2022 Denver Energy Code
Contractor/Inspector Commercial Code Considerations
Part 2: Compliance Paths

Community Planning and Development / Office of Climate Action, Sustainability and Resiliency

June 21, 2023
INTERPRETATION INSTRUCTIONS

• This session is available in both English & Spanish. Click on the “Interpretation” icon at the bottom of the Zoom window and choose either "English" or “Spanish”

• Esta sesión está disponible en inglés y español. Haga clic en el icono "Interpretación" en la parte inferior de la ventana de Zoom y elija "Inglés" o "Español"
Questions?

• Time is reserved at the end of the presentation for Q&A
• Please use the Q&A feature to submit your questions

• Responses to all questions not addressed today will be sent out by email to registered participants
• Additional questions may be sent to: energy.review@denvergov.org
# Training Series

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<th>Activity</th>
<th>Commercial/Multifamily (Wednesdays at 12 pm)</th>
<th>Residential (Thursdays at 1 pm)</th>
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<tbody>
<tr>
<td>Electrification</td>
<td>May 24</td>
<td>Compliance Overview May 25</td>
</tr>
<tr>
<td>Prescriptive Path</td>
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<td>June 1</td>
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<tr>
<td>Performance Paths</td>
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<td>Contractor/Inspector Part 1</td>
<td>June 14</td>
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</tr>
<tr>
<td>Contractor/Inspector Part 2</td>
<td>June 21</td>
<td>June 29</td>
</tr>
</tbody>
</table>
Timeline - Commercial Electrification and Performance Requirements

2023

- May 1st mandatory use of the 2022 Denver Energy Code and limited mandatory use of the 2022 Denver Green Code

2024

- Jan 1, 2024, Partial electrification of space and water heating

2025

- GOAL: New Buildings are designed Net Zero Energy

2026

- Energy Denver Permit Changes

2027

- Energy Denver Equipment Replacement

2030

- GOAL: New Buildings perform as Net Zero Energy

2040

- Xcel Energy required to provide 80% renewable electricity by 2030

BUILDING PROJECTS

- May 1st mandatory use of the 2022 Denver Energy Code and limited mandatory use of the 2022 Denver Green Code

- Jan 1, 2024, Partial electrification of space and water heating

- GOAL: New Buildings are designed Net Zero Energy

EXISTING COMMERCIAL AND MULTI-FAMILY BUILDINGS

- Energy Denver Permit Changes

- Energy Denver Equipment Replacement

- Energy Denver Performance Targets for Buildings 25k+ SF

- Energy Denver Performance for Buildings 5k-25k SF

- Dec. 31: Compliance deadline for buildings 15,001-24,999 sq. ft.

- Dec. 31: Compliance deadline for buildings 10,001-15,000 sq. ft.

- Dec. 31: Compliance deadline for buildings 5,000-10,000 sq. ft.

- 1st Interim Performance Target Due

- 1st Interim Performance Target Due with Timeline Adjustment

- Final Performance Target Due

- GOAL: Existing buildings perform as Net Zero Energy
2022 Denver Energy Code

- This is a high-level summary of the commercial prescriptive and performance paths of the 2022 Denver Energy Code

- Does not include all changes to the 2022 Denver Energy Code. Please refer to the 2022 Denver Energy Code for specific code language. [Denvergov.org/BuildingCode](https://Denvergov.org/BuildingCode)

- Denver-specific COMcheck and REScheck are anticipated fall 2023
Net Zero Energy Hub – Codes and Resources

www.denvergov.org/EnergyCode

Resources for:

- New provisions in the 2022 Denver Energy Code
- The Denver Energy Code compliance pathways
- Specifics to each phase of a new building project, from design and construction to alterations and additions
- Training videos to walk you through specific provisions that have been updated since the 2019 Denver Building Code
New Building Electrification Pilots

**Design Support:** partial funding for drawing sets and as-built drawings that can be reviewed by Denver builders to help inform how electrification can work for their projects.

**Pilot Projects:** partial funding for builders or property owners interested in leveraging city funds to help a new building project be built all-electric.

[www.denvergov.org/NetZero](http://www.denvergov.org/NetZero)

Equity and Local Focus: 50% of the pilot project funds will be prioritized for affordable housing or otherwise serve or benefit under-resourced communities in Denver. Denver-based and/or MWBE firms and organizations are especially encouraged to apply for incentives.
Tips for referencing code

2022 Denver Amendments
+ 2021 International Energy Conservation Code (IECC)
= 2022 Denver Energy Code (DEC)
Agenda

• 2022 DEC Requirements overview
• Setting up for success
• Prescriptive Path review
• Performance Path review
• Summary

Purpose: This presentation is the second part of installation and inspection requirements and considerations for commercial building projects focusing on prescriptive and performance paths.

See recordings of previous trainings for the first part for general installation and inspection requirements and more details on design submittal considerations.
2022 DEC Requirements Overview
Definition: **Commercial Building**

*Residential buildings* are detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and Group R-3 and R-4 buildings three stories or less in height above grade plane.

*Commercial buildings* are all other buildings.
Definition: All-Electric Property

All-Electric Property is one that contains no permanently installed equipment or appliances that utilize combustion, plumbing for fuel gas or fuel oil or fuel gas utility connection, installed within the building(s) or site, except for emergency power systems and standby power systems.
Commercial Compliance Process

• Choose a Compliance Pathway (C401.2.1): Prescriptive or Performance
• Meet requirements for all paths - partial list:
  ➢ HVAC/DHW/Lighting Commissioning
  ➢ Building Envelope Verification and Air Leakage Testing
  ➢ Complete 2022 DEC Checklist for Requirements
    ❖ Includes reporting Energize Denver Ordinance 2030 EUI Target
• Related
  ➢ Denver Green Buildings Ordinance - denvergov.org/Greenroofs
  ➢ Denver Green Code - denvergov.org/Greencode
Green Buildings Ordinance (GBO) applies to:
• New buildings and additions 25,000 square feet or larger
• Existing buildings 25,000 square feet or larger, upon roof recover or replacement
• Some multifamily residential projects need only comply with roof reflectance requirements and not additional green building options

NOTE: New construction options which require an extra 12% or 5% energy savings beyond code also require the project to be an All-Electric Property*

*Green Building Ordinance updates for Council approval June 2023 and effective October 1, 2023
**Limited mandatory use for new and major renovation commercial projects**

denvergov.org/GreenCode

**Table 101.4.1 Limited Mandatory Use: Quantity of Provisions Required**

<table>
<thead>
<tr>
<th>Chapter &amp; Title</th>
<th>New Construction</th>
<th>Major Renovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1</td>
<td>Scope and Administration: Ecological Impact Statement (EIS)</td>
<td>0</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Reserved</td>
<td>n/a</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Definitions</td>
<td>n/a</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Residential Energy [RE]</td>
<td>0</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Site Sustainability</td>
<td>4</td>
</tr>
<tr>
<td>Chapter 6</td>
<td>Water Use Efficiency [WE]</td>
<td>1</td>
</tr>
<tr>
<td>Chapter 7</td>
<td>Commercial Energy</td>
<td>1</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>Indoor Environmental Quality [EQ]</td>
<td>1</td>
</tr>
<tr>
<td>Chapter 9</td>
<td>Materials and Resources [MR]</td>
<td>3</td>
</tr>
<tr>
<td>Chapter 10</td>
<td>Construction and Plans for Operation [CX]</td>
<td>2</td>
</tr>
</tbody>
</table>
Setting up for Success
Success with Energy Compliance

- Energy is interdisciplinary and holistic
- Design team has weighed tradeoffs to select options that will optimize the design and achieve compliance

Therefore
- Build to construction documents
- Use RFIs before making substitutions
- Understand the impact of changes

- Reduce Design Loads
- Optimize Envelope
- Right-Size Equipment & Renewables
- Verified Installation
Inspector Support at Preconstruction Meetings

Energy-specific preconstruction meeting

- Attendees: Inspector, GC, PMs, Air barrier consultant, optional design team members

- Agenda topics:
  - Identify compliance path
  - Use 2022 DEC checklists and approved construction documents to tailor the discussion
  - Identify critical components of the design and construction that will achieve success
### 2022 Denver Energy Code Checklists

- Index to design documents for energy information
- See checklists in drawings for each discipline

<table>
<thead>
<tr>
<th>Code Section</th>
<th>Focus Area</th>
<th>Code Description</th>
<th>Drawing or Specification Number to demonstrate compliance (N/A if not applicable)</th>
<th>Submitter Notes (e.g. If &quot;N/A&quot; Please explain why requirement does not apply or is not demonstrated on drawings/specs)</th>
<th>Submittal Requirements and Clarifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>C402.1.5</td>
<td>Minimum insulation</td>
<td>Roofs, walls, and floors shall meet applicable maximum U-factor requirements of Table C402.1.5</td>
<td>A-301</td>
<td>Indicate location of: - Supplemental calculations if applicable</td>
<td></td>
</tr>
</tbody>
</table>

**CHECKLISTS:**
- General Compliance
- Building Envelope
- HVAC & Kitchen
- Service Water Heating
- Power & Lighting
- C406 (Prescriptive Only)
Compliance Pathway

• Check drawings for General Checklist:

2022 Denver Energy Code - Commercial Compliance Checklist

Prescriptive Path - General

• Inspector can see Permit Scope of Work text box where review team will list the compliance path from four options:
  ➢ Prescriptive Compliance Path
  ➢ C407 Energy Cost
  ➢ Appendix SE Site Energy
  ➢ Appendix PT Performance Target
**All-Electric Property**

- Check drawings for General Checklist:

<table>
<thead>
<tr>
<th>GENERAL</th>
<th>RESPONSE</th>
<th>SUBMITTER NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property type</td>
<td>Is this an all-electric property? (Y/N):</td>
<td>Y</td>
</tr>
</tbody>
</table>

- Inspector can see Permit Scope of Work text box where review team will list All-Electric Property status, if applicable:
  - All-Electric Property

- If All-Electric Property, permanent fuel equipment and utility connection are only allowed for emergency power systems and standby power systems.

ALL-ELECTRIC PROPERTY: A property that contains no permanently installed equipment or appliances that utilize combustion, plumbing for fuel gas or fuel oil or fuel gas utility connection, installed within the building(s) or site, except for emergency power systems and standby power systems.
Other Inspector Instructions

Inspector can see Permit Scope of Work text box where review team will list, if applicable:

- If alteration selected **test all gas piping**:
  - C503.3.3 Test all gas piping serving replacement furnace per Section 406 of the IFGC
  - C504.4.1 Test all gas piping serving replacement water heater per Section 406 of the IFGC

- If prescriptive path **C406 Reduced Air Infiltration** is used:
  - C406.9.1 Reduced Air Infiltration 0.25 cfm/sq. ft.
  - C406.9.2 Further Reduced Air Infiltration 0.15 cfm/sq. ft.

- If prescriptive path **C406 Renewable Energy** is used:
  - C406.5.1 Basic Renewable Credit with ___ kW_{DC} array
  - C406.5.2 Enhanced Renewable Credit with ___ kW_{DC} array

- If performance path **Renewable Energy** is included for compliance via drawings, lease, or contract:
  - Renewable Energy ___ kW_{DC} array
Prescriptive Path & C406 Additional Efficiency
C406 Additional Efficiency Credits

Prescriptive Path - C401.2.1 Option 1

• Comply with C402 through C406 and C408
• C406 Additional Efficiency Credits dependent on building type
• Fewer credits required for All-Electric Properties to incentivize electrification
• C406.1.1 – Tenant spaces* must attain a total of 10 credits (*not previously occupied)

<table>
<thead>
<tr>
<th>Building Type</th>
<th>Credit Requirement for All-Electric Properties</th>
<th>Credit Requirement for All Other Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifamily</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Healthcare/Hospital</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Hotel/Motel</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Office</td>
<td>10</td>
<td>31</td>
</tr>
<tr>
<td>Retail</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>School</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>Warehouse</td>
<td>10</td>
<td>48</td>
</tr>
<tr>
<td>All Other</td>
<td>10</td>
<td>40</td>
</tr>
</tbody>
</table>
# C406 Envelope Credits

<table>
<thead>
<tr>
<th>Sub-section</th>
<th>Group B</th>
<th>Group R &amp; I</th>
<th>Group E</th>
<th>Group M</th>
<th>Other*a</th>
</tr>
</thead>
<tbody>
<tr>
<td>C406.8.1: Reduced envelope UA**</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>• 15% Reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C406.8.2: Further reduced envelope UA**</td>
<td>15</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>• 25% Reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C406.9.1: Reduced air infiltration*</td>
<td>4</td>
<td>5</td>
<td>N/A</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>• Tested 0.25 cfm/sf</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C406.9.2: Further reduced air infiltration**</td>
<td>7</td>
<td>8</td>
<td>N/A</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>• Tested 0.15 cfm/sf</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*Credits supported by COMcheck IECC-2021

**Credits supported by COMcheck IECC-2021 with Denver Specific Instructions

Other credits are Denver Specific

Noted in Permit Scope of Work
C402 and C406 – Envelope

• Maintain envelope backstop of C402.1.5
• Envelope COMcheck & Inspection checklist
• Envelope performance verification and air leakage testing
• Any C406 efficiency credits?
  ✓ Reduced envelope UA
  ✓ Reduced air infiltration
C403.5 Economizer Requirements

Air or water economizers are required for the following cooling systems for prescriptive compliance:

Chilled water systems – chilled-water capacity less capacity of cooling units with air economizers
  • Local water-cooled systems: cooling capacity > 1,320,000 Btu/h
  • Air-cooled or district systems: cooling capacity > 1,720,000 Btu/h

Individual Fan Systems
  • Group R: total cooling capacity greater than 270,000 Btu/h
  • Other than Group R: total cooling capacity greater than 33,000 Btu/h
  • Systems with cooling capacity greater than 75,000 Btu/h require two stages of mechanical cooling
  • Systems with capacity greater than 33,000 Btu/h may use the economizer as the first stage (but many systems can use integrated economizers)
  • VRF Systems with Dedicated Outside Air Systems (DOAS) do not require economizers*

*Update for Council approval June 2023
# C403.7.4 Energy Recovery Requirements

## Table C403.7.4.2 (1)

### ENERGY RECOVERY REQUIREMENTS

(Ventilation systems operating less than 8,000 hours per year)

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥10 &amp; &lt; 20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DESIGN OUTSIDE OR EXHAUST AIRFLOW RATE (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5B Outside</td>
<td>NR</td>
</tr>
<tr>
<td>5B Exhaust</td>
<td>NR</td>
</tr>
</tbody>
</table>

## Table C403.7.4.2 (2)

### ENERGY RECOVERY REQUIREMENTS

(Ventilation systems operating 8,000 or more hours per year)

<table>
<thead>
<tr>
<th>CLIMATE ZONE</th>
<th>PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥10 &amp; &lt; 20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DESIGN OUTSIDE OR EXHAUST AIRFLOW RATE (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5B Outside</td>
<td>500</td>
</tr>
<tr>
<td>5B Exhaust</td>
<td>1,500</td>
</tr>
</tbody>
</table>
**C406 HVAC & Kitchen Credits**

<table>
<thead>
<tr>
<th>Sub-section</th>
<th>Group B</th>
<th>Group R &amp; I</th>
<th>Group E</th>
<th>Group M</th>
<th>Othera</th>
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</thead>
<tbody>
<tr>
<td>C406.2.1: 5% Heating eff imprv.*</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<tr>
<td>C406.2.2: 5% Cooling eff imprv.*</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C406.2.3: 10% Heating eff imprv.*</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C406.2.4: 10% Cooling eff imprv.*</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C406.2.5: &gt;10% Cooling eff imprv.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C406.2.6: &gt;10% Heating eff imprv.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C406.6 Dedicated OA sys (DOAS)*</td>
<td>5</td>
<td>8</td>
<td>N/A</td>
<td>2</td>
<td>5</td>
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<tr>
<td>C406.11: Fault detection*</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>C406.12: Efficient kitchen equipment*</td>
<td></td>
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</tr>
</tbody>
</table>

*Credits supported by COMcheck IECC-2021

**Credits supported by COMcheck IECC-2021 with Denver Specific Instructions

Other credits are Denver Specific
## C406 HVAC & Kitchen Credits

<table>
<thead>
<tr>
<th>Sub-section</th>
<th>Group B</th>
<th>Group R &amp; I</th>
<th>Group E</th>
<th>Group M</th>
<th>Other*</th>
</tr>
</thead>
<tbody>
<tr>
<td>C406.13: All-electric space heating</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>C406.14: Cold climate heat pumps</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>6</td>
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<tr>
<td>C406.16: Demand responsive thermostats</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>C406.17.1: Reduced fan power</td>
<td>2</td>
<td>N/A</td>
<td>6</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>C406.17.2: Further reduced fan power</td>
<td>4</td>
<td>N/A</td>
<td>11</td>
<td>14</td>
<td>6</td>
</tr>
</tbody>
</table>

*Credits supported by COMcheck IECC-2021
**Credits supported by COMcheck IECC-2021 with Denver Specific Instructions
Other credits are Denver Specific
C403 and C406 – HVAC & Kitchen

- Mechanical COMcheck & Inspection checklist
- HVAC Commissioning
- Any C406 efficiency credits?
  - Heating / cooling efficiency improvement
  - Dedicated outside air system
  - Fault detection and diagnostics
  - All-electric space heating
  - Cold climate heat pumps
  - Demand responsive thermostats
  - Reduced fan power
## C406 Service Water Heating Credits

<table>
<thead>
<tr>
<th>Sub-section</th>
<th>Group B</th>
<th>Group R &amp; I</th>
<th>Group E</th>
<th>Group M</th>
<th>Other*</th>
</tr>
</thead>
<tbody>
<tr>
<td>C406.7.2: Recovered/renew SWH&lt;sub&gt;b&lt;/sub&gt; *</td>
<td>N/A</td>
<td>14</td>
<td>1</td>
<td>N/A</td>
<td>14</td>
</tr>
<tr>
<td>C406.7.3: Eff fossil fuel SWH&lt;sub&gt;b&lt;/sub&gt; *</td>
<td>N/A</td>
<td>9</td>
<td>2</td>
<td>N/A</td>
<td>6</td>
</tr>
<tr>
<td>C406.7.4: Heat pump SWH&lt;sub&gt;b&lt;/sub&gt; *</td>
<td>N/A</td>
<td>5</td>
<td>1</td>
<td>N/A</td>
<td>5</td>
</tr>
<tr>
<td>C406.15: All-electric water heating</td>
<td>9</td>
<td>13</td>
<td>13</td>
<td>4</td>
<td>9</td>
</tr>
</tbody>
</table>

*Credits supported by COMcheck IECC-2021
**Credits supported by COMcheck IECC-2021 with Denver Specific Instructions
Other credits are Denver Specific
C404 and C406 – Service Water Heating

• Mechanical COMcheck & Inspection checklist
• SHW commissioning
• Any C406 efficiency credits?
  ✓ Recovered or renewable water heating
  ✓ Efficient fossil fuel service hot water
  ✓ Heat pump service hot water
  ✓ All-electric water heating
## C406 Power & Lighting Credits

<table>
<thead>
<tr>
<th>Sub-section</th>
<th>Group B</th>
<th>Group R &amp; I</th>
<th>Group E</th>
<th>Group M</th>
<th>Other a</th>
</tr>
</thead>
<tbody>
<tr>
<td>C406.3: Reduced light power**</td>
<td>7</td>
<td>2</td>
<td>8</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>C406.3.2: Reduced light power by 15%**</td>
<td>11</td>
<td>3</td>
<td>12</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>C406.3.2: Reduced light power by &gt;15%**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Proportional Credit</td>
</tr>
<tr>
<td>C406.4: Enhanced digital light control*</td>
<td>2</td>
<td>N/A</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C406.10: Energy monitoring*</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C406.5.1: Basic renewable credit*</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>C406.5.2 Enhanced renewable credit</td>
<td>9-18</td>
<td>7-14</td>
<td>6-12</td>
<td>7-14</td>
<td>7-14</td>
</tr>
</tbody>
</table>

*Credits supported by COMcheck IECC-2021
**Credits supported by COMcheck IECC-2021 with Denver Specific Instructions
Other credits are Denver Specific

Noted in Permit Scope of Work
C405 and C406 – Power & Lighting

- Lighting COMcheck & Inspection checklist
- Electric ready infrastructure
- Electric vehicle requirements
- Lighting control commissioning
- Any C406 efficiency credits?
  - Reduced lighting power
  - Enhanced digital lighting controls
  - Energy monitoring
  - On-site renewable energy
Example – C406.17 HVAC Fan Power Credit

Example: A grocery store contains (5) 10-ton rooftop HVAC systems, each with a constant volume supply fan with a design airflow of 4,000 cfm, return fans, and heat recovery.

- The heat recovery device effectiveness is 70%
- The total bhp of all systems is 23

Would this system be eligible for the fan power credit?

C406.17.2 Further reduced HVAC system fan power. The total design fan power for all HVAC units shall be no less than 20 percent lower than the fan power allowance defined in Table C403.8.1, Option 2.
C406.17 HVAC Fan Power Credit

Answer:

Allowed System bhp = 0.00094 \times (5 \times 4000) + 2.421 + 5.0351 = 26.256 \\
Design System bhp = 23

\((26.256 - 23) / 26.256 = 12.4\% \text{ reduction}\)

From Table C406.1(1), **7 credits** are available for the fan systems.

<table>
<thead>
<tr>
<th>Sub-section</th>
<th>Group M</th>
</tr>
</thead>
<tbody>
<tr>
<td>C406.17.1: Reduced fan power</td>
<td>7</td>
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<tr>
<td>• 10% reduction</td>
<td></td>
</tr>
<tr>
<td>C406.17.2: Further reduced fan power</td>
<td>14</td>
</tr>
<tr>
<td>• 20% reduction</td>
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</tbody>
</table>
## Performance Path Options

<table>
<thead>
<tr>
<th>Compliance Path</th>
<th>Energy Cost</th>
<th>Site Energy</th>
<th>Compares to Baseline Building</th>
<th>Compares to Performance Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified C407: Energy Cost</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Appendix SE: Site Energy</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Appendix PT: Performance Target</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Benefits:**
- Allows for a more holistic design process
- More flexibility with prescriptive requirements
- Calibrated towards Denver’s NZE goals
- Plan for GBO compliance
- Incentivizes all-electric buildings
Mandatory Requirements

All Performance Paths must meet 2022 DEC C407.2 mandatory requirements *and* 90.1-2019 Appendix G mandatory provisions

Performance Checklist

Why ASHRAE 90.1-2019 requirements?
• Since the Performance Path follows ASHRAE 90.1 Appendix G modeling protocol, those requirements supersede 2021 IECC
• Refer to the Prescriptive Path training for more details

Use the Performance Checklist during design to help identify mandatory requirements
Mandatory Requirements – Envelope

2022 Denver Energy Code
- C402.1.5 Minimum insulation
- C402.5 Thermal envelope and air barrier requirements
- C402.5.5 Room containing fuel burning appliances
- C402.5.8/9 Loading docks and vestibules
- C402.5.10 Recessed lighting
- C403.12 Data centers

ASHRAE 90.1-2019
- Use Appendix G for envelope baselines
- Can use semi-heated space categories
Mandatory Requirements – HVAC & Kitchen

2022 Denver Energy Code
• C402.4.11 Operable openings
• C403.1.2 Data centers
• C403.2.3 Fault detection diagnostics
• C403.2.4 Space heating equipment electrification

Alterations:
• C503.3.2 Low NOx Emissions requirements
• C503.3.3 Partial electrification

ASHRAE 90.1-2019
• Follow Appendix G modeling guidelines
• 6.4.1 Minimum equipment efficiencies*
• 6.4.2.1 Calculation of heating/cooling loads*
• 6.4.3 HVAC control requirements
• 6.4.3.4.5 Enclosed parking garage ventilation controls
• 6.4.3.6 Humidification/dehumidification*
• 6.4.4.1.3 Pipe insulation*
• 6.4.4.2.2 Duct/plenum sealing & leakage testing
• 6.4.5 Walk-in coolers and 6.4.5 Refrigerated display cases*
• 10.4.5 Air curtains*

*same or similar to 2022 DEC
Mandatory Requirements – Service Water Heating

2022 Denver Energy Code

- C404.10 Water heating equipment electrification
- C404.11 Demand response controls for electric storage DHW
- C404.12 Provide electric infrastructure for fossil fuel equipment

Alterations:
- C503.4.1 Partial electrification requirements

ASHRAE 90.1-2019

- Follow Appendix G modeling guidelines
- 7.4.2 Minimum equipment efficiencies*
- 7.4.3 Pipe insulation*
- 7.4.4 Service water heating controls*
- 7.4.5 Pool controls and covers
- 7.4.6 Heat traps*
- 10.4.2 Service water pressure booster systems

*same or similar to 2022 DEC
Mandatory Requirements – Power & Lighting

**2022 Denver Energy Code**
- C405.4 Lighting for plant growth
- C405.12 Energy monitoring
- C405.13 EV Spaces
- C405.14 Solar ready requirements
- C405.15 Electric infrastructure

**ASHRAE 90.1-2019**
- Follow Appendix G modeling guidelines
- 8.4.1 Voltage drop*
- 8.4.2 Automatic receptacle control*
- 8.4.4 Electric transformers
- **9.4.1 Interior/Exterior lighting controls**
- 9.4.1.2 Parking garage lighting controls*
- **9.4.1.3 Special application lighting controls**
- **9.4.3 Dwelling unit lighting efficacy**
- 10.4.1 Electric motor efficiencies*
- 10.4.3 Elevators & 10.4.4 escalators*
- **10.4.6 Whole building energy monitoring**

*same or similar to 2022 DEC
On-site Renewable Energy

- Renewable energy may be used to meet the Performance Path requirements for up to 10% of the proposed design’s energy cost (C407) or energy use (appendix SE and PT).
- Requires a fully designed photovoltaic array ready to permit.
- PV array energy production calculated using software such as Helioscope or PV Watts.
- System must be owned, be under a lease of minimum 15 years, or be under contract to purchase the energy generated for a minimum of 15 years.

When \( \frac{(PBP_{nre} - PBP)}{BBP} > 0.10 \), new buildings, additions to existing buildings, and/or alterations to existing buildings shall comply with the following:

\[
PCI + \left[ \frac{(PBP_{nre} - PBP)}{BBP} \right] - 0.10 < PCI_t
\]
Performance Path Energy Model Report

New report templates: Denver has adopted the DOE/PNNL 90.1 tool suite

• Leverages actively supported tools and technical assistance
• Provides modelers with a consistent tool compatible with other programs like LEED
• Teams will submit both:

  Part 1 - Compliance Form - ASHRAE Standard 90.1 Appendix G

  Part 2 – 2022 DEC Companion Tool – Denver-specific overlay for code and Green Buildings Ordinance
  https://Denvergov.org/BuildingCode
Performance Path Energy Modeling Report

90.1 Compliance Form
- Energy modeler certification
- Building types, areas, new / renovation
- Energy sources, rates
- Energy demand, use and cost, EUI
- Renewable energy
- Envelope, Lighting, HVAC, SHW, Process*

2022 DEC Companion Tool
- All-Electric Property - Y/N
- Confirm areas
- BPF for project
- Compliance:
  - 2022 DEC - C407, SE, PT
  - Green Buildings Ordinance

*Can substitute 2019 Commercial Energy Modeling Report Table 2 through 9/30/2023
Energy Model Submittal Package

Teams will upload a zipped file with:

- Energy model report files
- Input and output reports from energy simulation (IP units preferred)
- Energy rates
- Exceptional calculations
- On-site renewables – may be letter from owner with summary of contract or lease
- If adjacent buildings or topology shades building, include in a site plan

Naming convention: `<energyreport>_<address>_<date>.zip`
Summary
<table>
<thead>
<tr>
<th>Requirements for all paths (see Training #1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2022 DEC requirements</strong></td>
</tr>
<tr>
<td>C402.1.5 Minimum insulation requirements</td>
</tr>
<tr>
<td>C402.5 Envelope performance verification / testing</td>
</tr>
<tr>
<td>C403.2.3 Fault detection diagnostics</td>
</tr>
<tr>
<td>C403.2.4 Space heating partial electrification</td>
</tr>
<tr>
<td>C403.4.1.1 Heat pump supplementary heat</td>
</tr>
<tr>
<td>C404.10 Water heaters partial electrification</td>
</tr>
<tr>
<td>C404.11 Demand responsive water heating</td>
</tr>
<tr>
<td>C404.12 Water heater equipment location</td>
</tr>
<tr>
<td><strong>2022 DEC requirements continued</strong></td>
</tr>
<tr>
<td>C405.12 Energy monitoring</td>
</tr>
<tr>
<td>C405.13 Electric vehicles</td>
</tr>
<tr>
<td>C405.15 Electric infrastructure</td>
</tr>
<tr>
<td>C408.2 / C408.3 HVAC, SHW, lighting commissioning</td>
</tr>
<tr>
<td>C503.3.3 Gas furnace, unitary AC permit parity</td>
</tr>
<tr>
<td>C503.4.1 Gas and instantaneous SHW permit parity</td>
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## Verification & Commissioning Summary

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Prescriptive</th>
<th>Performance</th>
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<tbody>
<tr>
<td>C402.5.1.5 Air barrier drawing review</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>C402.5.1.5 Air barrier construction inspection</td>
<td>●</td>
<td>●</td>
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<tr>
<td>C402.5 Air leakage testing</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>C408.2 HVAC, SHW commissioning</td>
<td>●</td>
<td>●</td>
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<tr>
<td>C408.3 Lighting commissioning</td>
<td>●</td>
<td>●</td>
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<tr>
<td>C403.12.2.3 / 90.1-2019 6.4.4.2.1 Duct leak test</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>90.1-2019 6.4.4.2.1 Exterior duct leak test</td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>
What if things change during construction?

- Envelope changes
- Windows NFRC performance variation
- HVAC / DHW efficiencies
- Prescriptive – C406 Efficiency credits not met
- Performance – Field installation differs from modeled conditions

Coordinate between CPD, GC, owner, design team, and energy consultant to verify continued code compliance

Submit **Modified Drawings** with
- Revised C406 planning tool and compliance - or-
- Updated energy model submittal package

**What are Modified Drawings?**

Once a permit has been approved and issued, the project must be built to those approved plans. If changes are needed to the approved plans during construction, the changes must be reviewed and permitted. The changed documents and drawings submitted for review after initial permits were issued are called *modified drawings*.

Modified drawings are submitted as a new permit application in e-permits. Choose "building log" when prompted to select a permit type.
2022 DEC reasons for TCO

Energy code reasons for a Temporary Certificate of Occupancy instead of a regular Certificate of Occupancy:

- All-Electric Property has temporary gas
- Alterations - gas leak testing documentation
- Project does not meet air leakage testing requirements
- Required renewable energy system is not yet installed
Existing Building Support and Resources

Resources and technical assistance available through the Electrification Program website, www.denvergov.org/BuildingElectrification or contact us at:

- electrification@denvergov.org:
  - Electrification Feasibility Reports and incentives
- mechplumb.review@denvergov.org:
- Permitting and code compliance
How is electrification in existing buildings going for you?

CASR’s existing building electrification team would love to hear stories and feedback from contractors and building professionals about how heat pump installation is going for you!

If you’d like to share your experience with CASR email electrification@denvergov.org
Questions?

• Time is reserved at the end of the presentation for Q&A
• Please use the Q&A feature to submit your questions

• Responses to all questions not addressed today will be sent out by email to registered participants
• Additional questions may be sent to: energy.review@denvergov.org
Thank you!

For more information, visit:
Denver.gov/EnergyCode
Denver.gov/BuildingCode

Contact us:
Questions about energy code: energy.review@denvergov.org
Questions about programs & resources: sustainability@denvergov.org