modeling Unregulated Loads	Some flexibility w/ pre-approval	Flexible w/ pre-approval	Flexible	Flexible
Efficiency Backstop	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs	IECC Thermal Envelope Specs
Performance Verification Enforcement	Certificate of Occupancy, Disclosure	Disclosure; Bond or Solar Credit	Disclosure; Bond or Solar Credit	Bond or Solar Credit
ALL-ELECTRIC				
Equipment requirement	All-Electric Ready: conduit & panel space, conduit for central	All-Electric: except water heating	All-electric equipment	All-electric equipment
RENEWABLE ENERGY				
Minimum renewable offset	50%	75%	100%	100%
Minimum % Roof Area	25%	50%	70%	70%
GRID FLEXIBILITY				
Grid flexibility requirement	Grid Flexible Equipment	Implementation of Grid Flexible Metric	Improving Grid Flexibility + Increased Storage	Improving Grid Flexibility + Increased Storage

Commercial pEUI Targets



<u>Building Type</u>	<u>Denver Benchmarking</u> Site EUI Median Performance (kBtu/sf/yr)	<u>2019 Denver Energy Code</u> Site EUI Estimate (kBtu/sf/yr)	<u>Net Zero Energy Performance</u> Site EUI Target (kBtu/sf/yr)	2021 Site EUI (kBtu/sf/yr)	2024 Site EUI (kBtu/sf/yr)	2027 Site EUI (kBtu/sf/yr)	2030 Performance Verification
Small Hotel (R-1: 0-100,000 sf)	79	49	35	47	41	35	35
Large Hotel (R-1: 100,000 sf and larger)	92	71	54	68	61	54	54
Medium Office (Group B office: 40,000-100,000 sf)	72	28	21	26	24	21	21
Large Office (Group B office: 100,000 sf and larger)	66	58	37	54	45	37	37
Standalone Retail (Group M)	56	42	28	39	34	28	28
Warehouse (Group S)	45	13	9	13	11	9	9
Hospital (I-2, Condition 2)	236	107	n/a				
Restaurant (Group A-2 with commercial kitchen)	-	321	n/a				

Multifamily pEUI Targets



<u>Building Type</u>	<u>Denver Benchmarking</u> Site EUI Median Performance (kBtu/sf/yr)	<u>2019 Denver Energy Code</u> Site EUI Estimate (kBtu/sf/yr)	<u>Net Zero Energy Performance</u> Site EUI Target (kBtu/sf/yr)	2021 Site EUI (kBtu/sf/yr)	2024 Site EUI (kBtu/sf/yr)	2027 Site EUI (kBtu/sf/yr)	2030 Performance Verification
Mid-Rise Apartment (R-2: 4-7 stories)	64	38	23	35	29	23	23
High-Rise Apartment (R-2: 8 or more stories)	61	40	29	38	33	29	29

Other Building Types



<u>ASHRAE 90.1-2016</u>			
	2021	2024	2027
% Savings over Baseline	15%	30%	45%

Two modeling options:

- pEUI targets for typically predictable building types. Developers can model to prove they meet the pEUI for those building types.
- Alternately, projects can be modeled to a baseline and a percent better than baseline.

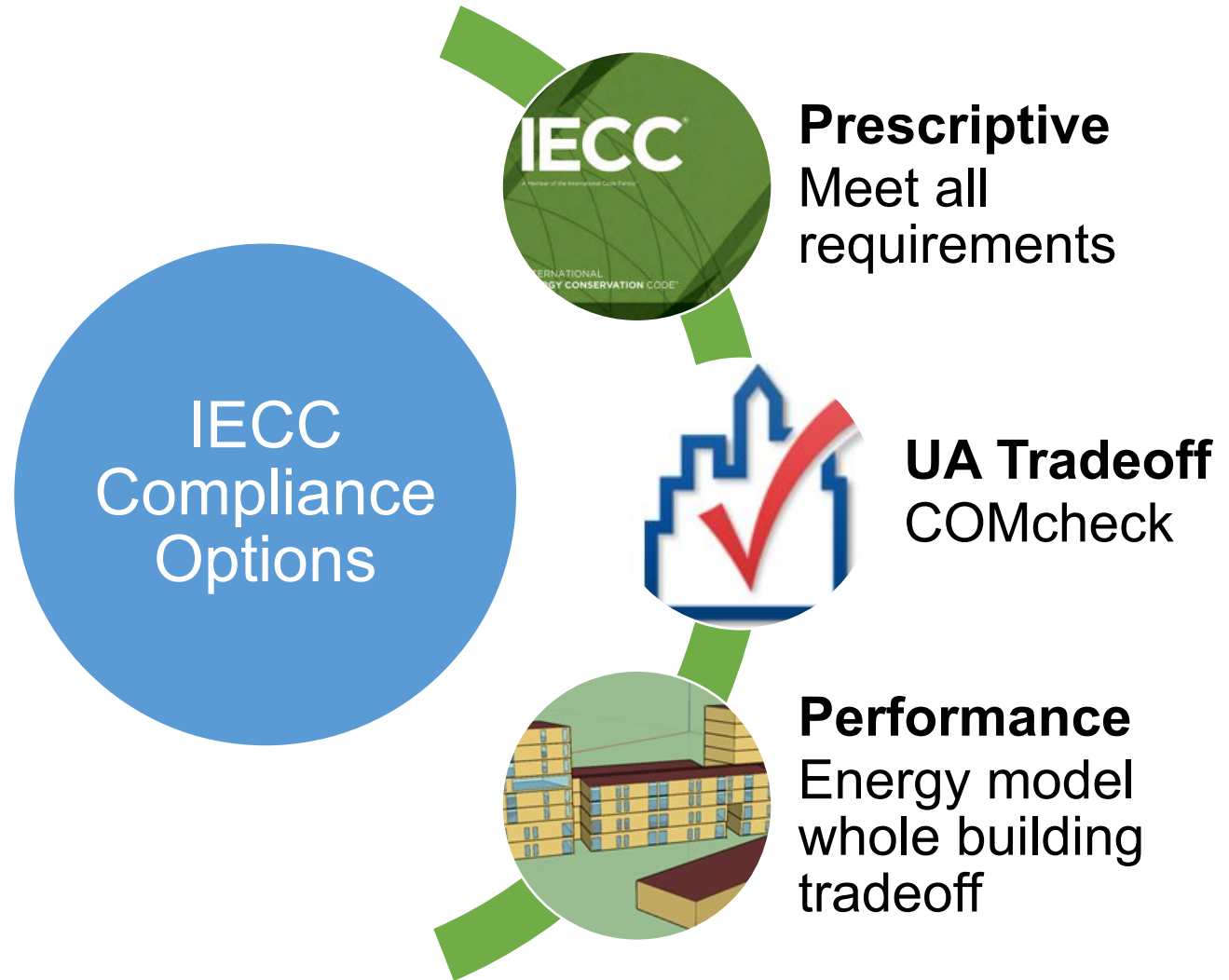
Energy Modeling Considerations

- Plug loads
 - Required schedules?
- Ventilation
 - Require ventilation in multifamily
- Energy modeling normalization
 - Required schedules and loads?
- Performance path backstops
 - IECC insulation requirements
- Energy modeling accuracy
 - Predicting the future?
 - Building lease rates, weather, construction defects, etc



Prescriptive Path

- Calibrated to require equivalent performance
 - Difficult to do
 - Calibrate each code cycle
- Eventually only allow for small projects, remodels, and TI



Denver Green Building Ordinance

18 new buildings issued permits under GBO May 2019-Dec 2019

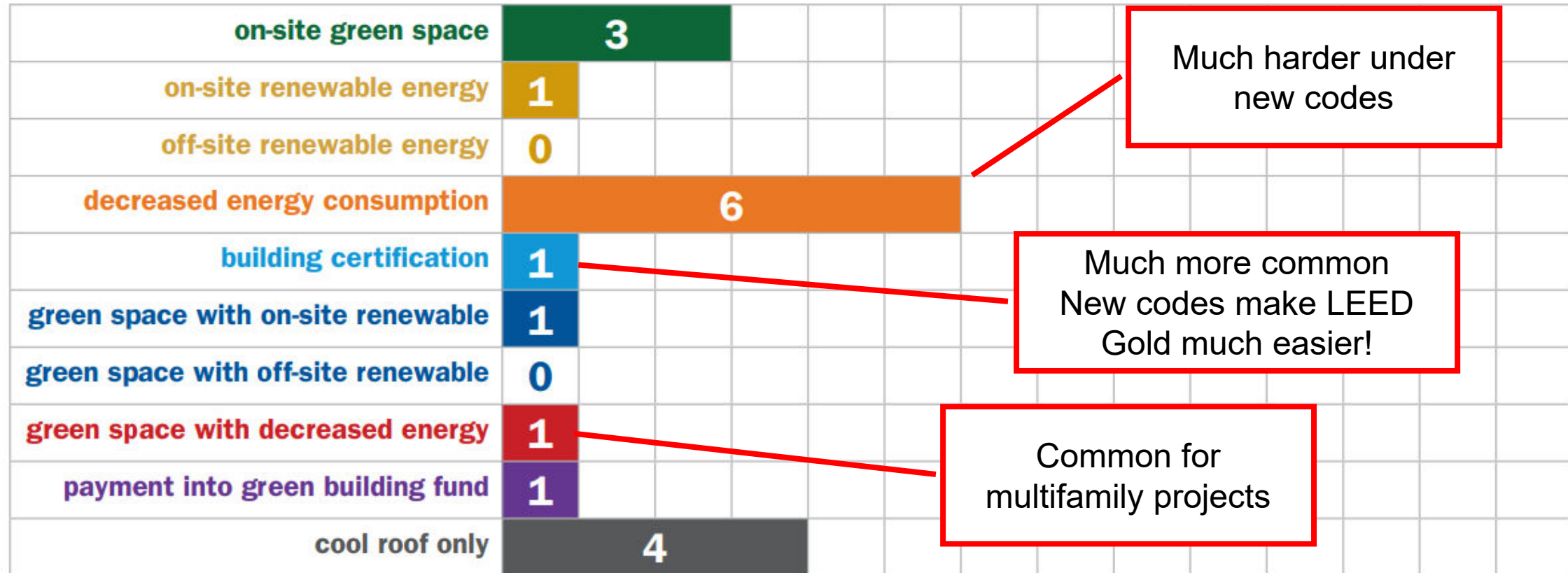
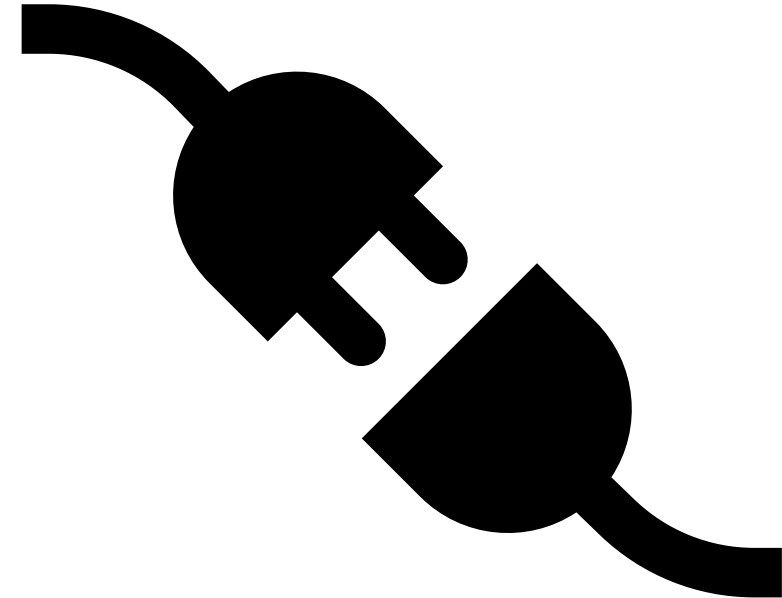


Figure 6 – GBO Compliance Option Selection for New Building Permits

- All electric ready
 - Mandatory
 - Physical space in panel
 - Capacity in panel
 - Wiring, conduit
- All electric option in C408 points
- All electric equipment mandatory!



Net Zero & Electrification



<u>Building Type</u>	<u>All Electric Equipment Required</u>		
	2021	2024	2027
Small Hotel (R-1: 0-100,000 sf)	All Electric Ready	Required*	Required
Large Hotel (R-1: 100,000 sf and larger)	All Electric Ready	Required*	Required
Medium Office (Group B office: 40,000-100,000 sf)	All Electric Ready	Required	Required
Large Office (Group B office: 100,000 sf and larger)	All Electric Ready	Required	Required
Standalone Retail (Group M)	All Electric Ready	Required	Required
Warehouse (Group S)	All Electric Ready	Required	Required
* Building types with central hot water systems, like apartments and hotels, all electric except for the central hot water system			

Net Zero & Electrification



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Warehouse (Group S)	All Electric Ready	Required	Required
Mid-Rise & High-Rise Apartment	All Electric Ready	Required*	Required
* Building types with central hot water systems, like apartments and hotels, all electric except for the central hot water system			

- Major hurdles and questions
 - Process loads – Pools, fireplaces, snowmelt, cooking ranges
 - Utility costs and rates
 - Technology
 - Low-ambient air source heat pumps for space heating, domestic hot water heating, and process water heating
 - Demand management control systems

