



2022 Denver Energy Code

Electrification for Commercial Buildings

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

May 24, 2023

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



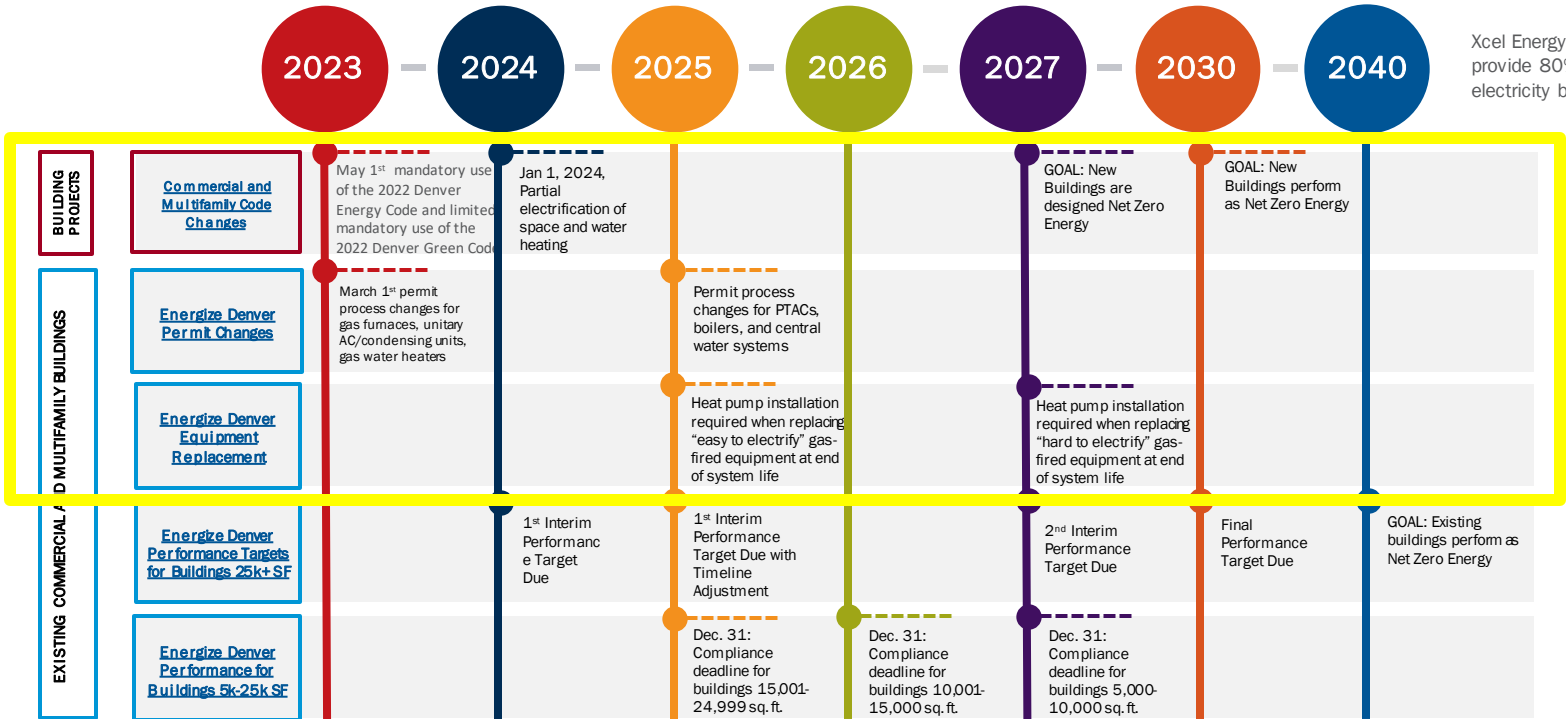
SCAN ME



	Commercial/Multifamily (Wednesdays at 12 pm)	Residential (Thursdays at 1 pm)
	Electrification May 24	Compliance Overview May 25
Prescriptive Path	May 31	June 1
Performance Paths	June 7	June 8
Contractor/Inspector Part 1	June 14	June 22
Contractor/Inspector Part 2	June 21	June 29

Timeline - Commercial Electrification and Performance Requirements

Xcel Energy required to provide 80% renewable electricity by 2030



2022 Denver Energy Code Prescriptive Path

- This is a high-level summary of the **commercial prescriptive path** 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



= Prescriptive provision



= Required for all paths

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

Home / Government / Agencies, Departments, and Offices / Climate Action, Sustainability & Resiliency / High Performance Buildings and Homes / **Net Zero Energy Hub - Codes and Resources**

Net Zero Energy Hub - Codes and Resources

This resource hub pulls together information from Denver and pairs it with resources from across the country to help building owners, professionals, and residents:

- Learn about changes in the 2022 Denver Building and Fire Code and the 2022 Denver Green Code
- Understand the importance of building electrification and energy efficiency
- See examples of successful Net Zero Energy building projects in a variety of building types and uses
- Navigate new regulations and requirements with confidence!



Resources for New Commercial and Multifamily Buildings

Buildings that are regulated by the Denver Commercial Building Code, which include commercial buildings and multi-unit residential buildings that are not regulated by the Denver Residential Code.



Resources for New Single Family, Duplex, and Townhomes

Any detached one- or two-family dwelling unit and townhomes three stories or less are regulated by the Denver Residential Code.

Tips for referencing code

2022 Denver Amendments

+

2021 International Energy Conservation Code (IECC)

=

2022 Denver Energy Code (DEC)

2022 Denver Energy Code

Key Electrification Highlights

1. Why Electrification?
2. Space Heating Electrification
3. Water Heaters Electrification
4. Additional Electric Infrastructure
5. C406 Electrification Options
6. Resources



= Prescriptive provision

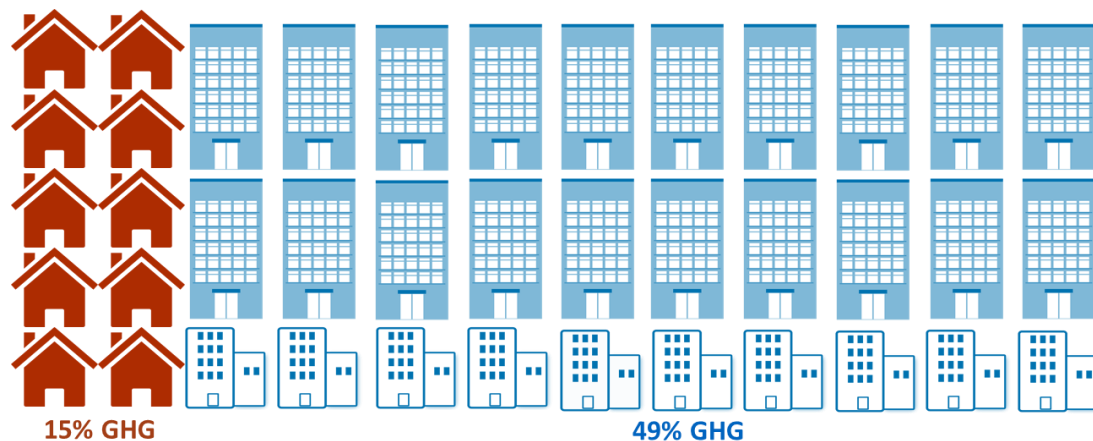


= Requirement for all projects



Why Electrification?

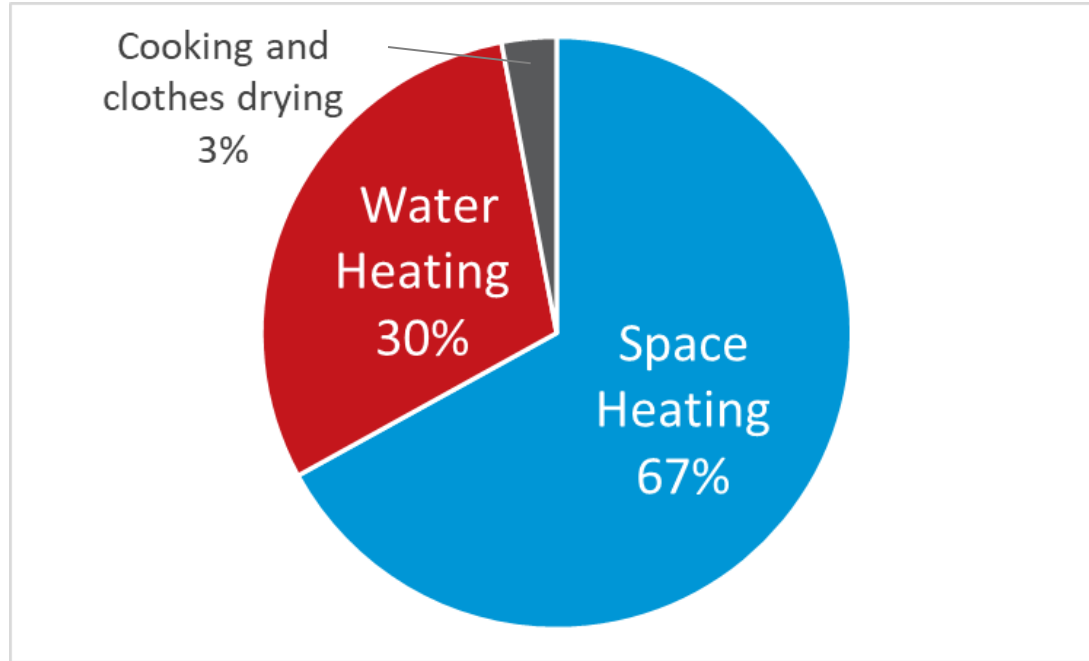
Buildings and Homes are responsible for 64% of Denver's GHG Emissions



Denver will eliminate greenhouse gas emissions by 2040.

- All new buildings and homes “net zero energy” by 2030
- All **existing** buildings and homes “net zero energy” by 2040

Gas Use in Buildings



Xcel Energy Renewable Production

Xcel Energy Carbon Reduction Trajectory

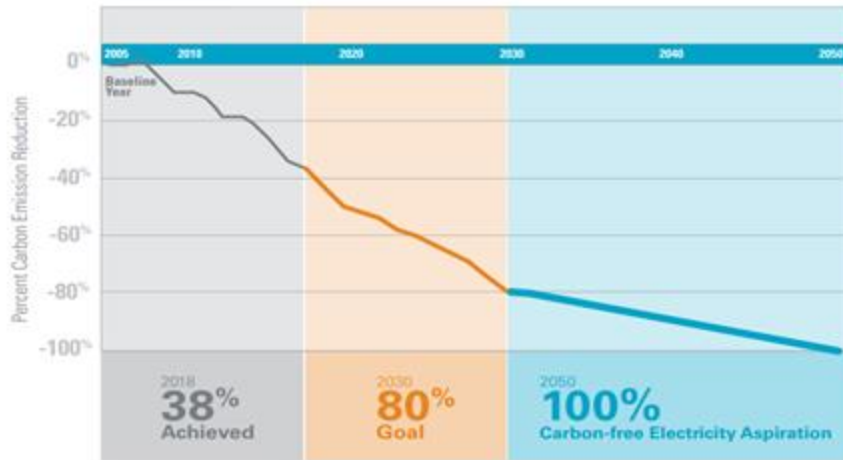


Figure 1: Our vision for the clean energy transition 2030 and 2050

Low emissions electricity is coming fast!

Electric energy is the only path to zero emissions.

Increases Grid Utilization

- Denver's electric system is already built to withstand summer air conditioning load, therefore winter heating needs can shift to electricity without significant infrastructure build-out

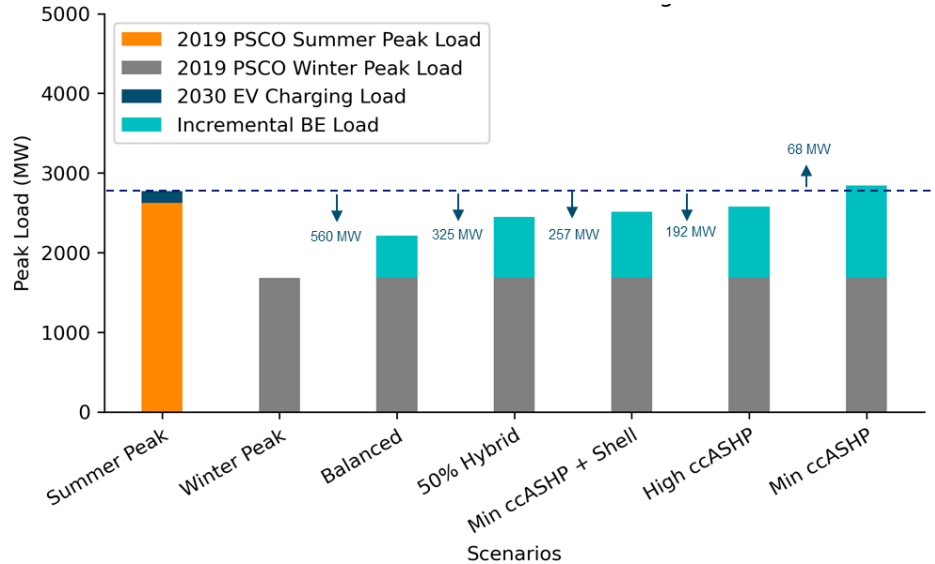


Figure 1. The Energize Denver Renewable Heating and Cooling Plan: Incremental Peak Load with 50% Building Electrification

Xcel Energy Electrification Timeline

Xcel Energy Grid Capacity Planning

- Files Distribution System Plan with the Public Utilities Commission every two years including distribution load forecast and grid needs assessment
- Implementing new load forecasting and demand management technologies to better predict and manage electrification

Xcel Energy Programs, Incentives, and Support

- Incentive programs, advisory services, and demand-management efforts included in Beneficial Electrification and Demand-side Management Plan, Transportation Electrification Plan, and other filings
- Dedicated [builder resources website](#) and team

Denver Engagement and Stakeholder Feedback

- Xcel Energy and CASR staff meet monthly to share information and troubleshoot electrification issues
- Denver to intervene in future PUC proceedings

Xcel Energy Carbon-free Electricity Goals

2030: 80% decarbonized grid
2050: 100% decarbonized grid

Xcel Energy Electrification Timeline

Public Utilities Commission (PUC) Filings

- [Beneficial Electrification Plan](#)
filed annually, next summer 2023
- **Distribution System Plan**
filed biannually, next late 2024
- [Transportation Electrification Plan](#)
filed triennially, next May 2023
- **Miscellaneous Proceedings** on distribution system barriers to electrification, expected early 2024
- [SB23-291](#) (pending Gov. signature) by July 1, 2024 requires PUC to examine electric utility policies and practices to determine if these pose a barrier to the beneficial electrification of buildings with respect to charges imposed for the cost of transformer/service upgrades

Xcel Energy Electrification Efforts

- In 2021, began implementing a new load forecasting tool to include assumptions about distributed energy resources and electrification
- Updating distribution standards in anticipation of increased adoption of electric vehicles and building electrification, placing fewer customers on larger distribution system transformers
- **Want to support Denver's PUC advocacy efforts? Contact us!**
electrification@denvergov.org

Heat Pumps

- Heat pumps move heat instead of creating it achieving 200-300% efficiency
- Progress in heat pump technology
- Cold climate heat pumps maintain more than 70% of their capacity at outside temperatures as low as 5 °F
- Many can operate effectively at -10 °F



Proven, Reliable Technology

- Heat pumps have been used since the 1800s in American refrigerators
- For decades to heat homes and buildings Asia and Europe.



Improving Equity through Electrification

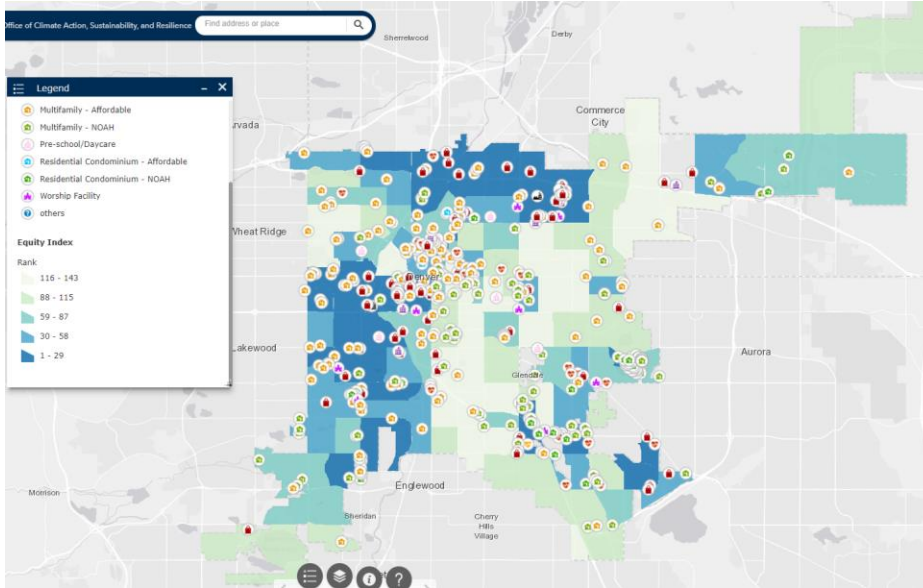


Figure 1. The Energize Denver Equity Priority Index

Improves equity:

- **Lowering the energy burden** through lower utility bills
- **Providing air conditioning** to those who lack it today
- **Improving safety:** Gas equipment in 30% of income-qualified homes in Denver fails carbon monoxide tests
- **Lowering exposure to indoor air pollutants:** Residents of homes with gas appliances have nearly three times the rate of asthma compared to homes with electric appliances

Reasons to electrify

- Reduces greenhouse gas emissions with on-site or off-site renewables
- Incentives and tax credits for heat pumps
- Provide heating and cooling in one system
- Increased safety from carbon monoxide and products of combustion
- Improves equity in Denver
- Increases comfort with less swings in temperature
- Energize Denver gives 10% credit to buildings with 80% electric site energy*
- Aligns with Green Buildings Ordinance paths using energy conservation**
- Simplifies 2022 Denver Energy Code prescriptive and performance paths

**Energize Denver draft for public comment May 2023*

***Green Building Ordinance updates for Council approval June 2023*

Space Heating Electrification

Partial Electrification for Space Heating



C403.2.4 – Space heating equipment

- Effective date of **January 1st, 2024**
- Fossil-fuel warm air furnaces and electric resistance space heating equipment not permitted for space heating
- Focus on systems with design, technology, and equipment that is currently available
- Aligns with Energize Denver requirements

- **Exceptions:**
 - Emergency power or standby power, as approved by building official
 - Makeup air systems where ERV is prohibited by Denver Mechanical Code
 - Electric resistance used for heat pump supplementary heat
 - Electric resistance up to 5 W/sf
 - Gas furnaces or electric resistance in heated plenums
 - Electric resistance in buildings that **use a performance path for compliance**
 - Replacement furnaces that comply with Alterations C503.3.3

Allowed Equipment



Gas Boilers



Gas Unit Heaters



Gas Infrared



VAV Electric Reheat

Partial Electrification for Space Heating



C403.2.4 – Space heating equipment

Allowed Equipment Examples

Boilers – fossil fuel and electric

Unit heaters – fossil fuel and electric

Radiant heat

Electric reheat in VAV boxes

Prohibited Equipment Examples with Limited Exceptions*

Furnaces

Gas RTUs

Gas DOAS / MAU*

Electric resistance FCUs*

Electric resistance PTAC/VTAC*

Partial Electrification for Space Heating



C403.2.4 – Space heating equipment

- Substitution options – **one for one**

- Split DX heat pumps
- RTUs with heat pump heating and electric resistance backup
- DOAS or MAU with heat pump heating and electric resistance backup
- PTACs/VTACs with heat pump heating and electric resistance backup

- Substitution options – **whole system**

- Water-source heat pumps
- Ground-source heat pumps
- Central air-cooled heat pump
- Heat recovery chiller
- Air-cooled VRF
- Water-cooled VRF

Supplementary Heat Controls



C403.4.1.1 - Controls that limit supplementary heat

Electric resistance or fossil fuel allowed:

- If the heat pump cannot meet load
- If the heat pump is in defrost mode
- If the vapor compression cycle malfunctions
- If the thermostat malfunctions



Water Heating Electrification

Partial Electrification for Water Heating



C404.10 Water Heaters

- Effective date of **January 1st, 2024**
- Fossil fuel and electric resistance instantaneous and storage water heaters are not be permitted to provide potable hot water
- Focus on systems with design, technology, and equipment that is currently available
- Aligns with Energize Denver requirements

- **Exceptions:**

- Electric resistance elements in heat pumps
- Electric resistance elements for recirculation loop temperature maintenance
- Electric storage water heaters with a volume ≤ 20 gallons
- Instantaneous electric water heaters within 10 feet of point of use
- Hot water storage tanks without electric resistance or fossil-fuel heating elements
- Water heating systems that require water temperature ≥ 141 °F
- Electric resistance equipment where on-site renewables serves 100% the annual service water heating requirement
- Electric resistance storage water heating equipment where solar thermal serves 75% of the annual service water heating requirement
- Systems ≥ 200 MBH, operating temperature ≥ 210 F, ≥ 120 gallons (per updates June 2023)
- Electric resistance in buildings that [use a performance path for compliance](#)
- Replacements of gas-fired storage water heaters or instantaneous water heaters that comply with Alterations C503.4.1

Partial Electrification for Water Heating



C404.10 Water Heaters

Allowed Equipment Examples

Boilers – fossil fuel and electric

Heat pump water heaters - individual

Heat pump water heaters - central

Prohibited Equipment Examples with Limited Exceptions*

Gas storage water heaters

Electric resistance storage water heaters*

Gas instantaneous water heaters

Electric instantaneous water heaters*

Partial Electrification for Water Heating



C404.10 Water Heaters

- Substitution options – **one for one**
 - Heat pump water heaters
- Substitution options – **whole system**
 - Central boiler with or without separate storage
 - Central heat pump water heater with electric resistance backup
- Heat pump water heaters – design considerations
 - Need air to pull heat
 - Discharge air-conditioned air
 - Larger size than gas or electric equivalents
 - Heat pump operating temperature

Demand Response Water Heating



C404.11 Demand Response Water Heating

- Electric storage water heaters
- 40-120 gallons
- Input rating less than 12 kW
- ANSI/CTA-2045-B Level 1 demand responsive controls

- Exceptions:
 - 180F water delivery temperature or higher
 - Water heaters that comply with Section IV, Part HLW or Section X of the ASME Boiler and Pressure Vessel Code
 - Water heaters that use 3-phase electric power

Electric Ready Infrastructure

Electric Ready Infrastructure



C405.15 Additional Electric Infrastructure

- Fossil fuel appliances and equipment or connections serving new buildings:
 - Provide a junction box within same space as fossil fuel appliance or equipment connected to an electrical panel by continuous raceways
 - Junction box, raceway, and bus bar in the electric panel and conductors serving the electric panel shall be sized to accommodate electric equipment sized to serve the same load as the fossil fuel appliance or equipment
 - Panel shall have reserved physical space for a three-pole circuit breaker
 - Junction box and electrical panel directory entry for the dedicated circuit breaker space shall have labels stating, “For future electric equipment”

Applicable fossil fuel appliances/equipment

Water heating equipment < 300 MBH

Warm air furnaces serving spaces without space cooling

Fireplaces, ranges, and stoves not defined as commercial cooking appliances

Commercial cooking appliances

Fossil fuel appliances and equipment serving dwelling units or sleeping units

Electric Ready Infrastructure



C405.15 Additional Electric Infrastructure

- What does it mean?
 - Fossil fuel equipment and appliances need electric infrastructure beyond what is required for operation
 - Electrical drawings must have additional infrastructure provided and clearly labeled
 - Electrical plans review will check loads for reasonableness
 - Can increase the cost of installing fossil fuel equipment and appliances



Water Heating Equipment Locations



C404.12 Water Heating Equipment Locations

- When required by C405.15 –
Additional electric infrastructure
 - 3' x 3' x 7' or larger
 - 760 cubic feet
- OR**
- 16" x 24" grill to a heated space AND
8" duct less than 10' for exhaust air

- Exceptions:
 - Less than 20 gallons of storage
 - Instantaneous heaters within 10' of point of use
 - Manufacturer recommendations for a specific heat pump water heater

C406 Additional Efficiency Credits

C406 - All Electric Space Heating



C406.13 – Electric Space Heating

- VAV total electric resistance (reheat) load must be less than 5 W/SF
- All other electric resistance load must be less than 1.35 W/SF
- Conditioned floor area only

Exceptions:

- Heat pump back-up electric resistance heat
- Supplementary electric resistance heating
- Electric resistance in heated plenums
- Electric resistance for freeze protection

C406.13 Additional Energy Efficiency Credits for Denver

Group B	4
Group R & I	6
Group E	6
Group M	9
Other	6

C406 - Cold Climate Heat Pumps



C406.14 – Cold Climate Heat Pump

- PTAC / VTAC COP of 1.5 or higher at 5F outdoor ambient temperature
- All other heat pumps COP of 1.75 or higher at 5F outdoor ambient temperature
- Total electric resistance load less than 1.35 W/SF

C406.14 Additional Energy Efficiency Credits for Denver

Group B	4
Group R & I	5
Group E -	5
Group M	9
Other	6

C406 Service Hot Water Heat Pump



C406.7.4 – Heat Pump SWH

- Heat pump water heaters where electric resistance water heaters are allowed
- EF of 3.0 or higher
- Air-source heat pumps shall not draw conditioned air from within the building

Eligible for:

R-1: Boarding houses, hotels, motels, R-2
I-2: Hospitals, psychiatric hospitals, nursing homes
E: Schools - kitchens / showers in locker rooms
A-2: Restaurants, banquet halls, or buildings containing food prep; A-3: Heath clubs, spas
F: Laundries
Service water heating is 10% of total energy loads

C406.7.4 Additional Energy Efficiency Credits for Denver - Area Prorated

Group B	NA
Group R & I	5
Group E	1
Group M	NA
Other	5

C406 Electric Water Heating



C406.15 – All-electric water heating

- All service water heating shall be provided by electric equipment

C406.15 Additional Energy Efficiency Credits for Denver

Group B	9
Group R & I	13
Group E	13
Group M	4
Other	9

Electrification Resources for New and Existing buildings

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



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.

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



Electrification Program

Starting on **March 1, 2023**, the requirements for pulling a permit to replace your AC units, gas-fired furnaces, and hot water heaters in commercial and multifamily buildings is going to change. For the fastest permitting process, we strongly recommend that you plan now for the new requirements.



Planning for Equipment Replacement

Starting on March 1, 2023, the requirements for pulling a permit to replace your gas-fired appliances is going to change. Learn more about what to expect.



Code Changes In 2023, 2025, and 2027

Energize Denver requires electrification for space and water heating equipment. This will happen through a series of updates to the Denver Building Code. Learn more about what to expect.



Electrification Feasibility Reports

Denver's updated building code will soon require you to look at whether electrifying your space and water heater and cooling is a good choice for you. Find out more about these requirements.



Incentives and Financing

We want to help you replace your



Home Electrification Incentives



Why Electrify?

Shifting to electric equipment like

Energize Denver – Existing Building Electrification Program

Existing Building Electrification Requirements

Partial electrification of space and water heating and cooling equipment upon system replacement in all existing commercial and multifamily buildings when cost-effective

Amending Denver Building and Fire Code	2023	2025	2027
Permit process: Requires plan review for unitary AC/condensing units serving a heated space, gas furnaces, gas hot water heaters – including cost feasibility of electrification	X		
Equipment replacement: Heat pumps required upon replacement of unitary AC/condensing units serving a heated space, gas furnaces, gas hot water heaters when cost-effective		X	
Permit process: Requires plan review for PTACs, VTACs, boilers, and central hot water systems – including cost feasibility of electrification		X	
Equipment replacement: Heat pumps required upon replacement of PTACs, VTACs, boilers, and central hot water systems when cost-effective			X

Overview of Changes Effective March 1, 2023

Permit process changes to near parity in permitting between gas systems and electrification

As of March 1, 2023, when replacing a unitary air conditioner or condensing unit, a natural gas furnace, or natural gas water heaters in commercial and multifamily buildings with another gas system or unitary AC, there are new requirements in Denver Energy Code, based on Energize Denver:

- Quick permits - permits that can be issued without the need for a plan review - for affected equipment will no longer be available
- Affected equipment replacements will require a plan review – including submitting additional documents like an Electrification Feasibility Report (EFR) during the permitting process- to obtain a permit
- Boilers are not affected until 2025
- denvergov.org/quickpermits

Electrification Feasibility Reports (EFR)

Assesses the feasibility of using an electric heat pump or dual fuel heat pump when replacing HVAC and water heating equipment and compares to a natural gas system on:

- Install costs
- Estimated annual energy cost change (%)
- Social cost of carbon dioxide over the life of equipment

[NewDayNewCode.com](https://www.newdaynewcode.com): EFR training and list of trained contractors

[Denvergov.org/BuildingElectrification](https://denvergov.org/BuildingElectrification) EFR Online tool



Furnace Permitting Changes Effective March 1, 2023

Permit process changes to near parity in permitting between gas systems and electrification

C503.3.3 When a gas-fired warm-air furnace is replaced with a gas-fired warm-air furnace, two of the following are required;

- An Electrification Retrofit Feasibility Report.
- Right sizing of equipment
- Perform leak testing of all gas pipes

C503.3.2 Also, the new fossil fuel furnace shall meet one of the following:

- Low-nitrogen dioxide emissions shall not exceed 14 nanograms of nitrogen dioxide per joule of useful heat delivered to the heated space.
- An Annual Fuel Utilization Efficiency of not less than 90 percent.

Exceptions:

- This section shall not apply when equipment is replaced as an Emergency equipment replacement.
- This section shall not apply to the replacement of gas-fired boilers used for space heat or water heat until 2025.

Exception: Indoor gas-fired make-up air units are not required to comply with this section.

AC and water heater permitting changes effective March 1, 2023

Permit process changes to near parity in permitting between gas systems and electrification

C503.3.3 When a unitary air conditioner or condensing unit serving a heated space is replaced with another unitary air conditioner, or condensing unit, one of the following is required:

- Provide an Electrification Retrofit Feasibility Report (EFR)
- Right sizing of equipment

C503.4.1 When a gas-fired storage water heater or instantaneous water heater is replaced with another gas-fired storage water heater or instantaneous water heater, one of the following is required:

- Provide an Electrification Retrofit Feasibility Report
- Perform leak testing of all gas pipes

Exceptions:

- This section shall not apply when equipment is replaced as an Emergency equipment replacement.
- This section shall not apply to the replacement of PTAC, VTACs and gas-fired boilers used for space heat or water heat until 2025.

Permitting to install Heat Pumps

[Permit process required to install heat pumps replacing covered equipment](#)

When a gas-fired furnace, water heater or unitary air conditioner is replaced with a heat pumps or partial heat pump furnace, then it cannot be permitted as a Quick Permit:

Applicant must apply for Building log through Denver's E-permits website

- Provide mechanical and electrical drawings prepared by a professional engineer
- Apply for a Zoning Permit for new exterior equipment
- Wastewater review will be required for new ground mounted equipment
- Landmark review may be required for new exterior equipment
- Structural review may be required for new roof mounted equipment

E-permits:

www.denvergov.org/epermits

How to apply for a permit using e-permits:

<https://youtu.be/NWtzaAPjID4>

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Thank you!

For more information, visit:

[Denvergov.org/EnergyCode](https://denvergov.org/EnergyCode)

[Denvergov.org/BuildingCode](https://denvergov.org/BuildingCode)

Contact us:

Questions about code: energy.review@denvergov.org

Questions about programs & resources: sustainability@denvergov.org

Commercial EV Requirements

C405.13 Electric Vehicle

- Changes from 2019 Denver Energy Code:
 - Updated the language and definitions to align with national level code language
 - New requirements for minimum charging rate and minimum circuit capacity
 - Energy load management systems for EVs are now allowed without admin modification
 - Increased the percent of *installed* charging stations for commercial and multifamily buildings
 - Multifamily:
 - Decreased the code-required number of EV capable spaces (conduit only) 80% to 40%
 - Decreased EV infrastructure from 100% of spaces to 60%

Occupancy	EVSE Installed Spaces	EV Ready Spaces	EV Capable Spaces
Group A, B, E, M	10%	5%	10%
Group I	5%	0%	5%
Group R-1 and R-2	15%	5%	40%
Group R-3 and R-4	2%	0%	5%
Group S-2 Parking Garages	10%	5%	0%

- EVSE installed spaces are required to meet the accessible / universal requirements in accordance with DCBC (amended IBC) section 1107
- Where all (100%) parking serving R-2 occupancies are EV ready spaces, requirement for EVSE spaces for R-2 occupancies shall not apply