

Northwest Metropolitan Regional Energy Code Cohort

Roadmap
to Net Zero
Energy New
Construction

April 2023

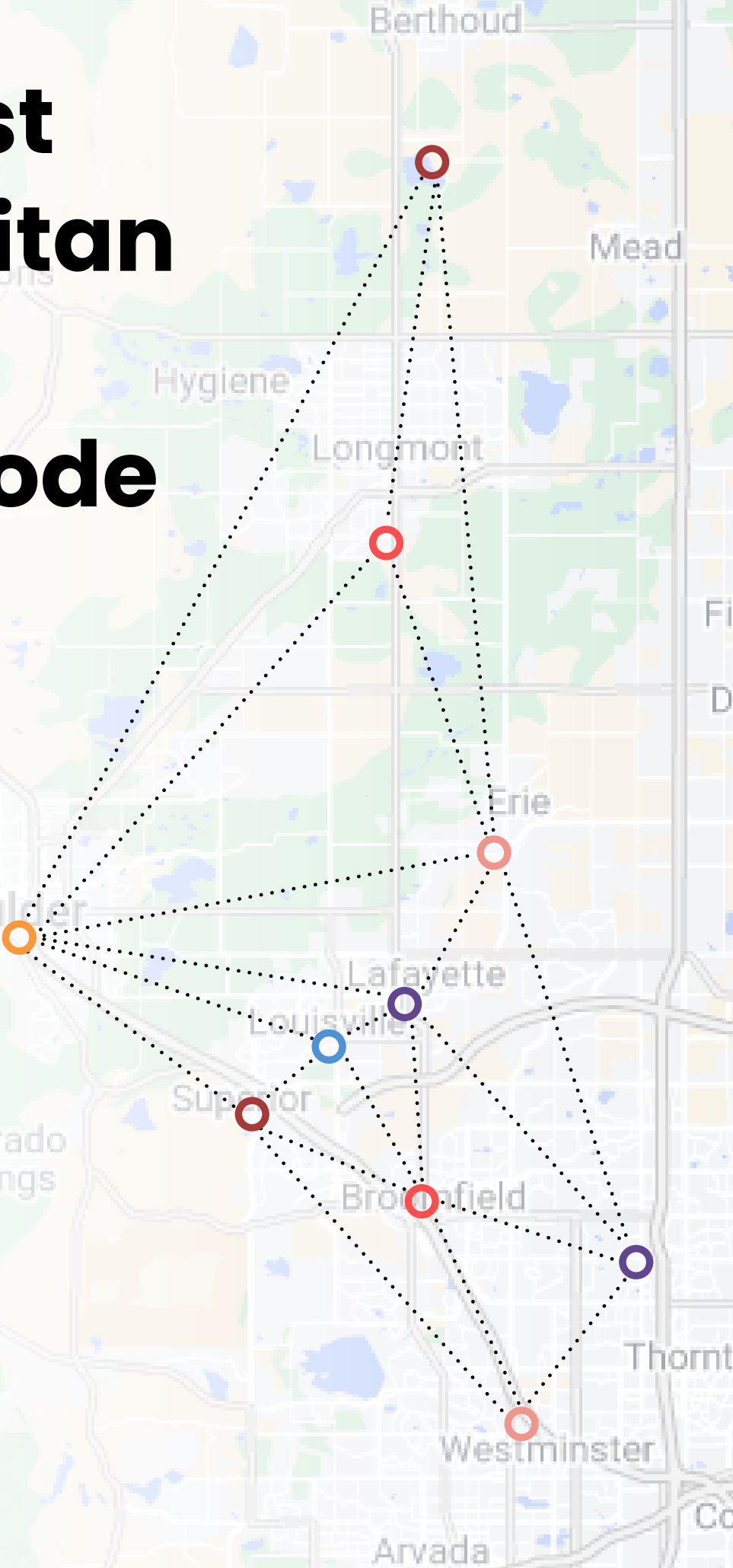


Table of Contents



Executive Summary	1
Introduction and Background	5
Elements of the Net Zero New Construction Roadmap	8
Residential Net Zero New Construction Roadmap	10
Commercial Net Zero New Construction Roadmap	14
Additional Non-Energy Code Elements	18
Additional Non-Energy Code Elements Roadmap	20
Affordability, Equity, and Implementation	24
Future Recommendations	29
Glossary	31
Endnotes	33
Photo Credits	34

Executive Summary



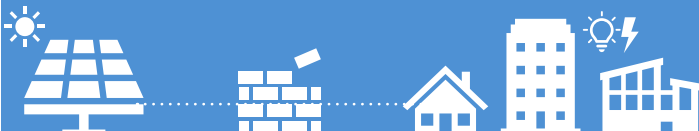
[Neighboring communities](#) in the area northwest of Denver convened an Energy Code Cohort (the Cohort) to collaborate on strengthening and adopting energy codes for new construction of residential and commercial buildings. The regional energy cohort work consisted of two phases. During Phase 1 of the Cohort work, participating communities worked together to review and adopt the 2021 International Energy Conservation Code (IECC) along with supporting amendments including electric vehicle readiness, solar energy readiness, electrification readiness, and enhanced energy efficiency. This regional energy code collaboration laid a foundation for Phase 2, during which the Cohort convened to develop a regional roadmap to achieve net zero codes in new construction by the end of 2030. The Roadmap to Net Zero Energy New Construction (Roadmap) lays out a stepped approach for communities to utilize during future energy code update cycles. While the goal of the Cohort is regional collaboration and coordination on future energy code updates, it is also recognized that jurisdictions may move on faster or slower timelines within the Roadmap steps.



The Roadmap includes five core elements of energy codes that address the operational carbon footprint of new buildings and phase out fossil fuels. The scope of the codes may, over time, broaden to include additional provisions which aim to reduce the life-cycle carbon emissions of newly constructed buildings. These provisions, while not summarized in the executive summary, have been included in the Roadmap as additional considerations for each jurisdiction as they update their energy codes.

Cohort Definition of Net Zero

By the end of 2030, newly constructed homes and buildings will be net zero with regards to operational energy. This will be accomplished through a combination of highly energy efficient construction and equipment, renewable energy systems, grid-interactive demand flexibility, and the elimination of fossil fuel combustion onsite.





RESIDENTIAL Net Zero New Construction Roadmap

2024

2027

2030

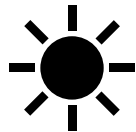


Efficiency Verified Compliance Pathways

All code compliance pathways included in the 2021 IECC are allowed.

Continued from 2024.

Only the ERI/HERS and prescriptive pathways are allowed.



Renewable Energy

Onsite solar photovoltaics (PV) or a fee-in-lieu is required to offset exterior energy uses (pools, spas, snowmelt, etc.).

Onsite PV is required to offset any onsite fossil fuel use, including exterior energy uses. Any exterior energy use still allows for a fee-in-lieu of the PV offset.

Continued from 2027.



Electrification

Electrification of space and water heating is required.

All-electric requirements are put into place with broad exceptions.

All-electric requirements are put into place with rare exceptions.



Energy Storage

Energy storage-ready is not required.

Energy storage-ready is required.

Energy storage installation is required.

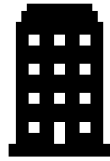


Demand Flexibility Integration

Demand flexibility capability is not required.

Demand flexibility capability for water heaters and HVAC is required.

Continued from 2027.



COMMERCIAL Net Zero New Construction Roadmap

2024

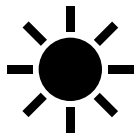
2027

2030



Efficiency Verified Compliance Pathways

Energy Use Intensity (EUI) Performance Standards are set for common building types.	EUI Performance Standards increase in stringency from 2024.	EUI Performance Standards increase in stringency from 2027.
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Renewable Energy

Onsite PV installation is required, either maximizing available roof space or meeting 50% of expected energy load; whichever is less.	Continued from 2024.	Continued from 2027.
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Electrification

Electrification of space and water heating is required.	Continued from 2024.	Continued from 2027.
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Energy Storage

Energy storage-ready is required.	Continued from 2024.	Energy storage installation is required.
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Demand Flexibility Integration

Demand flexibility capability is not required.	Demand flexibility capability for water heaters and HVAC is required.	Continued from 2027.
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Equity



Building codes are a crucial policy mechanism for achieving reductions in building energy use and greenhouse gas emissions. While working to refine and revise energy codes for building decarbonization, jurisdictions must also address broader racial equity and affordability challenges to ensure all community members reap the benefits of improved energy performance in buildings. The Roadmap examines equity benefits, challenges, and potential solutions, for jurisdictions to consider. Fully implementing equity in adopted building codes requires ongoing community engagement and regional coordination throughout implementation.

Identified Challenges

Identified Solutions

Maintaining overall housing affordability (note that housing markets, more than upfront or operating costs, determine home prices).

- Reference or conduct robust, credible, and unbiased analysis of both the upfront and lifecycle cost impacts and benefits of new codes.
- Provide additional support to low-income communities and smaller buildings.
- Help connect builders to available financial incentives, prioritizing small businesses and those of color.
- Reference or provide robust training for developers and building code officials on upcoming code updates; allow a phase-in period for new requirements.
- Ensure renters and community groups serving disproportionately impacted communities are engaged in stakeholder processes related to energy code advancements.

Ensuring rural communities and essential services have reliable electric grid connections as electrification requirements become more stringent.

- Include early and consistent communication with electricity providers.
- Consider alternatives or exemptions for certain homes or buildings in rural areas that may have unreliable electricity service.
- Provide appropriate compliance options for essential services (healthcare, water and sanitation, etc.) that have strict energy reliability needs.

Supporting construction-related firms in complying with new building codes.

- Conduct educational outreach and engagement with stakeholders involved in each stage of construction including designers, contractors, and other relevant trade professionals. Prioritize dedicated engagement of small businesses and businesses employing or serving communities of color.
- Incentivize certification programs and trainings related to building codes.
- Continuously monitor municipal staff and capacity needs.

Future Work

1

The Cohort should continue to **collaborate** prior to and during each code update cycle.

2

Future discussions should include a **variety of stakeholders** to incorporate perspectives from those involved in, or affected by, energy codes. These stakeholders may include tradespersons, local non-profits, regional groups, equity-focused groups, waste haulers, utilities, and other organizations working in related fields.

3

There is immense opportunity for future collaboration on **studies** that create a more accurate decision-making platform. Potential studies may include energy modeling to inform EUI targets, case studies, cost studies, and market analyses.

Introduction & Background



Introduction & Background



Buildings are one of Colorado’s four major sources of greenhouse gas pollution, as recognized in the State of Colorado’s Greenhouse Gas (GHG) Pollution Reduction Roadmap.¹ Building codes are a principal policy mechanism for governments to reduce energy use and carbon emissions in new construction (and, to a lesser degree, in retrofits of existing buildings). In particular, the [International Energy Conservation Code](#) (IECC, or energy code), published by the International Code Council, is the most common energy policy adopted by state and local governments nationwide. The most recent edition of the energy code, the 2021 IECC, reduces energy use and carbon emissions in buildings compared to previous editions. However, since future editions of the code are not yet developed and their impact on energy use and carbon emissions is therefore still uncertain, local governments have expressed an interest in purposefully setting a trajectory for further reducing carbon emissions from buildings and planning how to reach those targets.

In Colorado, efforts are underway to update both building codes and planning efforts to reflect community-specific decarbonization strategies. To supplement and accelerate community-led action, the State passed the Building Greenhouse Gas Emissions Bill² in June 2022, which sets new minimum energy code requirements for Colorado. Specifically, the bill requires any Colorado jurisdiction that updates its building codes between July 1, 2023, and June 30, 2026, to, at a minimum, adopt the 2021 IECC along with solar-ready and electric-ready (including electric vehicle [EV]-ready) standards. Then, the bill requires any jurisdiction that updates its building codes on or after July 1, 2026, to, at a minimum, adopt a low energy carbon code at least as strong as a forthcoming model code that is to be developed by the state’s Energy Code Board facilitated by the Colorado Energy Office.

In addition to the policy mechanisms geared at low-carbon building codes, other decarbonization efforts in the state are an important consideration for net zero code development. Colorado utilities continue to grow their renewable energy portfolios³ and electricity generation has become cleaner with carbon emissions from electricity use steadily decreasing in line with the increase in renewable generation. Because of this, local governments have an opportunity to take advantage of an increasingly decarbonized electric grid to power appliances and other building needs that previously used fossil fuels (e.g., heating, water heating, cooking, and clothes drying) – a strategy known as “electrification.” Recent advances in highly-efficient, all-electric technologies like heat pumps, combined with the cleaner grid, have brought electrification to the forefront.












Capitalizing on a cleaner grid through electrification also requires consideration of strategies to balance the anticipated increase in energy demand and available supply. Energy storage provides a way to capture excess energy when supply is high and demand is low, as well as a way to put power back on the grid when supply is low and demand is high. Additionally, integrating demand flexibility programs and technology for equipment and systems will be critical to improving grid efficacy, helping to control peak time use of electricity.

In an effort to advance building codes in alignment with the Colorado GHG Pollution Reduction Roadmap, the State of Colorado legislation, and an evolving electric grid, jurisdictions in the Northwest Metropolitan region of the Front Range worked collaboratively to develop a regional roadmap to a net zero code by the end of 2030.

Code Cohort Background

The Colorado Department of Local Affairs awarded a grant to neighboring communities in the area northwest of Denver to support regional collaboration in energy code updates that would achieve consistency and strengthen energy codes across the region. The project consisted of two phases. The first phase was the adoption of the 2021 IECC with supporting amendments and the second phase was the development of a regional roadmap for a net zero energy, new construction code.

An Energy Code Cohort (the Cohort) was convened with participation from seven communities; however, as the work progressed, other nearby jurisdictions joined the Cohort to collaborate on energy code work. The following communities participated in Phase 2, the Roadmap to Net Zero Energy New Construction.

- | | |
|---|---|
|  Boulder County (lead community) |  City and County of Broomfield |
|  City of Lafayette |  City of Longmont |
|  Town of Erie |  City of Boulder |
|  City of Northglenn |  Town of Berthoud (observing) |
|  City of Louisville |  City of Westminster (observing) |
|  Town of Superior | |

Phase 1 Summary

The goal of Phase 1 was regional collaboration on strengthening, updating, and adopting energy codes for residential and commercial buildings. In a series of five facilitated meetings, representatives from the building and sustainability departments of each community reviewed and discussed widely adopted and trending amendments to the 2021 IECC, opportunities for calibration with state legislation, and individual community goals. Code language and other adoption resources will be distributed in a publicly available energy code support package upon request.

Phase 1 Results

The Cohort ended Phase 1 by moving forward with the following for residential and commercial buildings:

- 2021 IECC Adoption**
- Supporting Amendments**
 - EV-Ready
 - Solar-Ready
 - Electric-Preferred
 - Cool Roofs
 - Horticulture Lighting Efficiency

Phase 2 Summary

Phase 2 commenced in August 2022. Like Phase 1, the communities listed above participated in another series of five facilitated sessions to determine the specific pathways and code elements necessary to achieve a net zero new construction code for the region by the end of 2030. Phase 2 results are outlined in the following sections. This Roadmap is intended to lay out a pathway of code elements with a flexible timetable. Jurisdictions will move at their own pace along the stepped pathway.

Elements of the Net Zero New Construction Roadmap



The Roadmap was developed based on participating jurisdictions having laid an energy code foundation in Phase 1 with the 2021 IECC adoption, including supporting amendments that better prepare a building for future installations of rooftop solar, electric vehicles, electric appliances, and electric space and water heating systems. Each component of the Roadmap builds upon those foundational elements through updates in the next three forthcoming code cycles in 2024, 2027, and 2030. Additional elements that took into consideration emerging technology, feasibility, and equity are also included. Equity considerations played a key role in determining the Net Zero Roadmap elements.

Defining Net Zero

The Cohort began the Roadmap discussion by defining what “net zero” means in the context of building codes. With grid decarbonization efforts in the State of Colorado, the Cohort determined the traditional definition of net zero—a building that produces as much energy as consumed onsite—needed to be reconsidered as the electric grid would soon supply a low-carbon power source. Grid decarbonization also encouraged the Cohort to consider non-traditional elements that could support net zero such as electrification, energy storage, and demand flexibility. The Cohort finalized a definition for net zero that included the elements detailed below.

By the end of 2030, newly constructed homes and buildings will be net zero with regards to operational energy. This will be accomplished through a combination of highly energy efficient construction and equipment, renewable energy systems, grid-interactive demand flexibility, and the elimination of fossil fuel combustion onsite.

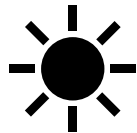
Energy Efficiency

Renewable Energy

Electrification

Energy Storage

Demand Flexibility



Helps reach 100% decarbonized electric grid.

Takes advantage of decarbonized grid.

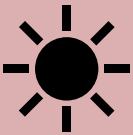
Supports a decarbonized grid.

Elements of Net Zero Code



Efficiency Verified with Compliance Pathways

The energy code includes many different compliance pathways. The “prescriptive path” includes efficiency levels for each individual building component. Several different “performance paths” allow for design flexibility and consideration of system relationships necessary to maximize efficiency. Increased use of certain performance paths (Energy Rating Index [ERI] or Home Energy Rating System [HERS] for residential, and energy use intensity (EUI) for commercial) speeds up approvals by building departments and makes it easier for elected officials to set the appropriate stringency levels.



Renewable Energy

Onsite renewable energy through photovoltaics (PV) can play a key role in supporting building decarbonization. However, with more carbon-free electricity being delivered by the grid, onsite PV may not be as crucial for achieving a carbon-neutral building.

In this Roadmap, onsite PV is used in residential buildings primarily to “offset” fossil fuel consumption in buildings, specifically for exterior energy uses such as pools, snowmelt, and fireplaces. (Onsite PV leads to emission reductions on the electric grid, rather than a direct offset of the emissions from fossil fuel use.) For commercial properties, an onsite PV requirement is recommended to support clean electricity goals for participating communities and to help offset the electricity load from commercial buildings.



Electrification

As electric utilities progress toward their renewable energy goals, the electric grid gets cleaner. To capitalize on the emissions reduction potential from renewably sourced electricity generation, the Roadmap increases the degree of building system electrification, requiring efficient electric equipment rather than equipment that burns fossil fuels. Electrification will create a higher electricity demand, a need for energy storage, and demand flexibility.



Energy Storage

With increasing deployment of renewable energy, energy storage becomes crucial to electric grid efficacy. Batteries can store excess energy and provide backup power by releasing that energy when renewable energy sources are not producing enough power. If configured to do so, energy storage also helps improve community resilience by providing an energy source during natural disasters and outages.



Demand Flexibility Integration

Demand flexibility is another method of improving electric grid efficacy as renewable energy deployment and distributed energy resources increase. Balancing electricity supply and demand can be done by shifting equipment and/or system energy use away from peak periods, with little to no impact on the end-user. Some utilities already have demand flexibility programs in place, but automatic control technology continues to improve. The Roadmap does not require homes or business to participate in demand flexibility, but ensures they have the capability to do so.



Residential

Net Zero New Construction Roadmap





Residential

Net Zero New Construction Roadmap

2024



All code compliance pathways are allowed.

All the code pathways in the 2021 IECC are still allowed, including Prescriptive, U/A Trade-off (RESCheck), Simulated Performance, and ERI pathways.



Onsite PV or a fee-in-lieu is required to offset exterior energy uses (pools, spas, snowmelt, etc.).

For all fossil-fueled exterior energy use (not including electricity), a home must offset the energy consumption of the exterior energy use with onsite PV or through paying a fee-in-lieu. Fees collected may be used by jurisdictions to incentivize additional electrification, efficiency, or renewable energy projects in their communities.



Electrification of space and water heating is required.

All space and water heating shall be provided by high-efficiency all-electric appliances.

Equity and affordability: Some all-electric appliances can cost more than gas appliances, however all-electric new construction is more affordable than gas, and much more affordable than retrofitting electrification. All-electric operating costs are increasingly competitive with gas, except for high-cost, fixed-rate electricity. Community-led incentive programs should provide support to energy-burdened households. Homes with unreliable electric service may experience outages, though electric outages also prevent most fossil-fueled appliances from running. Finally, some existing electric lines out to very rural areas may not be well-serviced or sufficient for increased electric loads and may need to be upgraded through assertive engagement with local utilities.



Residential

Net Zero New Construction Roadmap

2027



All code compliance pathways are allowed.

Continued from 2024.



Onsite PV is required to offset any onsite fossil fuel use, including exterior energy uses. Any exterior energy use still allows for a fee-in-lieu of the PV offset.

This PV requirement only applies to residential buildings eligible for an exception to the all-electric requirement and/or if the building has fossil-fueled exterior energy use.

Equity and affordability: Onsite PV may warrant incentives for affordable housing.



All-electric requirements are put into place with broad exceptions.

Criteria for exceptions can be decided within a jurisdiction, based on examples from other jurisdictions.



Energy storage-ready is required.

This requirement mandates space availability and electrical service routes for future energy storage systems.



Demand flexibility.

Water heaters and HVAC systems shall include the technical ability to connect to utility demand response programs.

Equity and affordability: Potential cost increases for grid-interactive efficient building technologies should be addressed through financial assistance and/or programs.



Residential

Net Zero New Construction Roadmap

2030



Only ERI/HERS and prescriptive pathways are available.

Compliance pathways are limited to the ERI pathway for new construction and the prescriptive pathway for remodels and renovations.



Onsite PV is required to offset any onsite fossil fuel use, including exterior energy uses. Any exterior energy use still allows for a fee-in-lieu of the PV offset.

Continued from 2027.



All-electric requirements are put into place with rare exceptions.

Exceptions may be applied in rare cases, as defined by the jurisdiction.



Energy storage installation is required.

Electrical energy storage system installation is required in new construction.

Equity and affordability: Cost of energy storage equipment should be addressed through incentives or subsidies.



Demand flexibility.

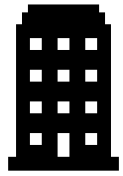
Continued from 2027.

Commercial Net Zero New Construction Roadmap



2024

Commercial Net Zero New Construction Roadmap



Energy Use Intensity (EUI) Performance Standards are set for common building types.

Most new buildings must achieve a property-type-specific EUI target. Backstop prescriptive requirements may be considered by each jurisdiction to encourage minimum energy efficiency levels for certain building components.

Equity and affordability: Common building types covered will need to verify energy performance with energy modeling, which may warrant incentives or programming to address cost burden. Incentives and programs to address cost burden are already provided by Xcel Energy and some other local utilities.



Onsite PV installation either maximizing available roof space or meeting 50% of expected energy load; whichever is less.

Available roof space is determined by sizing protocol in adopted solar-ready code language. Expected energy load will be determined by energy modeling. PV cannot contribute to a building's EUI score (see row above).



Electrification of space and water heating is required.

Space and water heating shall be provided by high-efficiency all-electric appliances (e.g., heat pumps). Fossil fuel powered cooking appliances, dryers, and process loads are still allowed, as well as certain technical situations where high-efficiency electric systems are not feasible. A limited amount of electric resistance is also allowed.

Equity and affordability: Financial assistance may be warranted to support under-resourced buildings and communities in electrification. Dedicated engagement is needed to assess and address needs in disproportionately impacted communities.

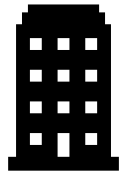


Energy storage-ready spaces are required.

These requirements are outlined in Appendix CB of the 2021 IECC and will already be implemented in participating jurisdictions through Phase 1.

2027

Commercial Net Zero New Construction Roadmap



Energy Use Intensity (EUI) Performance Standards are lowered from 2024.

This step increases the stringency of EUI performance standards from the 2024 code cycle. Backstop prescriptive requirements are maintained and strengthened.



Onsite PV installation either maximizing available roof space or meeting 50% of expected energy load; whichever is less.

Continued from 2024.



Electrification of space and water heating is required.

Continued from 2024.



Energy storage-ready spaces are required.

Continued from 2024.



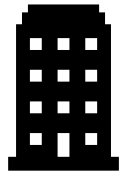
Demand flexibility.

Water heating systems and HVAC systems shall include the technical ability to connect to utility demand response programs. Improvements and cost decreases in this technology are predicted in this time frame.

Equity and affordability: Potential cost increases for grid-interactive efficient building technologies should be addressed through financial assistance and/or programs. Dedicated engagement is needed to assess and address needs in disproportionately impacted communities.

2030

Commercial Net Zero New Construction Roadmap



Energy Use Intensity (EUI) Performance Standards are lowered from 2027.

This step tightens the stringency of EUI performance standards from the 2027 code cycle. Backstop prescriptive requirements are maintained.



Onsite PV installation either maximizing available roof space or meeting 50% of expected energy load; whichever is less.

Continued from 2024.



Electrification of space and water heating is required

Continued from 2024.



Energy storage installation is required.

Electrical energy storage system installation is required in new construction.

Equity and affordability: Increased cost for energy storage equipment should be addressed through incentives or subsidies.



Demand flexibility.

Continued from 2027.

Additional Non-Energy Code Elements



Additional Non-Energy Code Elements



From design to demolition, the lifecycle of a building provides many opportunities for policy mechanisms to lessen impacts on carbon emissions, resource use, and occupant health. Energy codes can ensure efficiency and electrification, but additional provisions can mitigate emissions from waste created at the construction site from building materials and from modifications to existing buildings.

The Cohort discussed code requirements that widened the scope of the Roadmap to address embodied carbon, operational and construction-based waste, existing building updates, and water use.

Embodied Carbon

Embodied carbon encompasses all anthropogenic GHG emissions from building material extraction through the end of that material's useful life. These emissions may come from sourcing raw materials, manufacturing, transporting materials, construction and/or installation of that material, ongoing use, maintenance and repairs, and disposal. Strategies for addressing embodied carbon continue to evolve, but existing policy typically uses Environmental Product Declarations (EPDs), which identify life cycle emissions of different products and carbon limits for specific materials.

Waste: Construction-Based and Operational

Of all the waste that goes to a landfill, 20-40% is generated from construction and demolition (C&D) of buildings.⁴ Many of these materials can be reused or recycled, but with current practices and landfill rates, contractors often do not have an incentive to do so. This Roadmap outlines policy mechanisms that, when paired with intentional community organizing, can effectively reduce the amount of construction-based waste going to disposal facilities. Success of C&D waste diversion may depend on the availability and accessibility of recycling infrastructure, which may improve on the path to 2030.

Operational waste in a building is often overlooked in initial building design, but ensuring proper infrastructure is a low-cost and feasible strategy for waste diversion and curbing landfill emissions. This can be as simple as making certain a building has enough space to include appropriately sized receptacles for trash, recycling, compost, and any other waste stream relevant to the occupancy use type (i.e., electronic waste, durable goods).

Existing Buildings: Renovations, Additions, Alterations, and Changes in Occupancy

Though the primary focus of this Roadmap is new construction, existing building modifications are leverage points for decarbonization. Renovations, additions, alterations, and changes of occupancy present occasions for requiring energy improvements and are feasible first steps for jurisdictions to address existing building stock. Specific policy mechanisms could be discussed in a separate regional effort.

Water

Colorado is an arid environment in which climate change exacerbates existing drought and water supply issues. Addressing both indoor and outdoor water use efficiency is an important opportunity for climate change mitigation and community resilience.

Additional Non-Energy Code Elements Roadmap

2024



Collect EPDs for specific materials (align with State tax rebates).

An EPD is a way for building planners and designers to assess the impact of the materials they're using. The State of Colorado offers tax rebates for certain construction materials through Senate Bill 22-051 Policies to Reduce Emissions from Built Environment, and EPDs are used to apply for the rebate.⁵

Equity and affordability: Collection of EPDs may impose administrative burdens on purchasers and limit available building products that can be used, while the investment into developing EPDs may burden small manufacturers. Incentives are important tools to develop the market and support a transition to low embodied carbon materials.

Provide adequate space for waste receptacles.

Building design should accommodate collection for trash, recyclables, durable goods (for multifamily buildings), and compost.

Permit applications for new construction must include a plan for C&D waste.

A C&D plan must identify materials to be diverted or deconstructed, a plan for separating those materials onsite, where those materials will go, and how the project team will track them.

Equity and affordability: Processing planning documentation may stretch existing staff resources and slow permitting; funding should be sought to add staff capacity.

Additional Non-Energy Code Elements Roadmap

2024

continued



Energy code updates for renovations, additions, alterations, and changes in certificates of occupancy.

Jurisdictions can set specifications for which energy improvements must be made and project thresholds that trigger those improvements.

Equity and affordability: Increasing the energy performance of existing residential buildings can increase the habitability and reduce the energy cost burden for residents. Provisions should be considered to ensure costs for upgrades are not disproportionately placed on tenants in residential and commercial spaces.

Indoor water efficiency requirements.

These requirements are to be determined per jurisdiction. Note: Colorado law already requires WaterSense plumbing fixtures.⁶

Outdoor water efficiency requirements.

These requirements are to be determined by jurisdiction in accordance with state statute.

Note: Regulation 86 in the Code of Colorado Regulations, which addresses the use of greywater, is being updated in 2023.⁷

Effective stormwater management.

These requirements are to be determined per jurisdiction. Stormwater management addresses water quality issues by mitigating sediment and pollutants from runoff of construction projects and existing buildings.

Additional Non-Energy Code Elements Roadmap

2027



Apply low carbon limits for specific materials (align with State tax rebates).	Set low carbon limits for one or more of the eligible materials in Senate Bill 22-051. ⁸ Equity and affordability: Low carbon limits for specific materials may pose a challenge for small builders in meeting requirements. Equity-targeted incentives should play a role.
Provide adequate space for waste receptacles.	Continued from 2024.
Permit applications for new construction must include a plan for C&D waste and must reach a minimum diversion rate of 25%.	The next step in stringency after requiring a C&D plan is establishing a minimum percentage of diversion that a project must achieve. A jurisdiction can opt to apply penalties to projects that do not reach this requirement. Equity and affordability: Waste diversion may be difficult for small sites and small contractors. Recycling may pose a higher cost than landfilling construction and demolition waste. Incentives and program assistance should be directed to these projects.
Energy code updates for renovations, additions, alterations, and changes in certificates of occupancy.	Continued from 2024.
Indoor water efficiency requirements.	Continued from 2024.
Outdoor water efficiency requirements.	Continued from 2024.
Effective stormwater management.	Continued from 2024.
Apply requirements that address healthy indoor spaces.	Improving healthy indoor spaces can be done by addressing emissions of materials (i.e., paints, adhesives, flooring).

Additional Non-Energy Code Elements Roadmap

2030



Apply low carbon limits for specific materials (align with State tax rebates).	Continued from 2027.
Provide adequate space for waste receptacles.	Continued from 2027.
Permit applications for new construction must include a plan for C&D waste and must deconstruct the building.	<p>In addition to a C&D plan, the permit will not be issued unless the old building is deconstructed as required.</p> <p>Equity and affordability: Deconstruction may be difficult for small sites and small contractors. Deconstruction may pose a higher cost than demolition and landfilling construction and demolition waste. Incentives and program assistance should be directed to these projects.</p>
Energy code updates for renovations, additions, alterations, and changes in certificates of occupancy.	Continued from 2027.
Indoor water efficiency requirements.	Continued from 2027.
Outdoor water efficiency requirements.	Continued from 2027.
Effective stormwater management.	Continued from 2027.
Apply requirements that address healthy indoor spaces.	Continued from 2027.

Affordability, Racial Equity, and Implementation



Affordability, Racial Equity, and Implementation



Advanced energy codes present more benefits than challenges to affordability and to addressing the needs of communities disproportionately impacted by racial injustice and climate change. New construction presents the one-time opportunity to eliminate the cost of fossil fuel infrastructure, establish building envelopes that are highly efficient, and tie building energy use to an electric grid that is increasingly decarbonized and cost-competitive with gas. As building technology electrifies, it's important that lower-income residents and historically excluded communities not be stranded on less efficient and fossil fuel technology.

It should also be noted that additional equity benefits may be reaped by addressing existing building stock through renovations, additions, alterations, and changes in occupancy, as many disproportionately impacted residents rent or own older building stock. We intend that this new construction Roadmap supports durable and resilient construction that measures up to building performance standards addressing existing buildings.

How Do Building Codes Support Equity?

Climate change disproportionately impacts communities that have already been subjected to systemic injustice.* Lower-income communities and communities of color in Colorado are more likely to live in neighborhoods and homes with:

- Less tree cover, creating heat islands;
- Greater proximity to sources of air pollution and inadequate access to air filtration, leading to higher rates of indoor air pollution;
- Inefficient building envelopes and equipment, subjecting residents to heat, cold, high energy bills, and safety concerns; and
- Higher percentages of renters, who have little control over these built environment factors while landlords have little financial incentive to invest in upgrades.

Building codes that ensure high energy performance, especially for affordable housing, play a crucial role in securing habitable and affordable living conditions for residents while ensuring a just transition toward a climate-resilient future for all Coloradans.

* [Colorado HB21-1266](#) and Environmental Justice Task Force Recommendations.

Affordability

The availability of affordable and attainable housing presents a major challenge to many communities in the Cohort. Design, permitting, construction, and furnishing costs associated with advanced codes may aggregate to raise first costs for some home builders and developers or in some cases could slow the construction of much-needed affordable housing; however market rates, not relatively marginal construction cost differences, determine the majority of home prices.

High energy performance comes with its own affordability implications. More energy efficient construction and appliances may impose some higher upfront costs but will save occupants money through lower utility bills. Loosening standards for affordable housing would result in lower-performing homes and technologies for lower-income households, along with higher exposure to heat, cold, and air pollution with attendant health effects, which risks further entrenching historic economic and racial inequities in building stock.

Finally, considerations of energy code costs and benefits must be put into broader context of the full costs and benefits of new construction, including land costs, school quality (and other similar factors that influence land and home costs), density, home size, connection fees, desired home and community amenities.



Potential Solutions: Homeowners and Businesses

Communities should invest in outreach and engagement in advance of code adoption cycles to identify, implement, and publicize programs, incentives, or other support mechanisms that offset the increased cost to build to higher standards. Robust and impartial analysis is critical to public information as well as decision-making on codes. First-cost and operating cost analyses should be updated periodically to reflect evolving construction, equipment, and fuel costs, as well as financial assistance. Community engagement should involve culturally competent and language-accessible education on the benefits of higher standards. This Code Cohort should reconvene to coordinate on deeper engagement that prioritizes communities and businesses of color. This process should include impacted stakeholders to best understand the barriers and opportunities to affordable housing including potential homeowners, developers, designers, builders, and renters.

Ultimately, communities should consider strategies that achieve equity by providing additional support to disproportionately impacted communities, lower-income households, and builders of smaller or affordable homes in meeting code requirements. Developing creative financial assistance and local financing mechanisms ahead of code updates will supplement existing and incoming State or federal programs to help lower-income households and small homes take advantage of cost savings from efficient and low-carbon products. For example, the Roadmap currently does not differentiate between large and small houses, although large homes typically consume more energy and impose a greater burden on the grid than smaller homes. Placing additional requirements for larger homes to conserve energy or to pay fees for excess energy use would help disincentivize excessive energy use while providing a funding source for financial assistance.

Communities could consider the following ideas to help address affordability:

- Increasingly stringent requirements can be implemented based on **square footage**, requiring larger homes to meet the highest energy improvement standards, and thereby incentivizing smaller homes with smaller energy loads.
- An **electrical grid impact fee** could be assessed based on square footage, starting at a specified size. These fees can fund incentives or financial assistance for smaller homes or lower-income households to purchase high-efficiency equipment. Similar to the mechanism above, this may also serve as a disincentive to larger homes.
- Publicize existing tax credits, utility rebates, and other **financing mechanisms** that can be leveraged to help pay down upfront costs.
- Work with existing **direct service organizations**, such as affordable housing, weatherization, community health, community assistance, and aging services, to ensure that support and financial assistance reach those who need them.
- Communities may wish to **reevaluate zoning laws** to incentivize density and/or smaller homes, such as raising height limits for multifamily proposals and allowing construction of accessory dwelling units (ADUs), while protecting solar access with solar setbacks. Another option includes incentivizing or pre-approving models like ENERGYSTAR manufactured homes to improve affordability and incentivize construction.



Potential Solutions: Developers

Strengthening the codes will increase the responsibilities of developers who specialize in some classes of affordable housing. Working with developers on code rationale and compliance will help smooth the path for future projects that will increase available affordable housing stock.

Communities could consider the following ideas to help encourage the development of affordable housing:

- Building officials should develop **communication strategies** that clarify when codes will be implemented and what will be required of developers.
 - An example of an effective communication strategy that building departments can employ is a fact sheet or business case that explains the return on investment of the advanced codes for building owners and developers. Cases should highlight the marketability of the long-term benefits of the code requirements.
- Providing **process incentives** for affordable housing developers will ease their burden. Municipal permitting processes can cause significant delays; providing trade-offs or incentives can reduce barriers to development.
- For existing buildings needing retrofits, incentivizing the use of an **energy performance improvement calculator** and providing **rebates** upfront, can support project evaluations and encourage integration of high efficiency appliances into existing building upgrades.

Finally, renters face a unique challenge, as they are often times barred from upgrading rental units and/or equipment. Furthermore, renters have historically been excluded from a role in developing policies governing the built environment. As the Cohort seeks to expand the availability of affordable rental units, communities should consider renters a key equity stakeholder for engagement and prioritization for investment through incentives, financial assistance, and programmatic support.



Resiliency

Some homes in the Cohort communities, especially in Boulder County, are situated in rural communities around the mountains where grid connectivity remains inconsistent and poses safety concerns during the hottest and coldest times of the year. Electrification may present a challenge for new homes in certain locations. Conversations with electricity providers should continue to strengthen distribution networks and avoid stranding homes at the edges of the grid.

Similarly, some critical infrastructure facility types have different energy use profiles and demands than typical commercial buildings. Healthcare facilities and water and sanitation facilities, for example, are required to have backup generation to cover essential loads in the case of a grid outage, and such backup generators may not be sized for full electrification. Additional conversations with facility managers and community leaders can help determine which critical infrastructure may qualify for special considerations under the Roadmap codes.

Finally, based on Cohort insights, the agricultural industry in Boulder County may struggle with meeting commercial building codes due to their unique energy use profiles. Small agricultural businesses often require large investments into expensive equipment to grow, process, and deliver their products. Engagement with industry stakeholders can inform a decarbonization approach that addresses these concerns in the codes.



Support For Code Implementation

New construction projects undergo a long process from design through permitting and construction to commissioning. Stakeholders during each stage of construction must be able to understand and adhere to the new construction standards. Changes to the building code will impact the professionals who make up this ecosystem, particularly those in small, local firms.

Communities could consider the following ideas to help support local construction-related firms in complying with new building codes:

- Communities can conduct **educational outreach and engagement** with local design professionals, construction companies, and contractors to ensure these small firms access the available resources to implement and integrate the new codes into their work.
- Communities may consider working through trade organizations and state agencies to incentivize or facilitate access to **certification programs and trainings** that support new technologies and techniques required by the new codes. This will support small firms and increase the supply of certified professionals, making them more accessible for homeowners, builders, and developers.
- Compliance and enforcement of some aspects in new codes may increase the demand on municipal staff time and resources. As communities plan to adopt future code cycles, they may benefit from **reassessing staff capacity and needs**.



Future Recommendations

The purpose of the Cohort is to **maintain consistency and collaboration** as communities work to combat climate change with building codes. In an ever-evolving policy environment, the Cohort must continue to coordinate on updates, convening again prior to each code cycle, to ensure there is consistent alignment. The Net Zero Roadmap can serve as a launching point for discussion and jurisdictions can work together to decide how to implement each element to achieve climate goals and net zero new construction.

Deeper involvement of a variety of stakeholders will also be essential to energy code progression in Cohort communities. Local decision makers need to hear perspectives and insight from those involved in energy code implementation and compliance. These stakeholders include building and planning department staff, builders and developers, suppliers, realtors, utilities, and trades.

Stakeholders outside of the energy code realm are also essential to integration of more holistic sustainability initiatives within the built environment. These include community members affected by the built environment such as homeowners, renters, and community support providers. Many of these voices also come from non-profits like Eco-Cycle and the Colorado Green Building Guild, regional groups such as Resource Central and Boulder County Resource Conservation Advisory Board, waste haulers and collection facilities, water utilities, affordable housing organizations, and other groups that work in fields related to the additional consideration elements of the Roadmap.

Opportunities for Future Collaboration

To create the most accurate platform for decision making, jurisdictions involved in the Cohort need to collaborate on future work. There has been an expressed need from participating communities for studies that investigate topics outlined in the next steps below.

Immediate Opportunities for 2024 Code Update:

- 1** EUI targets developed through robust modeling that are specific to common building types and achieve regional energy improvement goals.
- 2** Residential and commercial case studies for electrification in new construction with an emphasis on cost.
- 3** Cost studies of code update impacts on residential and commercial buildings, especially examining cost impacts on disproportionately impacted and low-income communities.

For 2027 Code Updates & Beyond:

- 4** Market study of life-cycle analysis tools such as Environmental Product Declarations and modeling software, to align life-cycle requirements with market-readiness.
- 5** Regional coordination among jurisdictions, landfill operators, waste haulers, and others to ensure construction & demolition recycling programs are supported by lower landfill fees and infrastructure for waste collection and sorting.

For maximum implementation success of the Net Zero New Construction Roadmap, Cohort communities should convene prior to each code cycle update, collaborate on regional study opportunities, and involve a variety of stakeholders to incorporate necessary perspectives on all stages of building code development.



All-Electric Building: A building that contains no combustion equipment or plumbing for combustion equipment within the building or building site.

Building Types:

Commercial: For building code purposes, all buildings that are not included in the definition of “Residential” below.

Multifamily: A property that includes multiple separate housing units within one building or set of buildings. Multifamily buildings with more than three stories must comply with the commercial chapter of the energy code, and multifamily buildings with three stories or less must comply with the residential chapter of the energy code.

Residential: Includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses) and residential multifamily buildings three stories or less in height above grade plane.

Combustion Equipment: Any equipment or appliance used for space heating, water heating, cooking, aesthetic purposes, and/or clothes drying that uses fuel gas or fuel oil.

Decarbonization: The reduction of GHG emissions through a combination of no-carbon energy sources, energy efficiency and conservation, and resource conservation.

Demand Flexibility: The process of using communication and control technology to shift electricity use across hours of the day while delivering end-use services (e.g., air conditioning, domestic hot water, electric vehicle charging) at the same or better quality but lower cost. This occurs by applying automatic control to reshape a customer’s demand profile continuously in ways that either are invisible to or minimally affect the customer, and by leveraging more-granular rate structures that monetize demand flexibilities capability to reduce costs for both customers and the grid.⁹

Electrification: The process of replacing equipment that is traditionally powered with fossil fuels to that which is powered by electricity.

Beneficial Electrification: Per CRS 40-1-102,¹⁰ converting the energy source of a customer’s end use from a non-electric fuel source to a high-efficiency electric source, or avoiding the use of non-electric fuel sources in new construction or industrial applications, if the result of the conversion or avoidance is to:

- Reduce new GHG emissions over the lifetime of the conversion or avoidance.
- Reduce societal costs or provide for more efficient utilization of grid resources.

Electric-Ready: A residential home or commercial building that uses fossil fuels for space heating, water heating, cooking, clothes drying, and/or vehicles and that has pre-wiring, a dedicated circuit, panel space, and sufficient physical space for future all-electric equipment, or as otherwise specified by code

Electric-Preferred: A new building that meets the electric ready standard and requires extra efficiency or renewable energy if the building systems use fossil fuels.

Electric Vehicle (EV)-Ready: Preparing parking spaces for the future installation of EV chargers. There are three levels of EV-ready:

EV-Capable: A designated parking space that includes electric panel capacity, a dedicated branch circuit, and raceway for eventual installation of an EV charger.

EV-Ready: A designated parking space that is EV-capable and has a 240-volt receptacle installed for an EV charger, or as otherwise specified by code.

EV Supply Equipment (EVSE)-Installed: A designated parking space that has a minimum Level 2 charging station installed.



Energy Burden: The amount of household income spent on energy costs. An energy-burdened household spends at least 10% of their household income on energy costs, while the average Colorado household spends about 2%.¹¹

Energy Use intensity (EUI): A metric for measuring a building's energy use as it relates to building size. An EUI is calculated by dividing the total amount of energy the building consumes in one year by the total square footage of the building.

Environmental Product Declaration (EPD): A document that details the lifecycle analysis of a product, as well as the carbon dioxide equivalent emissions impact (represented as global warming potential) of that product.

EV Supply Equipment (EVSE): The electrical conductors and associated equipment external to the electric vehicle that provide a connection between the premise's wiring and the electric vehicle to provide electric vehicle charging.

Exterior Energy Use: Energy consumed by equipment for outdoor amenities, including but not limited to snowmelt systems, spas, pools, and outdoor fireplaces.

International Energy Conservation Code (IECC): Part of a suite of building codes published by the International Code Council, updated in an extensive process every three years, and adopted at the state or local level. The energy code has a chapter focused on commercial buildings and a chapter on residential buildings, each offering several flexible methodologies for builders to reach specific energy targets.

Net Zero: By the end of 2030, newly constructed homes and buildings will be net zero with regards to operational energy. This will be accomplished through a combination of highly energy efficient construction, renewable energy systems, grid-interactive demand flexibility, and the elimination of fossil fuel combustion on-site.

Solar-Ready: Designating and reserving roof space, identifying location for conduit, and providing sufficient panel capacity in preparation for a future installation of solar photovoltaic (PV) system, or as otherwise specified by code.

Endnotes

- 1 "GHG Pollution Reduction Roadmap." Colorado Energy Office, <https://energyoffice.colorado.gov/climate-energy/ghg-pollution-reduction-roadmap>
- 2 "Building Greenhouse Gas Emissions." Building Greenhouse Gas Emissions, Colorado General Assembly, 2 June 2022, <https://leg.colorado.gov/bills/hb22-1362>
- 3 Xcel Energy has a goal to achieve 100% carbon-free electricity by 2050. Additionally, investor owned utilities in the state must reach 80% renewable electricity by 2030, as directed by state statute.
- "Net-Zero Energy Provider by 2050." Xcel Energy, <https://co.my.xcelenergy.com/s/our-commitment/carbon-reduction-plan>
- "Sunset Public Utilities Commission." Sunset Public Utilities Commission, Colorado General Assembly, 30 May 2019, <https://leg.colorado.gov/bills/sb19-236>
- 4 UHG Consulting. Boulder County Construction And Demolition Infrastructure Study, Materials Generation Estimate And Market Analysis. 2011, <https://assets.bouldercounty.gov/wp-content/uploads/2018/05/constdemolitionrpt2011.pdf>.
- 5 "Policies to Reduce Emissions from Built Environment." Policies To Reduce Emissions From Built Environment, Colorado General Assembly, 30 May 2019, <https://leg.colorado.gov/bills/sb22-051>
- 6 "New Appliance Energy And Water Efficiency Standards." New Appliance Energy And Water Efficiency Standards, Colorado General Assembly, 30 May 2019, <https://leg.colorado.gov/bills/hb19-1231>
- 7 Department of Public Health and Environment Water Quality Control. <https://www.sos.state.co.us/CCR/GenerateRulePdf.do?ruleVersionId=6527&%2CfileName=5%20CCR%201002-86>
- 8 "Policies to Reduce Emissions from Built Environment." Policies To Reduce Emissions From Built Environment, Colorado General Assembly, 10 Oct 2022, <https://leg.colorado.gov/bills/sb22-051>
- 9 "The Economics of Demand Flexibility: How 'Flexiwatts' Create Quantifiable Value for Customers and the Grid." RMI, 2 Mar. 2022, <https://rmi.org/insight/the-economics-of-demand-flexibility-how-flexiwatts-create-quantifiable-value-for-customers-and-the-grid/>
- 10 Colo. Rev. Stat. 40-1-102 (Lexis Advance through all legislation from the 2022 Regular Session and the results of the November 2022 General Election), <https://advance.lexis.com/api/document/collection/statutes-legislation/id/633G-GN83-GXJ9-33T9-00008-00?cite=C.R.S.%2040-1-102&context=1000516>
- 11 "Low-Income Services." Colorado Energy Office, <https://energyoffice.colorado.gov/low-income-services#:~:text=%23FFFFFF,all%2064%20counties%20of%20Colorado>



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