



nbi new buildings
institute

Connecticut Climate Resilient Energy Code

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.

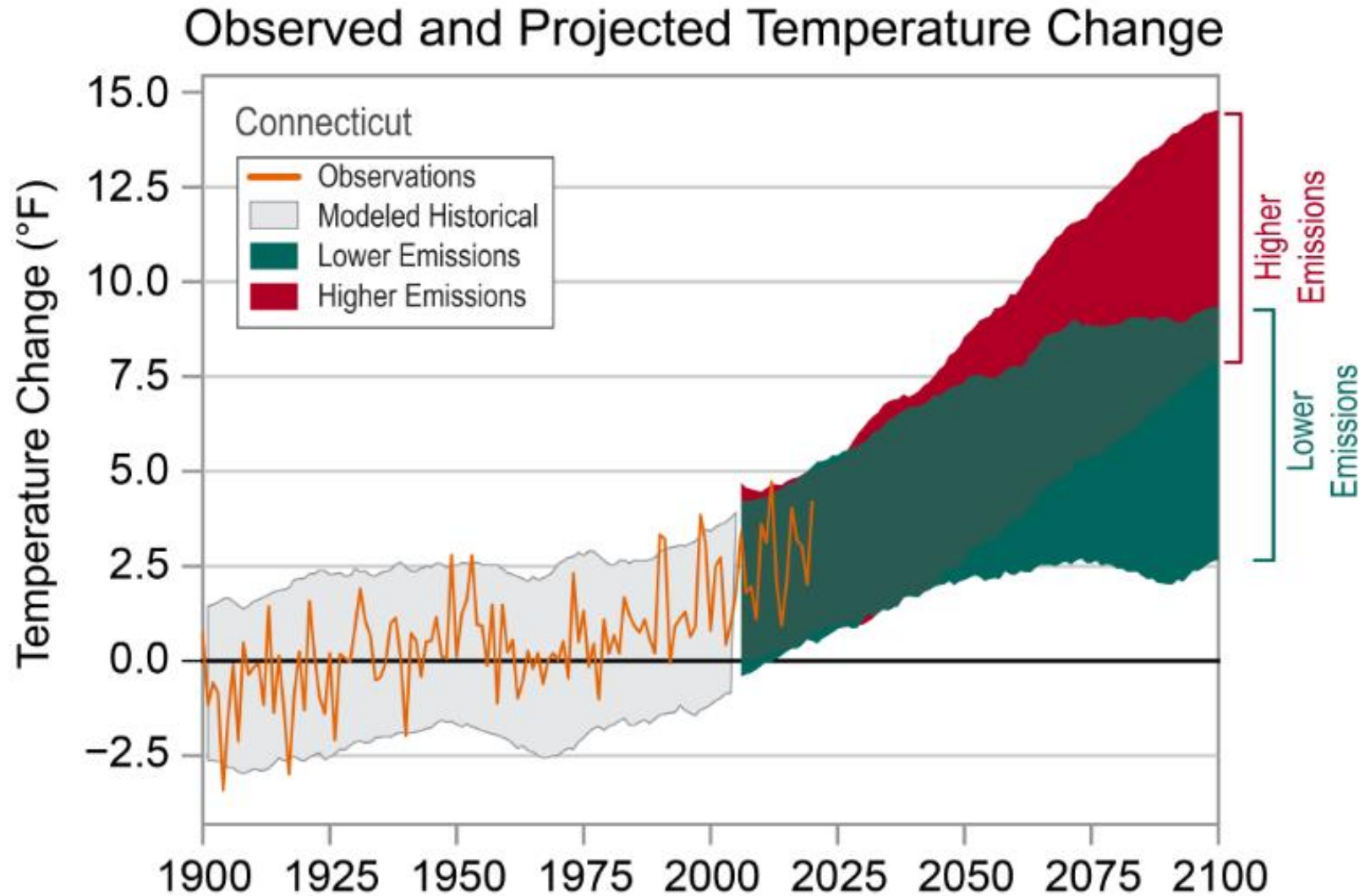


"Resilience"

- Capacity for **buildings** and infrastructure and their **users or occupants**, to **withstand**, **respond to**, and **recover from** different forms of acute and chronic **stressors**, **shocks**, and **disruptions**.
- **Thermal Stress**
- **Grid Disruption**



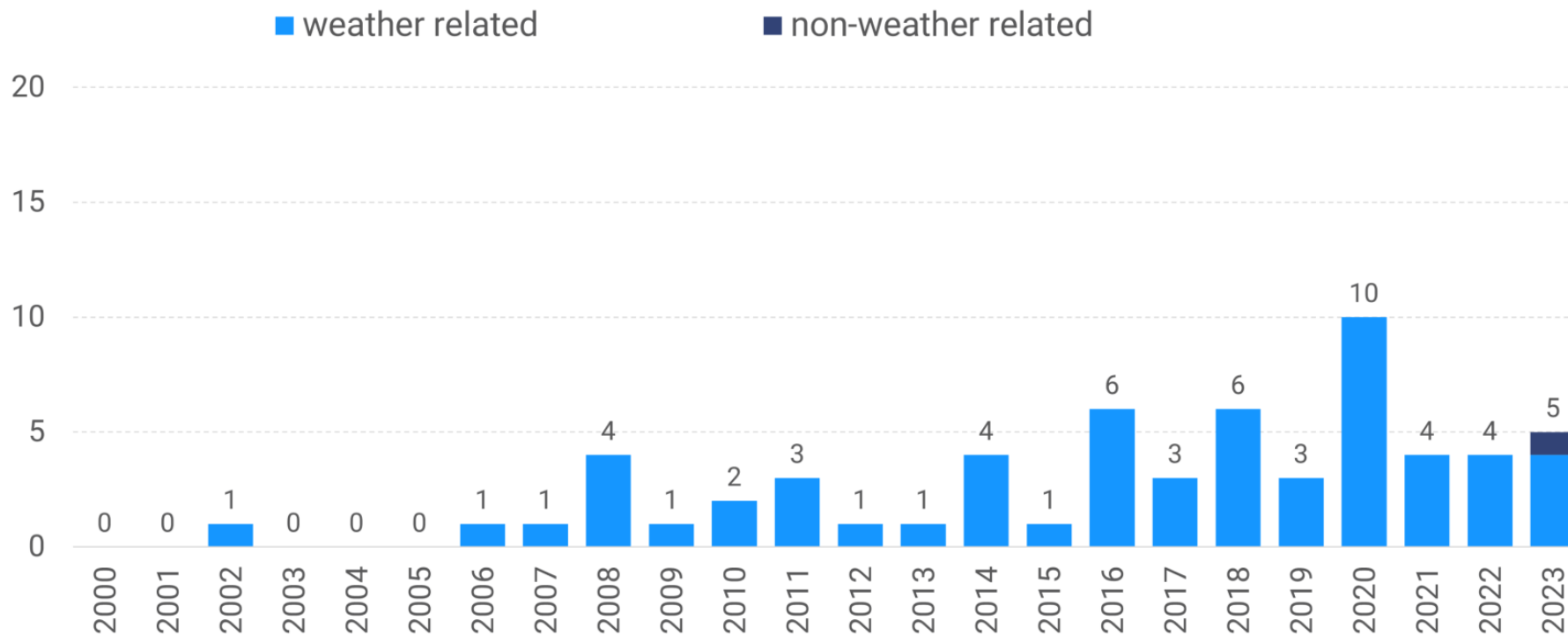
Thermal Stress



Grid Disruption

Power Outages in Connecticut

Number of outages affecting Connecticut and at least 50,000 customers from 2000 to 2023



Data Source: U.S. Department of Energy, Form OE-417

PowerOutage .report



What's a climate resilient energy code?

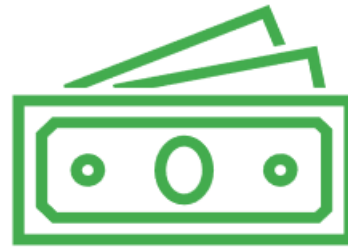
Designed to enhance a building's ability to continue providing heating, cooling, fresh air, access to water, plugs for essential devices (medical devices, phone charging, refrigeration) and comfortable conditions (temperature, humidity, etc.) in order to help occupants more safely shelter in place during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



**Improved
Comfort**



**Increased
Safety**



**Reduced
Costs**



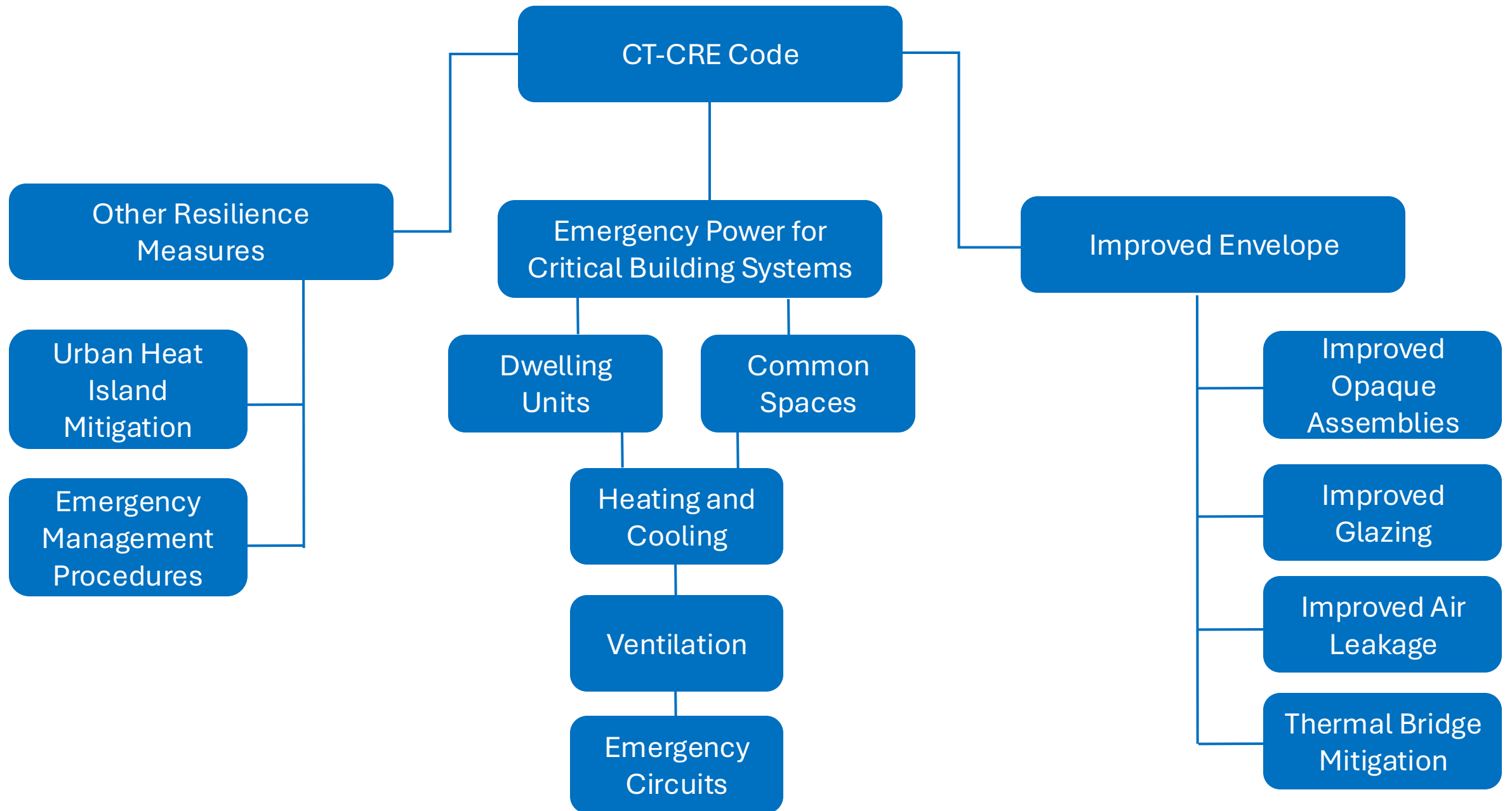
**Peace
of Mind**



Code Framework

- **Overlay** code ammendments
- **IECC** - Residential
 - **IECC** - Commercial
 - **IBC**
 - **ASHRAE** (Future Work)







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 $< 54^{\circ}\text{F}$ for extreme cold and SET degrees $> 86^{\circ}\text{F}$ 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

Climate Resilient Energy (CRE) Code

Thermal resilience impact summary

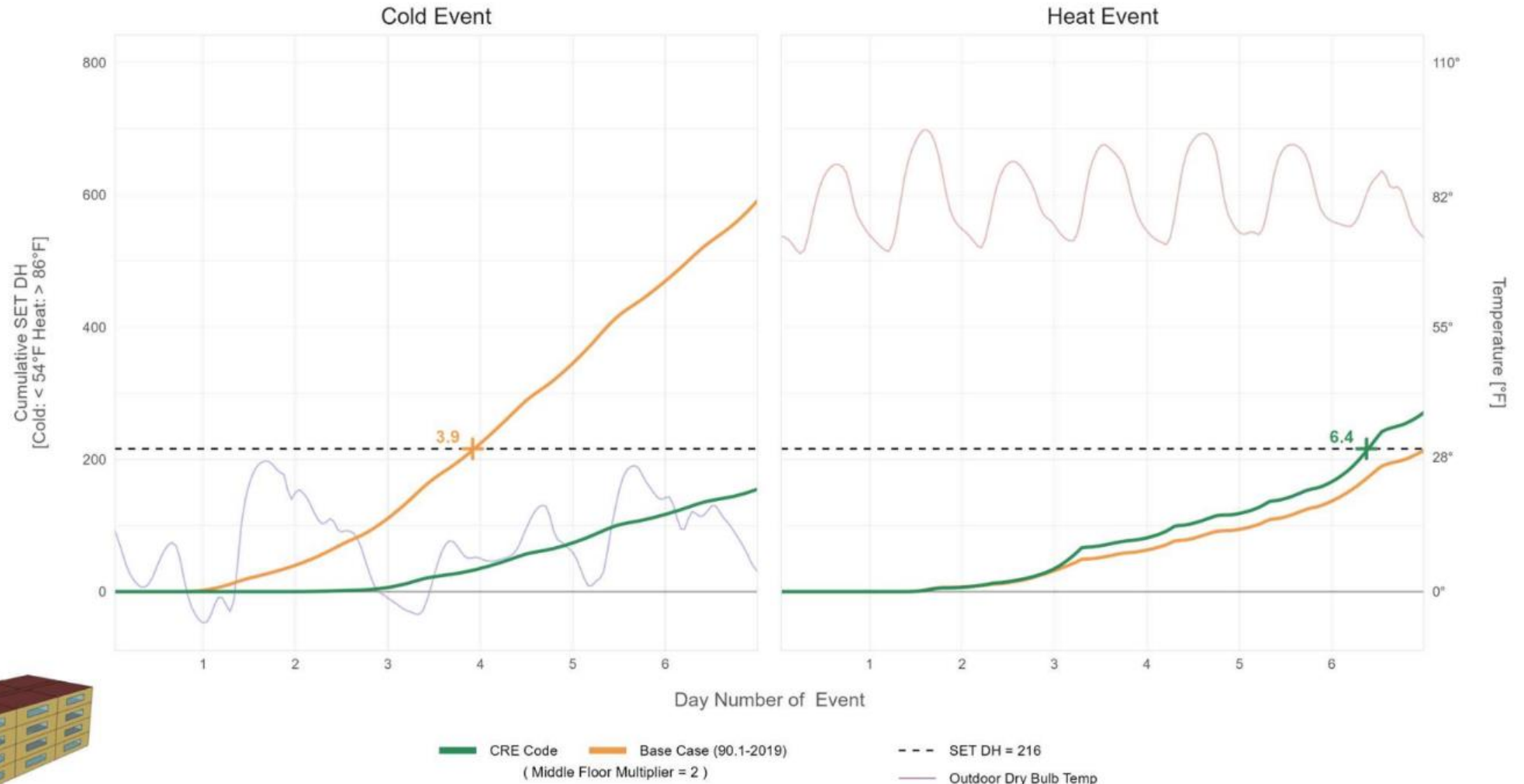
Average SET Degree Hours per apartment unit*

Location	Building Type		Extreme Cold				Extreme Heat			
			3 days		7 days		3 days		7 days	
			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.

Midrise Apartment Average 'Occupied' Unit

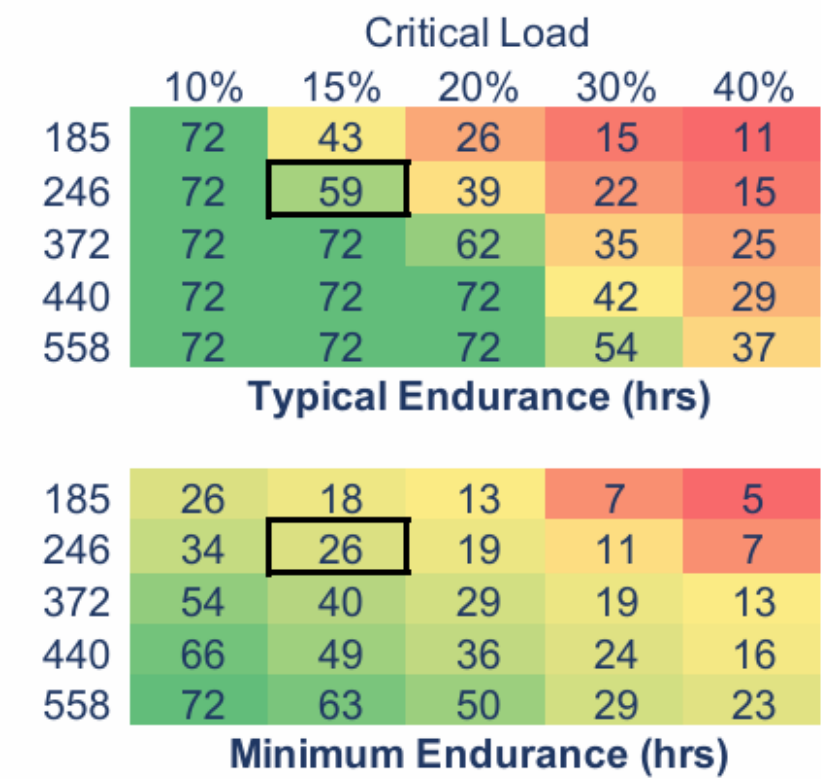
Brainard





Resilient Power ₁		
Solar	46 kW	
Battery	60 kW / 246 kWh	
Financial Returns		
Capital Cost	\$503,800	
ITC	\$149,500	
Capital Cost - Tax Benefit	\$354,300	
IRR	5.9%	
NPV @6%, 20yrs	(\$900)	
Simple Payback (years)	8.2	
Utility savings	First Year	20 Years
Energy Savings	(\$4,440)	(\$122,028)
Demand Savings	\$6,809	\$191,267
Other Savings	\$0	\$0
Revenue & Cash Flow	First Year	20 Years
Total Utility Savings	\$2,369	\$69,239
RRES Buy-All Incentive	\$21,886	\$417,546
CT Energy Storage Solutions Incentive	\$155,255	\$205,728
Total O&M Expenses	(\$4,939)	(\$120,007)
Replacement capex	\$0	(\$71,821)
Capital Cost after ITC	\$0	(\$354,337)
Cash flow	\$174,571	\$146,347

Battery Size (kWh)



Next Steps

- In CT
 - Finalize Code
 - Calibrate Envelope Measures
 - Refine Through Pilot Projects
 - Coordinate w/ DOH, FHA, DEEP, for Integration Into Policy and Programs
- Expand to More Climate Zones
- Develop Performance Path

