CleanEnergyGroup

A Climate Resilient Energy Code for Multifamily Affordable Housing

April 29, 2025

www.cleanegroup.org

Webinar Logistics

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Submit questions and comments via the Q&A panel 

Automated **captions** are available 

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This webinar is being recorded. We will email you a webinar recording within 48 hours. This webinar will be posted on CEG’s website at **www.cleanegroup.org/webinars**

Clean Energy Group

Affordable, reliable, clean energy for all.

Climate Resilience and Community Health

Distributed Energy Access and Equity

Energy Storage and Flexible Demand

Fossil Fuel Replacement

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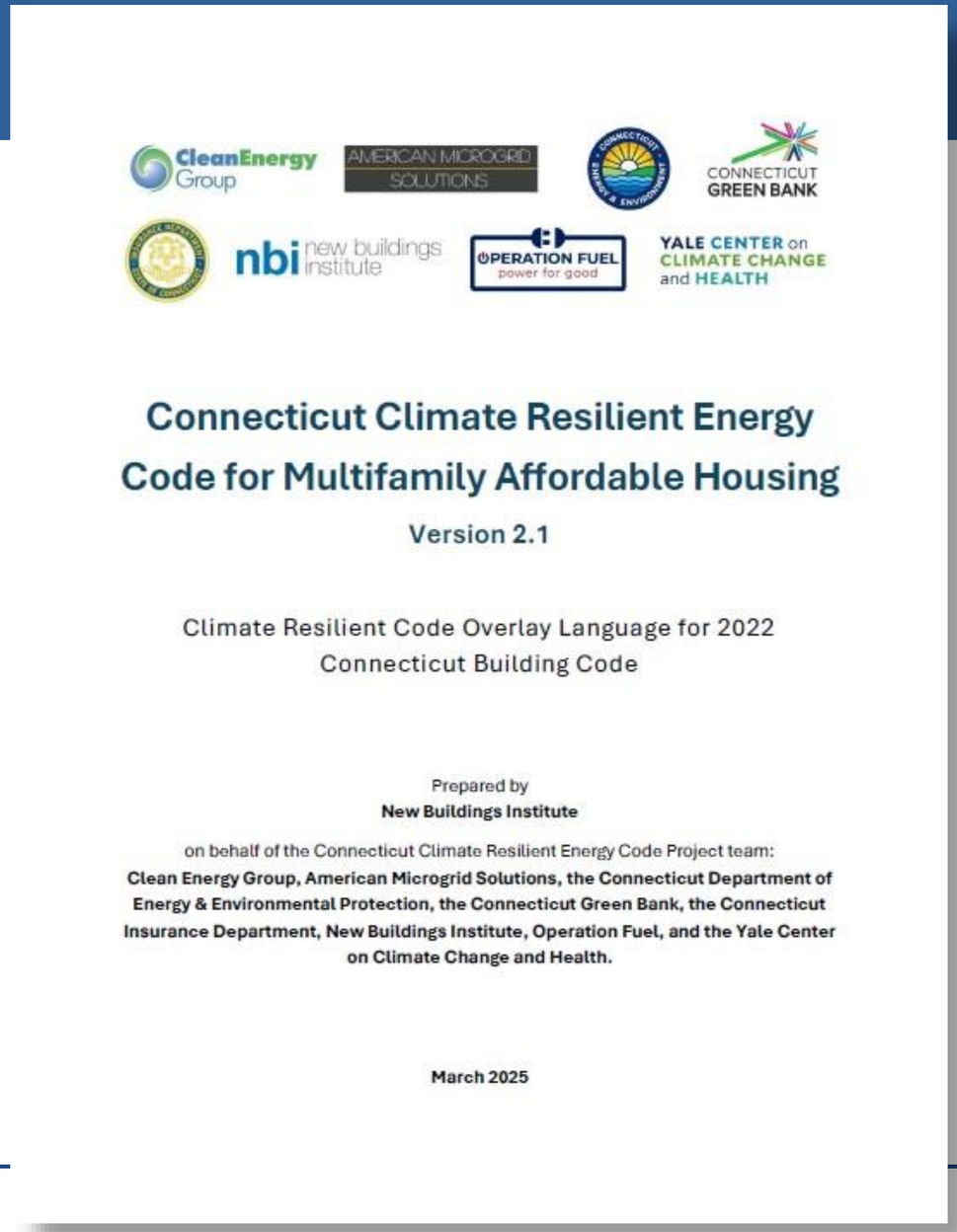
March 2025

Draft Connecticut Climate Resilient Energy Code

Available at:

www.cleanegroup.org/publication/draft-ct-climate-resilient-energy-code



Associate Director of Codes and Policy

Webinar Speakers

A Climate Resilient Energy Code for Multifamily Affordable Housing

Seth Mullendore

President and Executive Director
Clean Energy Group

Tristan Grant

Associate Director of Codes and Policy
New Buildings Institute

CleanEnergyGroup

nbi new buildings institute

Thank You

Seth Mullendore
President and Executive Director
Clean Energy Group
Seth@cleanegroup.org

Upcoming Webinars

Solar+Storage Financing Options for Nonprofits (5/7)

Impact of Direct Pay: How a Washington Church Installed Resilient Solar+Storage (5/20)

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A Climate Resilient Energy Code for Multifamily Affordable Housing

April 29, 2025

What's a climate resilient energy code?

Designed to enhance a building's ability to continue providing heating, cooling, fresh air, access to water, plugs for essential devices (medical devices, phone charging, refrigeration) and comfortable conditions (temperature, humidity, etc.) in order to help occupants more safely shelter in place during severe weather events or power outages.

Improved Comfort

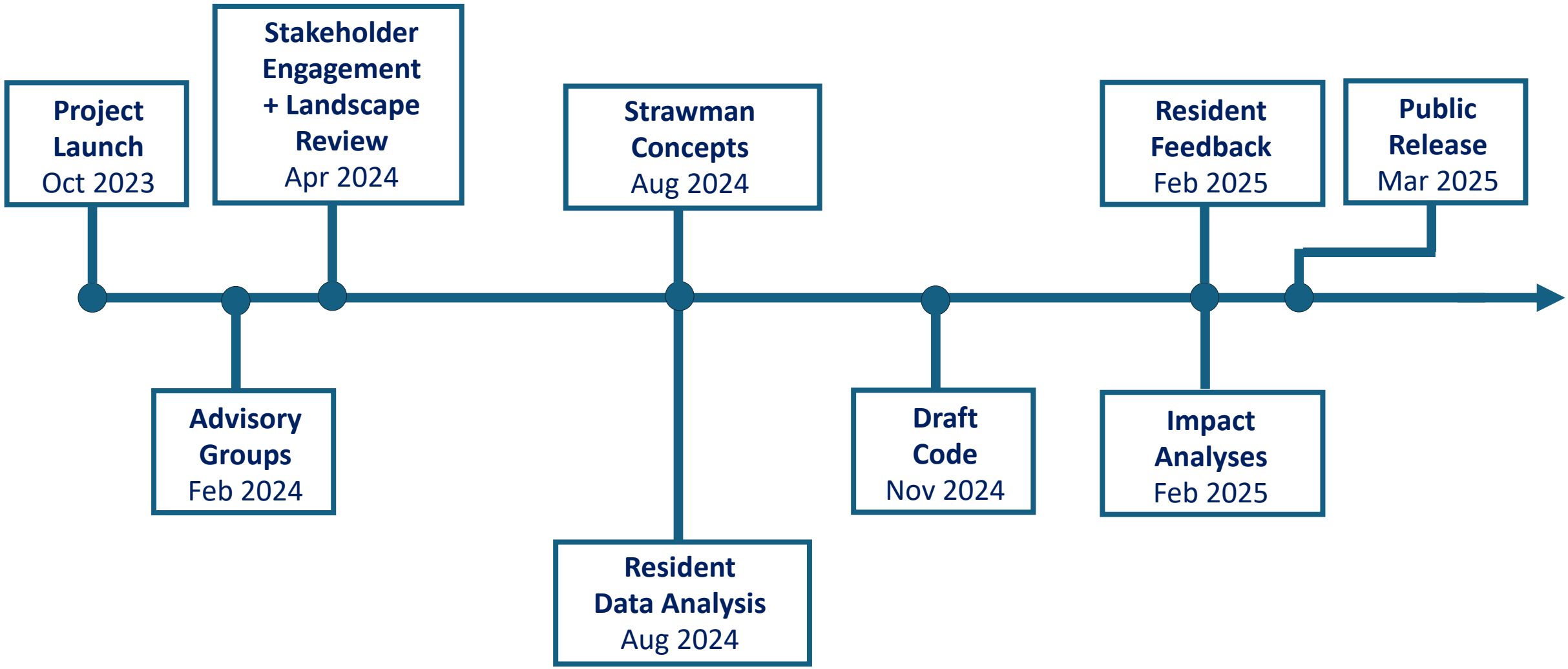
Increased Safety

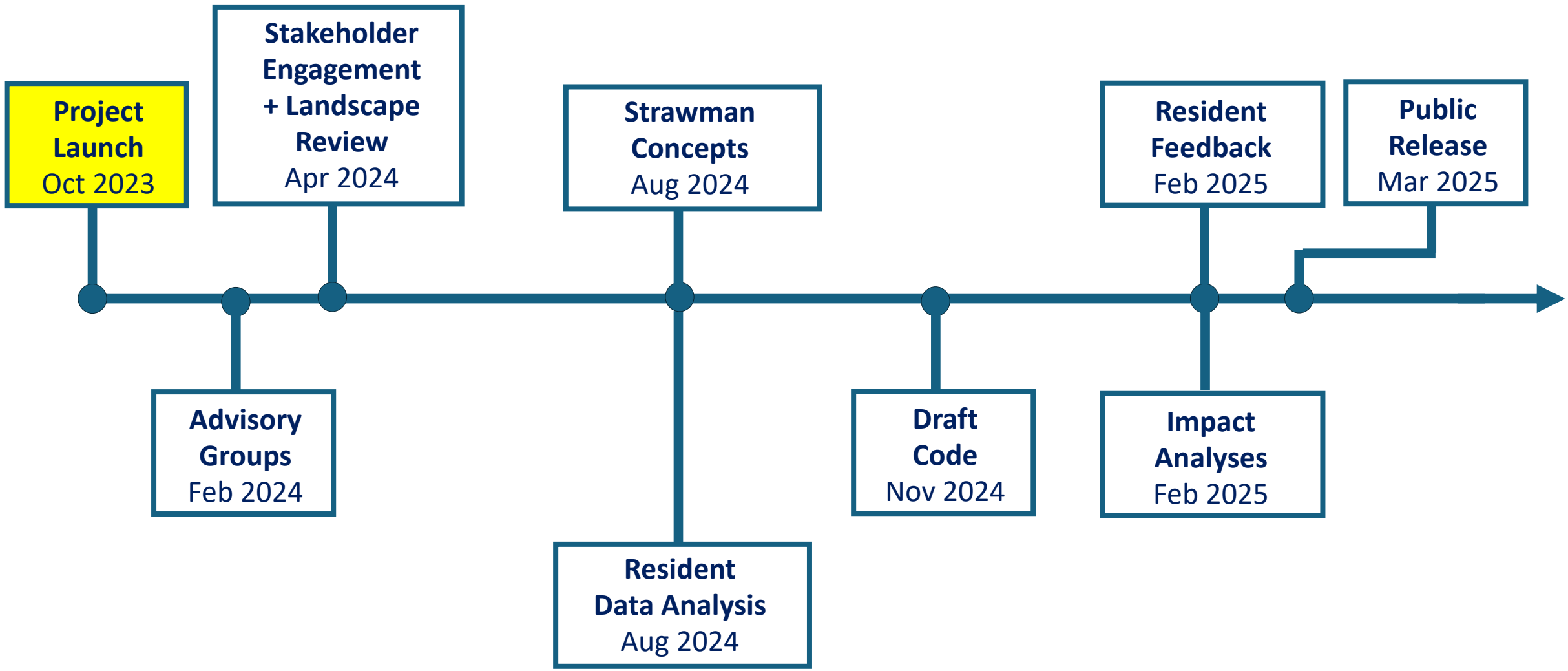
Reduced Costs

Peace of Mind

Climate Resilient Energy Codes for Multifamily Affordable Housing

This work is supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Building Technologies Office Award Number DE-EE0010940.


Project Launch
Oct 2023
Stakeholder Engagement + Landscape Review
Apr 2024
Strawman Concepts
Aug 2024
Resident Feedback
Feb 2025
Public Release
Mar 2025
Advisory Groups
Feb 2024
Resident Data Analysis
Aug 2024
Draft Code
Nov 2024
Impact Analyses
Feb 2025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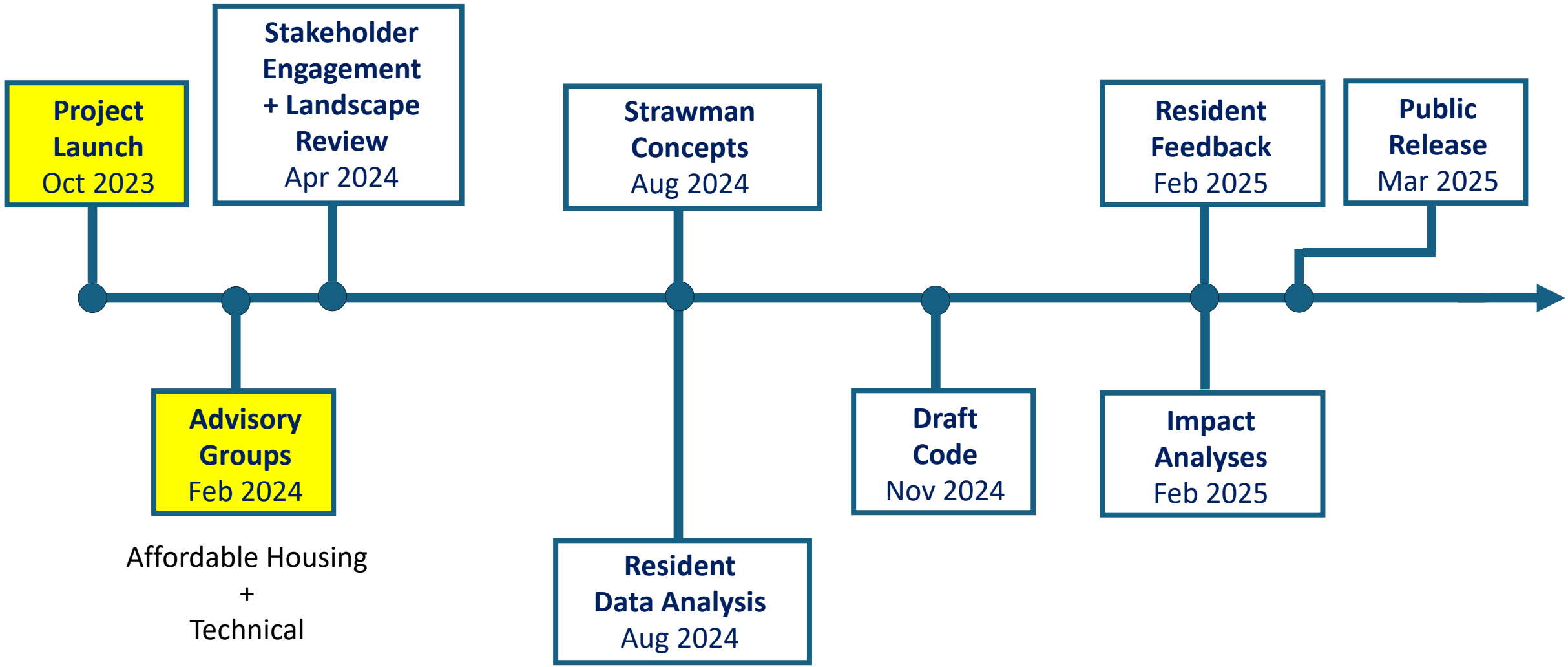
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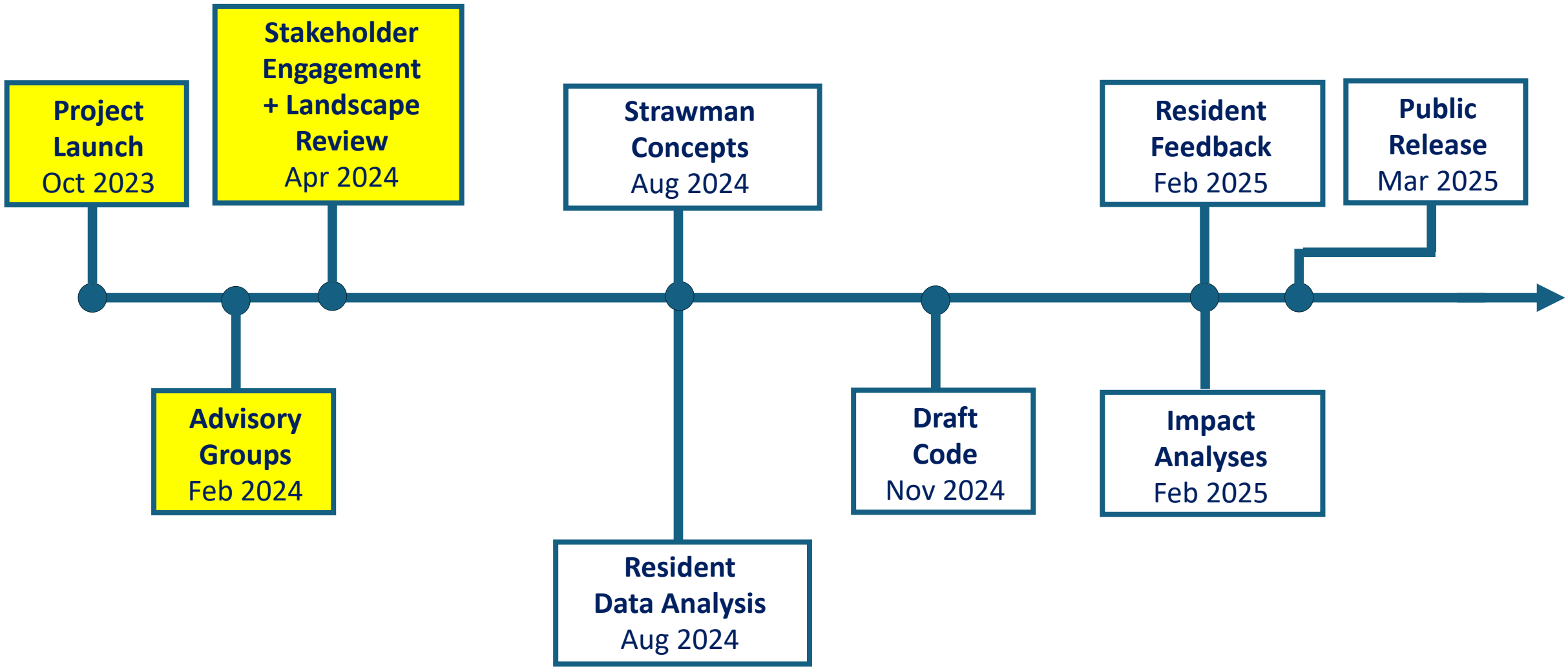
28 stakeholders + review of existing codes and regulations



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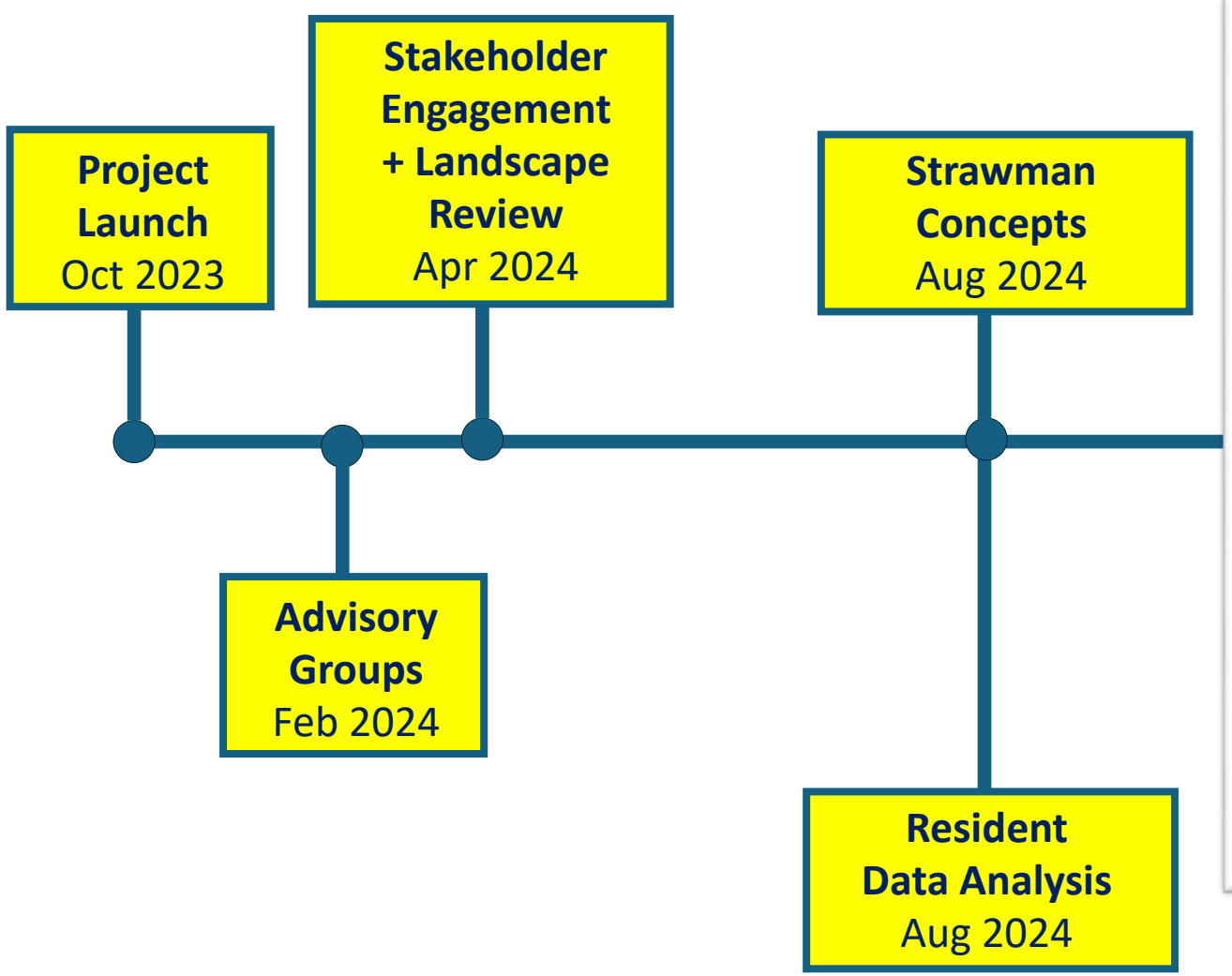

The table below provides a high-level summary of all proposed code concepts, presented in the order of appearing in the CRE code. Each measure includes proposed code language and a reason statement, highlighting its purpose and impact.

Measure	Description
1. Building Envelope and Passive Strategies	
This section includes measures to enhance the building envelope and utilize passive design strategies for improved energy efficiency. Provisions cover advanced air sealing, insulation, high-performance glazing, cool roofs, and surfaces to reduce heating and cooling demands. Requirements for window shading and setting a percentage area for shaded or high-solar reflectance surfaces help mitigate solar heat gain. These measures ensure compliance with the latest standards, promoting buildings with superior thermal performance and lower energy consumption.	
Advanced Air Sealing	This proposal will be aimed at minimizing uncontrolled air leakage through the building envelope to enhance thermal performance, reduce peak load, and reduce energy consumption.
Advanced Insulation and Glazing Requirements	This proposal will require high-performance insulation and glazing to improve thermal resistance and reduce heat transfer, contributing to lower heating and cooling load and demand.
Cool Roofs and Surfaces	This proposal will require the installation of roof and surface materials designed to reflect more sunlight and absorb less heat, helping to reduce cooling loads, improve building energy efficiency, and reduce urban heat island impacts

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Oct 2023

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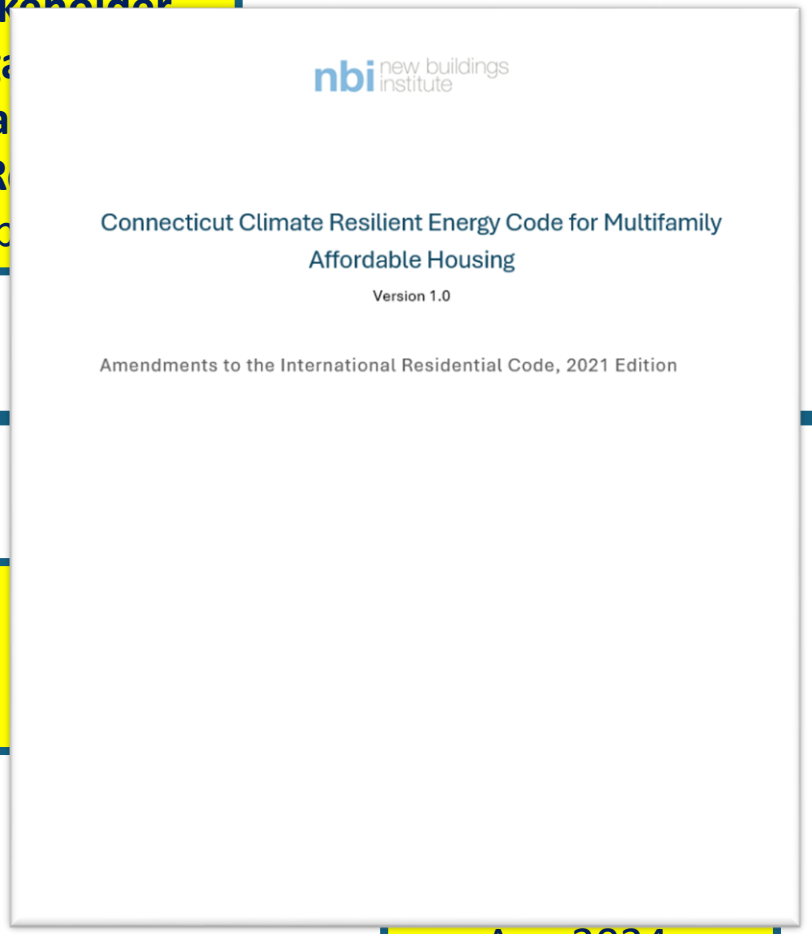

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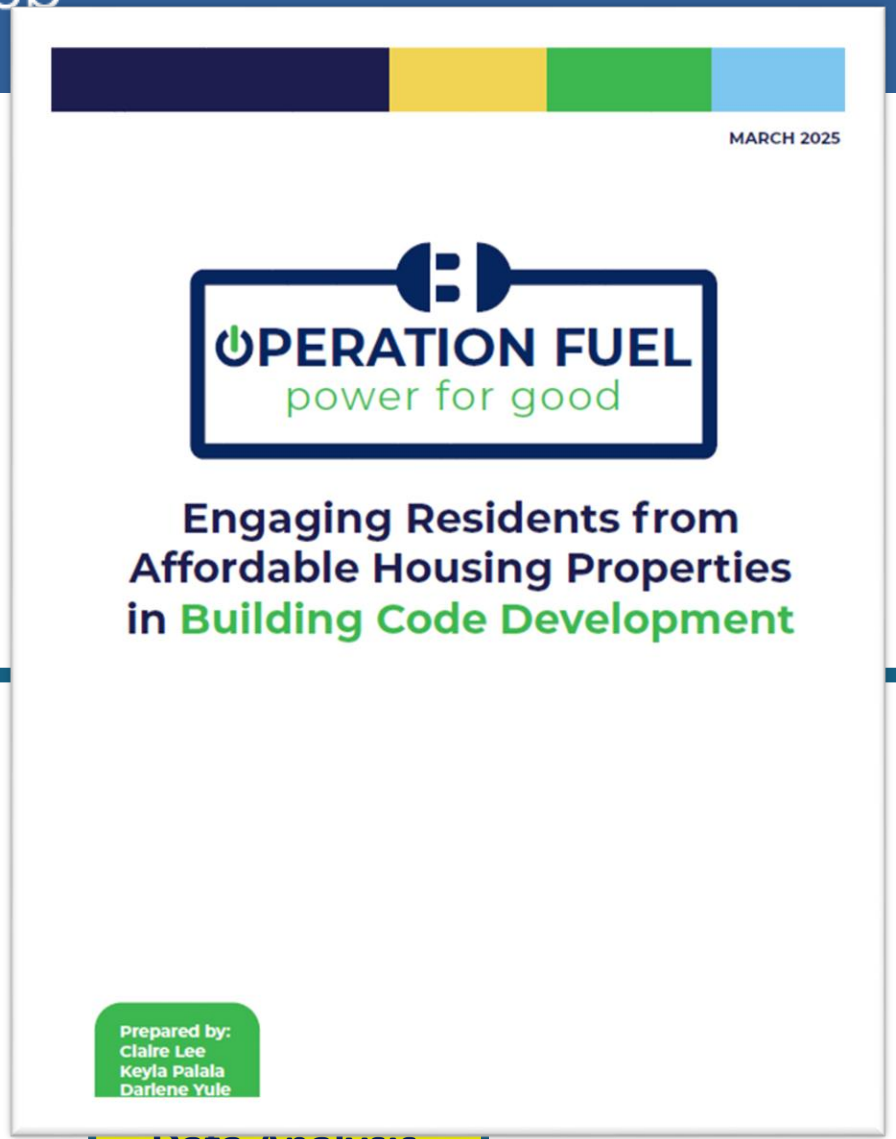

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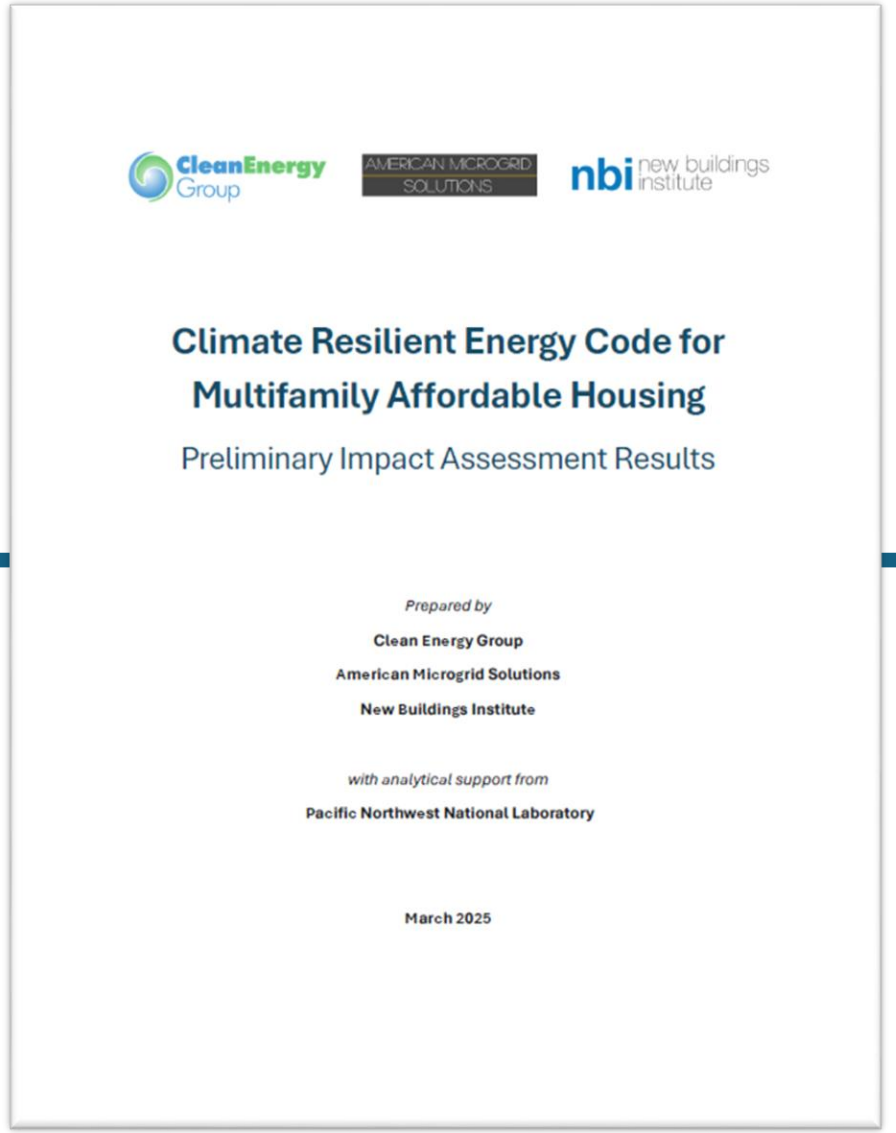

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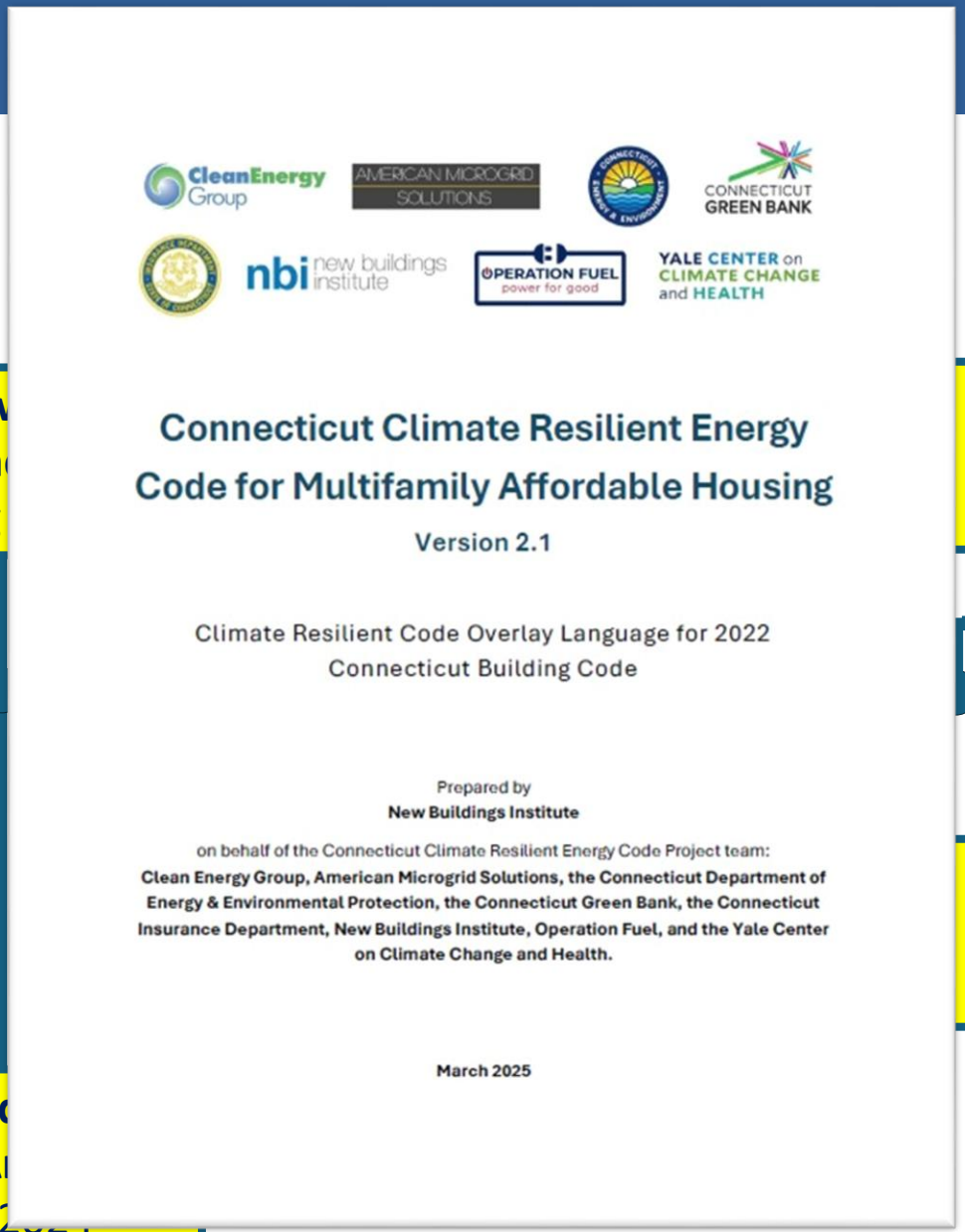

CleanEnergy Group | AMERICAN MICROGRID SOLUTIONS | CONNECTICUT GREEN BANK

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Connecticut Climate Resilient Energy Code for Multifamily Affordable Housing

Version 2.1

Climate Resilient Code Overlay Language for 2022 Connecticut Building Code

Prepared by
New Buildings Institute

on behalf of the Connecticut Climate Resilient Energy Code Project team:
Clean Energy Group, American Microgrid Solutions, the Connecticut Department of Energy & Environmental Protection, the Connecticut Green Bank, the Connecticut Insurance Department, New Buildings Institute, Operation Fuel, and the Yale Center on Climate Change and Health.

March 2025

Preliminary Impact Assessment Results

Analyzed impacts for representative 30-unit, mid-rise apartment building in Connecticut.

Climate Resilience

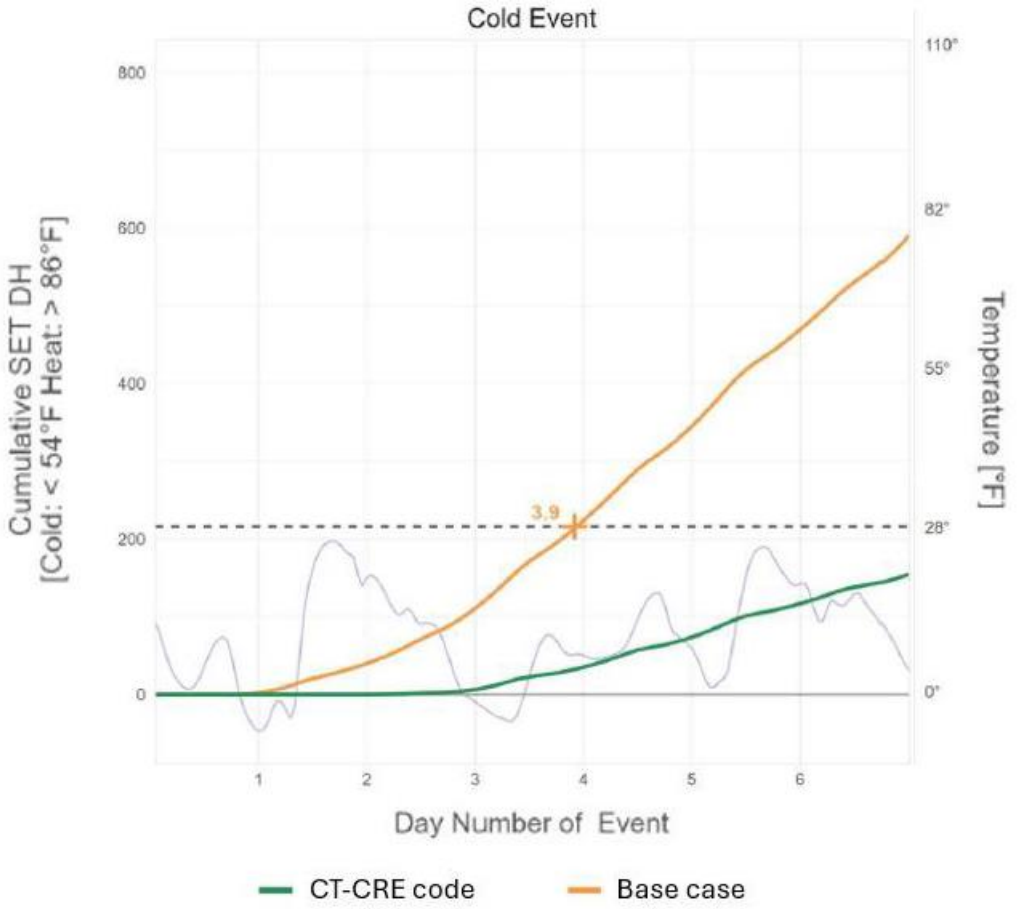
- 46-kW solar, 60-kW / 246-kWh battery system
- Backup power: 26 hours (min), 59 hours (typical)
- Improved ability to maintain habitable temperatures during extreme cold events

Energy Use

- ~9% reduction in grid electricity consumption

Cost

- Master metered: 5.9% IRR, -$900 NPV
- Individually metered: -6.8% IRR, -$123,400 NPV



Resident Listening Sessions

Multifamily Affordable Housing Locations	Participants per Location
Cheshire	12
Hartford	10
Manchester	11
New Britain	5
New Haven	27
Windsor	15

"Everything that we're discussing here, in structure and envelope, is the product of my buildig right now. It's under city investigation ... everything we're talking about here is what I'm going through in that building."

- New Britain Participant

"You're [going to] have a hard time with the population here because so many people can't even use a cellphone."

- New Haven Participant

"Changes will not be implemented in affordable housing because then it will no longer be affordable."

- Hartford Participant

"A lot of us can't even go down one flight ... most of us have disabilities of one kind or another."

- New Haven Participant

Next Steps

- Collection public comments through June 27 - *comments@cleanegroup.org*
- Conduct second round of resident listening sessions
- Revise and finalize code language
- Conduct updated impact analyses
- Dissemination and engagement with states, municipalities, and affordable housing providers

Project Goal

At least 3 housing providers commit to adopt and implement the code at one or more of their properties.

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Connecticut Climate Resilient Energy Code

Intent of the Code

- **Climate resilient energy** systems
  - Renewable **emergency energy** systems
  - **Power essential services** for multifamily affordable housing residents during **grid outages**
- Allow vulnerable residents to safely **shelter in place**
- Improve **health** and **safety** outcomes.
- Increase **energy affordability**

JBDG Corporate Office | Seattle, WA
Credit: Johnson Braund Design Group, Inc.

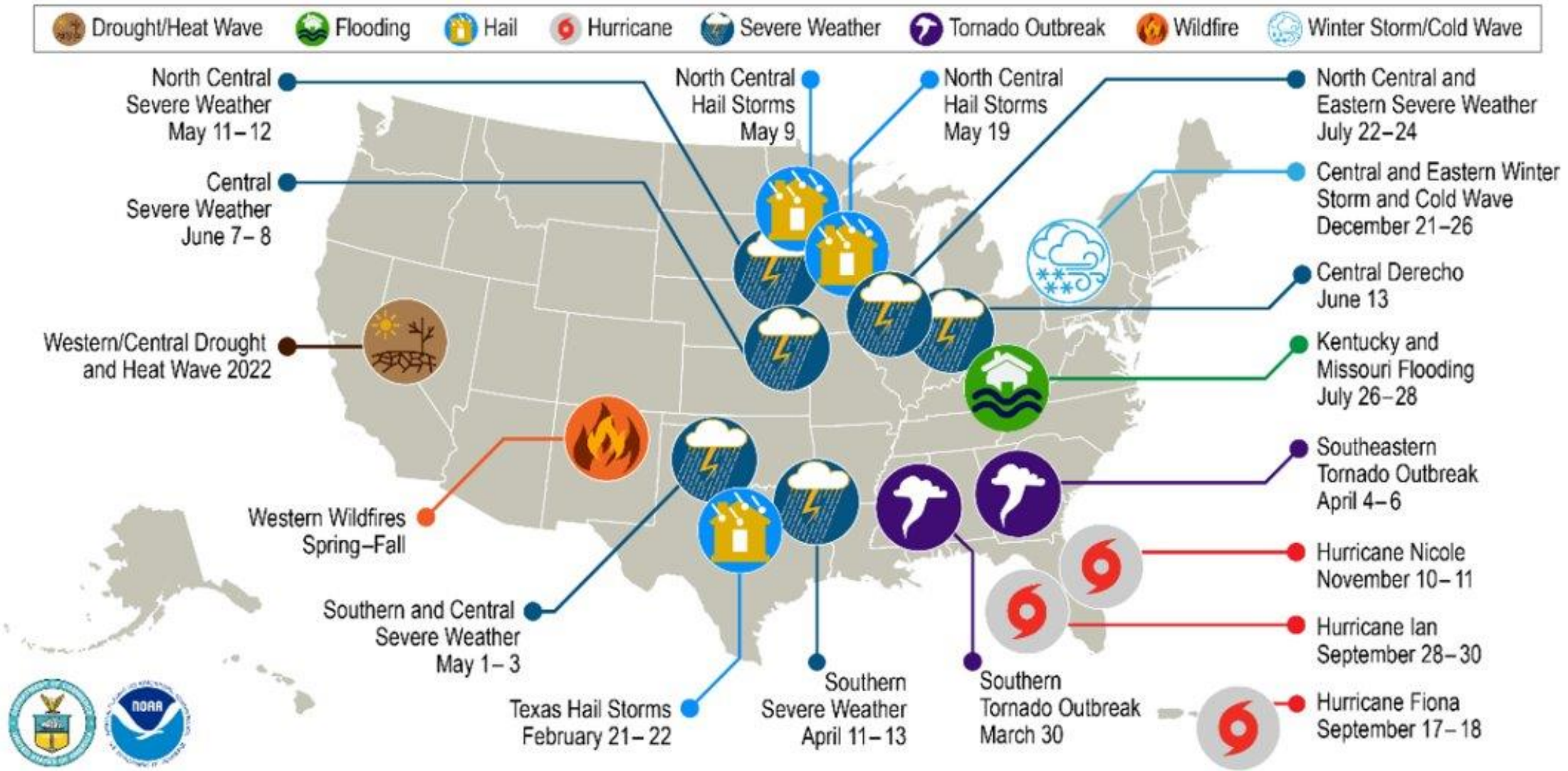
"Resilience"

- "The **capacity** to **withstand** or to **recover quickly** from difficulties; toughness:"

IBC Purpose (101.3)

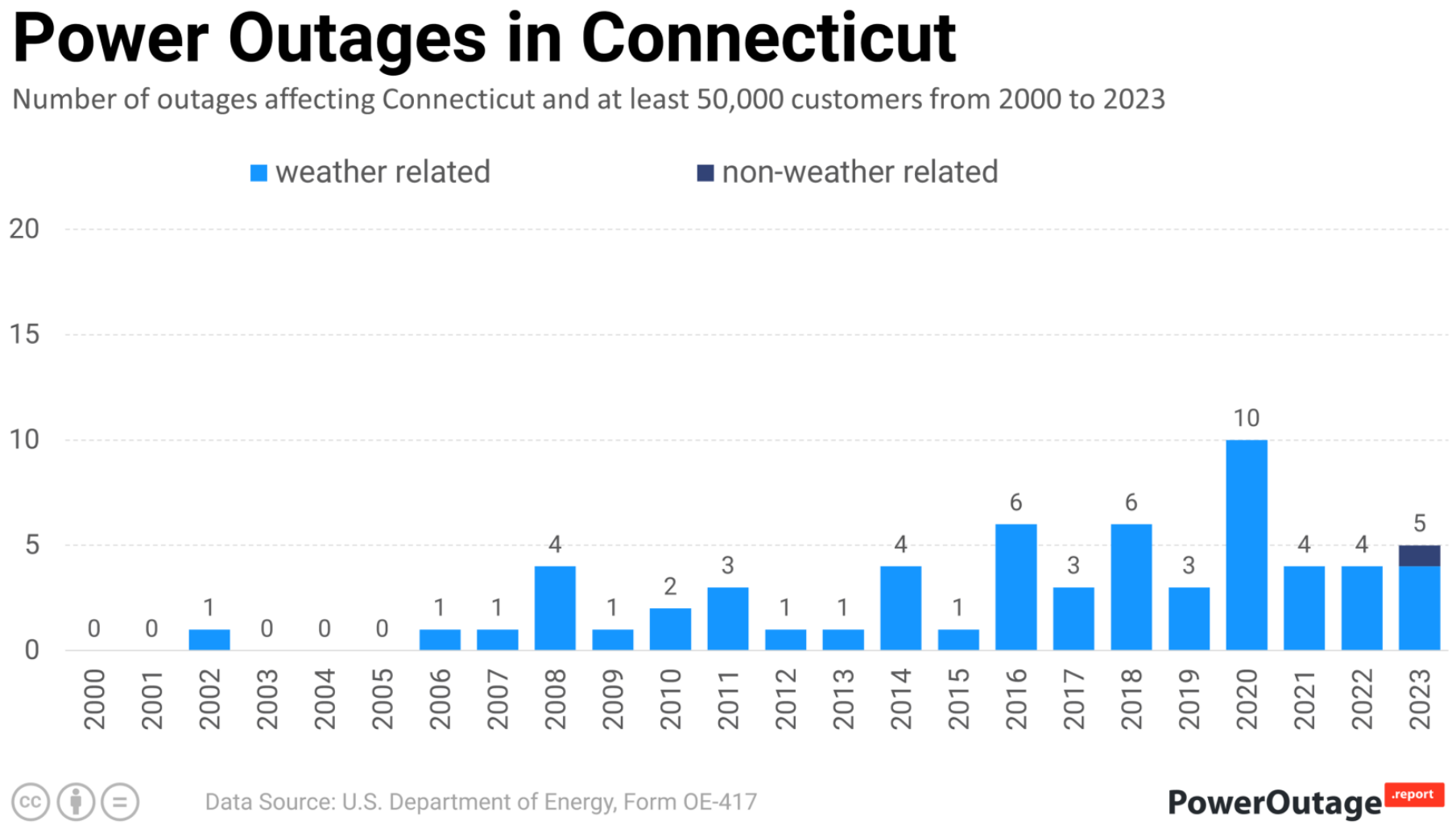
“The purpose of this code is to establish the minimum requirements to provide a reasonable level of safety, health, and general welfare through structural strength, means of egress, stability, sanitation, light and ventilation, energy conservation, and for providing a reasonable level of life safety and property protection from hazards of fire, explosion or dangerous conditions, and to provide a reasonable level of safety to fire fighters and emergency responders during emergency operations.”

U.S. 2022 Billion-Dollar Weather and Climate Disasters



This map denotes the approximate location for each of the ***18 separate billion-dollar weather and climate disasters that impacted the United States in 2022.***

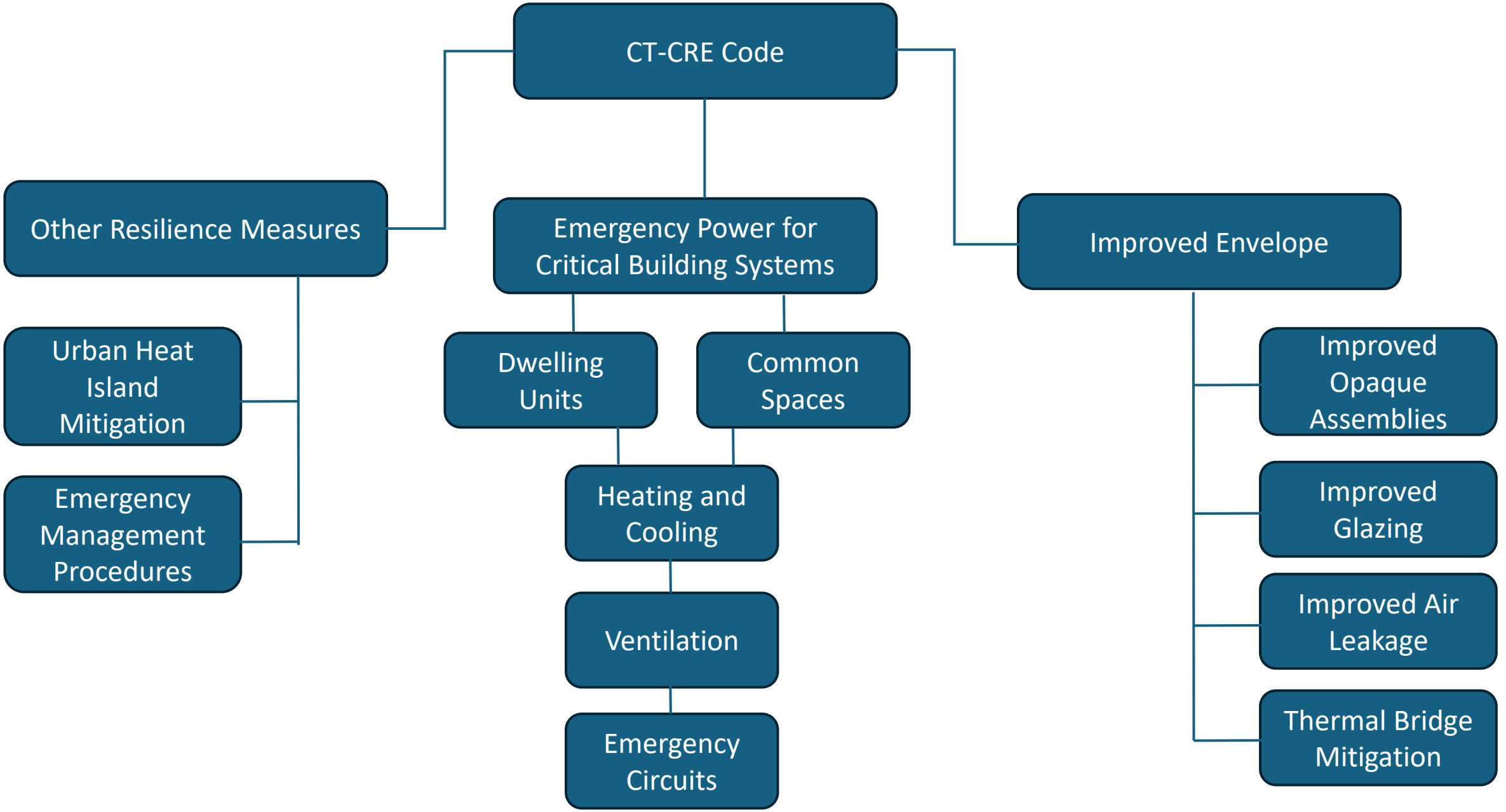
Grid Disruption



https://poweroutage.report/connecticut

Code Framework

- **Overlay** guide / resources
- **Residential**
  - Single Family through 3-story Multifamily
  - International Residential Code, Building Code, and IECC-R
- **Commercial**
  - 4+ story multifamily
  - International Building Code, IECC, and ASHRAE 90.1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Urban Heat Island Mitigation
Emergency Management Procedures
Emergency Power for Critical Building Systems
Dwelling Units
Common Spaces
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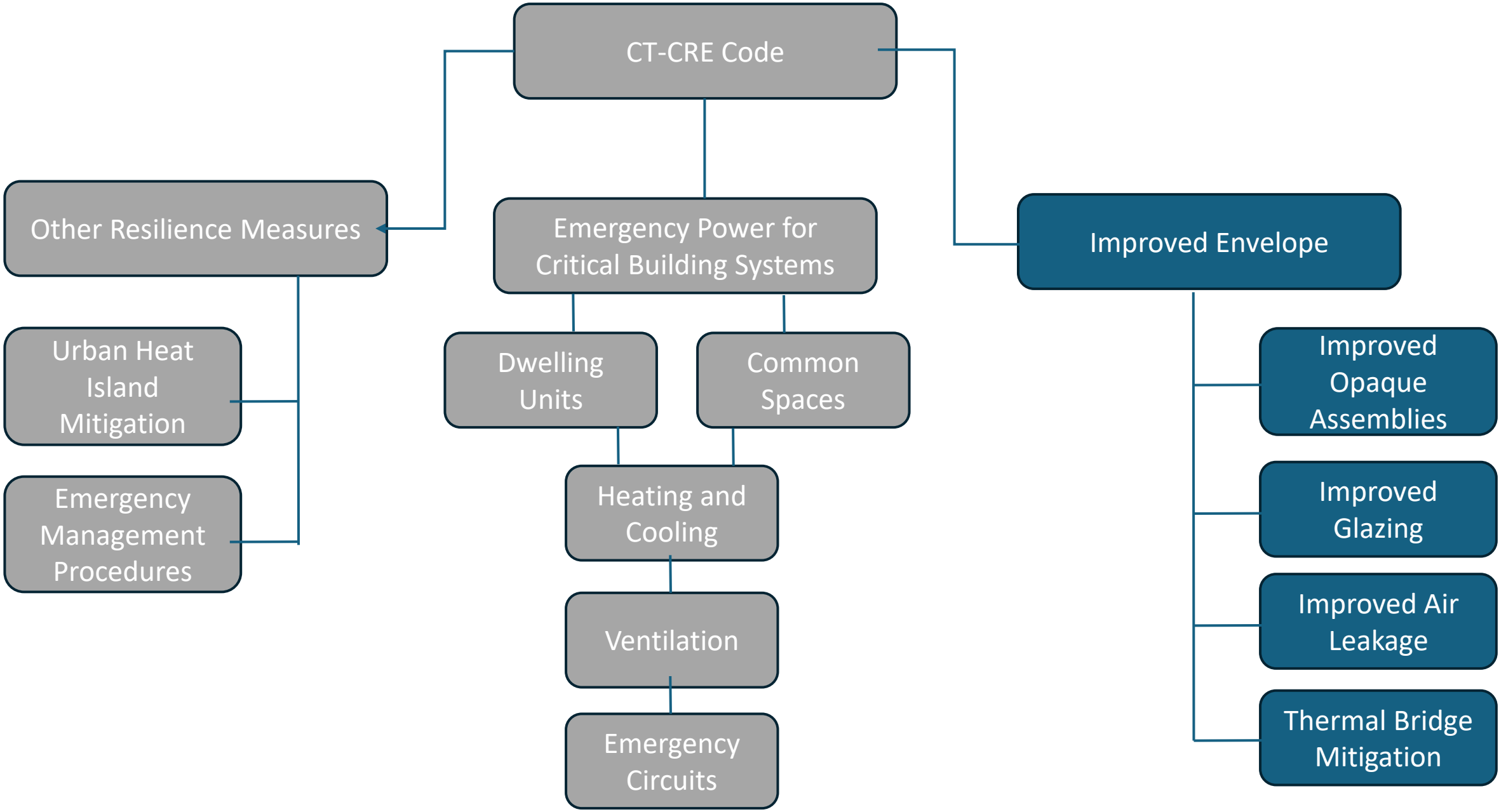
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Enhanced Envelope Measures

- Passive House **high performance envelope** design as reference
- **Passive survivability** benefits
- Case studies show **1% - 4.3% incremental cost** premium
  - Passive House Cost Data (1).pdf

Summary of Incremental Cost of Multifamily Buildings Built to the Phius Standard

Project	Number of Units	Incremental Cost
Old Colony Phase 3C	55	2.8%
North Commons	53	4.3%
Depot Village / Hanson Village	48	4.1%
Finch Cambridge	98	1.4%
Harbor Village	30	1.8%
Mattapan Station	135	2.0%
Bartlett Station / Kinzie	52	1.0%

The David and Lucile Packard Foundation Headquarters | Los Altos, CA *Photo: Jeremy Bittermann*

Table 2. Winter resilience case results –interior temperature.

										% of Hours in Simulation Above Threshold Temperature									
						°F	°C	°F	°C	> 18°C	> 16°C	> 13°C	>10°C	> 7°C	> 4°C	> 2°C	> -1°C	> -4°C	> -7°C	> -9°C	> -12°C
Case	Season	Const. Type	Orientation	Standard	WWR %	Avg. Temp.	Avg. Temp.	Min. Temp.	Min. Temp.	>65°F	>60°F	>55°F	>50°F	>45°F	> 40°F	> 35°F	> 30°F	>25°F	>20°F	>15°F	>10°F
1	Winter	Wood framed	SW	PHIUS	20	**43.8**	**6.6**	**29.2**	**-1.6**	3%	14%	21%	32%	42%	53%	68%	97%	100%	100%	100%	100%
2					60	**50.9**	**10.5**	**33.5**	**0.8**	13%	27%	41%	47%	61%	78%	97%	100%	100%	100%	100%	100%
3				ASHRAE	20	**32.0**	**0.0**	**18.1**	**-7.7**	0%	3%	7%	15%	19%	23%	36%	42%	54%	91%	100%	100%
4					60	**28.5**	**-2.0**	**14.4**	**-9.8**	0%	1%	6%	12%	17%	20%	27%	38%	41%	61%	98%	100%
5			NE	PHIUS	20	**40.4**	**4.7**	**27.1**	**-2.7**	3%	8%	16%	22%	33%	42%	55%	81%	100%	100%	100%	100%
6					60	**35.5**	**2.0**	**22.9**	**-5.1**	3%	5%	13%	18%	22%	33%	39%	47%	83%	100%	100%	100%
7				ASHRAE	20	**30.3**	**-0.9**	**17.7**	**-8.0**	2%	5%	8%	13%	18%	22%	28%	38%	45%	79%	100%	100%
8					60	**21.8**	**-5.7**	**10.3**	**-12.0**	2%	3%	4%	6%	8%	13%	16%	18%	22%	36%	60%	100%
9		Concrete/ICF	SW	PHIUS	20	**57.6**	**14.2**	**49.2**	**9.5**	12%	37%	62%	95%	100%	100%	100%	100%	100%	100%	100%	100%
10					60	**57.3**	**14.0**	**46.8**	**8.2**	11%	39%	59%	83%	100%	100%	100%	100%	100%	100%	100%	100%
11				ASHRAE	20	**49.2**	**9.6**	**36.8**	**2.7**	3%	16%	27%	42%	61%	84%	100%	100%	100%	100%	100%	100%
12					60	**42.9**	**6.1**	**27.5**	**-2.5**	2%	10%	18%	29%	39%	48%	68%	93%	100%	100%	100%	100%
13			NE	PHIUS	20	**56.3**	**13.5**	**47.9**	**8.8**	7%	28%	53%	85%	100%	100%	100%	100%	100%	100%	100%	100%
14					60	**53.2**	**11.8**	**43.1**	**6.2**	3%	19%	38%	60%	93%	100%	100%	100%	100%	100%	100%	100%
15				ASHRAE	20	**48.1**	**8.9**	**35.7**	**2.1**	3%	13%	23%	38%	55%	79%	100%	100%	100%	100%	100%	100%
16					60	**39.7**	**4.3**	**25.4**	**-3.7**	2%	6%	14%	20%	33%	40%	56%	78%	100%	100%	100%	100%

From: White, Lisa. Wright, Graham. 2020. Building Performance Analysis Conference. "ASSESSING RESILIENCY AND PASSIVE SURVIVABILITY IN MULTIFAMILY BUILDINGS "

Climate Resilient Energy (CRE) Code
Thermal resilience metric analysis

Standard Effective Temperature (SET)

- SET is an effective indoor temperature metric that accounts for indoor dry-bulb temperature, relative humidity, mean surface radiant temperature, and air velocity, as well as the activity rate and clothing levels of occupants.

SET Degree Hours

- SET degree hours are the number of degrees above or below a specified indoor comfort threshold summed over a specified period.
- This study uses the comfort thresholds referenced in the LEED pilot credit (IPpc100, USGBC 2022).
  - Comfort threshold: SET degrees < 54°F for extreme cold and SET degrees > 86°F for extreme heat
  - To earn the pilot credit, the cumulative SET degree hours above or below the threshold shall not exceed 216 degrees over a 7-day period.
- This study provides SET degree hours
  - Occurring over 3 days and 7 days
  - Under no power conditions
  - During extreme heat and extreme cold
  - On average based on all apartment units in the building
  - For each apartment unit in the building

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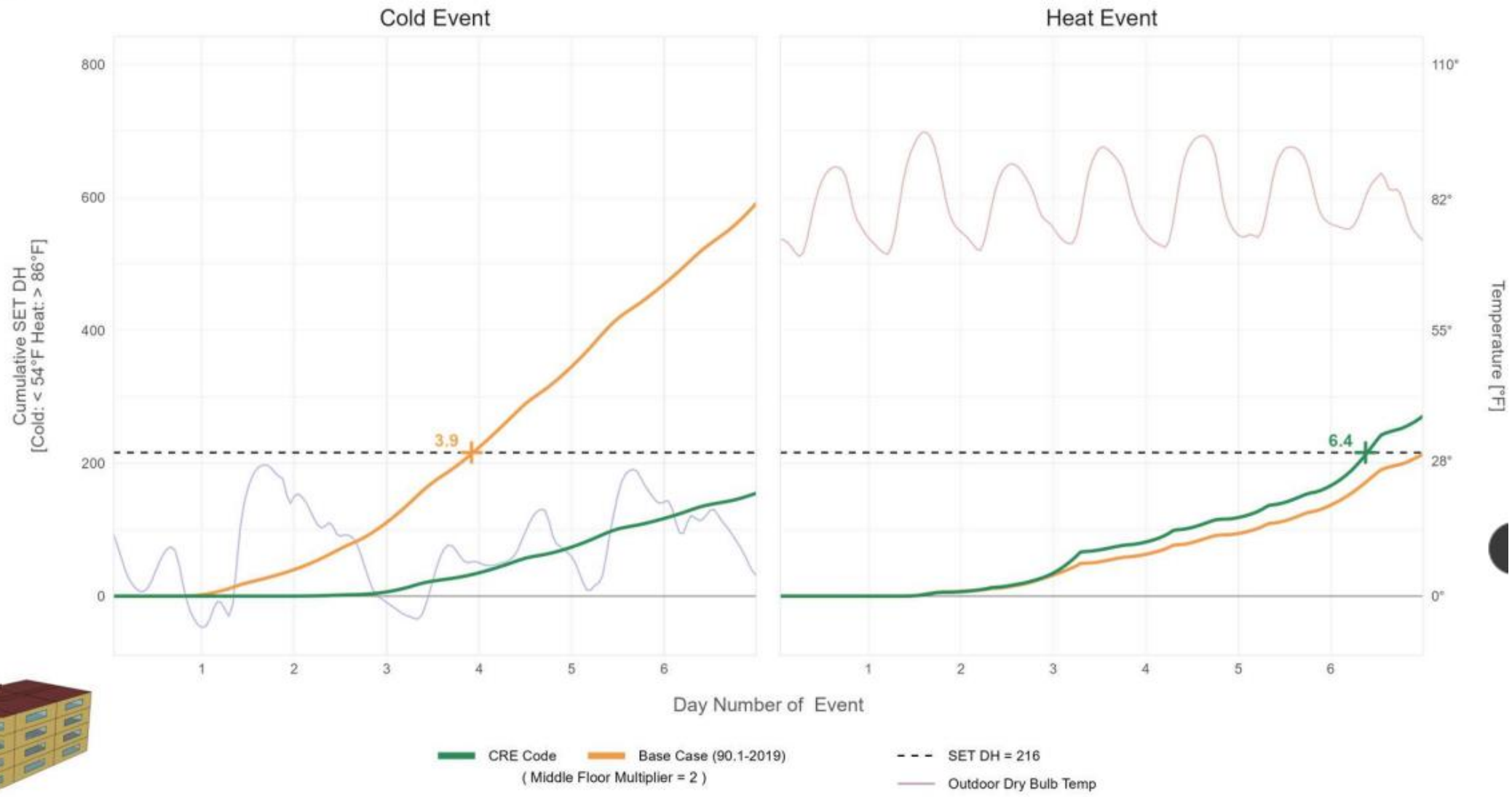
Midrise Apartment
Average 'Occupied' Unit

Brainard



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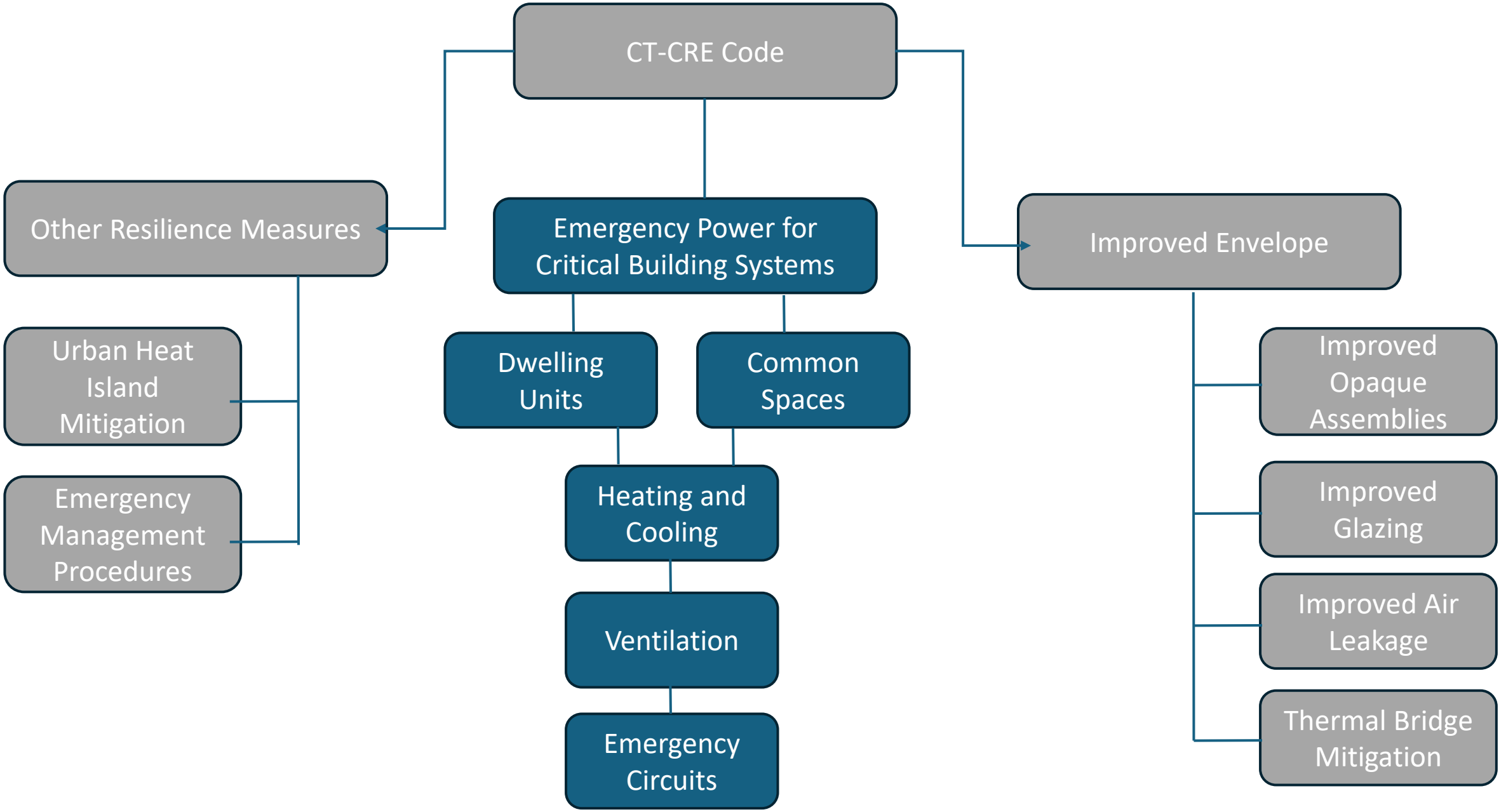
Climate Resilient Energy (CRE) Code Thermal resilience impact summary

Average SET Degree Hours per apartment unit*

			Extreme Cold				Extreme Heat			
			3 days		7 days		3 days		7 days	
Location	Building Type		SET DH	% redux	SET DH	% redux	SET DH	% r edux	SET DH	% redux
Brainard	Midrise	Base	111		592		32		214	
		CRE	6	94%	155	74%	35	-10%	271	-27%
	Highrise	Base	111		778		30		260	
		CRE	51	54%	229	71%	27	11%	269	-4%
	Lowrise	Base	948		2,885		220		752	
		CRE	628	34%	2,214	23%	267	-21%	979	-30%
Bradley	Midrise	Base	131		676		22		121	
		CRE	13	90%	203	70%	22	4%	143	-18%
	Highrise	Base	128		886		21		149	
		CRE	61	52%	282	68%	15	27%	130	13%
	Lowrise	Base	1,109		3,274		215		703	
		CRE	768	31%	2,582	21%	256	-19%	916	-30%

* SET DH values assessed during no power conditions. Values higher than 216 over a 7 day period indicate non-livable conditions unless sufficient backup power is provided.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Emergency Power for Critical Systems

- "Resilient" Building Systems
  - Heating and cooling
    - Ventilation
    - Electrical Circuits
      - Outlets for medical and other devices
      - Power to pumps where needed to deliver potable water
- Dwelling or Common area "**cool/warm room**" approach
  - Minimum SF/occupant

Add new Section as follows

E3408.2.1.1 Distributed Heating and Cooling Systems. Where dedicated heating and cooling systems are provided to individual *dwelling units*, power from *emergency power systems* shall be provided to heating and cooling systems serving not less than 50% of the *habitable space* of each *dwelling unit*.

Add new Section as follows

E3408.2.2 Critical Ventilation Systems. Power from an *emergency power system* shall be provided to ventilation systems serving all *dwelling units* and community rooms and spaces provided with heating and cooling according to E3408.2.1.

Add new Section as follows

E3408.1.5.1 Load duration. Emergency power systems shall be designed to provide the required power for a minimum duration of 24 hours unless specified otherwise in this code.

Add new Section as follows

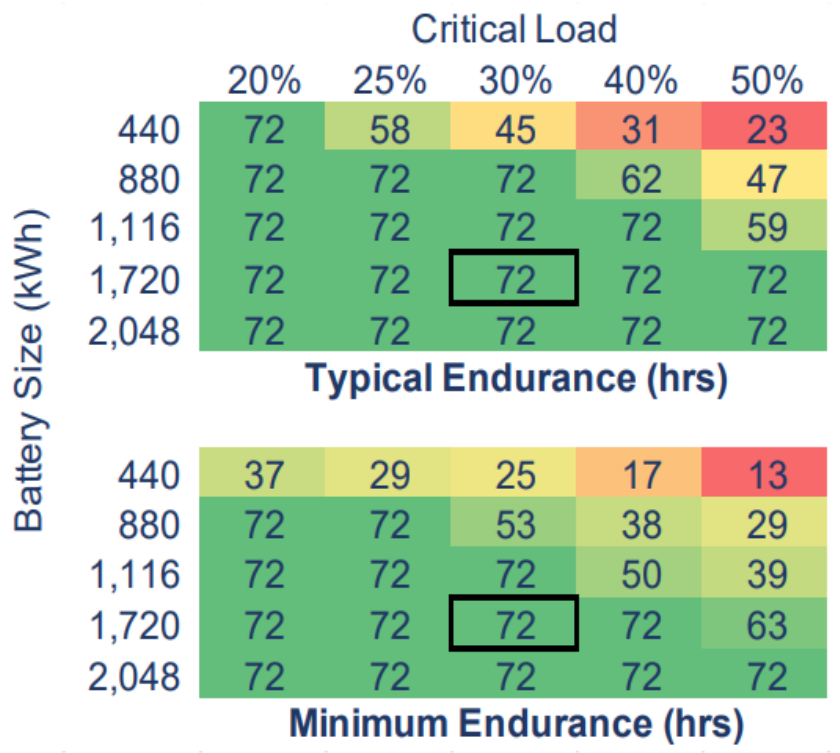
E3408.1.5.2 Critical Heating and cooling sizing. Demand and load sizing for heating and cooling systems served by *emergency power systems* according to E3408.2 and calculated at interior design temperatures of 60°F for heating and 82°F for cooling shall satisfy the *emergency power system* sizing requirements of this section.

Equipment and Controls Requirements

- **Heating and cooling**
  - Smart thermostats
  - Automatic temperature setbacks in grid outage
- **Ventilation**
  - Balanced energy/heat recovery
  - Automatic airflow reduction in grid outage
- **Emergency circuits**
  - Load shedding if additional system capacity and/or loads backed up

Emergency Power Sizing

- Set Minimum Solar + Storage Provisions
- Emergency Power Sizing Criteria
  - Can be calculated using reduced loads based on controls



Critical Load

Battery Size (kWh)	20%	25%	30%	40%	50%
440	72	58	45	31	23
880	72	72	72	62	47
1,116	72	72	72	72	59
1,720	72	72	72	72	72
2,048	72	72	72	72	72

Typical Endurance (hrs)

Battery Size (kWh)	20%	25%	30%	40%	50%
440	37	29	25	17	13
880	72	72	53	38	29
1,116	72	72	72	50	39
1,720	72	72	72	72	63
2,048	72	72	72	72	72

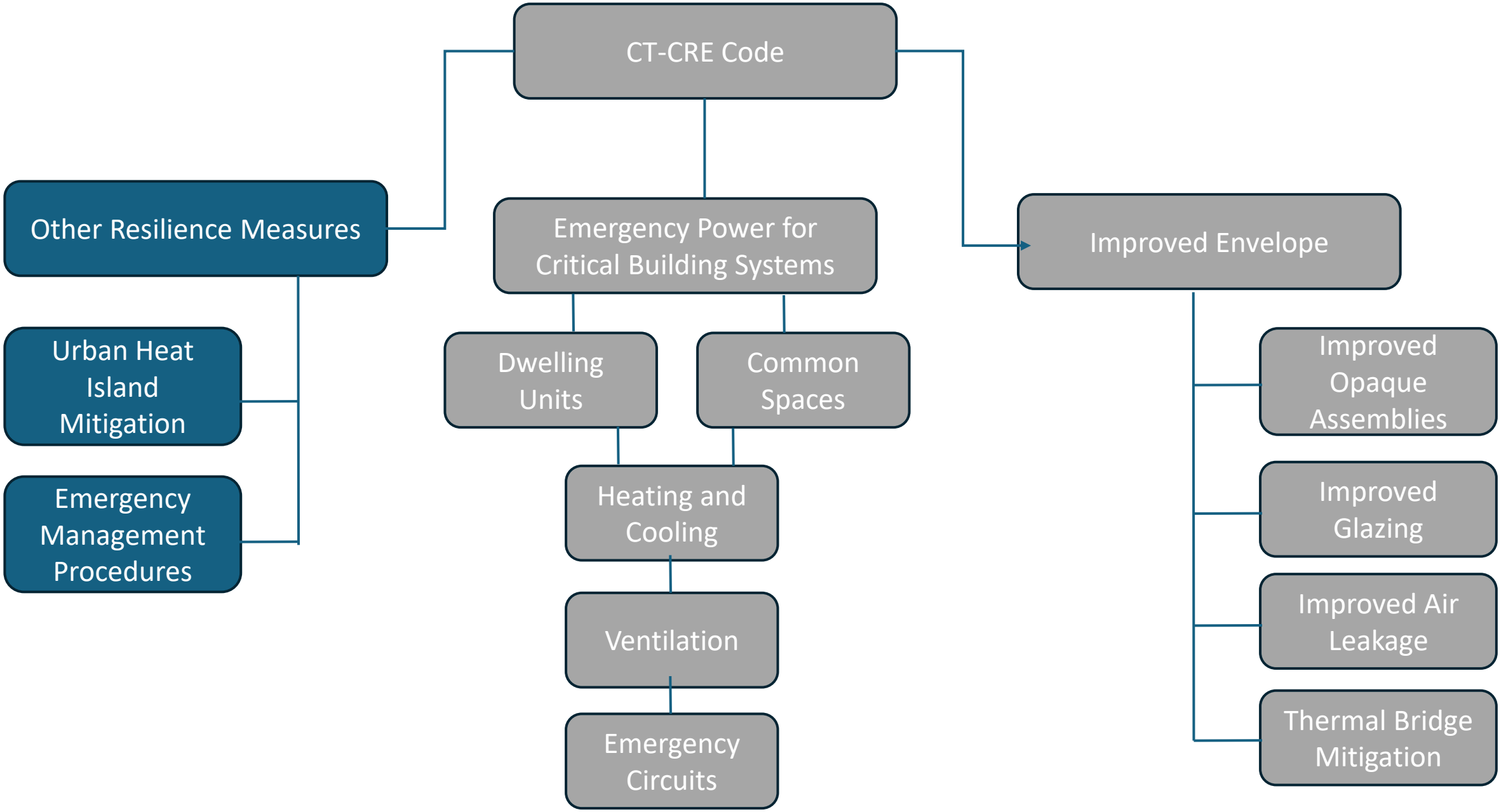
Minimum Endurance (hrs)

C403.13 On-Site renewable energy systems. Building projects shall contain on-site renewable energy systems with a rated capacity of not less than 2 W/ft2 (22 W/m2) multiplied by the horizontal projection of the gross roof area over conditioned spaces and semi-heated spaces. The building gross roof area used for calculation excludes the following:

C405.14.1 Electric energy storage system (ESS) capacity.

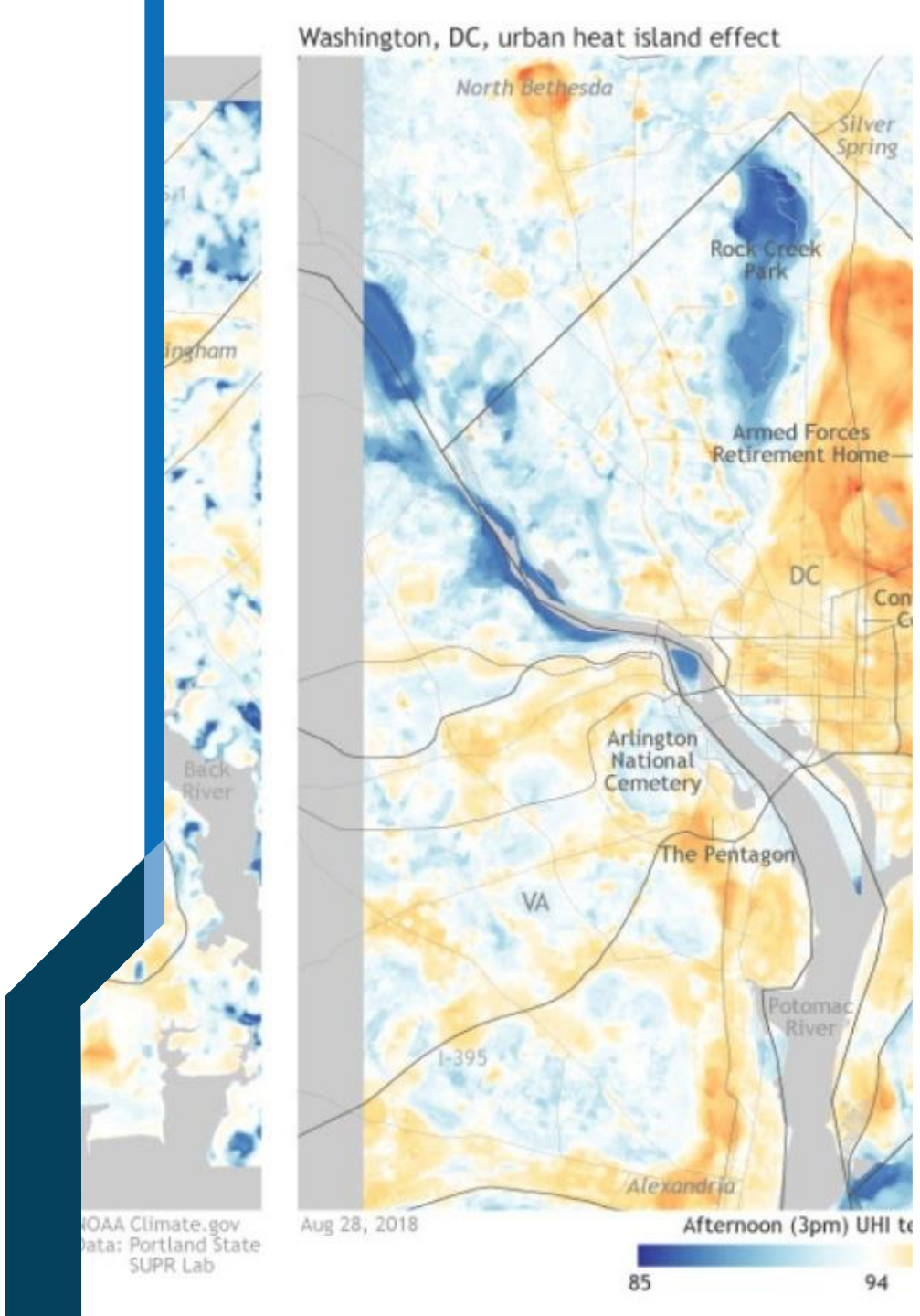
Each building shall have one or more ESS with a total rated energy capacity and rated power capacity as follows:

3. ESS-rate energy capacity (kWh) ≥ 5.0 x required on-site renewable energy system calculated according to C405.13 with no area deductions or exceptions applied.
4. ESS-rated power capacity (kW) ≥ 1.25 x required on-site renewable energy system calculated according to C405.13 with no area deductions or exceptions applied.


CT-CRE Code
Other Resilience Measures
Urban Heat Island Mitigation
Emergency Management Procedures
Emergency Power for Critical Building Systems
Dwelling Units
Common Spaces
Heating and Cooling
Ventilation
Emergency Circuits
Improved Envelope
Improved Opaque Assemblies
Improved Glazing
Improved Air Leakage
Thermal Bridge Mitigation

Urban Heat Island Mitigation

- Leading (and growing) natural hazard cause of **mortality**
- Impact on worker productivity, **health outcomes** and costs
- Impacts on energy use, energy cost, **system performance**



Emergency Operations and Resident Manuals

- Impact of **behavior** on real world performance
- Best practices for **building management** and system operation
- Outline **intent** of design, systems, controls