

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

Less is More: Building to Zero Energy, Water, and Carbon

National Energy Codes Conference Seminar Series
Building Technologies Office

Summer 2022



NECC Seminar Series Lineup

Catch the entire lineup of sessions bi-weekly—Thursdays @ 1p ET:

- 8/18: Taking Charge of Climate Change through Stretch Codes
- 9/8: Energy Codes and Utility Programs: The Peanut Butter & Jelly of Energy Efficiency
- 9/22: Energy Code Implementation: Insights from the Field to the Classroom
- **10/6: Less is more: Building to Zero Energy, Water and Carbon**
- 10/20: Cracking the Code: Unlocking the Benefits of Off-site Construction
- 11/17: Outside-the-Box Options to Advance Multifamily Building Efficiency

> Learn more: <https://www.energycodes.gov/2022-summer-seminar-series>





Less is More: Building to Zero Energy, Water, and Carbon

NECC Seminar Series

October 6, 2022

About NEEP

A Regional Energy Efficiency Organization



One of six REEOs funded in-part by U.S. DOE
to support state and local efficiency policies and programs.

Northeast Energy Efficiency Partnerships



“Assist the Northeast and Mid-Atlantic region to reduce building sector energy consumption by at least 3% per year and carbon emissions by at least 40% by 2030 (relative to 2001)”

Mission

- We seek to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities.

Vision

- We envision the region's homes, buildings, and communities transformed into efficient, affordable, low-carbon, resilient places to live, work, and play.

Approach

- Drive market transformation regionally by fostering collaboration and innovation, developing tools, and disseminating knowledge



Less is More: Building to Zero Energy, Water, and Carbon



- Andrea Krim
 - Building Policy Manager, NEEP
- Jessie Burley
 - Sustainability and Parking Manager, Town of Breckenridge (CO)
- Mike Collignon
 - Executive Director, Green Builder Coalition
- Inonge Mubita
 - Manager of Buildings, International Living Future Institute

Zero Energy, Water, and Carbon





Zero Energy Ready Homes



TOWN OF
BRECKENRIDGE

Jessie Burley

Sustainability & Parking Manager

jessieb@townofbreckenridge.com



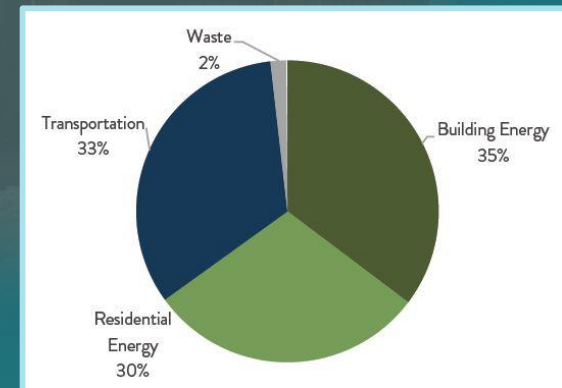
SUSTAINABLEBRECK

About Breckenridge, Colorado

- First sustainable building code 2007
- First SustainableBreck Plan 2011, updated in 2022
- 47% of the workforce lives in the community
- **GOAL:** 100% renewable electricity for municipal facilities by 2025
- **GOAL:** Balance of 37% resident housing and 65% vacation/lodging
- Custom homes and short term rentals
- **Alta Verde:** To be a model in sustainable, long-term affordable housing by achieving net zero designation and first to MFU to achieve ZERH under the new code

Community Challenges

- **Housing Need:**
 - 1,400 homes are needed in Breckenridge by 2023 - 1,300 of the homes needed are rentals
 - Maintaining low rents, affordable living costs, and healthy communities
- **Carbon Pollution:**
 - $\frac{2}{3}$ of emissions are generated by buildings (by sector)
 - $\frac{2}{3}$ of emissions are generated by electricity and natural gas (by source)
 - Low-income populations have higher exposure to climate related hazards & health risks
 - Net zero new construction by 2030 to achieve carbon emissions reduction goals
 - 54% natural gas increase in 2023 w/utility



Zero Energy Ready Homes

- Adopt codes two years after I-Code set release (2018 codes adopted in 2020)
- Seek to maximize and go above energy code to achieve climate goals and energy efficiency
 1. Do we want to create our own code or use an already existing code?
 2. Do we want to address just residential or commercial too?
 3. Do we want to address indoor/building energy use only, or address outdoor energy use too?



DOE Zero Energy Ready Home Waiver for the use of Air Source Heat Pumps in Climate Zone 7, through the Performance Compliance Pathway

July 1, 2021

The U.S. Department of Energy (DOE) Zero Energy Ready Home (ZERH) Version 1 program currently requires relatively low Energy Rating Index (ERI) scores for homes in Climate Zone 7 that are using air-source heat pumps (ASHPs) as the home's heating system.

This waiver policy provides a pathway to utilize ASHPs in Climate Zone 7 that will result in DOE ZERH ERI Target Scores that are more comparable to those found in Climate Zone 6. At the same time this waiver policy requires that an ASHP used in Climate Zone 7 has sufficient heating capacity to meet the home's heating load at the design temperature. Note that this waiver is a temporary policy for DOE ZERH Version 1 that will be sunset once the ERI modeling software used to determine DOE ZERH V1 compliance is updated to reflect a revised algorithm for ASHPs in Climate Zone 7.

Raters should take the following steps to utilize this pathway for Climate Zone 7 homes that are using an ASHP as the home's heating system.

1. Confirm that the home is located in Climate Zone 7, and is using an ASHP for the home's heating system.
2. Complete an energy model for the home based on its specifications and its location in Climate Zone 7. This model should reflect the Proposed Home's use of the proposed air-source heat pump.
3. Using this energy model, modify the project location to reflect the nearest county that is located in Climate Zone 6. For this revised energy model, record the DOE Zero Energy Ready Home Version 1 ERI Target Score. This is the maximum ERI score permitted for DOE ZERH V1 compliance. If the Size Adjustment Factor (SAF) applies, then record the DOE ZERH V1 ERI Target Score with the SAF applied. Document the DOE ZERH ERI Target score using a software report or a screen capture.
4. Change the energy model back to the actual project location in Climate Zone 7. Note the ERI Score of the Proposed Home.
5. Confirm and provide to the DOE ZERH program the Project Submission form below.
6. Submit the Project Submission form and documentation of the DOE ZERH ERI Target (Step #3 above) to the DOE ZERH program via email to zarp@newportpartnersllc.com. DOE ZERH certification certificates will be sent back to the energy rater within 3-5 business days following the submission of a complete and accurate waiver form.

Alta Verde Workforce Housing



Phase I:

- 80 units
- <60% AMI
- 81,358 SF
- All electric heating and power
- ~650 kW solar PV

Phase II:

- 172 units
- 80-120% AMI
- 171,315 SF
- All electric heating and power
- ~1.2 MW solar PV



Learning Along the Way

Phase I:

- Prescriptive pathway (ZERH)
- Offsets energy used on site (net annual basis)
- Electrification, heat pumps

Phase II:

- Performance based model
- More emphasis on building envelope vs. mechanical systems
- Decreases energy consumption overall, then offsets with PV



Long Term Affordability



Utilities Expected: Net Zero versus non-Net Zero (Typical Utility)								
Apartment Size	# of units	Xcel Solar Demand Charges*		Typical Utility Allowance**		Difference		
		Per Unit Per Month	Annual	Per Unit Per Month	Annual	Per Year	over 10 years	over 20 years
0	14	\$10	\$1,680	\$55	\$9,240			
1	38	\$10	\$4,560	\$61	\$27,816			
2	78	\$13	\$12,168	\$84	\$78,624			
3	42	\$13	\$6,552	\$106	\$53,424			
TOTAL	172		\$24,960		\$169,104	\$144,144	\$1,441,440	\$2,882,880

* Based on Xcel Solar Demand Charges (Secondary PV Time-of-Use Service) and \$0 Consumption Charge

** Based on HUD 2021 Summit County Utility Allowance Schedule

Thank You!



Jessie Burley

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Less is More: Building to Zero Energy, Water, and Carbon



Mike Collignon

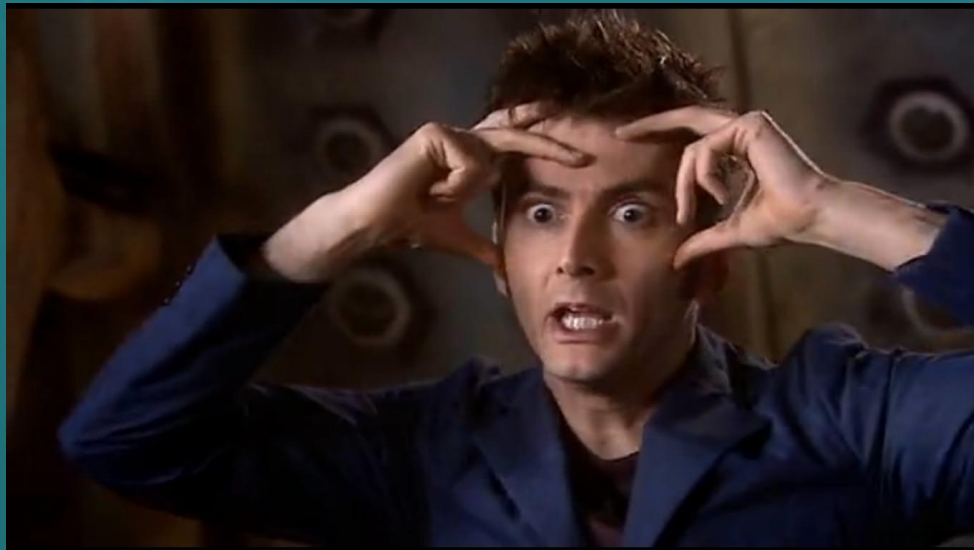
Executive Director, Green Builder® Coalition

mcollignon@greenbuildercoalition.org

Less is More: Building to Zero Energy, Water, and Carbon



- **Zero Energy** – Can we achieve it if we're not also zero water?
- **Zero Water** – Can we achieve it if we're not also zero energy?



Less is More: Building to Zero Energy, Water, and Carbon

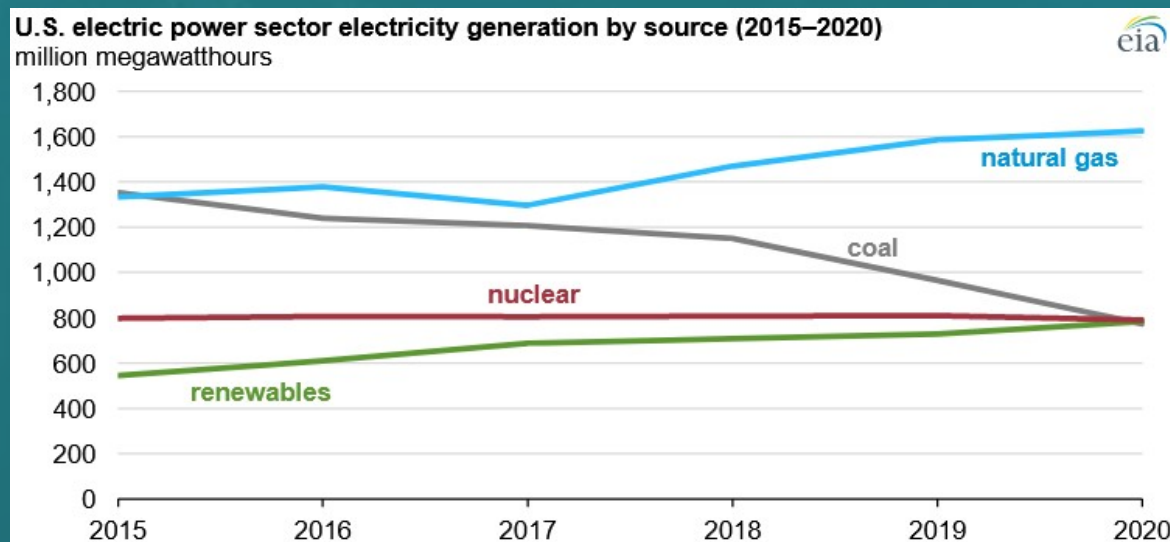


- Energy production in the U.S.
- Entire grid reduced water usage 10.5% in 2020
 - 47.5 trillion gallons
 - Las Vegas – 178.485 billion gallons
 - 266 Las Vegas... es
 - Per kWh? *Only* 11.9 gal/kWh (avg.)
 - Reduction attributed to... moving away from coal

Less is More: Building to Zero Energy, Water, and Carbon

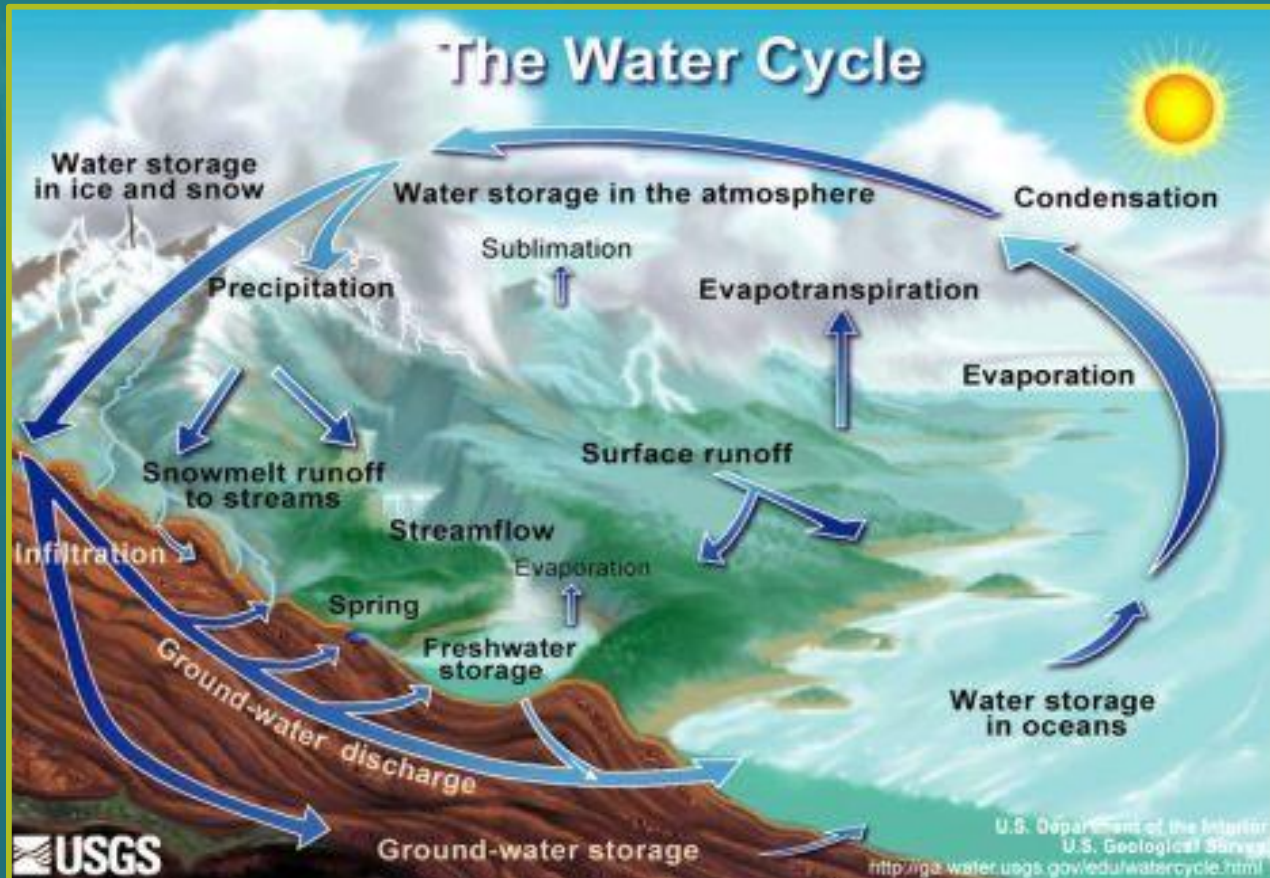


- **Source matters!**
 - Coal: 21.4 gal/kWh
 - Natural Gas: 2.8 gal/kWh
- **Method matters, too!**
 - Closed-loop systems: 66%
 - Dry or hybrid: 7%
 - Once-through: 23%



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- Wait, didn't you just mention a closed-loop system?



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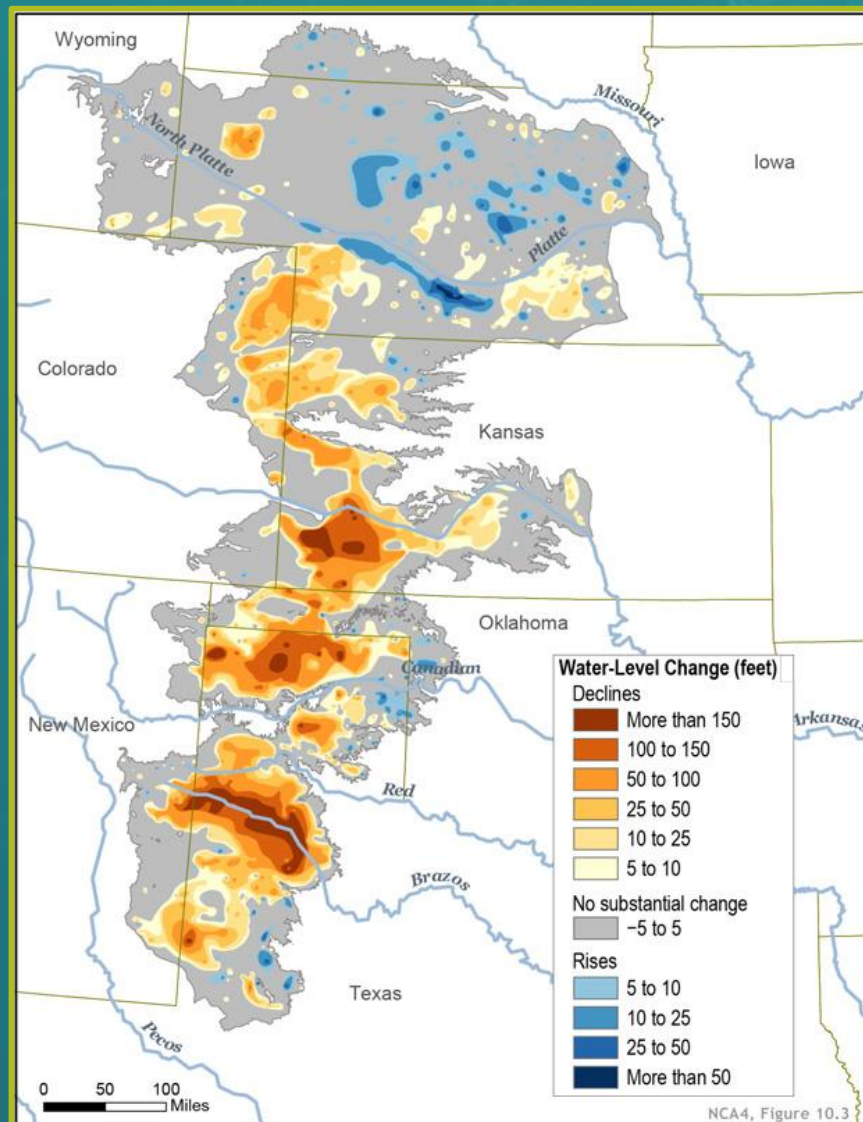
The New York Times

Montana's Famed Trout Under Threat as Drought Intensifies

The state is imposing more restrictions on fishing this year as the combination of extreme conditions, including low river levels, fish die-offs and the crush of anglers, poses long-term problems.

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Ogallala Aquifer



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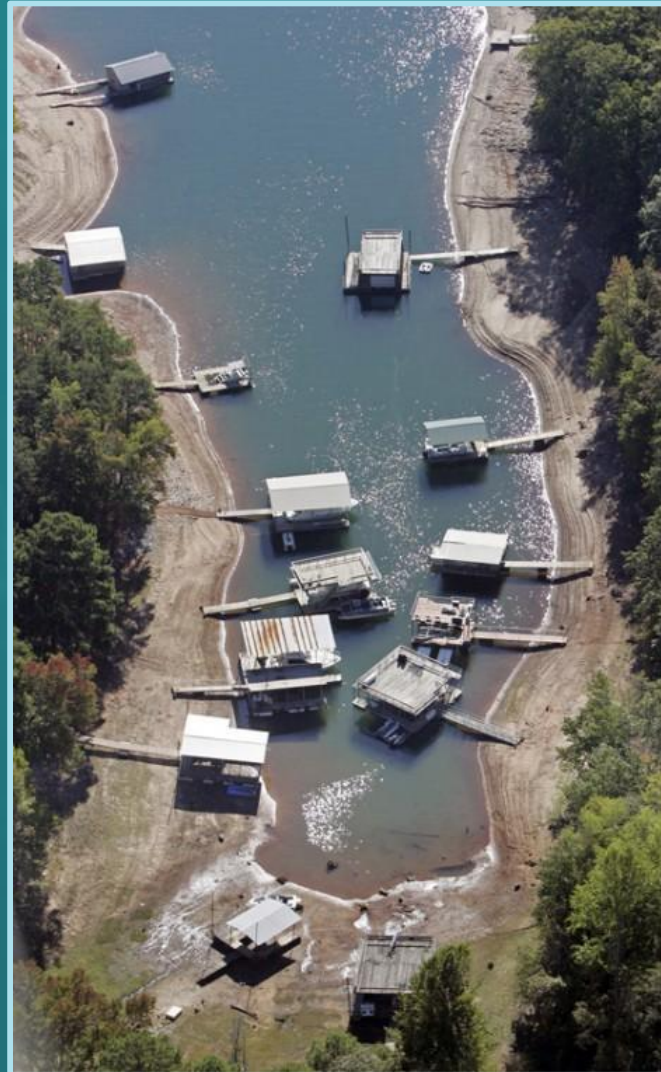
**Don Pedro
Reservoir**



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Lake Lanier
2007



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- Zero Water policies



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- **Water Efficient Policies**
 - **Require WaterSense-equivalent fixture flow rates**
 - 14 states, including California, Colorado, Georgia, New York, Texas, plus D.C.
 - **Require water rating**
 - Santa Fe, NM
 - **Incentives**
 - Vermont energy code – points table
 - Santa Barbara, CA – multifamily submetering (alt. code compliance)
 - Product rebates – toilets, showerheads, turf removal, rain barrels

Less is More: Building to Zero Energy, Water, and Carbon

- The biggest hurdle?



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- Zero Water – Can we achieve it?
- Yes! If...
 - We work together
 - We embrace technology
 - We have a new perspective on water

Thank You!



Mike Collignon

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International Living Future Institute



INTERNATIONAL
LIVING FUTURE
INSTITUTESM



**LIVING
BUILDING
CHALLENGE**



ZERO CARBON
CERTIFICATION



ZERO ENERGY
CERTIFICATION



CORE
GREEN BUILDING
CERTIFICATION

Declare.

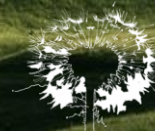
Just.



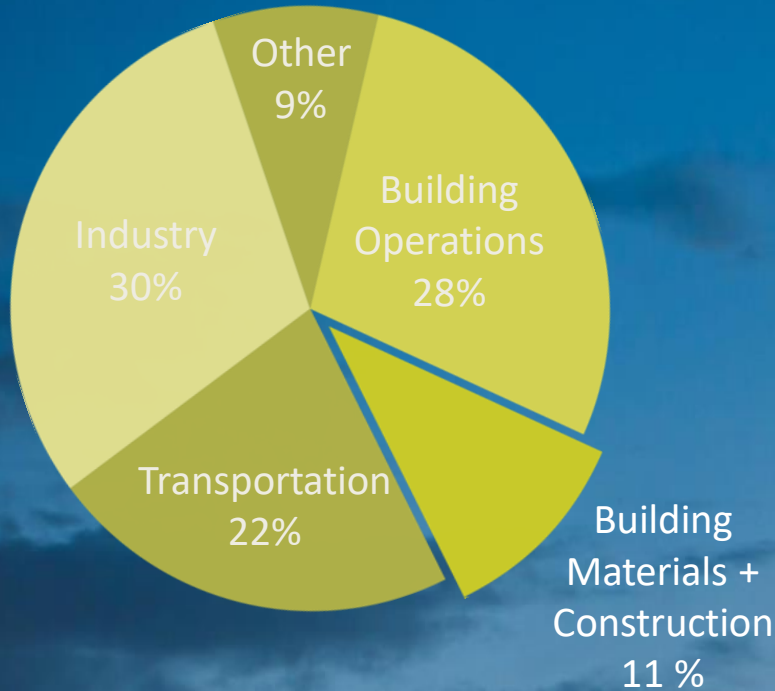
**LIVING
PRODUCT
CHALLENGE**



ZERO CARBON CERTIFICATION



INTERNATIONAL
LIVING FUTURE
INSTITUTESM



THE BUILDING SECTOR HAS A CARBON PROBLEM

39% of global CO₂ is from building operations and building materials + construction!

Global CO₂
Emissions by
Sector



REDUCE

site energy consumption
+ eliminate new
combustion*

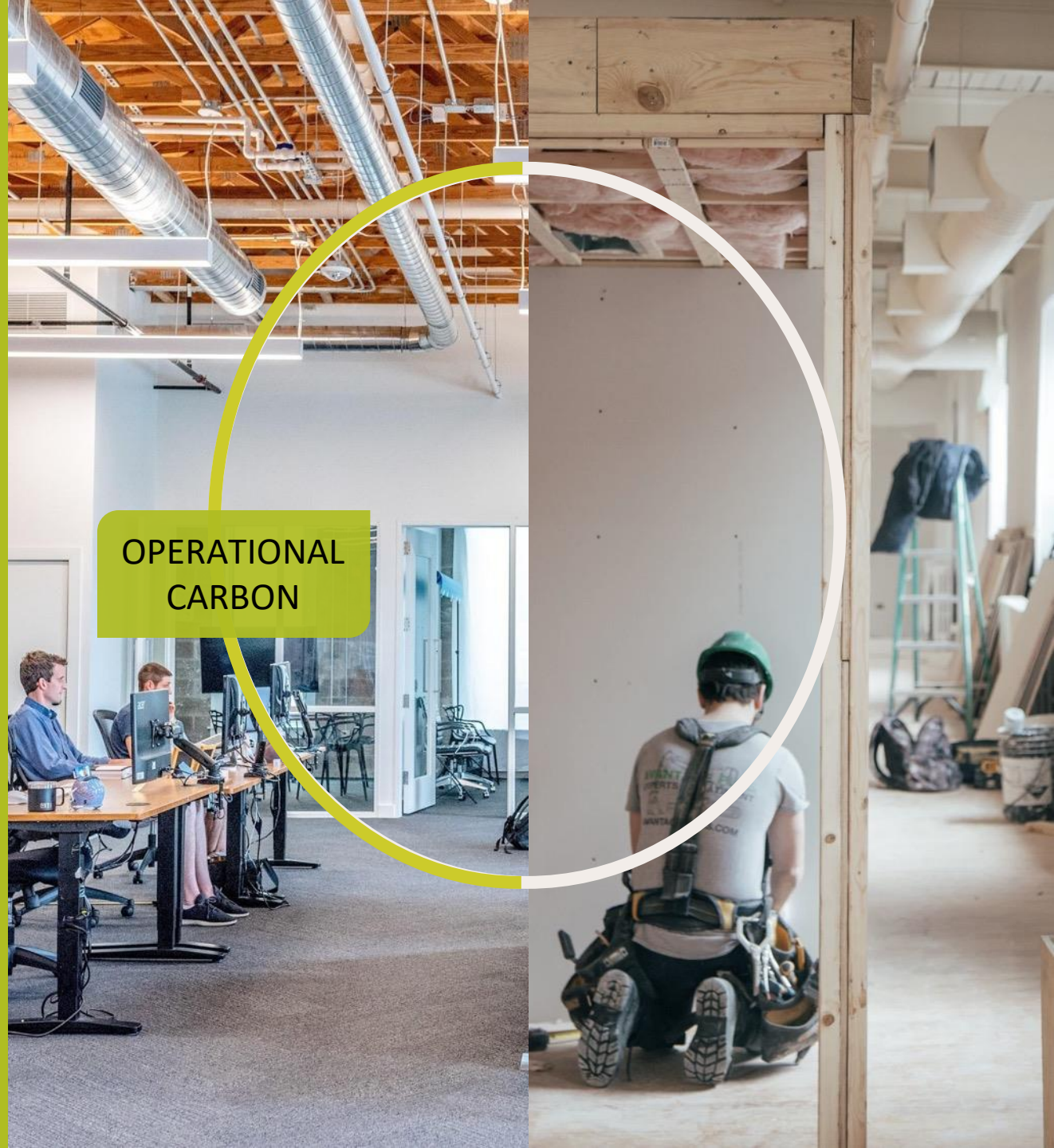
OFFSET

with installed or
procured renewable
energy

*New buildings

A green rounded rectangular box containing the text "OPERATIONAL CARBON". A large white circle with a green outline overlaps the box and the background images.

OPERATIONAL
CARBON





REDUCE

Carbon in primary materials*

DISCLOSE

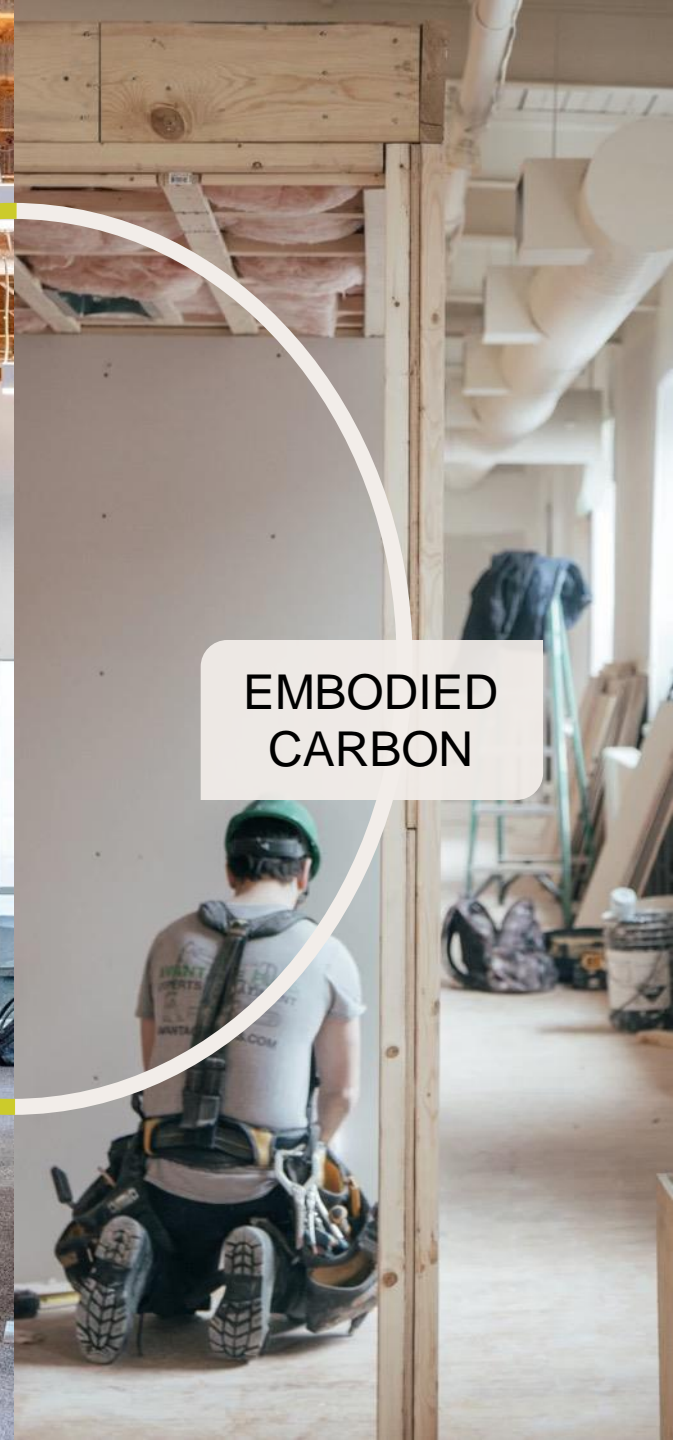
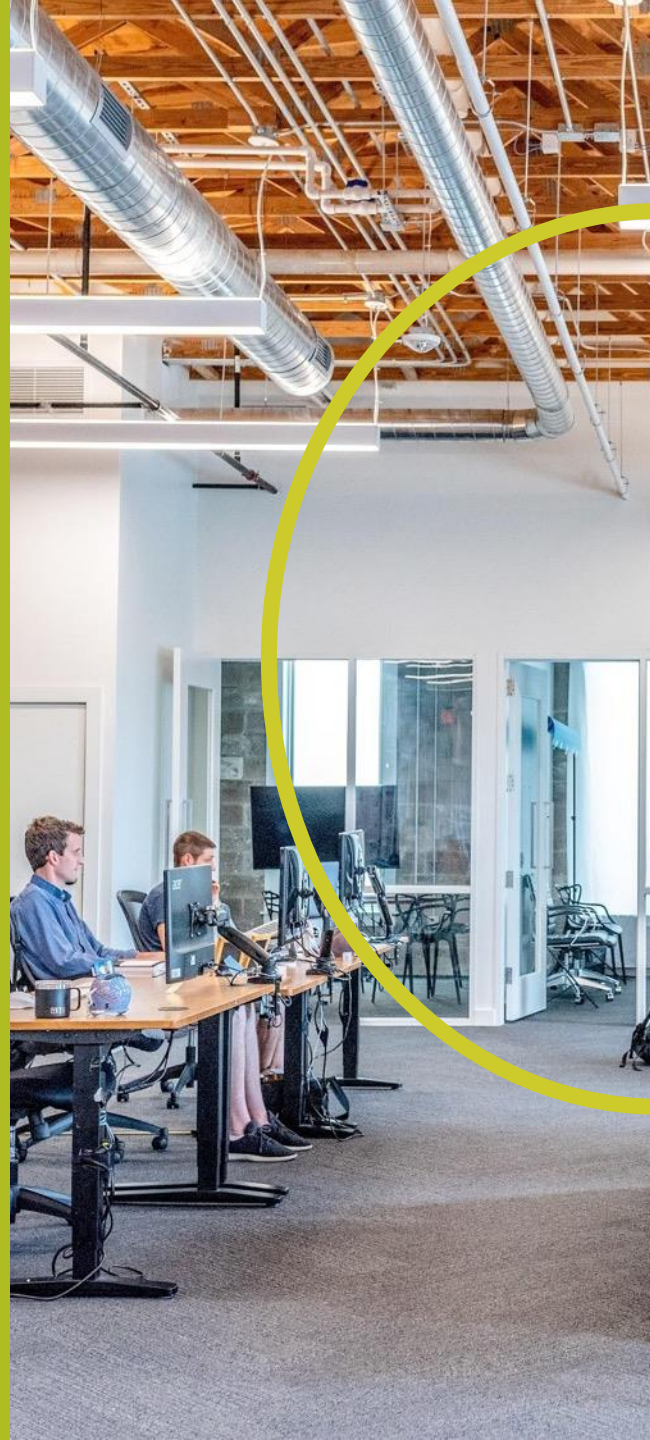
Reduction strategies + total embodied carbon

OFFSET

Sequestering materials or carbon offsets**

*New buildings

** New materials only



EMBODIED CARBON





Key Process Elements

Conduct a life cycle assessment

Specify low carbon as selection criteria

Reuse key structural materials

The background image shows a construction site on a red-tiled roof. Several workers in high-visibility vests and hard hats are visible. Some are standing near solar panels that are being installed. The scene is brightly lit, suggesting a clear day. The text is overlaid on semi-transparent colored boxes.

Low-Embodied Carbon Materials Procurement

Optimize building assemblies

Request product specific-EPDs

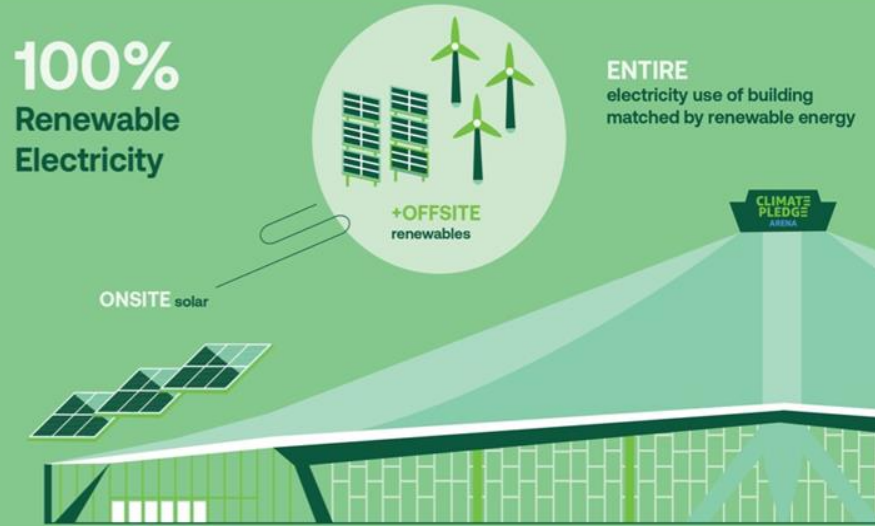
Offset remaining carbon

Design for Low Carbon

Building Decarbonization



100% Renewable Electricity



Low Embodied Carbon

REUSING materials to avoid construction impacts

PRESERVING historic roof

PRESERVING historic glass walls



Achieving Net Zero Embodied Carbon



Archimania - 663 Cooper Street

Material reuse

**Achieved a 67% reduction in
embodied carbon**



Image Courtesy of Archimania

Google - 6 Pancras Square

Designed for flexibility

Material reuse

Maximize recycled content



Image Courtesy of Google

The Future of Carbon

Opportunities

- More available tools and resources
- Work at the policy level

Challenges

- Available data
- Building specific targets



Thank You!



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living-future.org/zero-carbon/

<https://living-future.org/>

[zero-carbon/](http://living-future.org/zero-carbon/)



Q&A



Thank you!

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Thank You!

Building Energy Codes Program

www.energycodes.gov/training

BECP help desk

<https://www.energycodes.gov/technical-assistance/help-desk>



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