Building Resiliency: Construction and Development Responds to Climate Change

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March 14, 2024

Portland Building Decarbonization

ECOnorthwest

Policy Goals and Motivations

To support BPS in developing policies that are a win-win for the environment and for Portland's community members, ECOnorthwest analyzed **three policy topics answering important questions.**

- **Carbon Performance Standards for Large Buildings** What emissions targets should the City set? What are the anticipated costs for property owners? What are the likely impacts on renters?
- **Cooling Temperature Standards** What would a cooling requirement for rental housing mean for the costs on property owners and renters?
- **New Construction Electrification** When building new housing, is it less costly over the long-term to use only electricity and eliminate natural gas use?

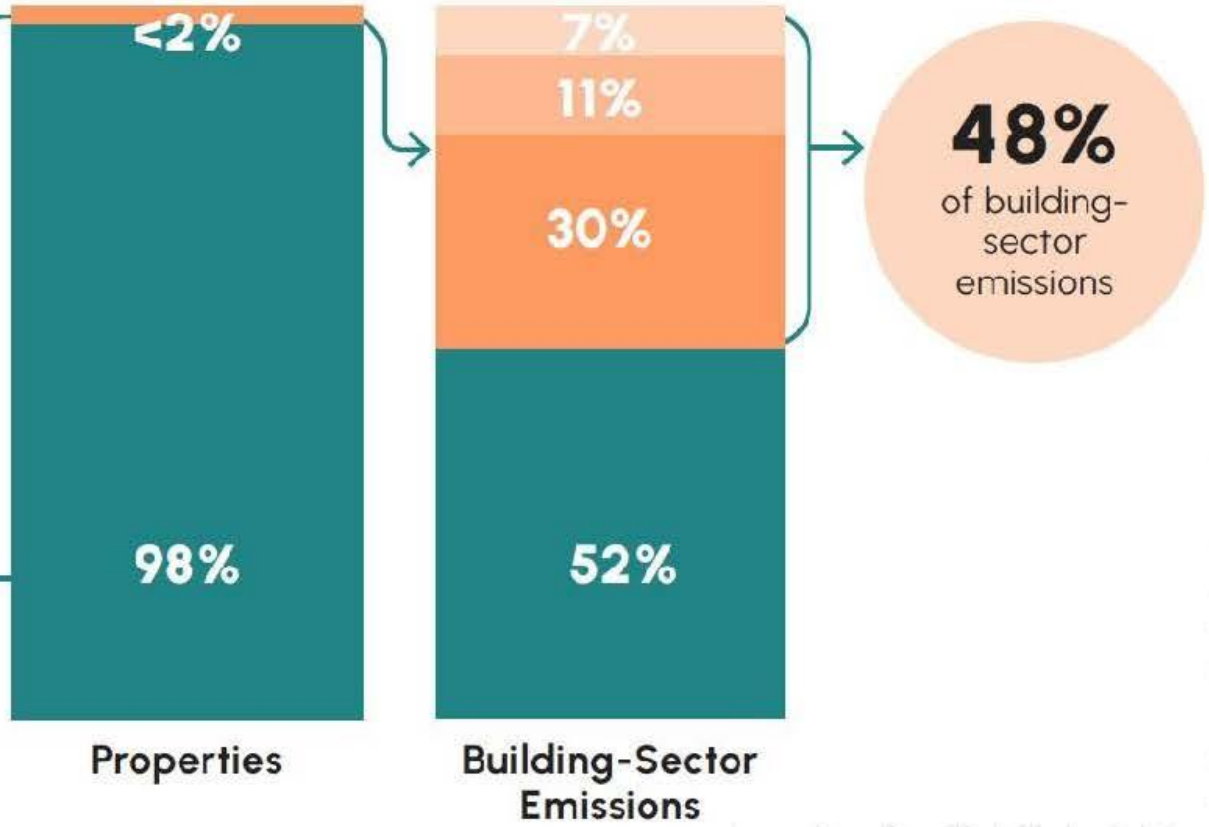
Building Carbon Performance Standards

Large Multifamily Properties

Large Office Properties

Other Large Properties
(hotel, medical office, retail, school, warehouse, etc.)

Properties < 20,000 sq ft
(including single-family residential)



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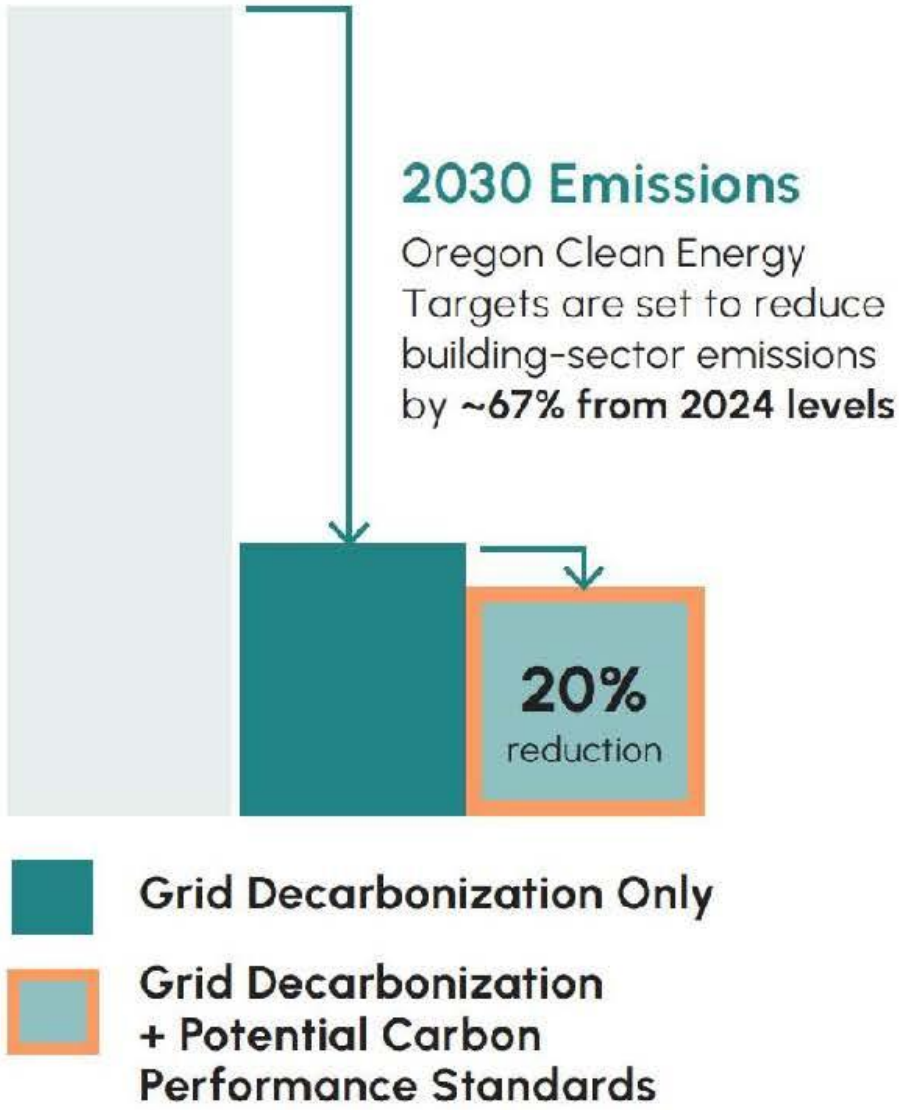
Building Carbon Performance Standards



To further reduce carbon emissions by 2030, BPS could establish new carbon performance standards that require each property to reduce its annual emissions level below key greenhouse gas intensity (GHGI) targets:

- **2.05 kg CO2e per sq ft** for large office properties
- **1.01 kg CO2e per sq ft** for large multi-family properties

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Building Carbon Performance Standards

What measures could multifamily property owners implement? How much would they cost?

Compliance with carbon performance standards would likely result in replacing natural gas furnaces and/or electric resistance baseboard heaters with heat pumps.

- **450 multi-family rental properties, 15,000+ rental units, $152 M for NOAH and $3 M for market-rate units**
- **Smaller, older properties** are more likely to have higher emissions and require electrical upgrades to accommodate the installation of new heat pumps. Cost estimate: **$10,600 per unit,** which includes $4,400 for an electrical panel upgrade.
- **Larger, newer properties** are likely to have lower emissions and not require upgrades to electrical panels. Cost estimate: **$5,600 per unit.**

Cooling Standards

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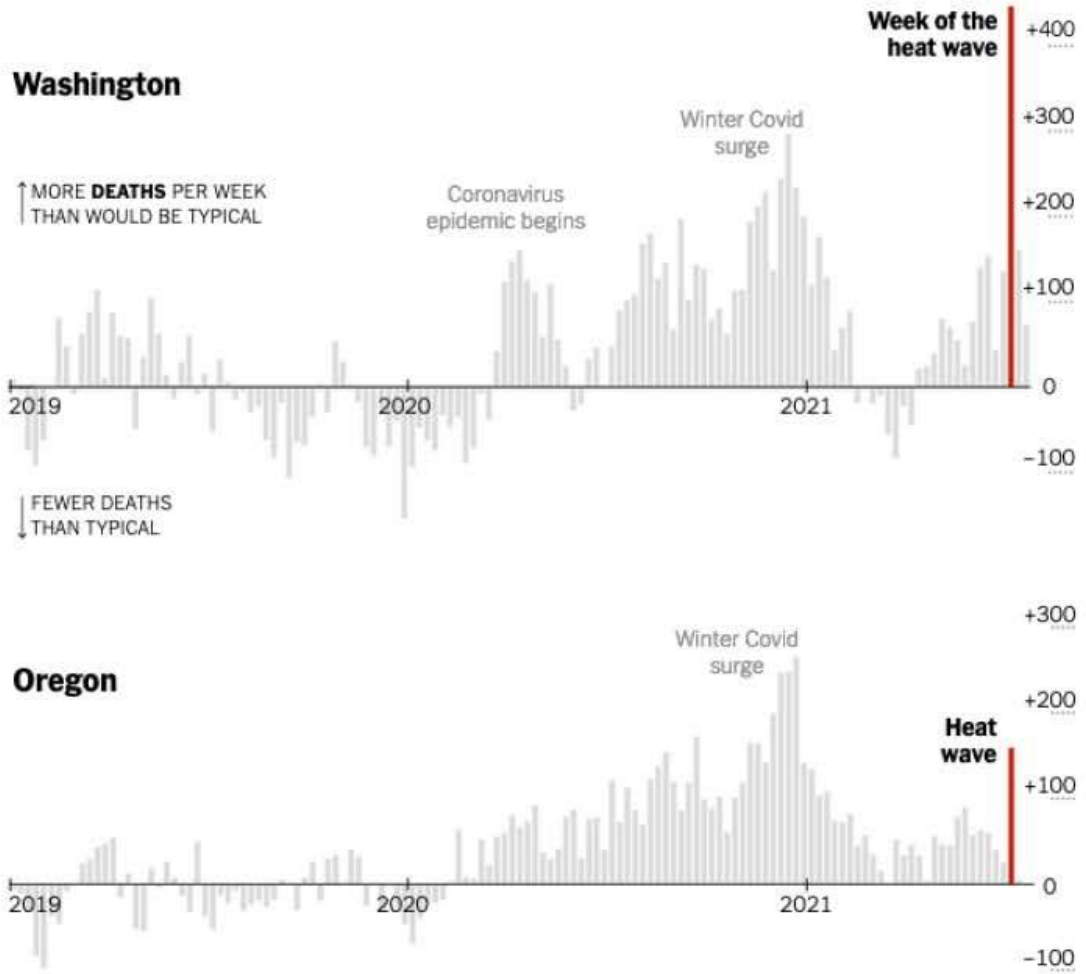
Cooling Standards

The New York Times

Hidden Toll of the Northwest Heat Wave: Hundreds of Extra Deaths

By Nadja Popovich and Winston Choi-Schagrin Aug. 11, 2021



Source: Centers for Disease Control and Prevention · Deaths in recent weeks are most likely undercounted because of lags in reporting.

https://www.nytimes.com/interactive/2021/08/11/climate/deaths-pacific-northwest-heat-

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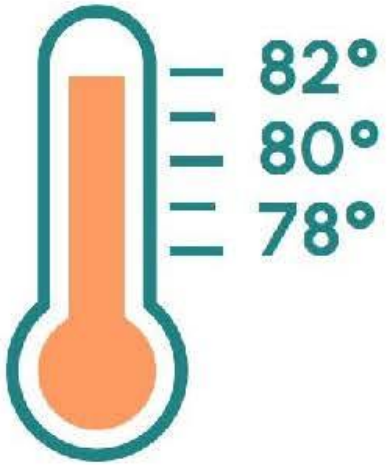
Cooling Standards



Some jurisdictions in the country have passed maximum temperature standards.

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Cooling Standards

17%

of Portland's rental units

don't have A/C

COOLING REQUIREMENT	WINDOW A/C (NO LABOR)	MINI-SPLIT HEAT PUMP
Common Space	$1.4 million	$39 million
In-Unit	$7.9 million	$50 million

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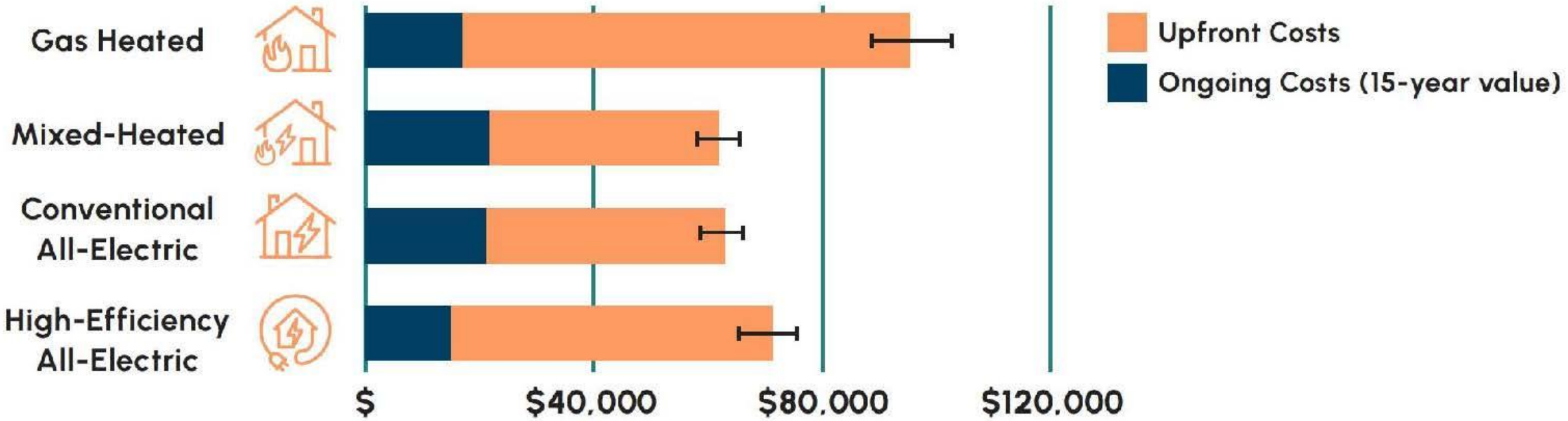
New Construction Electrification

Upfront Construction Costs and Ongoing Utility Bills for Multifamily Buildings



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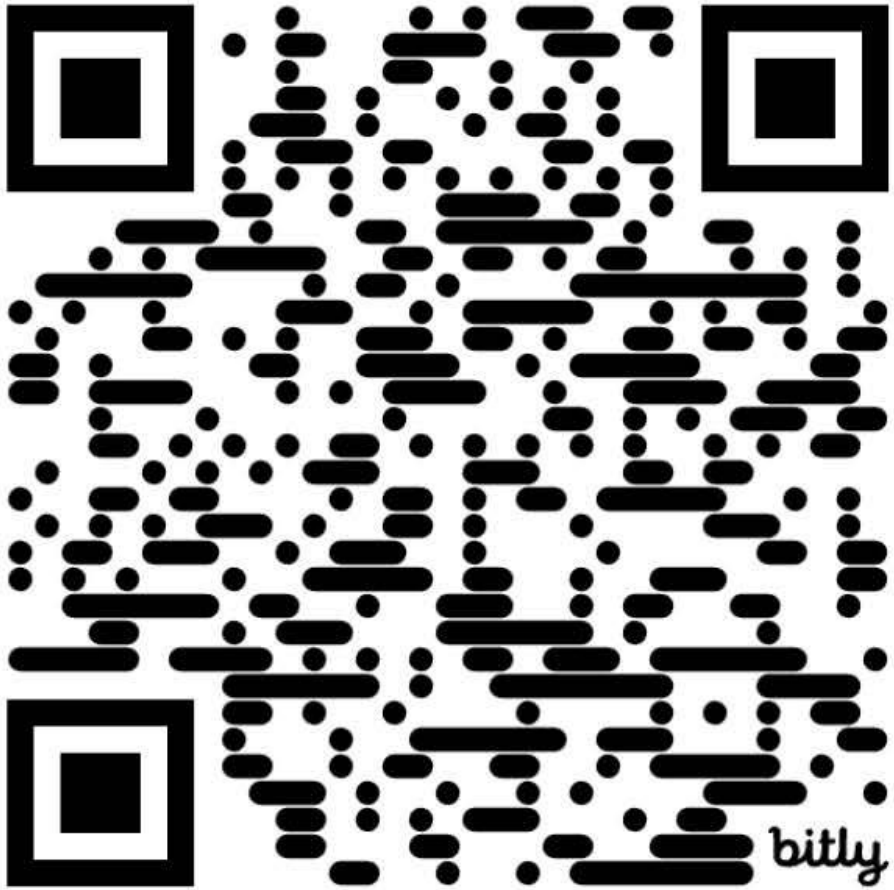
Thank you!

Download the reports at:
https://bit.ly/3DL7CmR



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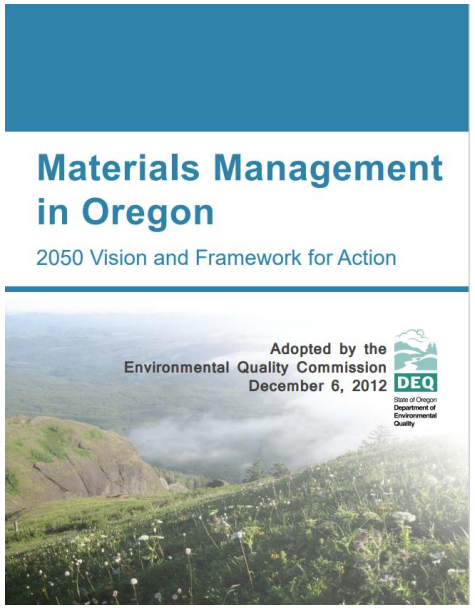
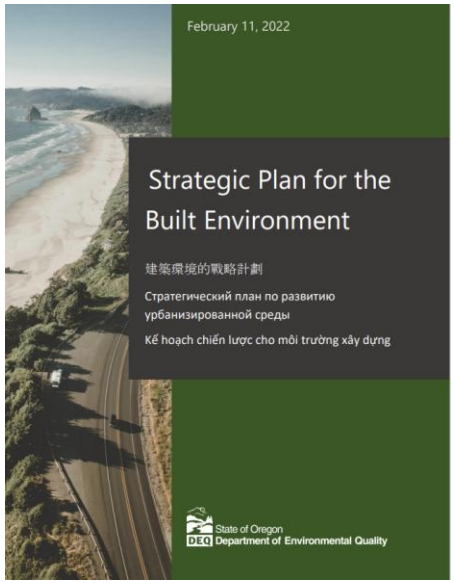
Embodied Carbon Reduction Opportunities in Oregon

March 14, 2025

Rita Haberman | Oregon Department of Environmental Quality

Basis for Oregon DEQ's built environment work





2050 Vision:

Oregonians in 2050 produce and use materials responsibly -- conserving resources, protecting the environment, and living well

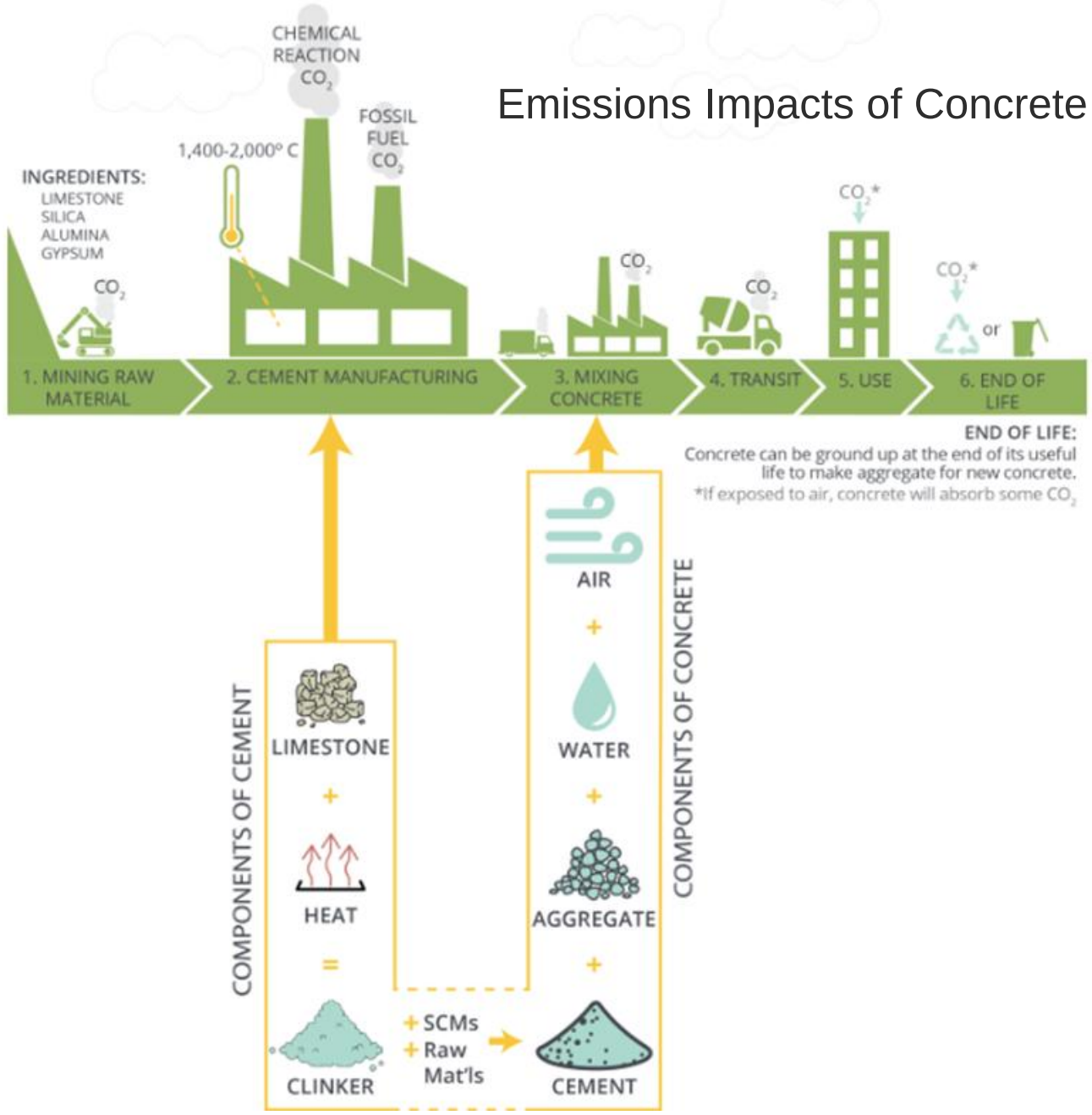
Mission of Built Environment program:

Build relationships, influence policy, and support work that accelerates progress toward eliminating harmful impacts of the built environment, enhancing the well-being of people and place, and creating a more just future for all beings

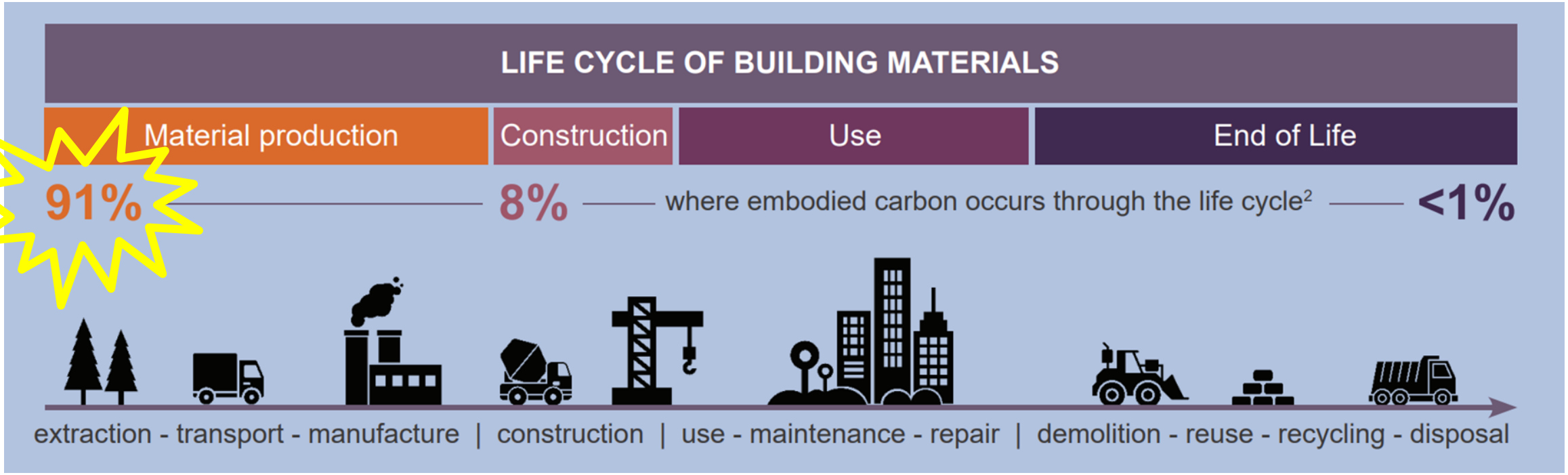
Emissions Impacts of Concrete

Embodied carbon

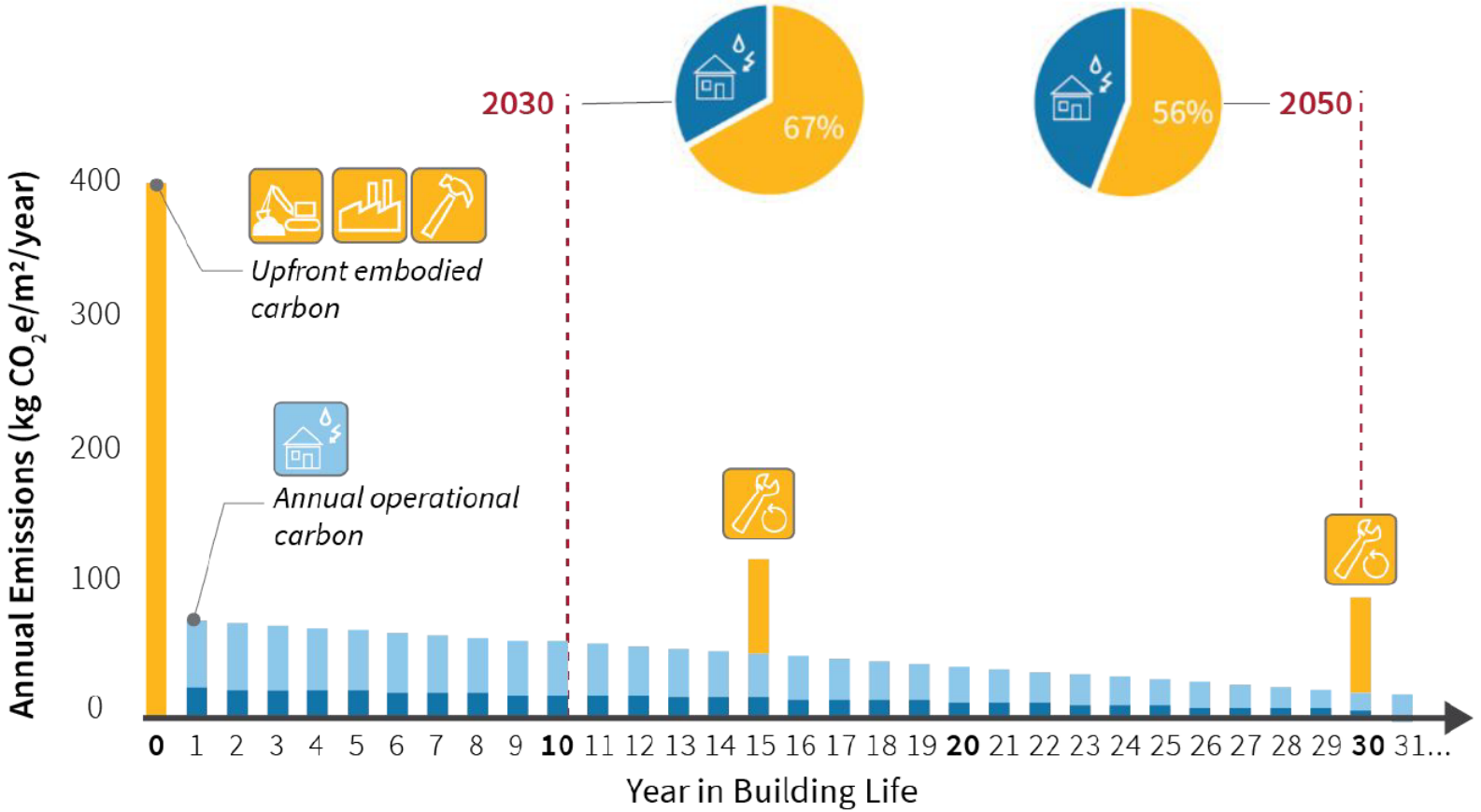
is the greenhouse gas (GHG) emissions from resource extraction, manufacture, transport, installation, maintenance, disposal, and recovery of materials/products.



Upstream Impacts



Urgency of embodied carbon



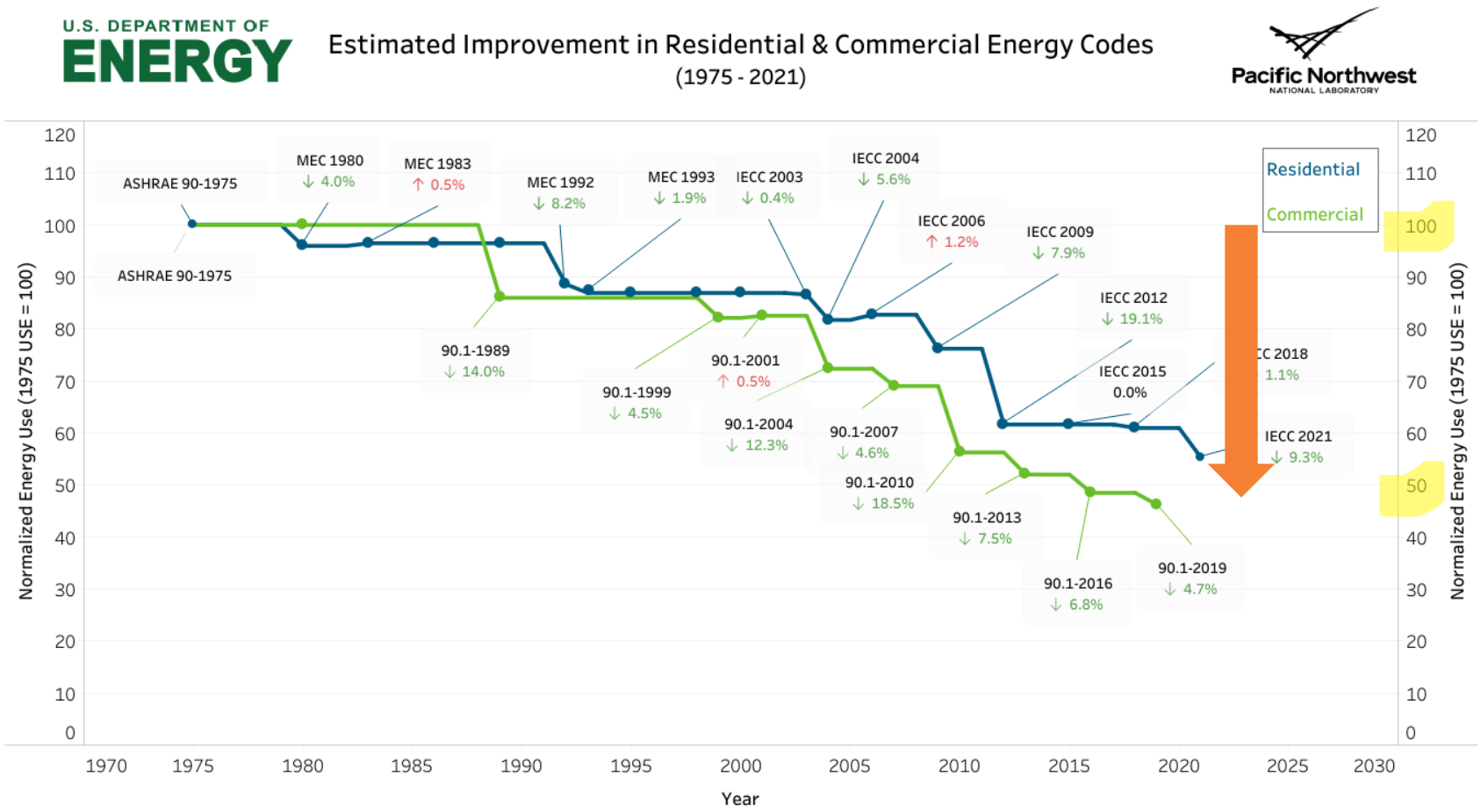
In a high performance building, embodied carbon is

⅔ of total emissions in the first 10 years

½ of total emissions in the first 30 years

Image Source: *AIA-CLF Embodied Carbon Toolkit for Architects, 2021*

Codes work



~50% reduction in operational energy usage over 50 years

How do we measure embodied carbon?

Life Cycle Assessment (LCA)

"the compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle"

ISO 14040
ISO 14044

Environmental Product Declaration (EPD)

ENVIRONMENTAL IMPACTS

Declared Product:
Mix 45SS420A • Bend Plant
Exterior SOG
Compressive strength: 4000 PSI at 28 days

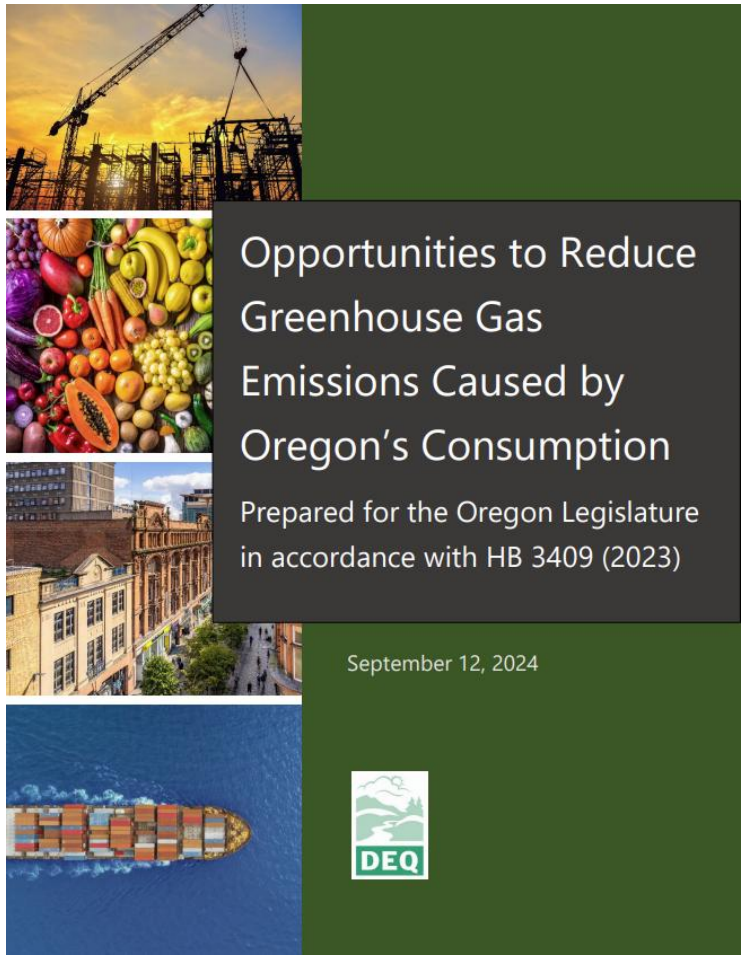
Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	387
Ozone Depletion Potential (kg CFC-11-eq)	9.8E-6
Acidification Potential (kg SO_2-eq)	2.42
Eutrophication Potential (kg N-eq)	0.47
Photochemical Ozone Creation Potential (kg O_3-eq)	58.0
Abiotic Depletion, non-fossil (kg Sb-eq)	1.2E-6
Abiotic Depletion, fossil (MJ)	1,229
Total Waste Disposed (kg)	2.76
Consumption of Freshwater (m^3)	2.89

Product Components: natural aggregate (ASTM C33), Portland cement (ASTM C150), batch water (ASTM C1602), slag cement (ASTM C989), admixture (ASTM C260)

Additional detail and impacts are reported on page three of this EPD

What's the significance of embodied carbon for Oregon?



14.4%

of Oregon's consumption-based GHG emissions stem from construction materials

Resources:
PNW Environmental Product Declaration Partnership

- Secured $3.8 million from U.S. EPA
- Oregon-Washington-International Code Council
- Support 200 manufacturers serving OR-WA to develop 1,000 **Environmental Product Declarations**
- Technical and financial assistance
- Focus on carbon intensive materials:
  - concrete
  - asphalt
  - steel
  - structural wood
  - emerging products

Environmental Product Declaration

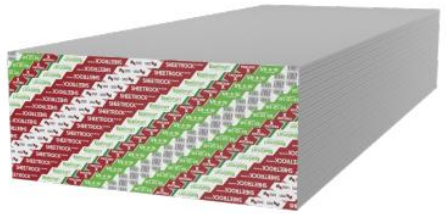
5/8 in. (15.9 mm) Sheetrock® Brand EcoSmart Panels Firecode® X

Aliquippa, PA, Bridgeport, AL, Galena Park, TX, Jacksonville, FL, Plaster City, CA, Rainier, OR, Shoals, IN, Sigurd, UT, Sperry, IA, Sweetwater, TX, Washingtonville, PA

USG CGC

Sustainable and ultralightweight 5/8 in. (15.9 mm) enhanced proprietary Type X panels for interior wall and ceiling applications

- Living Building Challenge™ Red List Free
- Up to 94.6% recycled content (regionally available)
- Achieved GREENGUARD Gold Certification and qualifies as a low VOC emitting material (meets CA 01350)
- USGBC® LEED® v4—may assist in achieving additional credits
- Underwriters Laboratories Inc. (UL) Classification as to fire resistance, surface-burning characteristics and noncombustibility
- Comply with ASTM C1396, *Standard Specification for Gypsum Board*, for 5/8 in. (15.9 mm) and Type X gypsum wallboard
- Offer comparable sound, strength and sag resistance to standard 5/8 in. (15.9 mm) Type X
- Listed by UL in the most widely specified wall, column, floor- and roof-ceiling assemblies and horizontal membranes



TRACI V2.1 ENVIRONMENTAL IMPACTS (CRADLE-TO-GRAVE)	
Functional Unit – 1,000 sf (92.9 m^2)	
Global Warming Potential (kg CO_2 eq.)	**3.56E+02**
Ozone Depletion Potential (kg CFC-11 eq.)	**1.38E-08**
Acidification Potential (kg SO_2 eq.)	**7.56E-01**
Eutrophication Potential (kg N eq.)	**7.23E-02**
Photochemical Ozone Creation Potential (kg O_3	**1.85E+01**
Abiotic Resource Depletion Potential Fossil Fuels	**8.42E+02**

Resources:
Oregon's U.S. EPA Climate Pollution Reduction Grant

Zero Emission Vehicle Rebates
$31 million

Electric Vehicle Chargers
$10.9 million

Medium- and Heavy-Duty ZEV Rebates
$14.8 million

Medium- and Heavy-Duty ZEV Grants
$6 million

Medium- and Heavy-Duty EV Chargers
$3 million

Energy Efficient Housing Incentives
$21.3 million

Building Performance Standards Incentives
$12.1 million

Heat Pump Incentives
$25.3 million

Residential Weatherization
$8 million

Building Reuse and Space-Efficient Housing
$25.6 million

Food Waste Infrastructure
$28.9 million

Landfill Gas Controls
$6.6 million

$197 Million for Oregon

Resources: US EPA Grant
Low-Embodied Carbon Housing: 2 Strategies

Building Reuse-to-Residential

~30% of Portland office buildings are vacant

~50% of "Main Street" second-story spaces are vacant

Credit: UO Inst. for Policy Research and Engagement

Build Space-Efficient Residential

"Missing Middle"

Credit: Sustainable Connections.org

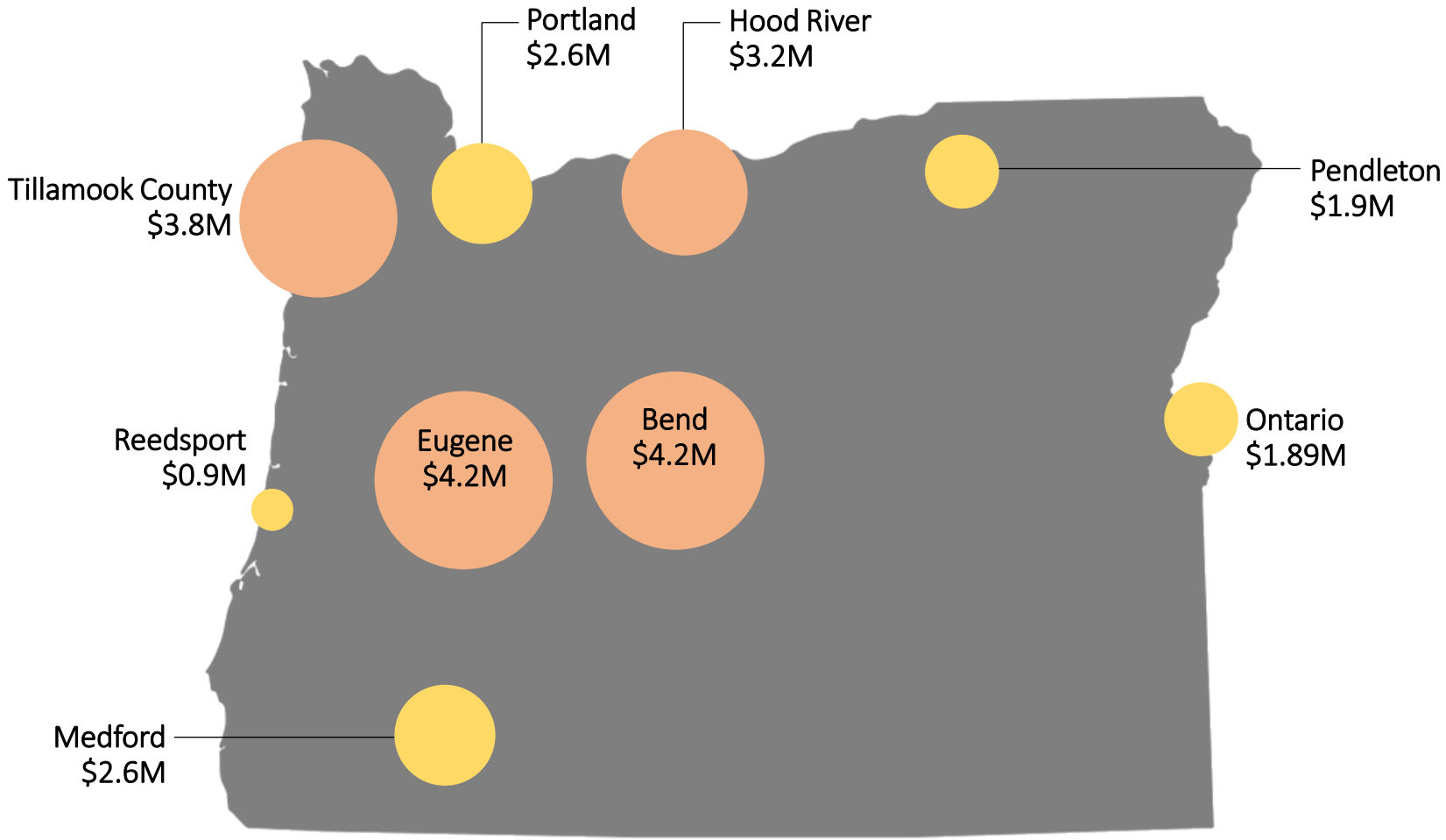
Embodied & Operational Carbon Reductions vs. “Conventional” new Housing

	Building Reuse-to-Residential	Space-Efficient “Middle” Residential
Construction materials/products	Reuse – some – existing structure, envelope, interiors, systems	Require less materials/products to build
Energy to operate	*If smaller*, require less energy to heat/cool/ventilate	Require less energy to heat/cool/ventilate
Storage space	*If smaller,* less space for “stuff”	Less space for “stuff”
Public infrastructure	Use existing streets, utilities	*If infill,* use existing streets, utilities
Other co-benefits	Reactivate downtowns, Walkability, Less vehicle dependence, miles driven	*If infill,* Walkability, Less vehicle dependence, miles driven
TOTAL carbon reductions	**- 40% to -75%**	**- 20% to - 40%**

Oregon's Climate Pollution Reduction Grant: Low-Embodied Carbon Housing, $25.6M

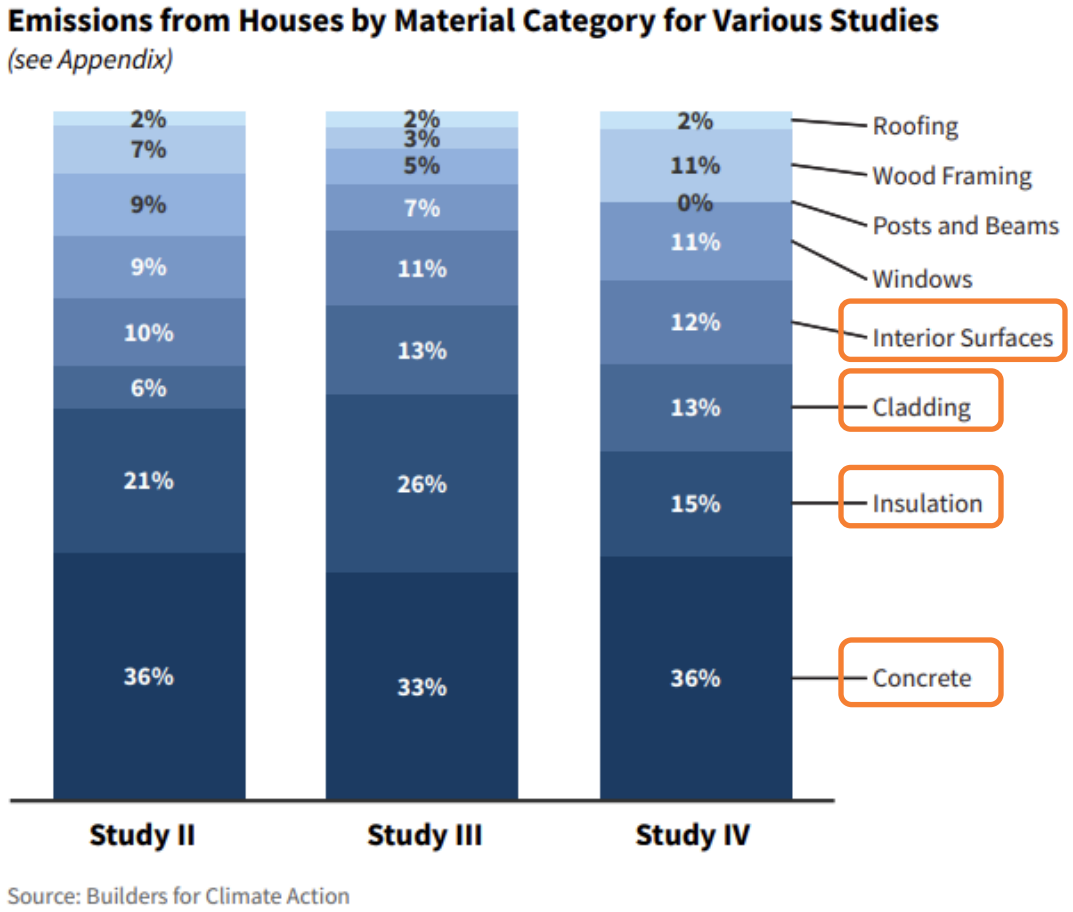
Space-Efficient Housing
$20k rebate/home
730 new homes
80% - 120% AMI

Reuse-to-Residential Housing
$45k rebate/home
210 "new" homes
80% - 120% AMI



Resources:
Technical Assistance on Embodied Carbon

- Funded housing projects must demonstrate a 10% EC reduction
- ~70% of EC impacts of residential stem from few product categories
  - 30% - 50% project impact reductions are achievable
- Oregon DEQ is developing technical assistance resources



The Hidden Emissions in Residential Construction, RMI, 2023

Resources

Embodied Carbon 101

- Embodied Carbon 101
- EPD 101
- Building LCA 101
- Buy Clean Policies: Overview & Implementation
- Building Embodied Carbon Performance Requirements
- Embodied Carbon and Codes
- Deconstruction, Salvage, and Reuse Policies

Architecture 2030

High-impact materials

Carbon-smart materials

References & Trainings

Oregon-specific support by Oregon DEQ

Support recipients of US EPA Climate Pollution Reduction Grants, and beyond

Forthcoming 2Q2025

Select Snapshot of Embodied Carbon Policies

- **Residential Deconstruction Ordinance** (City of Portland, 2016)
- **Low-carbon Concrete Policy** (City of Portland, 2019)
- **Buy Clean Oregon** (HB 4139, 2022)
- **Oregon Building Codes Div. Study of Embodied Carbon & Codes** (HB 3409-7, 2023) – report & recommendations issued Dec. 2024
- **Sustainability Guidelines for Oregon State-owned Buildings** (HB 3409-18, 2023)
- **Washington Buy Clean, Buy Fair** (2024)
- **California CALGreen Embodied Carbon Requirements** (eff. 2024)
- **Pacific Coast Collaborative Low-Carbon Construction Task Force** vision & action plan (2024)

Key Takeaways:
Embodied Carbon Reductions

- It’s a critical climate action strategy
- Tap into practical and cost-neutral strategies & resources
- Get involved: Carbon Leadership Forum, Portland Hub

Rita Haberman, rita.haberman@deq.oregon.gov

earthadvantage

EARTH ADVANTAGE

RESILIENCE IN AFFORDABLE HOUSING: PLANNING, BUILDING & SUSTAINING FOR THE FUTURE

Presented by
Eric Foley, Senior Manager, MF Programs

ABOUT EARTH ADVANTAGE

Earth Advantage is a Portland-based nonprofit whose mission is to create an **informed and humane real estate market**.

We work to ensure the US housing market recognizes the elements of homes that create climate risk and values the characteristics of homes that provide climate solutions.

OUR WORK

- ***Climate-Friendly Housing***
- ***Green Data Solutions***
- ***Workforce Training***
- ***Climate Justice***

WHY RESILIENCE MATTERS

UNHOUSED INDIVIDUALS AND AFFORDABLE HOUSING RESIDENTS ARE OFTEN THE MOST VULNERABLE TO CLIMATE DISASTERS AND ECONOMIC SHOCKS. A RESILIENT APPROACH NOT ONLY PROTECTS THEM FROM IMMEDIATE THREATS BUT ALSO ENSURES LONG-TERM STABILITY AND REDUCED FINANCIAL BURDENS.

DID YOU KNOW?

- Every $1 spent on resilient design saves $6 in disaster recovery costs. That's not just smart design – it's smart economics.
- Resilient housing reduces long-term maintenance costs by up to 30% by integrating durable materials, passive design, and smart infrastructure.
- High performance, energy-efficient affordable housing can reduce tenant utility bills by up to 50%, helping maintain affordability in housing.

RESILIENCE IN MULTIFAMILY BUILDINGS

Resilience refers to the capacity of buildings to endure, adapt to, and recover from various adverse events or disruptions while ensuring their occupants' safety and well-being.

- **Natural Disasters**: Enduring earthquakes, floods, and storms with robust construction.
- **Climate Extremes**: Adapting to changing climates with energy-efficient systems.
- **Utility Outages**: Ensuring power, water, and sewage continuity during outages.
- **Health and Safety**: Prioritizing occupants' well-being in emergencies.
- **Community Well-Being**: Supporting the broader community as a resource.
- **Long-Term Viability:** Planning for aging infrastructure, efficiency, and adaptability.

CLARIFYING RESILIENCE GOALS

Defining Objectives: Create a shared understanding of the Resilience Goals, the type of events to consider, and the services provided during these events.

A. DURATION

- **Life Safety Evacuation:** Safely evacuate occupants during emergencies
- **Shelter in Place:** Provide short/long-term strategies and basic services (heat, power, lighting).

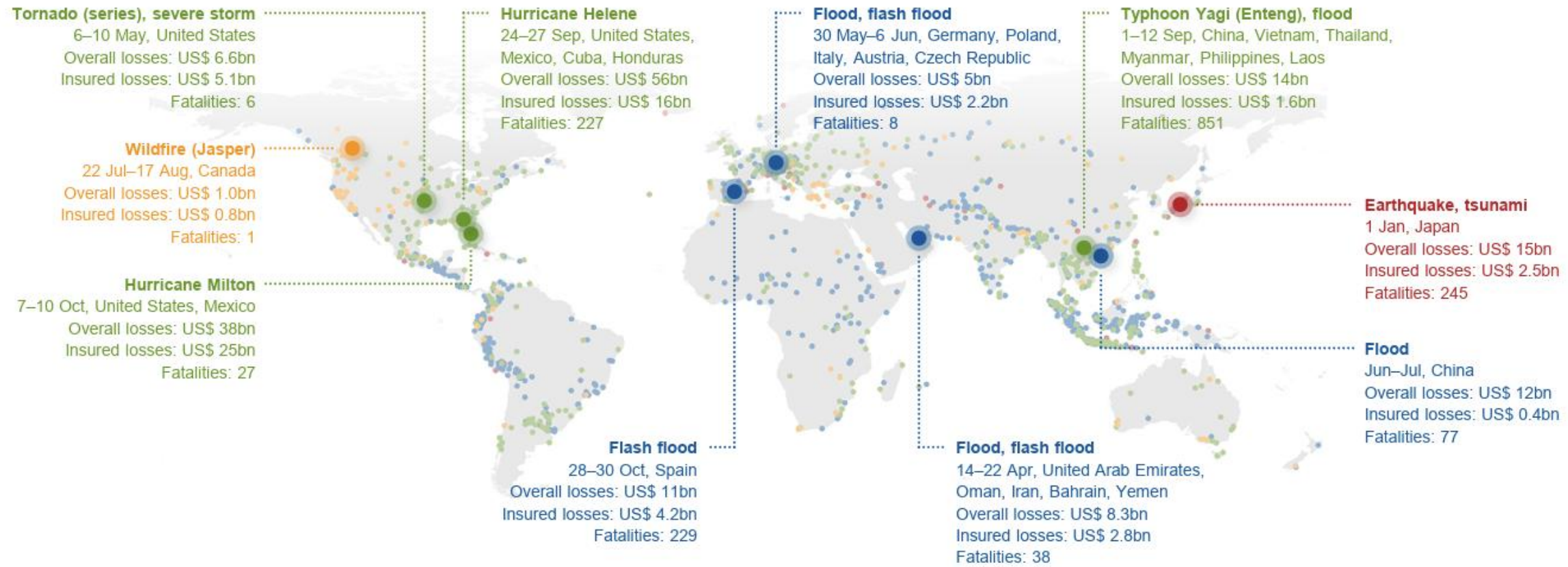
B. GOAL

- **Type of Event:** Prepare for various events (Power Outage, Severe Weather, Wildfire, Earthquake).
- **Duration of Operation:** Define operational duration during disruptions.
- **Services Provided:** List essential services (Heating, Cooling, Ventilation, Hot Water, Transportation, Sewer).

Nat cat loss events 2024

Natural catastrophes caused overall losses of US$ 320bn worldwide

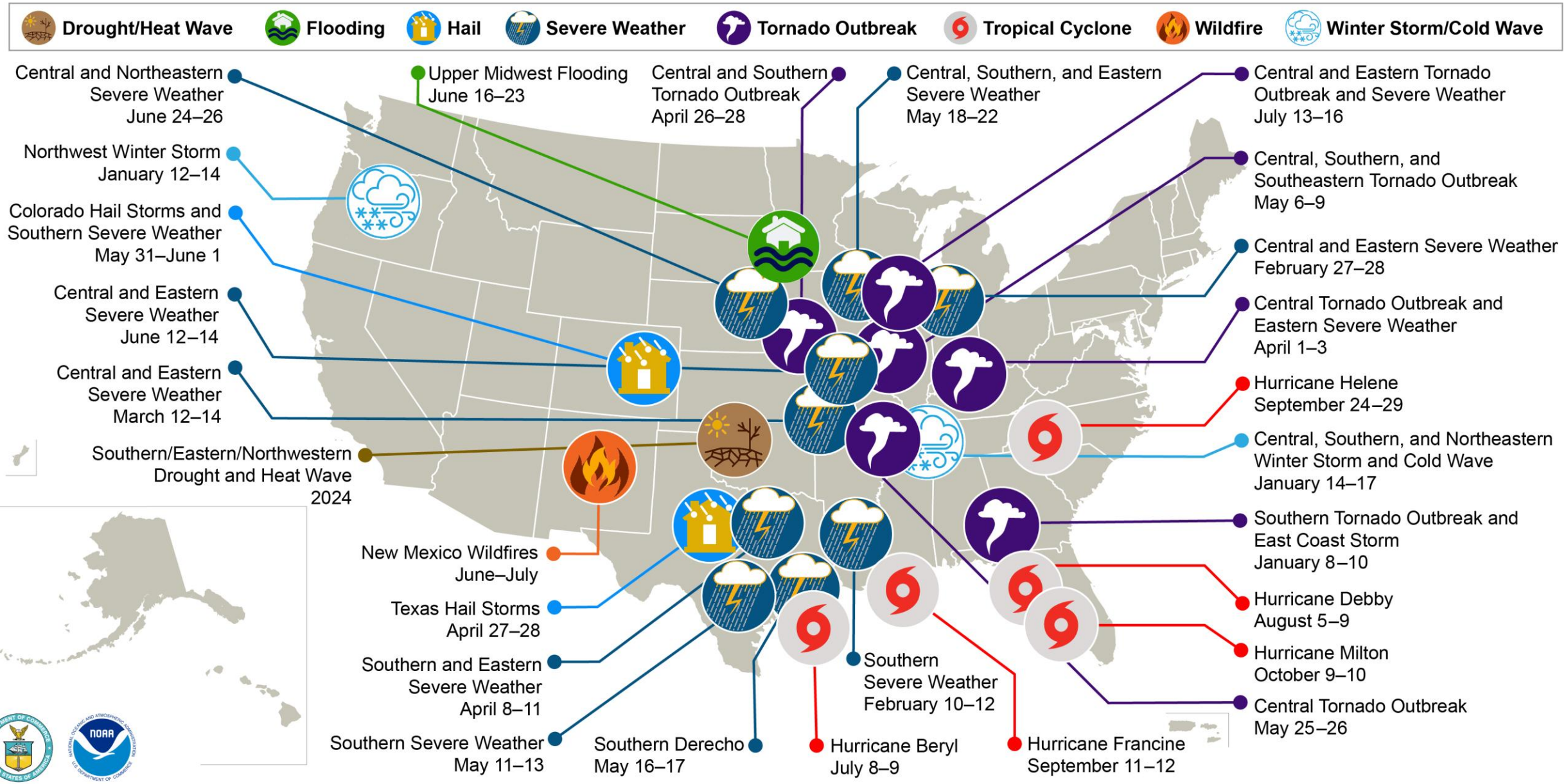
Munich RE



Source: Munich Re, NatCatSERVICE, 2025

Source: https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2025/natural-disaster-figures-2024.html

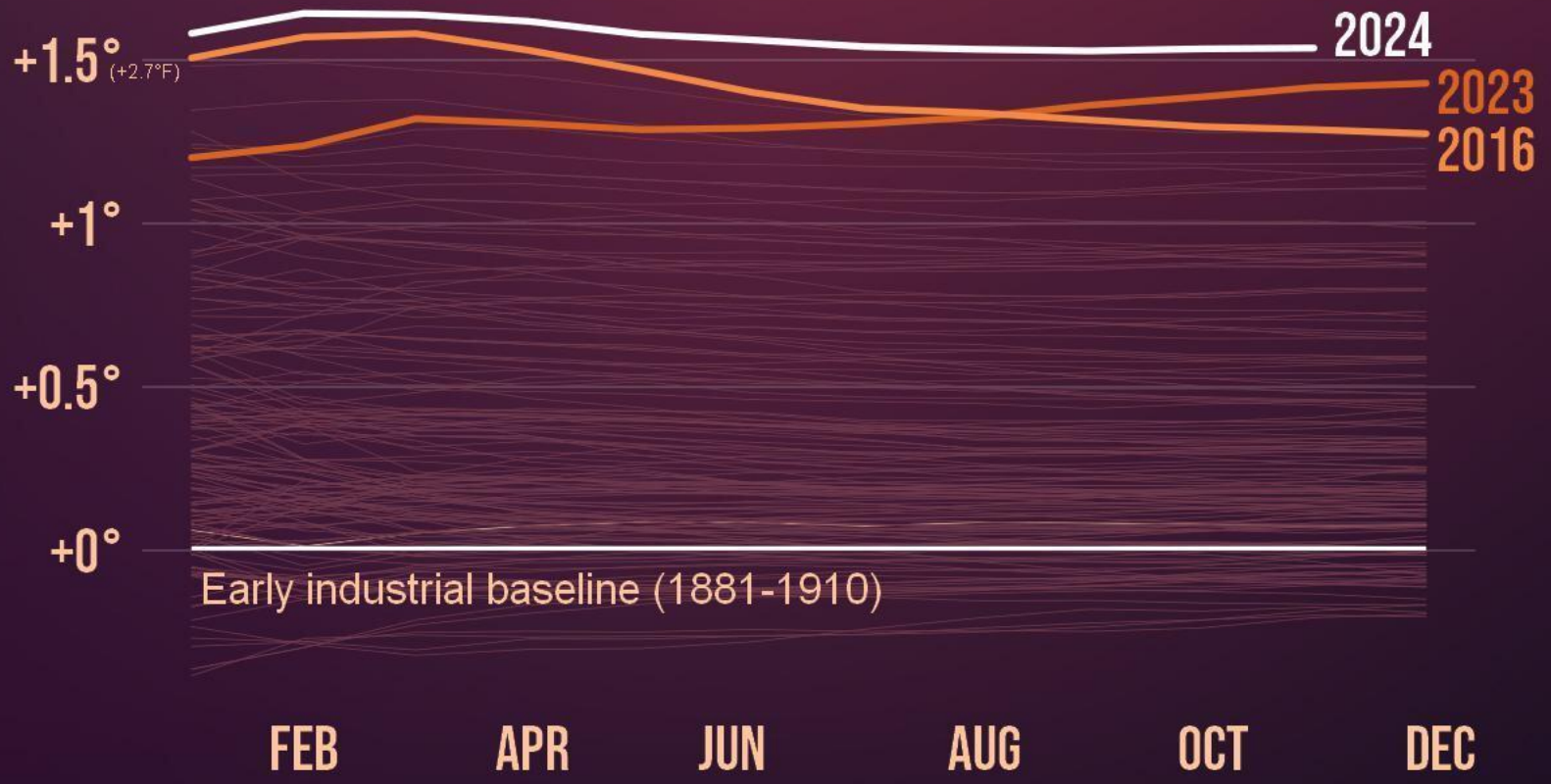
U.S. 2024 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **27 separate billion-dollar weather and climate disasters that impacted the United States in 2024.***

HOTTEST YEARS ON RECORD

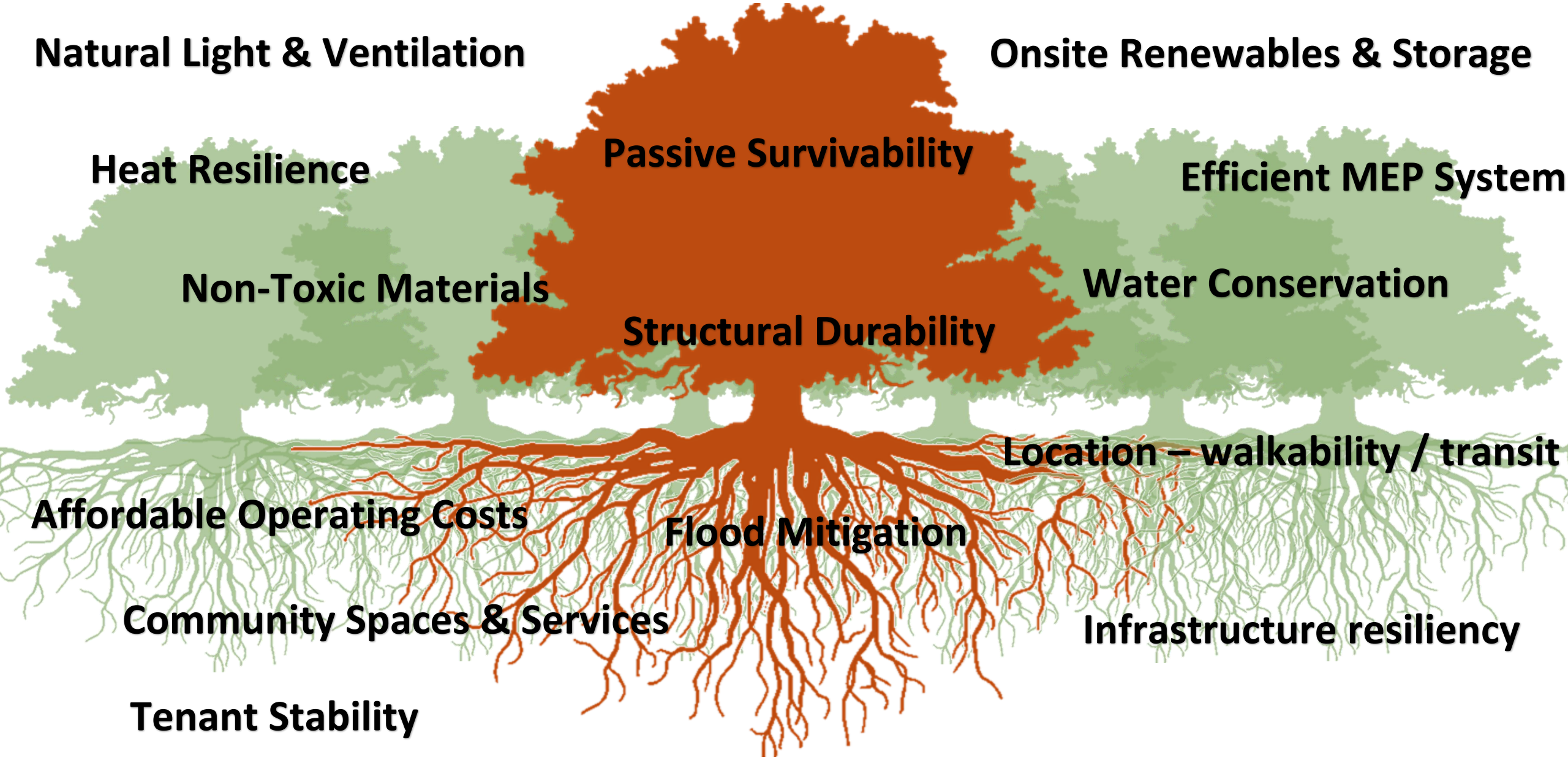
Global year-to-date anomalies (°C)



Source: NASA GISS & NOAA NCEI global temperature anomalies averaged and adjusted to early industrial baseline (1881-1910). Data as of 12/12/2024

CLIMATE CENTRAL

RESILIENCE IN PRACTICE


Natural Light & Ventilation
Onsite Renewables & Storage
Passive Survivability
Heat Resilience
Efficient MEP System
Non-Toxic Materials
Water Conservation
Structural Durability
Location – walkability / transit
Affordable Operating Costs
Flood Mitigation
Community Spaces & Services
Infrastructure resiliency
Tenant Stability

ENERGY EFFICIENCY IS RESILIENCE

Conservation First

1. ENHANCING PASSIVE SURVIVABILITY

Energy efficiency plays a crucial role in enhancing passive survivability, which refers to a building's inherent capacity to maintain habitable conditions without active heating, cooling, or mechanical systems during emergencies.

By reducing energy consumption and heat loss, energy-efficient designs contribute to a more resilient building environment, ensuring occupants' well-being and safety in the event of a heating/cooling system loss.

ENERGY EFFICIENCY IS RESILIENCE

Lowering Risk of Grid Overload

2. EFFICIENT EQUIPMENT

Efficient mechanical systems are vital in reducing energy demand and lowering the risk of electricity grid failures during extreme events such as heatwaves or winter storms.

By decreasing energy demand, efficient systems help prevent peak demand from exceeding the grid's capacity, enhancing the electrical infrastructure's overall resilience.

This proactive approach to energy management benefits individual buildings and contributes to the stability and reliability of the power grid.

ENERGY EFFICIENCY IS RESILIENCE

Ensuring Continuity of Energy Services

3. ONSITE GENERATION + STORAGE

Onsite generation and storage systems are pivotal in enhancing the continuity of energy services by providing autonomous power supply capabilities and ensuring uninterrupted energy supply during grid failures or emergencies - fortifying building resilience.

Coupled with the reduced loads resulting from energy efficiency measures, these systems capitalize on lower energy demand, optimizing their performance.

This reduction in building load during critical moments further strengthens the overall resilience of grid infrastructure.

INSPECT WHAT YOU EXPECT IS RESILIENCE

Field Verifications by Trusted Verification and Testing Firms Ensuring Systems, Assemblies, Equipment Performance and Operation

4. 3rd PARTY FIELD VERIFICATION AND TESTING

A. SUSTAINABILITY CERTIFICATON

Green building certifications, like Earth Advantage, enhance resiliency through durability, comfort, and resource efficiency. Verified in the field, these standards ensure real-world performance and climate adaptability.

B. INITIAL COMMISSIONING

Initial commissioning involves a comprehensive evaluation of building systems during construction to ensure they operate efficiently and as intended. This process includes system testing, calibration, and fine-tuning to achieve optimal performance from the start.

C. RECOMMISSIONING PROCESS

Recommissioning is an ongoing practice that periodically reevaluates and adjusts building systems. This proactive approach helps maintain and enhance system efficiency over time, ensuring that the building continues to operate at peak performance levels.

HAVE A PLAN & BE PREPARED

Enhancing Building Safety During Disruptions

5. SHELTERING & EVENT SPECIFIC STRATEGIES

Create/Adapt, Train/Practice your Resiliency Plan

Refer to Federal, State, Metro, City of Portland, Organization Plans

Attend Trainings (BEECN, NET, etc.), Practice your Plan

Supplies and Equipment:

Kits: Emergency kits in common areas.

Backup Power: Generators or batteries for critical services.

Medical Supplies: Basic medications and first-aid equipment.

Communication Systems:

Emergency Response: Alarms, announcements, and contact with authorities.

Coordination: Direct communication with local authorities.

PREPARE FOR

Power Outages:

Backup Power: Solar + Energy Storage for critical systems.

Emergency Lighting: Lighting on evacuation routes.

Sever Weather:

Cooling systems for heatwaves and heating for ice storms.

Safe Areas: Designated areas for shelter during extreme weather.

Wildfires:

Indoor Air Quality: Advanced filtration systems to maintain clean indoor air.

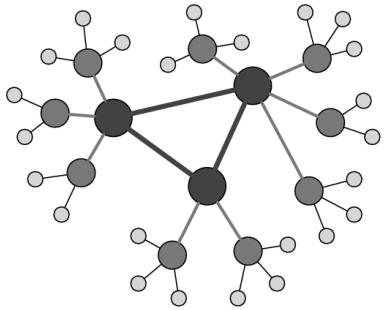
Earthquakes:

Secure Furniture: Anchoring heavy items.

REAL WORLD EXAMPLES

CENTRAL CITY CONCERN

- **HUB AND SPOKE**
- CONSERVE FIRST
- EFFICIENT MEP + APPLIANCES
- RENEWABLES + BACKUP
- 3rd PARTY VERIFIED
- HAVE A PLAN



On-site health care clinic with housing

124-unit
SRO, STUDIO

← TODAY

PASSIVE DESIGN STRATEGIES
- AIR-SEALING
- Increased Thermal Shell (Hight Eff. Windows)

HIGH EFFICIENCY MEP EQUIPMENT
- In-Unit & Common Area - Ductless Heat Pumps
- 2-Stage Bath Fans
- Hight Efficiency Lighting, Plumbing & Appliances

ON-SITE RENEWABLES
- 132 MWH/Yr Solar PV Array

EUI | Baseline 55 | As-Designed 40 / 36 (w/ w/o solar)

60-unit [40 PSH & 20 Fair market rent restricted w/o rental subsidies]
SRO, STUDIO

ON-SITE RENEWABLES
- 47 MWH/Yr Solar PV Array

85-unit [65 PSH ≤30% AMI | 20 ≤ 50% AMI]
SRO, STUDIO

ON-SITE RENEWABLES
- 59 MWH/Yr Solar PV Array

Interim EUI | Baseline 54 | As-Designed 35 / 28 (w/ w/o solar)

138-unit [30-60% AMI]
STUDIO, 1BD, 2BD, 3BD

ON-SITE RENEWABLES
- 162 MWH/Yr Solar PV Array

EUI | Baseline 53 | As-Designed 43 / 39 (w/ w/o solar)

ECO-CHARRETTE
- Integrative Design

PASSIVE DESIGN STRATEGIES
- AIR-SEALING
- Increased Thermal Shell

HIGH EFFICIENCY MEP EQUIPMENT
- In-Unit & Common Area - Heat Pumps
- 2-Stage Bath Fans
- Hight Efficiency Lighting,
- High Efficiency Plumbing Fixtures
- High Efficiency Appliances

HACIENDA CDC

- **FUTURE PROOFING**
- CONSERVE FIRST
- EFFICIENT MEP + APPLIANCES
- RENEWABLES + BACKUP
- 3rd PARTY VERIFIED
- HAVE A PLAN

← TODAY

↑ TOMORROW

142-unit [21 PSH ≤30% AMI | 41 ≤ 60% AMI]
STUDIO, 1BD, 2BD, 3BD

PASSIVE DESIGN STRATEGIES
- AIR-SEALING
- Increased Thermal Shell (Hight Eff. Windows)

HIGH EFFICIENCY MEP EQUIPMENT
- In-Unit & Common Area - Ductless Heat Pumps
- DOAS / MERV 13/ 2-Stage Bath Fans
- Hight Efficiency Lighting, Plumbing & Appliances

ON-SITE RENEWABLES
- 322.83 MWH/Yr Solar PV Array

EUI | Baseline 41 | As-Designed 32 / 25 (w/ w/o solar)

67-unit [12 PSH ≤30% AMI | 55 ≤ 60% AMI]
1BD, 2BD, 3BD, 4BD

All-electric

Rooftop and accessory structure solar

Battery Backup

Heat Pump Mini Slit Systems

Heat Pump Water Heaters

EV Charging

NW HOUSING ALTERNATIVES

- **NEST APPROACH**
- CONSERVE FIRST
- EFFICIENT MEP + APPLIANCES
- RENEWABLES + BACKUP
- 3rd PARTY VERIFIED
- HAVE A PLAN

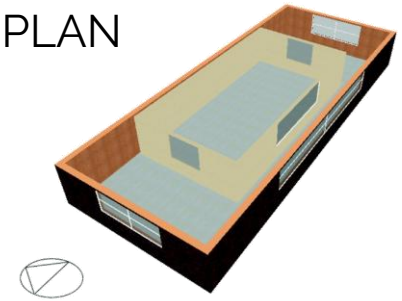


Figure 1 NTED™ example building configuration.

63-unit [21 PSH ≤30% AMI | 41 ≤ 60% AMI]
STUDIO, 1BD

SENIOR HOUSING, BIPOC Communities

PASSIVE DESIGN STRATEGIES
- AIR-SEALING
- Increased Thermal Shell (Ext. + R31 Batt

HIGH EFFICIENCY MEP EQUIPMENT
- In-Unit - Ductless Heat Pumps
- Common Area - VARIABLE REFRIGERANT FLOW
- ERV/DOAS Ventilation w/ 72% Recovery
- Heat Pump Water Heater and low-flow fixtures

ON-SITE RENEWABLES
- 64.55 MWH/Yr Solar PV Array

EUI | Baseline 41 | As-Designed 30 / 26 (w/ w/o solar)

Pursuing Earth Advantage MF Platinum
ENERGY STAR Multifamily New Construction
DOE Zero Energy Ready

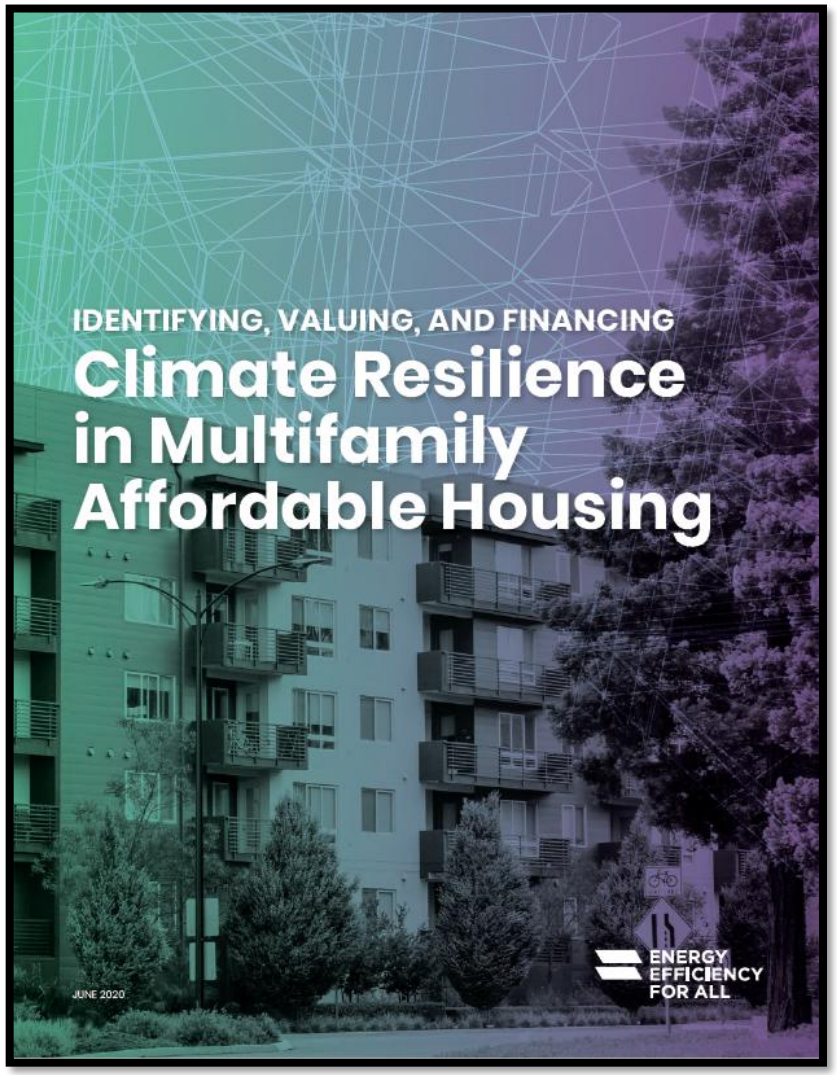
CALL TO ACTION

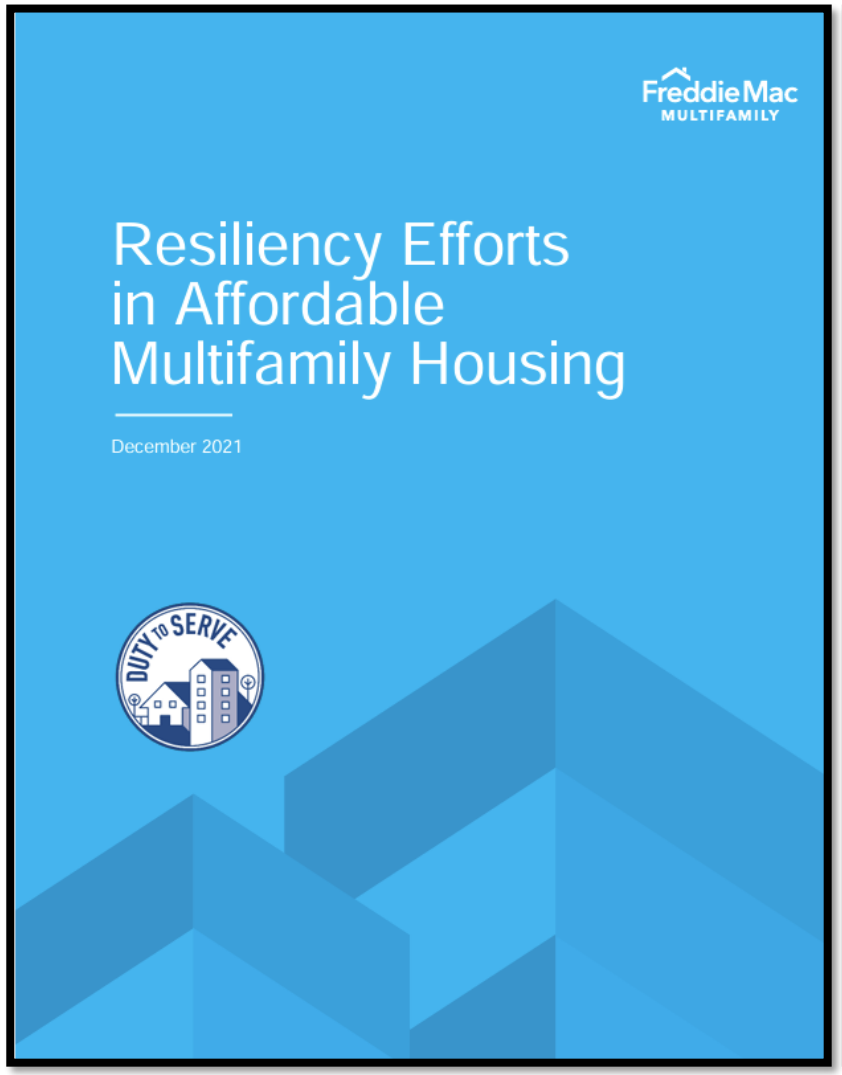
RESILIENCE IS NOT JUST A FEATURE – IT'S THE FOUNDATION OF TRUE AFFORDABILITY AND BOTH SHORT- AND LONG-TERM PREPARDNESS. WE MUST DESIGN, BUILD, OPERATE AND INVEST IN HOUSING THAT REMAINS SAFE, LIVEABLE AND COST-EFFECTIVE IN A CHANGING WORLD.

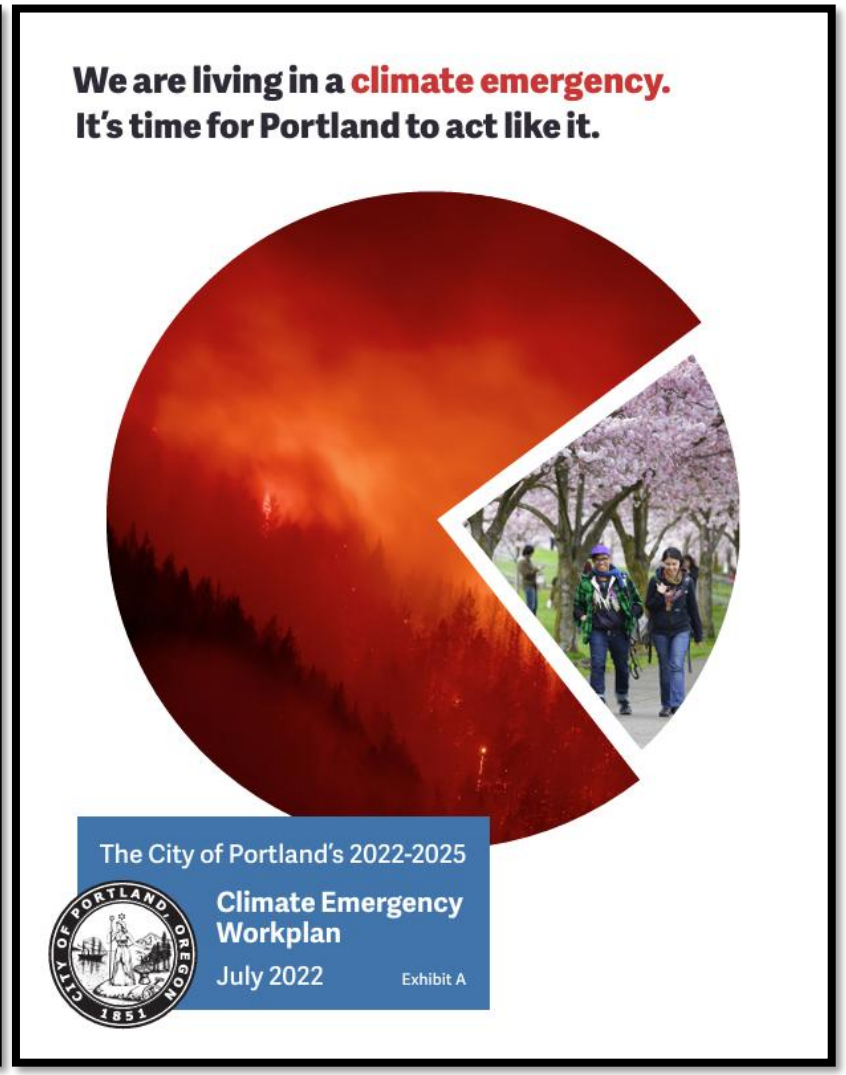
THANK YOU !

ERIC FOLEY
efoley@earthadvantage.org

ADDITIONAL RESOURCES







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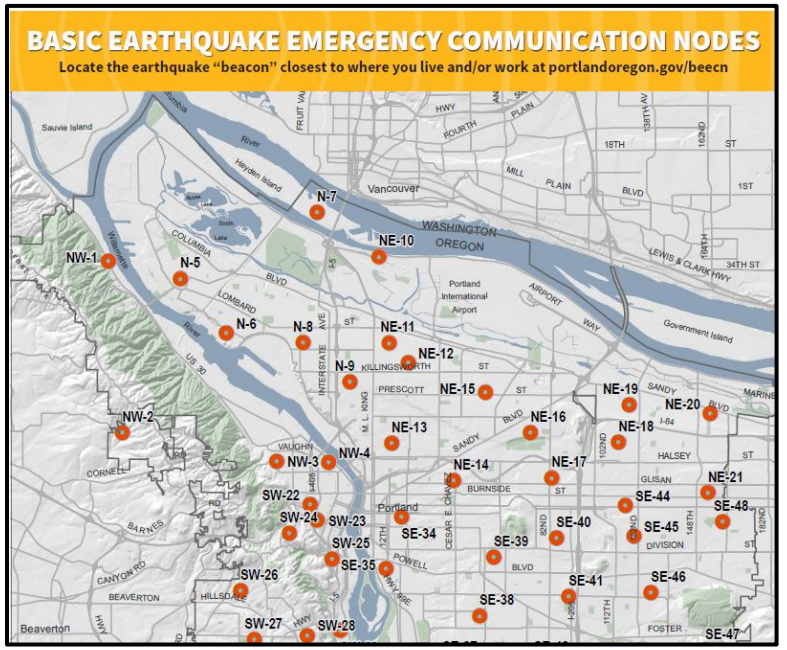
https://mf.freddiemac.com/docs/2021_freddie_mac_multifamily_duty_to_serve_resiliency_report.pdf
https://www.portland.gov/bps/climate-action/documents/climate-emergency-workplan-2022-2025/download

BEECN
(Basic Earthquake Emergency Communication Nodes)
portland.gov/beecn

- **Free** 1½ hour training
- Online monthly or in-person 8+ people
- Emergency communications when mobile/landlines/internet is down
- 50 locations across Portland



NET
(Neighborhood Emergency Teams)
portland.gov/net

- **Free** 28-hour training by PBEM and PF&R
- NETs provide emergency assistance in their own neighborhoods
- 95% of people are rescued by neighbors in a disaster
- Fire Safety & Utility Control, Light Search & Rescue, First Aid, Disaster Psychology, Community Education, Radio, Terrorism
- **Free** Advanced Training opportunities

EXTRA : BEST PRACTICES & FUTURE READY SOLUTIONS

← TODAY

BUILDING DESIGN & CONSTRUCTION

INTEGRATED PASSIVE & HIGH-PEFORMANCE STANDARDS AND RESOURCES.

- Orientation, shading, and natural ventilation to reduce energy demand
- Access to trusted & experienced local organizations providing trades training, verification and performance testing services
- Green Building standards that provide practical and reliable durability and resilient outcomes

BUILDING DESIGN & CONSTRUCTION

INTEGRATED PASSIVE & HIGH-PEFORMANCE STANDARDS AND RESOURCES.

- Bio-Adaptive facades – dynamic materials that adjust based on sunlight, temperature and humidity.
- Phase-change materials (PCM): Embedded in walls to store and release heat, stabilizing indoor temperatures.
- 3D printed building envelopes using climate adaptive materials.

INFRASTRUCTURE & BUILDING MATERIALS

Building Energy Independence & Climate Adaptation through Renewable Energy & Microgrids for a Sustainable Future

- Self-healing concrete: microbes in concrete that repair cracks automatically.
- Resilient floating homes in flood-prone urban areas.
- Advanced aerogels and graphene-based materials for extreme weather durability.

← TODAY

POWERING RESILIENCE

Building Energy Independence & Climate Adaptation through Renewable Energy & Microgrids for a Sustainable Future

- Rooftop solar PV + battery storage for energy independence.
- Community solar programs for affordable housing developments
- Net-zero energy housing with high-efficiency heat pumps

POWERING RESILIENCE

Building Energy Independence & Climate Adaptation through Renewable Energy & Microgrids for a Sustainable Future

- Virtual power plants (VPDs): aggregating distributed energy resources (DERs) from affordable housing to stabilize the grid.
- Building-integrated photovoltaics (BIPV): solar-generated windows and facades.
- Hydrogen fuel cells and back-up energy storage.

SMART MAINTENANCE & TECHNOLOGY

Predictive tools and automations to improve performance

← TODAY

- Smart thermostats, demand response energy systems, and Internet of Things (IoT) sensors for real-time monitoring.
- Leak detection and shutoff systems to prevent water damage.
- AI assisted HVAC optimization for low-income housing.

SMART MAINTENANCE & TECHNOLOGY

Predictive tools and automations to improve performance

- AI assisted predictive maintenance that detects structural and system failures before they occur.
- Blockchain enabled energy credits for decentralized, peer-to-peer renewable energy trading in multifamily.
- Digital twins for real-time building performance modeling.

← TODAY

COMMUNITY SOLUTIONS

Equity-Based & Community Resilience Strategies

- Community land trusts (CLTs) to protect against climate displacement
- Tenant education on emergency preparedness and energy conservation
- Financial incentives (LIHTC, IRA) for resilient affordable housing new and existing construction.

COMMUNITY SOLUTIONS

Equity-Based & Community Resilience Strategies

- Climate migration planning: proactive policies for relocating communities at risk.
- Resilience Hubs or Webs: onsite emergency power, food storage, and communications for disruptive climate events and disasters.
- AI-assisted climate risk mapping to optimize affordable housing site selection.