

U.S. DEPARTMENT OF
ENERGY

Office of
**ENERGY EFFICIENCY &
RENEWABLE ENERGY**

Approaching Zero, Where Do We Go From Here For Commercial Buildings?

National Energy Codes Conference Seminar Series
Building Technologies Office

Summer 2021



NECC Seminar Series Lineup

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

- 8/12: Grid Integration and Electrification in Energy Codes
- **8/26: Approaching Zero, Where Do We Go From Here for Commercial Buildings**
- 9/9: Codes Around the Globe: A Cross-National Comparison of Building Energy Codes (AT 2PM ET)
- 9/23: Evolution of Commercial Building Design and Construction
- 10/7: Equity and Codes: Ensuring Codes and Energy Efficient Buildings Address Affordable Housing Needs
- 10/21: Zoning and Land-Use Regulation: Emerging Tools for Advancing Climate-Friendly Development

> Learn more: <https://www.energycodes.gov/2021-summer-seminar-series>

Today's Moderator



Michael Tillou, P.E.— Senior Buildings Research Engineer, PNNL

Today's Panelists



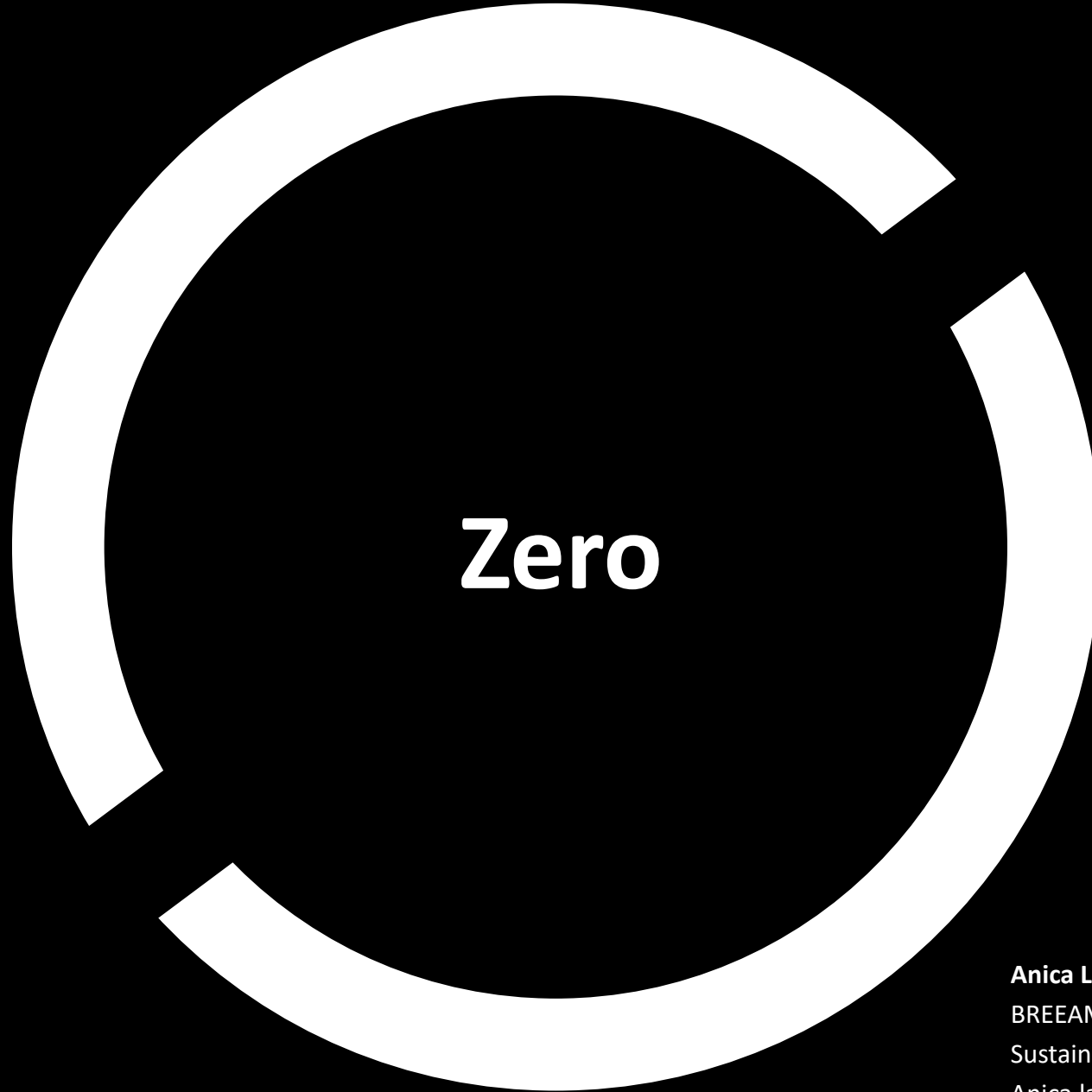
Anica Landreneau, ASSOC. AIA, LEED AP BD+C, WELL AP – Director of Sustainable Design, HOK



Thomas Phoenix, P.E, FASHRAE, LEED AP – Principal, CPL Architects & Engineers

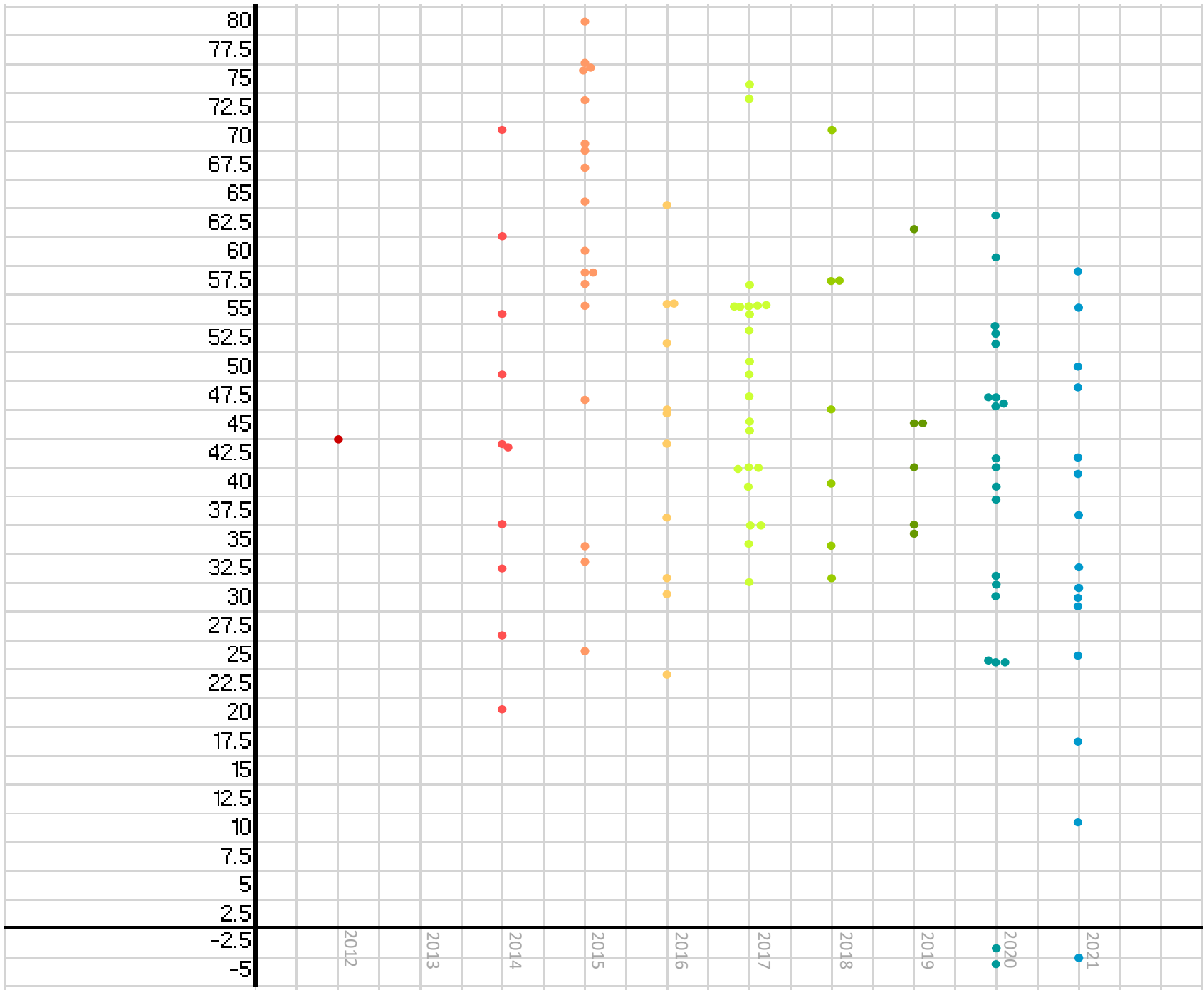


Kim Cheslak – Director of Codes, NBI



Zero

Anica Landreneau, Assoc. AIA, LEED AP, WELL AP,
BREEAM Assessor, fitwel Ambassador
Sustainable Design Director | HOK
Anica.landreneau@hok.com | 202.944.1490



Tracking site EUI of
market rate corporate
 & commercial office
 buildings reported
 through AIA 2030
 program (S, M, L, XL);

projects with clearly indicated substantial program
 area dedicated to laboratory, data center or other
 high intensity energy uses removed from data set.

4th & Harrison
900,000 sf
San Francisco, CA
pEUI 25.6 kBtu/sf/yr + onsite solar PV (Net Zero Core & Shell) + offsite RE (tenant energy use)





Corporate Facility, Guyana
90,000 sf
pEUI 31 kBtu/sf/yr + onsite solar PV
Payback <7 years



1101 16th Street NW | Washington, DC

EUI **31.4** kBtu/sf/yr

135,000 sf

Retrofitting 1101 16th Street (constructed 1972-1975) was cited by developer as 'less than half the time or cost of new construction for a Class A office building', reduced operating carbon emissions by >53%, saved >94% existing structure and its embodied carbon; Certified LEED Platinum



1771 N Street NW | Washington, DC

73,315 sf

EUI **27.3** kBtu/sf/yr

Retrofitting 1771 N St (built 1968) reduced operating carbon emissions by >72%, and saved 97% existing structure and its embodied carbon; tracking LEED Gold

Howard County Circuit Courthouse, Maryland

237,000 sf

pEUI 34.5 kBtu/sf/yr + 60% electrical demand met through onsite solar PV, remainder met through offsite solar PPA;

Tracking LEED Gold



Why do **codes** matter?



The U.S. is projected to construct 45 billion square feet over the next decade.

One of the biggest opportunities and one of the simplest solutions is to

address operating + embodied carbon emissions in our building codes.

U.S. Energy Information Administration Annual Energy Outlook 2019



- Per LBNL, avg. cost to enforce energy code:
 - \$139/commercial bldg
 - \$49/single-family home
- In larger cities (higher salary, overhead):
 - \$400–\$500/commercial bldg
 - \$150–\$200/single-family home

It has *amazing*
ROI:

Every \$1 invested
in energy code
compliance saves
\$6.

The US can't *afford* outdated energy codes:

1/3

U.S. households face challenges paying energy bills.

25

million U.S. households report *forgoing food and medicine* to pay energy bills.

7

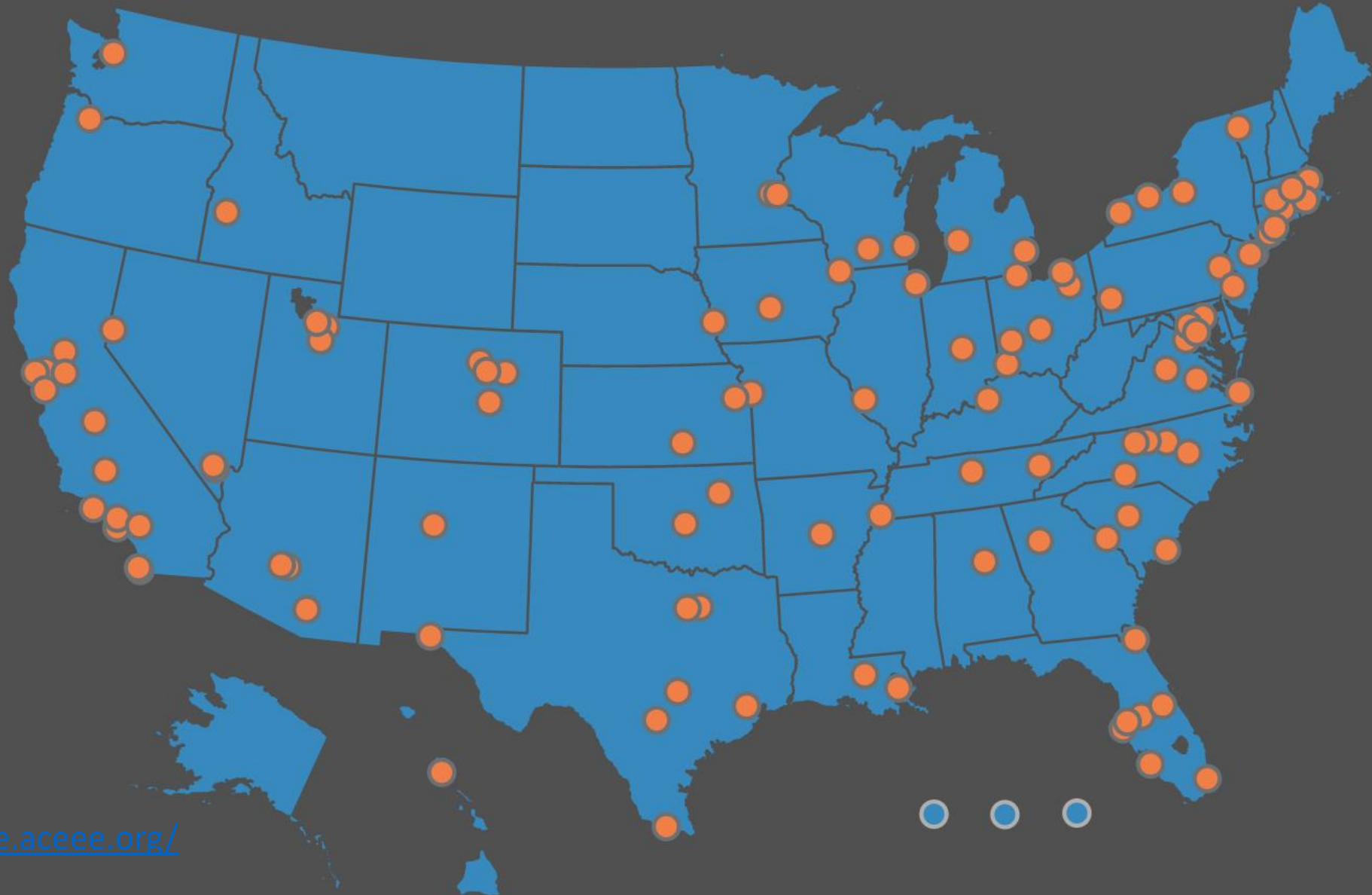
million U.S. households decide between paying energy bills and basic needs *nearly every month*.

Mortgage default risks are on average

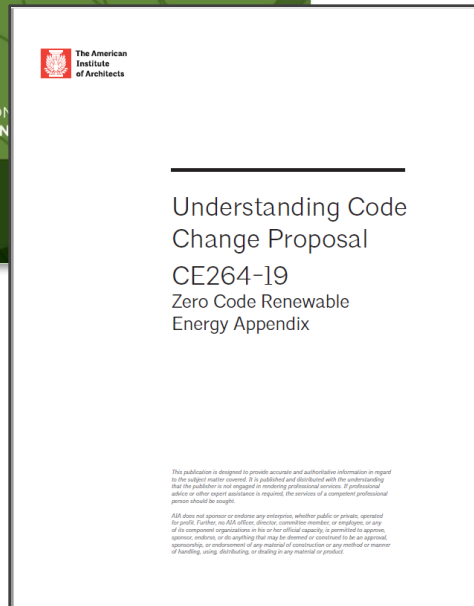
32%

lower in energy-efficient homes.

When state law doesn't prohibit Cities and Counties may *require* more stringent standards than at state level (ex. MD); where prohibited, local govt may *incentivize* more stringent standards and codes where they cannot require (ex. VA)



CE264-19 Zero Code Appendix IECC 2021

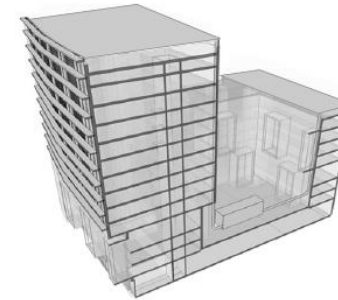


ZERO CODE™

Commercial • Institutional • Mid-Rise/High-Rise Residential Buildings

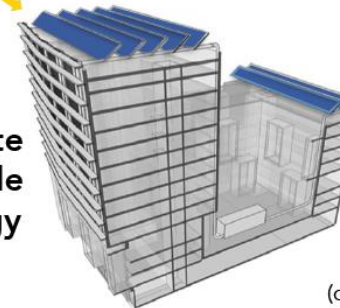
1 Design an energy efficient building

- Efficiency Standard: ASHRAE 90.1-2016 minimum; ASHRAE 189.1-2017; others
- Efficient building envelope / daylighting
- Passive heating / cooling / ventilation
- Efficient systems / equipment / controls



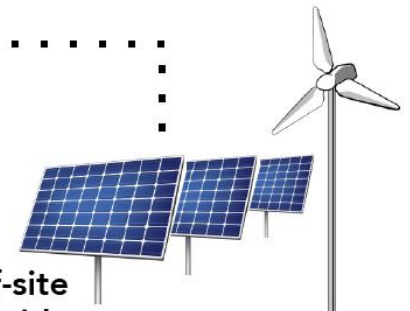
2 Address the remaining building's energy needs with:

on-site renewable energy



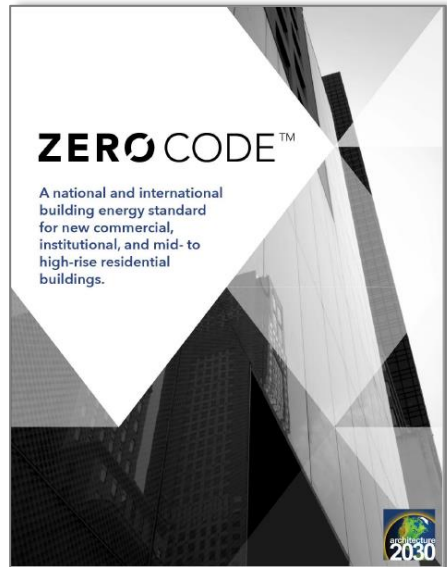
and/or off-site renewable energy

wind • solar • hydro
(other non-CO₂ emitting sources)

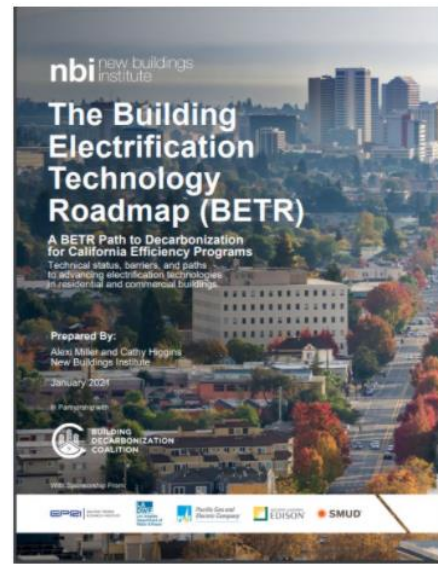


Source: Architecture 2030
Graphic adaptations: Sefaira; DOE

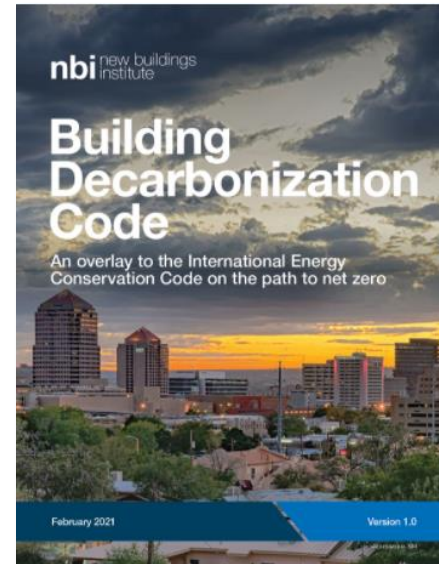
Model Code Language + Tools



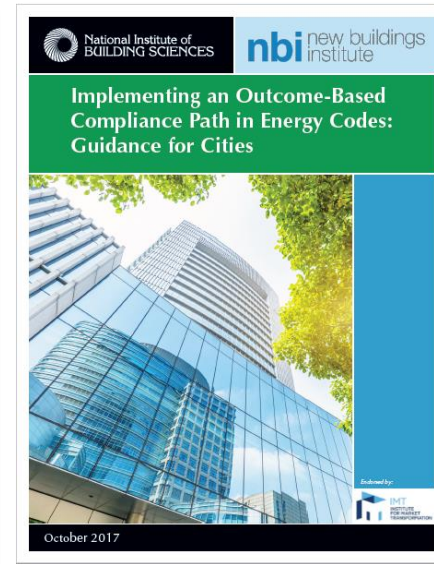
<https://zero-code.org/>



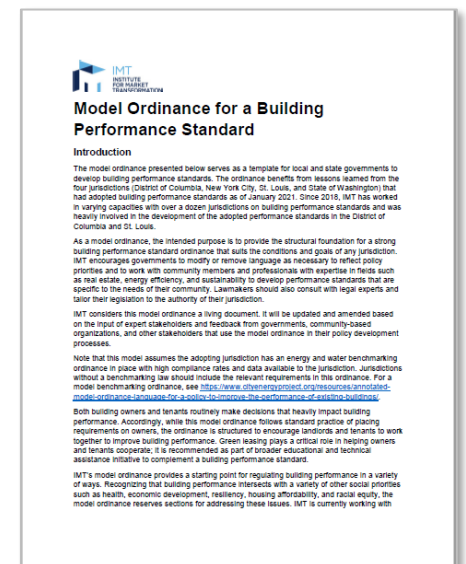
<https://newbuildings.org/resource/building-electrification-technology-roadmap/>



<https://newbuildings.org/resource/building-decarbonization-code/>



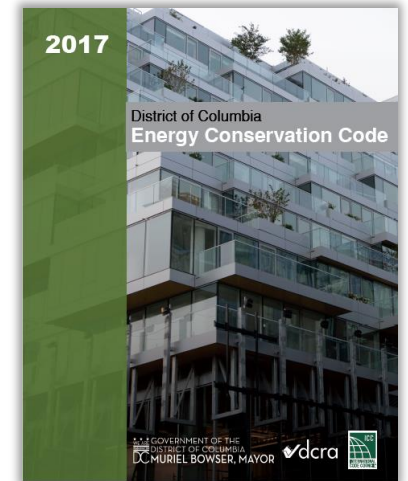
<https://newbuildings.org/resource/implementing-outcome-based-compliance/>



<https://www.imt.org/resources/model-ordinance-for-building-performance-standards/>

Appendix Z – Washington, DC

- May be incentivized pre-2026
- Minimum Performance Req'ts:
 - Energy Use Intensity (EUI)
 - Thermal Energy Performance
 - Commissioning
 - Modeling Professional Quals
 - Air Tightness
- No onsite combustion fossil fuels (i.e. electrification)
- Metering, Monitoring, Reporting
- Renewable Energy
 - Photovoltaic panels
 - Solar thermal systems
 - Wind turbines
 - Biogas
- Minimum 5% onsite RE
- 25% site area used for PV
- Offsite Tier I RE meeting DC RPS
- 5-yr agreement for offsite RE



Lifecycle Performance Accountability

1. New Construction: Net Zero now or very soon (onsite + offsite RE); net positive soon!
2. Benchmarking: *A vehicle for reporting performance (which drives improvement) + onsite RE generation + offsite RE procurement every single year until the building is decommissioned)*
3. Performance standards: start phasing in; continuous optimization
4. Existing Buildings: improved performance now through BPS
5. Existing Buildings: Net Zero soon!



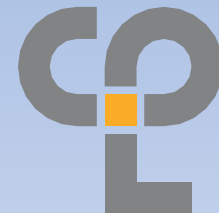
Anica Landreneau, Associate AIA, LEED AP BD+C, WELL AP, BREEAM, fitwel
Senior Principal | Director of Sustainable Design | HOK
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Approaching Zero Energy: Where Do We Go From Here for Commercial Buildings

From Zero Energy to Zero Carbon

August 26, 2021

Thomas H. Phoenix, P.E., FASHRAE, LEED AP
Principal, CPL Architects & Engineers
ASHRAE Presidential Member
Chair, AEDG Steering Committee
Co-Chair, ASHRAE Task Force for Building Decarbonization

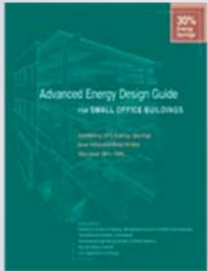


“By combining incredibly energy efficient design with renewable energy generation, zero energy buildings are the holy grail of energy efficient building operation,”

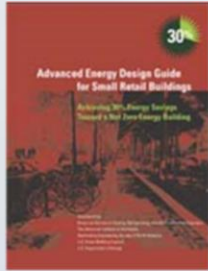
ASHRAE Presidential Member Kent Peterson 2007-08

Advanced Energy Design Guides

Energy Performance beyond ASHRAE 90.1



Small Office



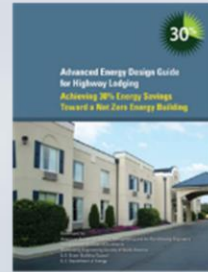
Small Retail



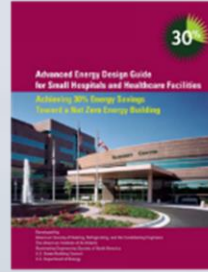
K-12 School



Warehouse

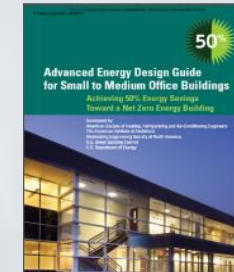


Highway Lodging



Small Hospital

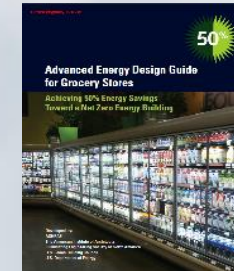
- From 2002 to 2015 - Eleven guides published
- Free download: www.ashrae.org/freeaedg



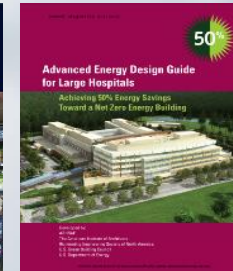
Office



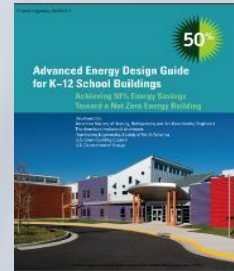
Med-Big Box Retail



Grocery Stores



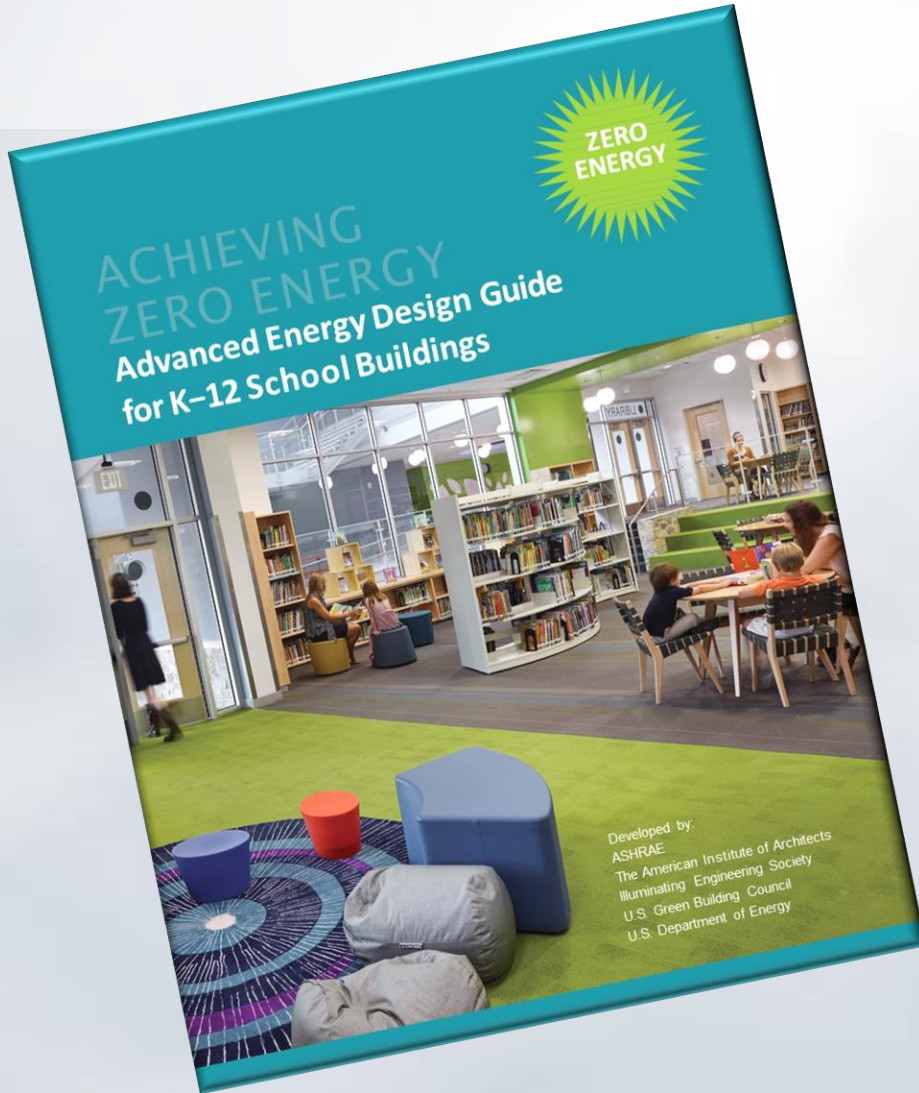
Hospitals



K12 Schools



Achieving Zero Energy



January 2018



June 2019

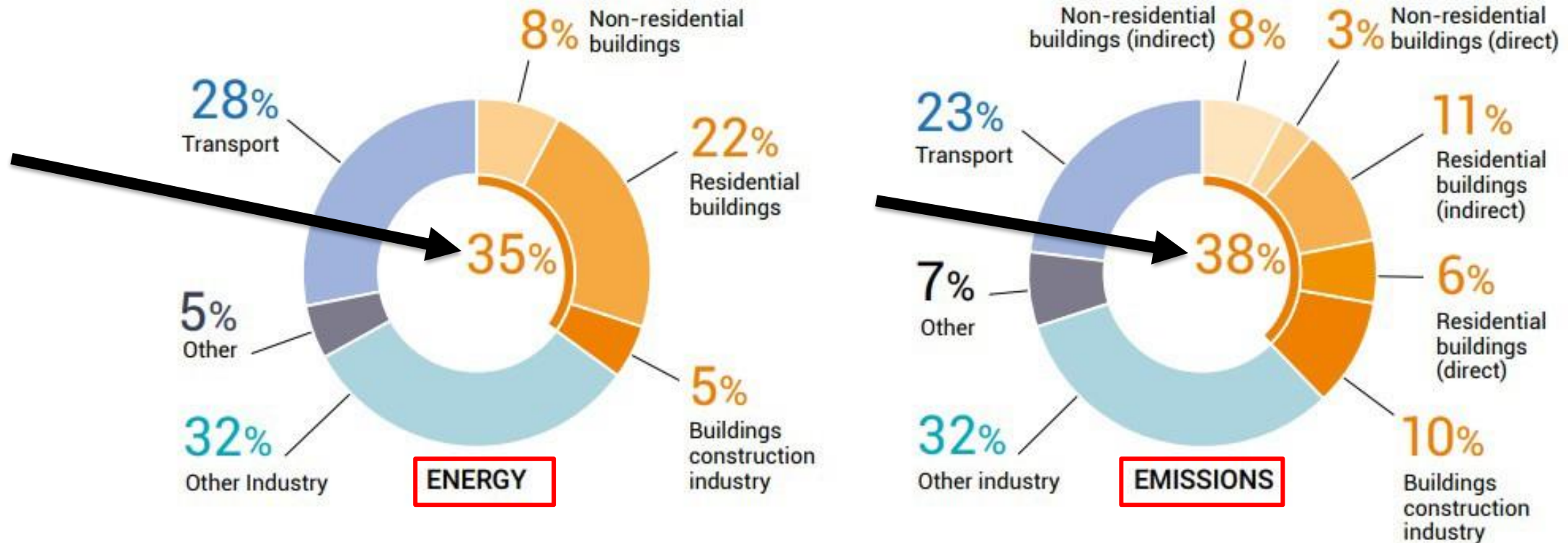
“The times they are a-changing”

*Focus of the Building Industry is now
about getting to*

Carbon Neutral

Do buildings make a difference?

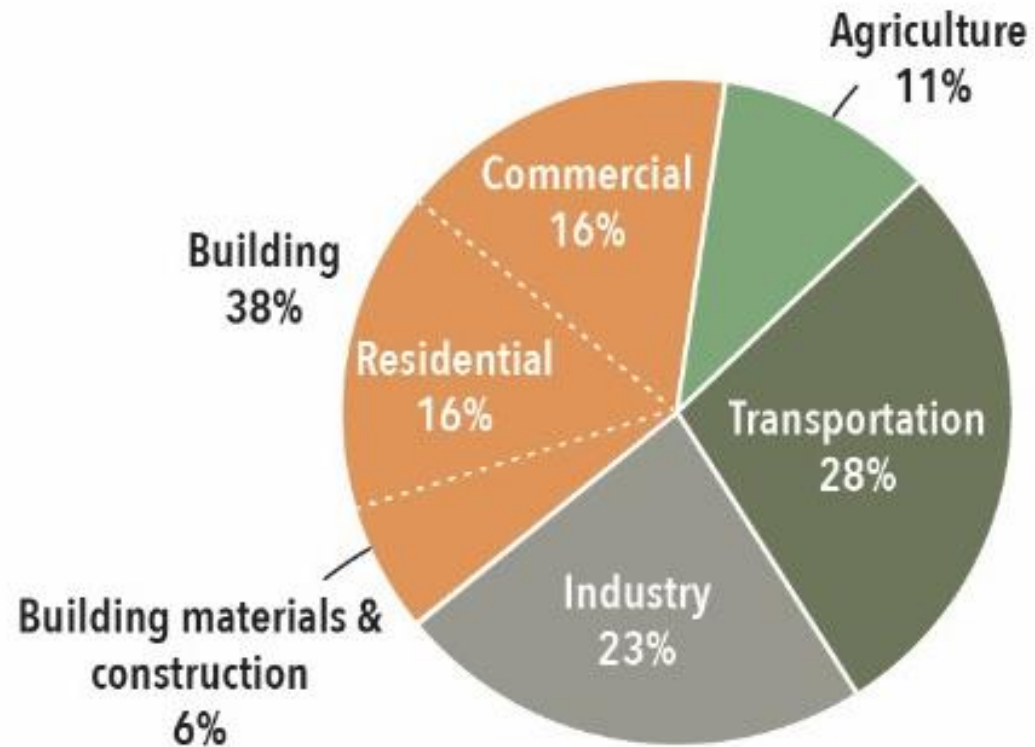
Global share of buildings and construction final energy and emissions, 2019



Notes: Buildings construction industry is the portion (estimated) of overall industry devoted to manufacturing building construction materials such as steel, cement and glass. Indirect emissions are emissions from power generation for electricity and commercial heat.

Sources: (IEA 2020d; IEA 2020b). All rights reserved. Adapted from "IEA World Energy Statistics and Balances" and "Energy Technology Perspectives".

Do buildings make a difference?



U.S. GHG emissions with industry production for building reassigned

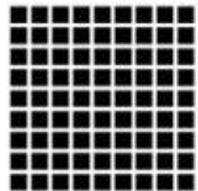
SOURCE: Carnegie Mellon Center for Building Performance and Diagnostics (2020).

**Are Zero Energy &
Zero Carbon
Really Disconnected?**

The Five Foundations of Zero Carbon Building Policies



Energy Efficiency



Renewable Energy



Grid Integration + Storage



Building Electrification



Life-Cycle Impacts



Zero Carbon Building Policy

ASHRAE Task Force for Building Decarbonization

Working Groups

Knowledge
Hub

Embodied
Carbon/LCA

Building
Performance
Standards

Sequestration
on Building
Site

Operational
Carbon

Building
Standards &
Codes

Appliance &
Equipment
Standards

Grid Building
Intersection

Training &
Education

Energy to Carbon Issues

Metrics

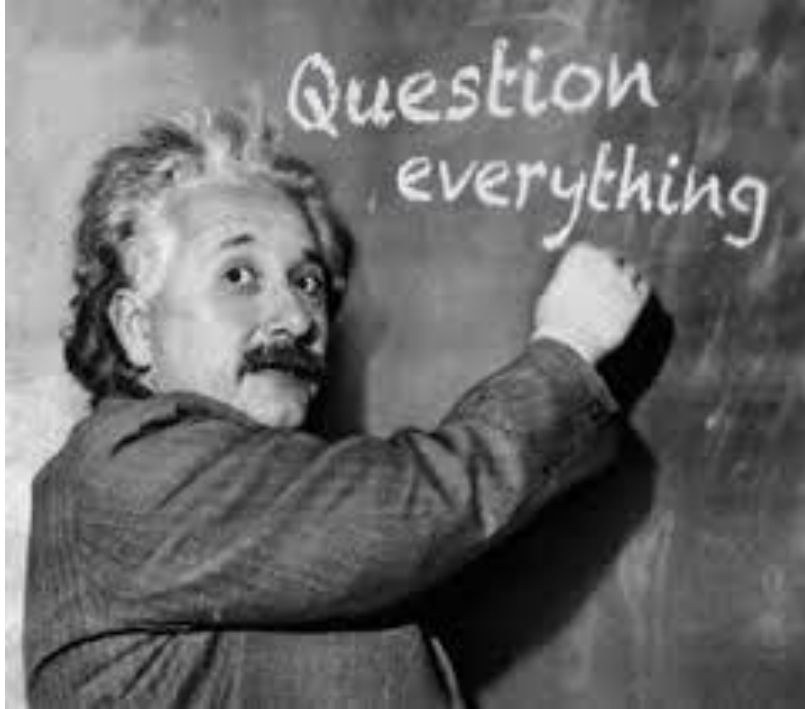
Electric Utility Grid

Embodied Carbon

What's in the Future?

- **Achieving Zero Energy is still the First Step**
- **Decarbonizing Electric Utility Grid**
- **Carbon Focused Codes & Standards**
- **Design for the Future**

Questions?



tphoenix@cplteam.com



nbi new buildings
institute

Approaching Zero

August 2021

VanDusen
BOTANICAL GARDEN

Office Building Energy Use



Existing Building

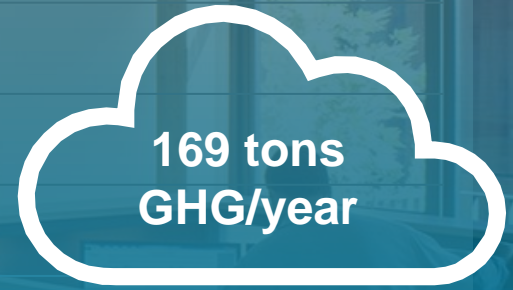
US Codes

ZNE

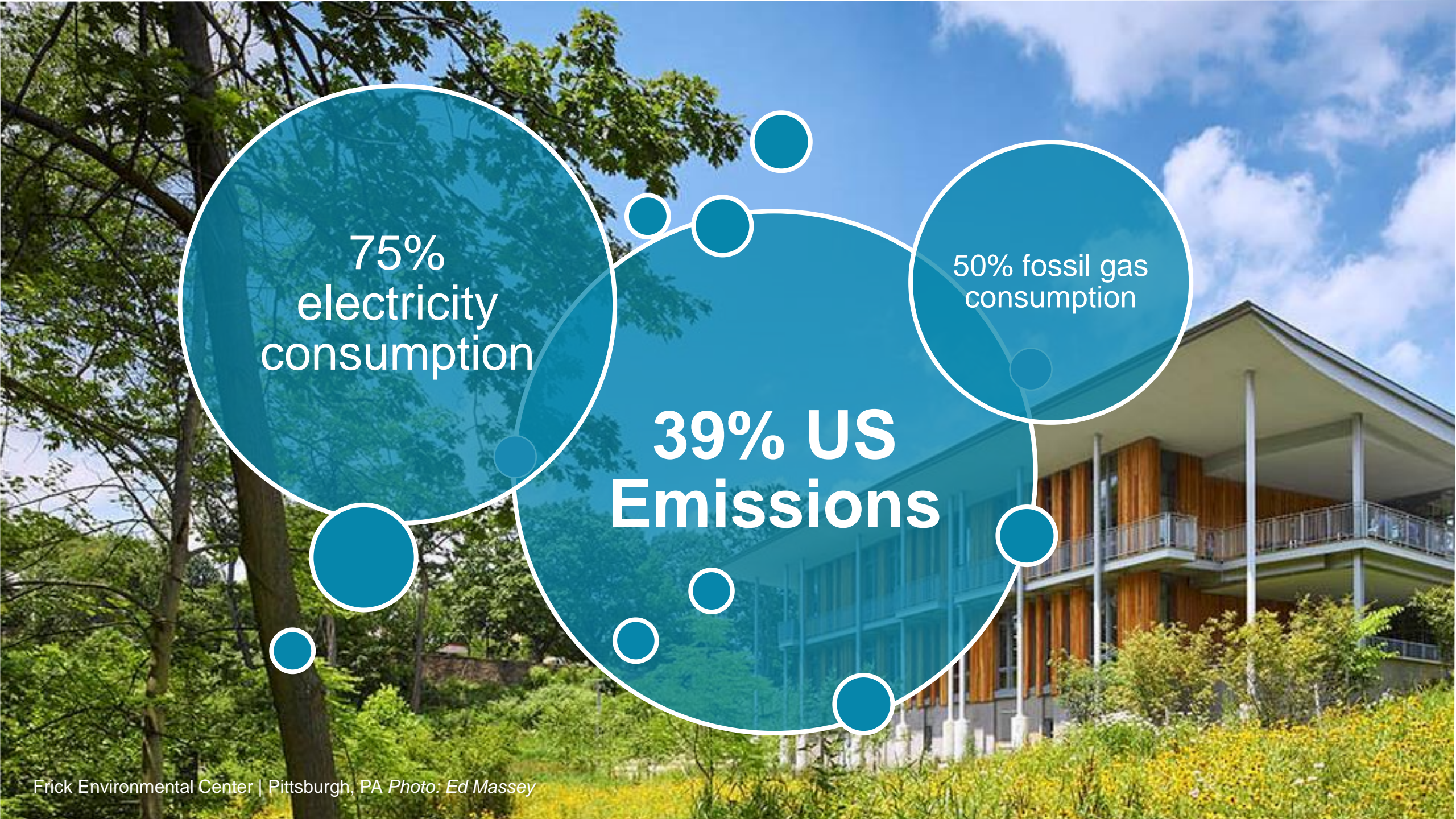
Just 1 ZNE Building



will save



169 tons
GHG/year

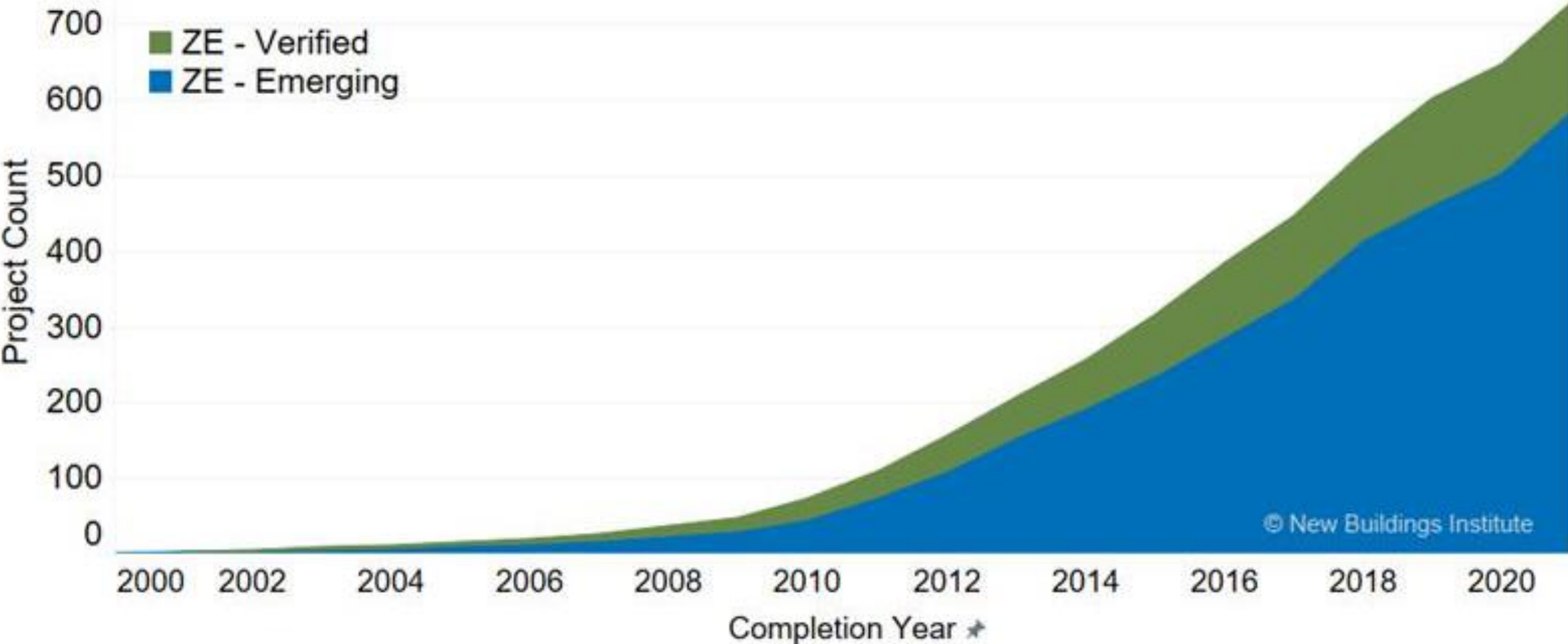


75%
electricity
consumption

50% fossil gas
consumption

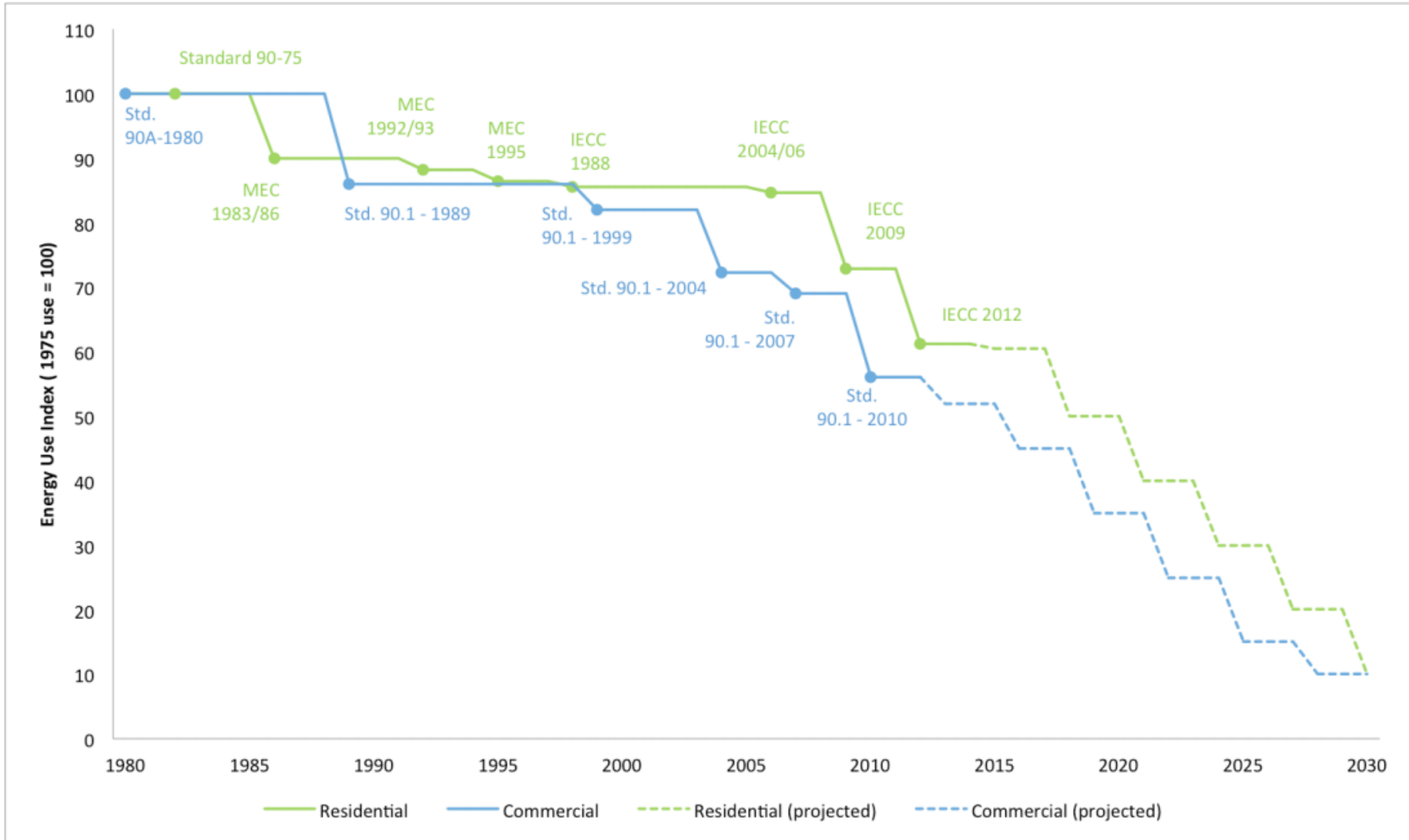
39% US
Emissions

Getting to Zero Database



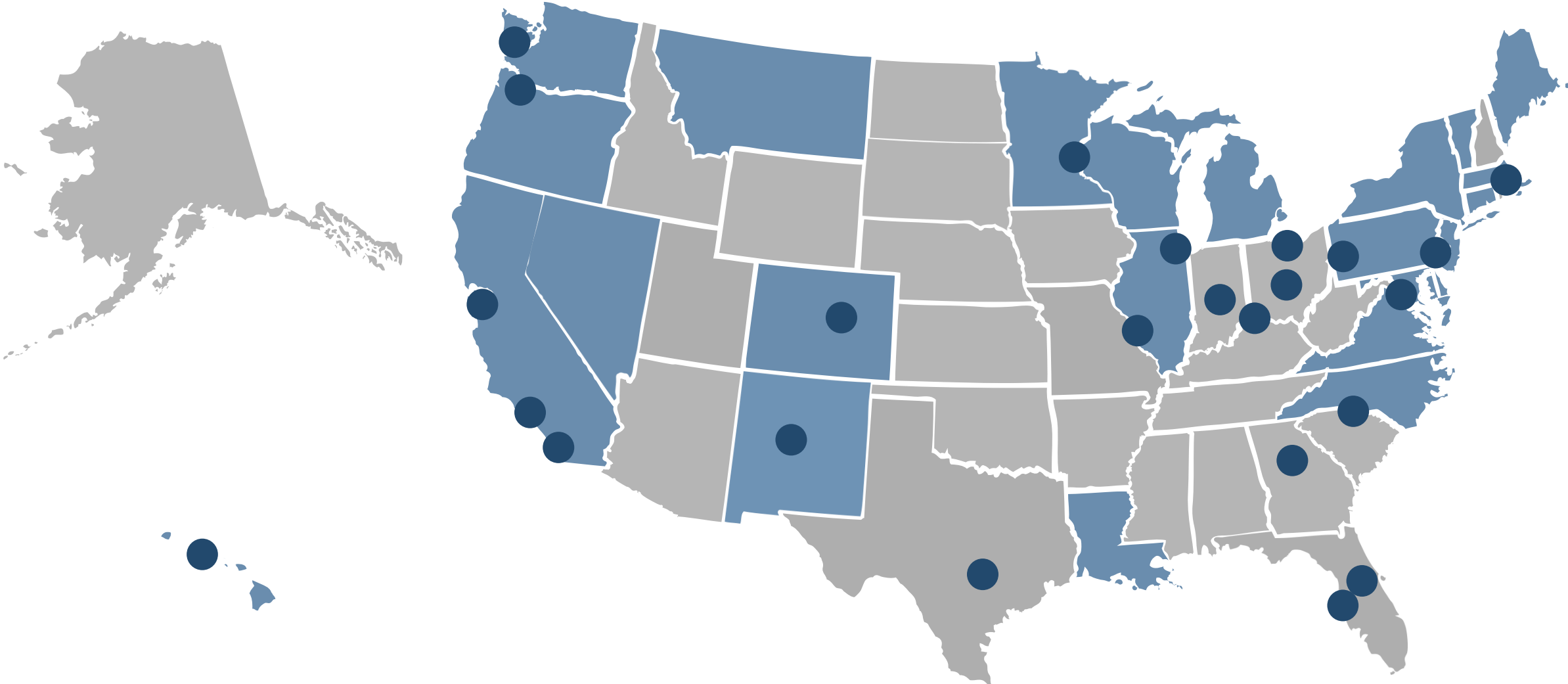
© New Buildings Institute

Progress of Model Codes



History of US Building Codes 1980-2012.
Source US DOE BECP

US Leadership*



* Includes USCA, CESA, ACCC Cities

Generational Shift in Building Regulation

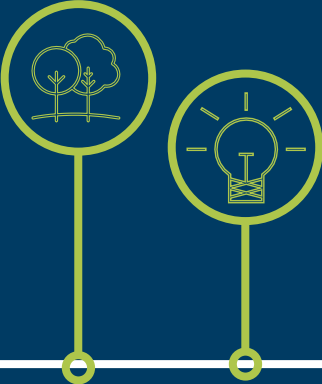
1970s Codes & Standards

Building energy codes
Utility rebate programs
National appliance standards



1990s Market Leadership

ENERGY STAR released
LEED standard released



2000s Disclosure

Benchmarking policies



2010s Zero Energy

NZE Certifications released
GTZ Database created



2020s Performance

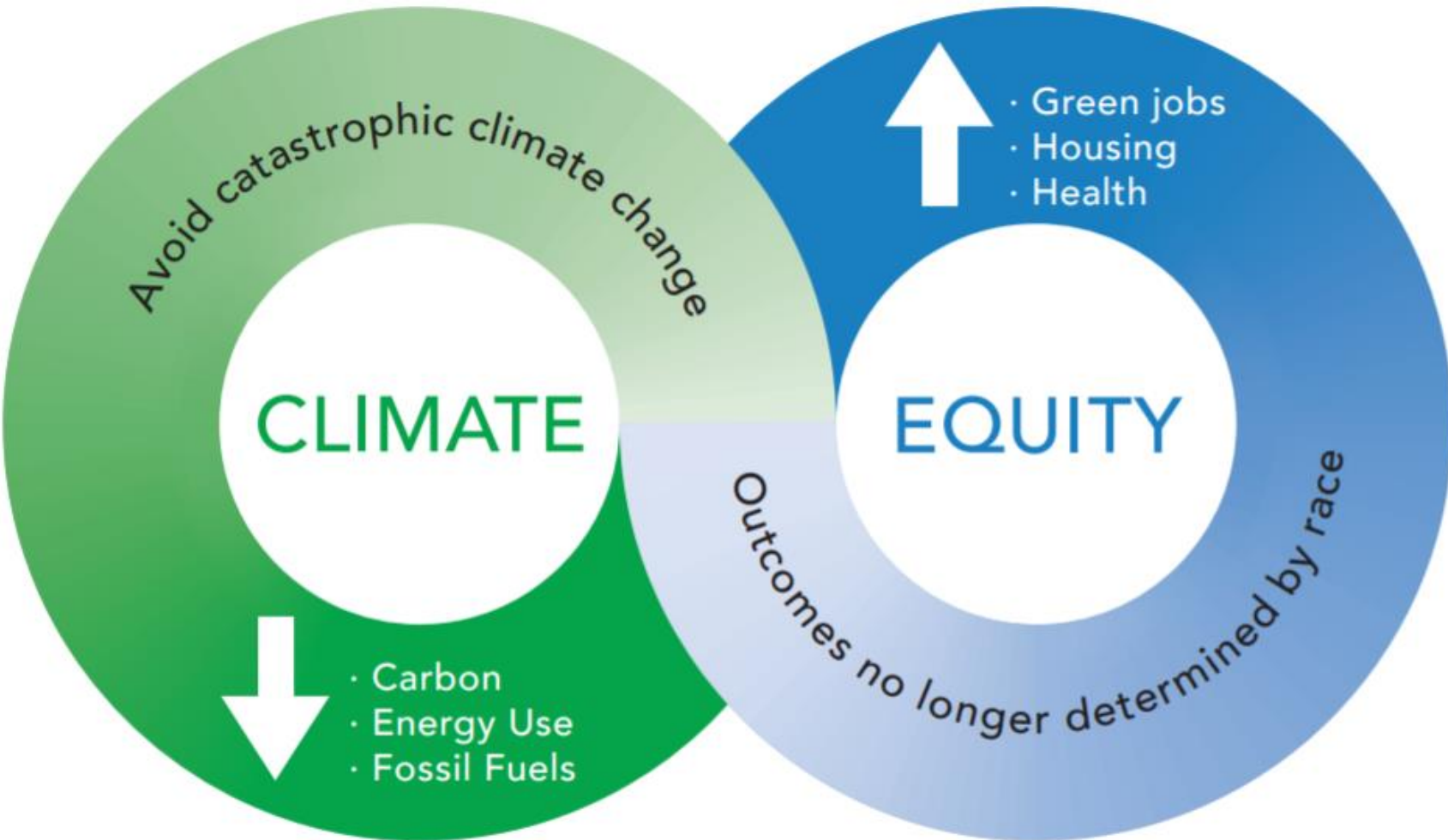
Carbon centered regulations
Equity and environmental justice
Building performance standards



Towards a Climate Code

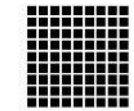
SKOLSTREJK
FÖR
KLIMATET

Climate and Equity Goals



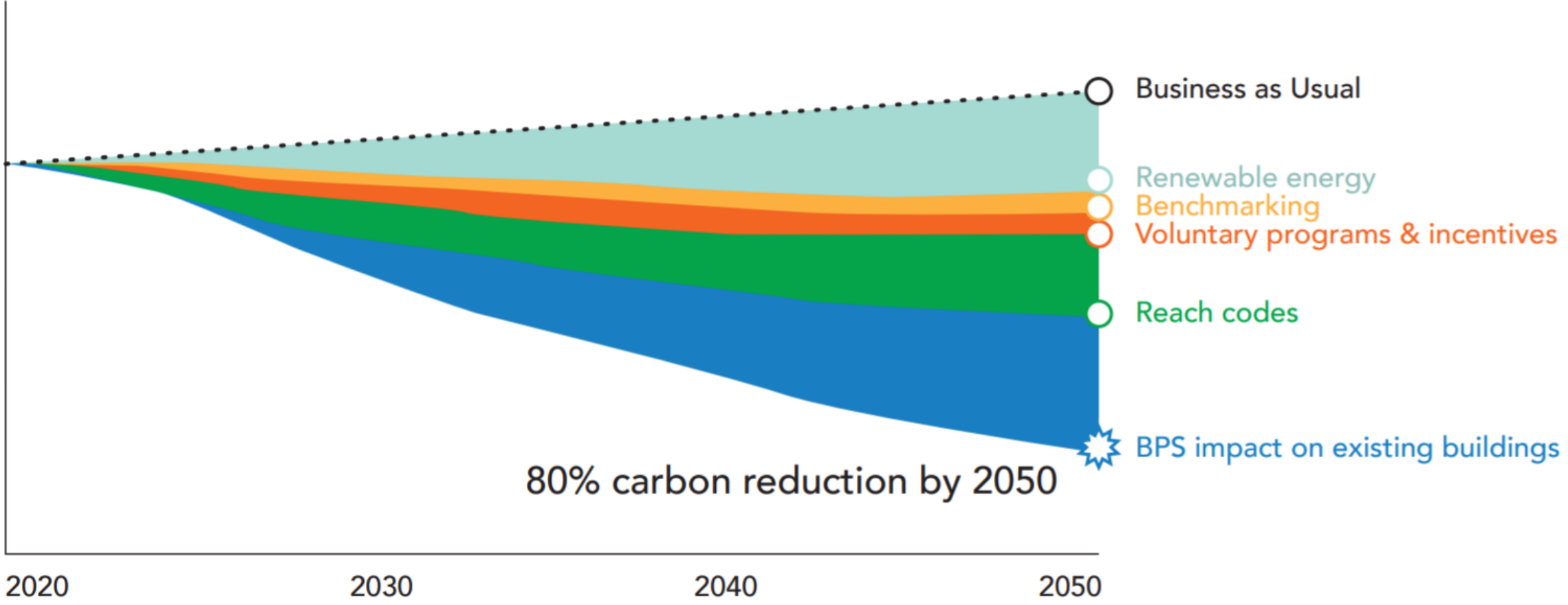
Source: ACCC BPS Framework

New Goals for Buildings



	Scope	Goal
Efficiency	Base Codes / Building Systems	Highly Efficient / Passive Resilience
Electrification	Building Systems + Vehicles	Produce no onsite carbon emissions
Renewables	Onsite, Offsite + Procurement	Onsite resilience, Support RPS and additive procurement
Grid Integration	Controls, Storage	TOU Carbon reduction and Grid-sensitive
Lifecycle Impact	Embodied Carbon, Refrigerants + Deconstruction	Lifecycle GHG reductions
Equity	IAQ, Materials + More	Just transition, Improve health, Local Jobs, Affordability

Scale of Impact for EB Policies



80% carbon reduction by 2050

Source: ACCC BPS Framework

© New Buildings Institute 2021

Reframing Cost Effectiveness

1

Minimize liability & future proof

Safeguard against a changing energy market where gas and other fossil fuels are likely to become less accessible and more expensive over time.

2

Maximize usable square footage

Electric HVAC equipment maximizes available square footage (e.g. heat pump units installed on walls near ceiling vs. steam radiator taking up floor space).

3

Health benefits

All-electric appliances, especially electric stoves and cooktops, reduce indoor air pollutants. Good building envelopes protect against pest infestation and other asthma triggers.

4

Increased resilience

Weatherization and solar + storage help keep the power on and temperatures consistent in the event of a power outage or extreme weather event.

5

Occupant comfort

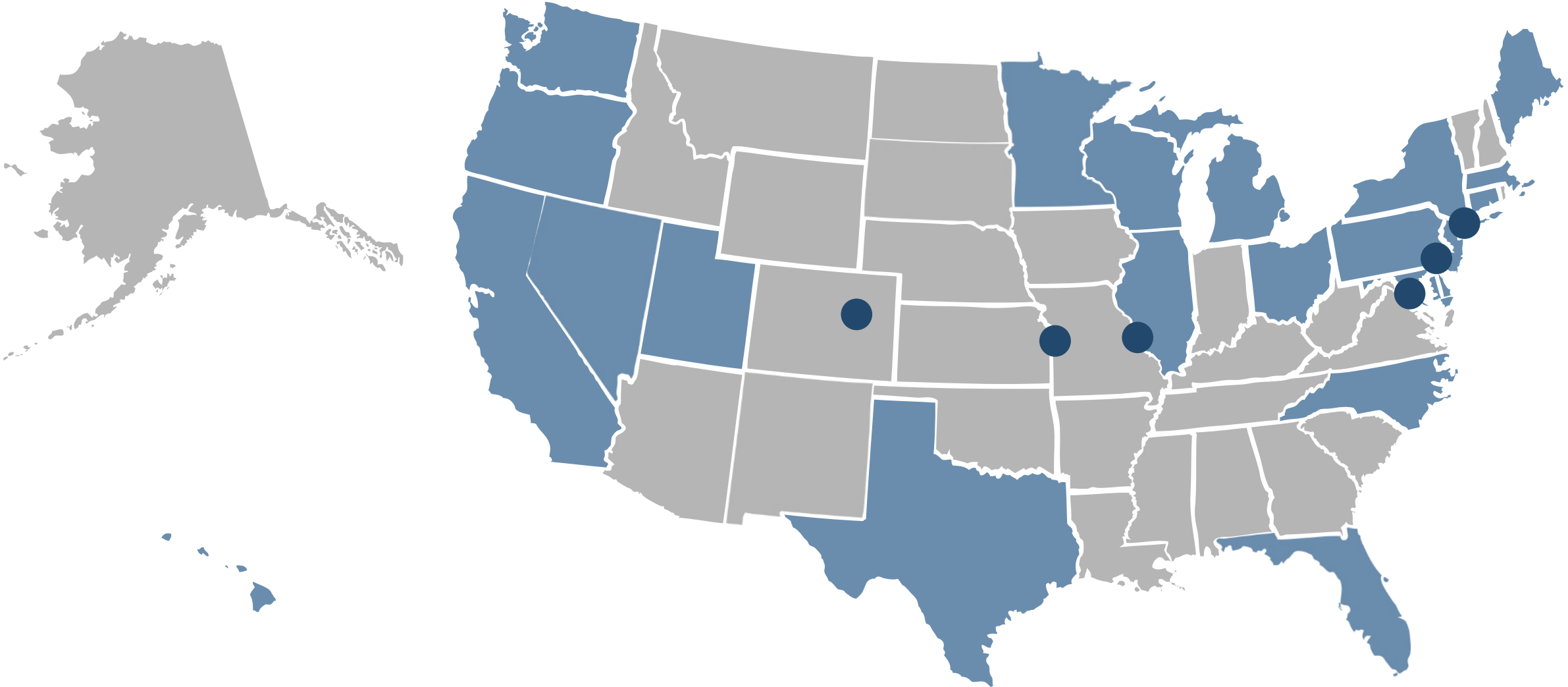
Improved comfort from increased air-flow/movement, addressing previously unmet cooling needs (through heat pumps), and noise reduction.

6

Safety

Reduced risks associated with aging gas infrastructure leaks; induction cooktops reduce instances of fire and burns.

Codes Developing through 2023



Questions?

Kim Cheslak

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nbi new buildings
institute

www.newbuildings.org

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