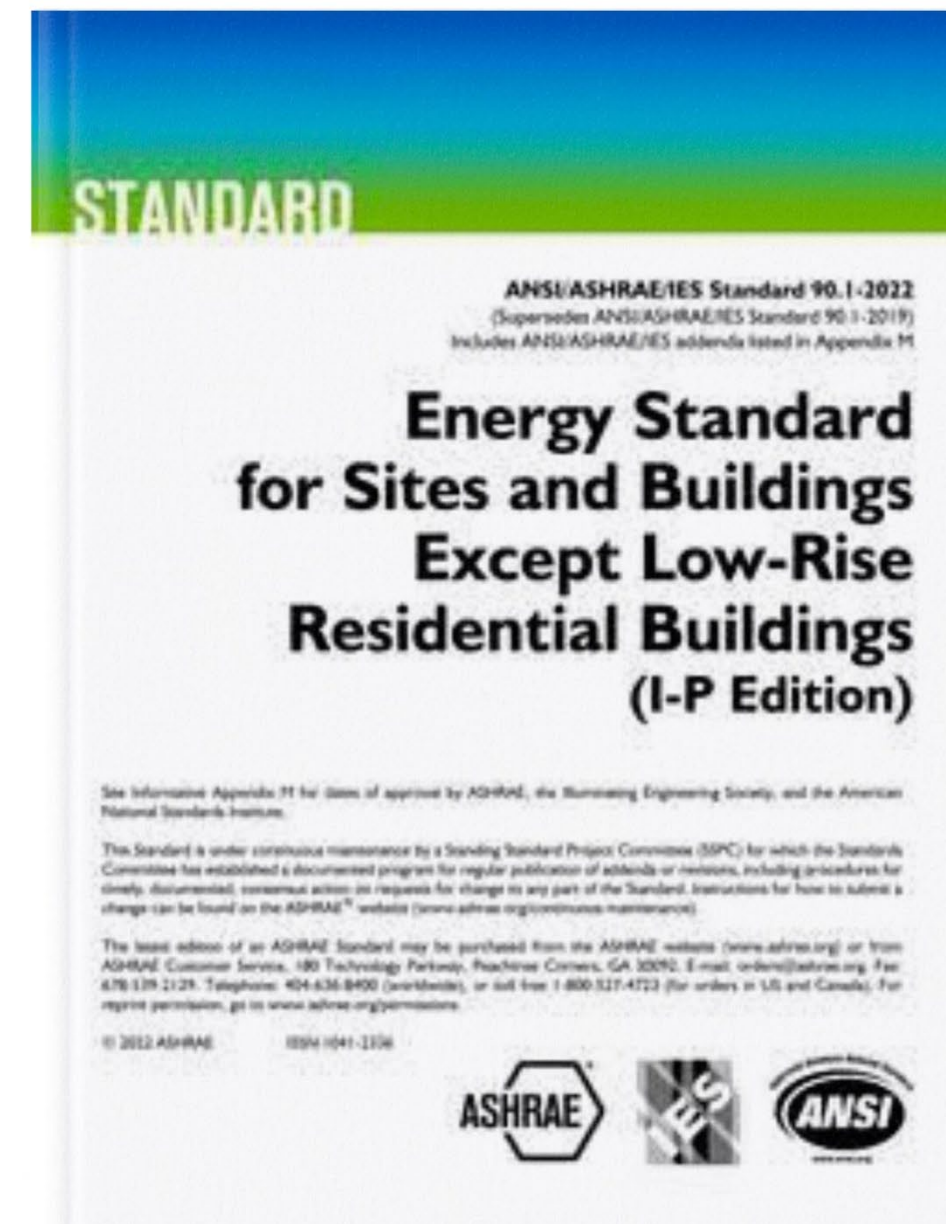
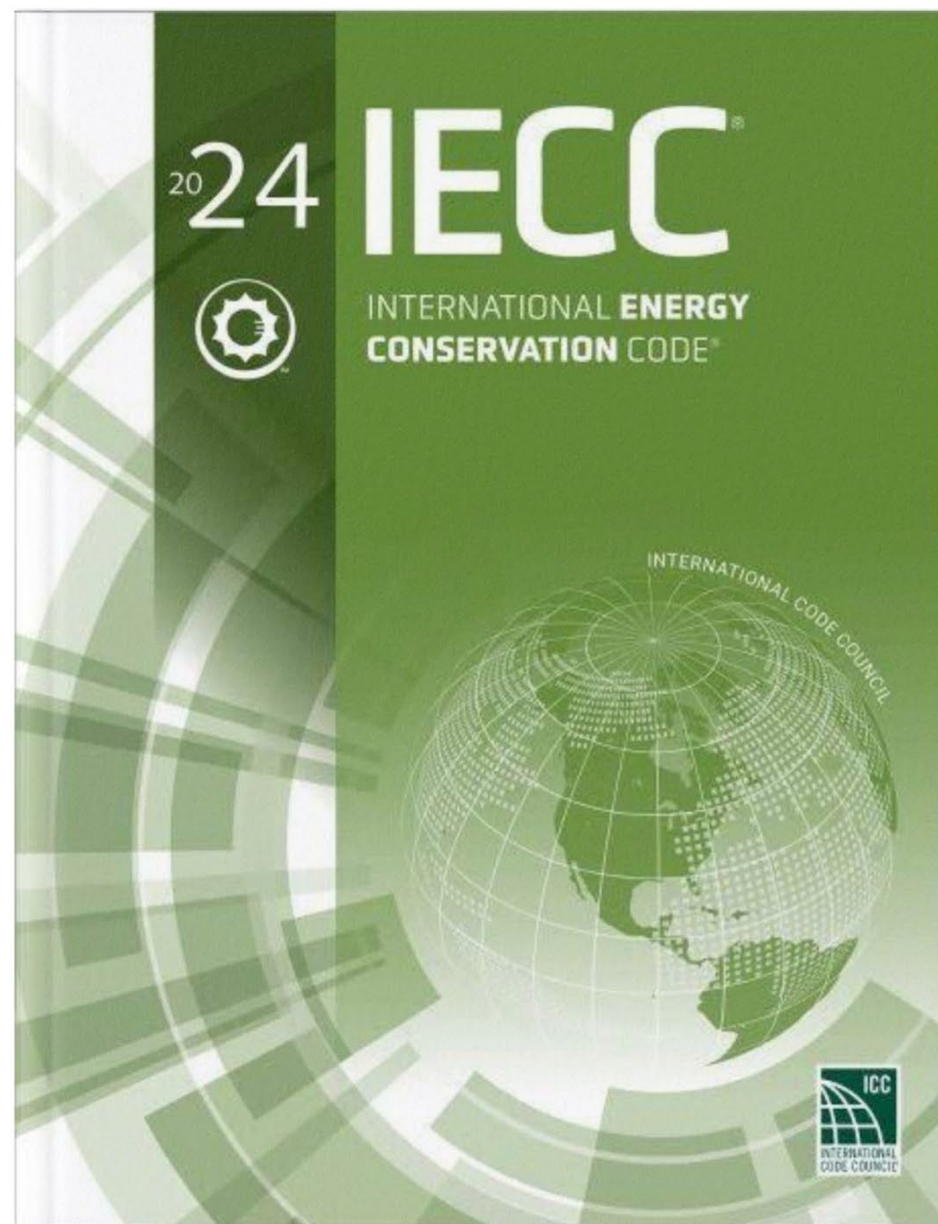


# **Energy Code Driven Design Changes: Cost, Performance, and Integrated Facade and Mechanical Design**

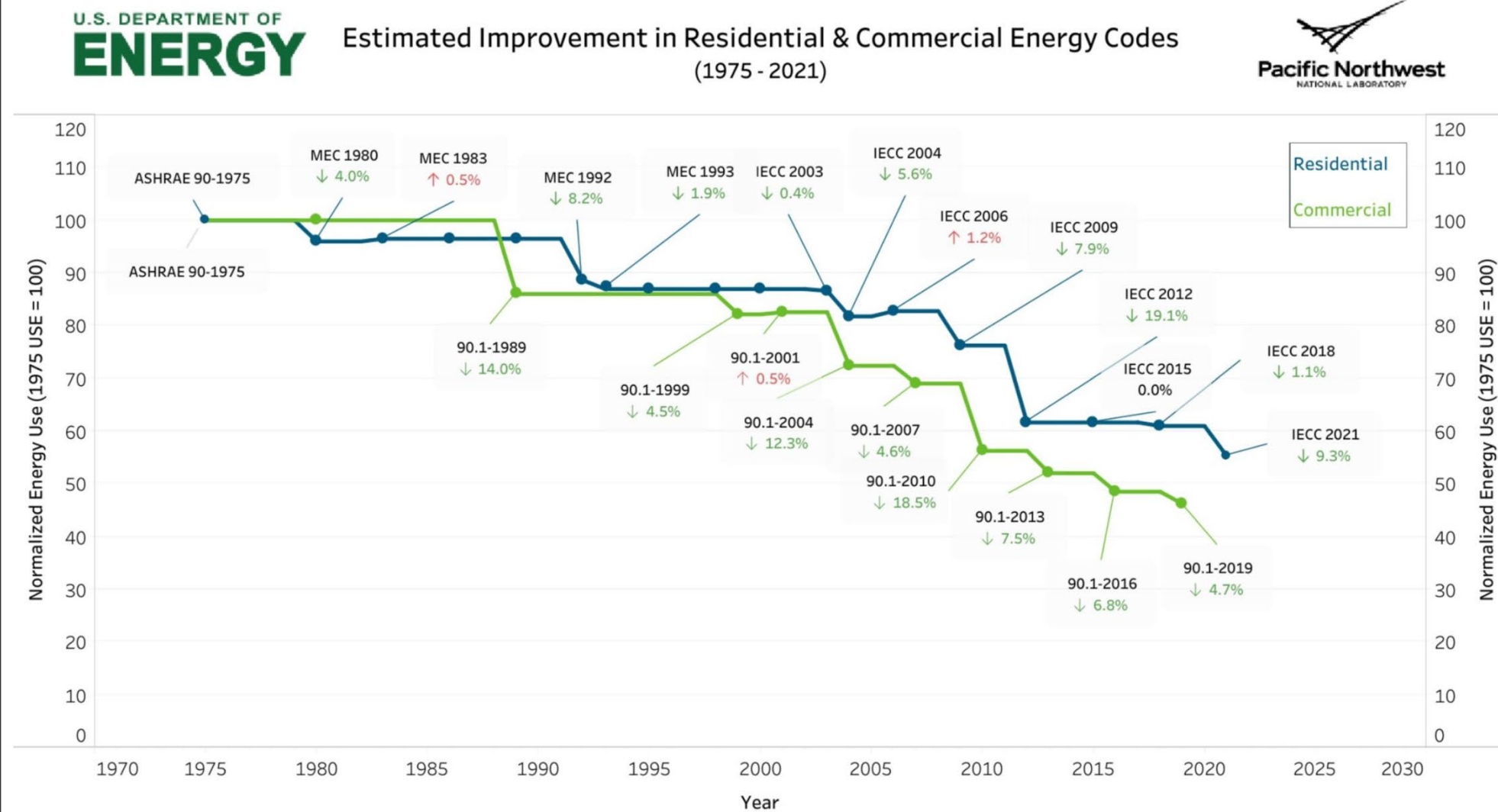
**Weijun Allen Mei, Jayati Chhabra, Akram Maradni,  
Cosmin Vrajitoru, James White**

# Energy codes and standards

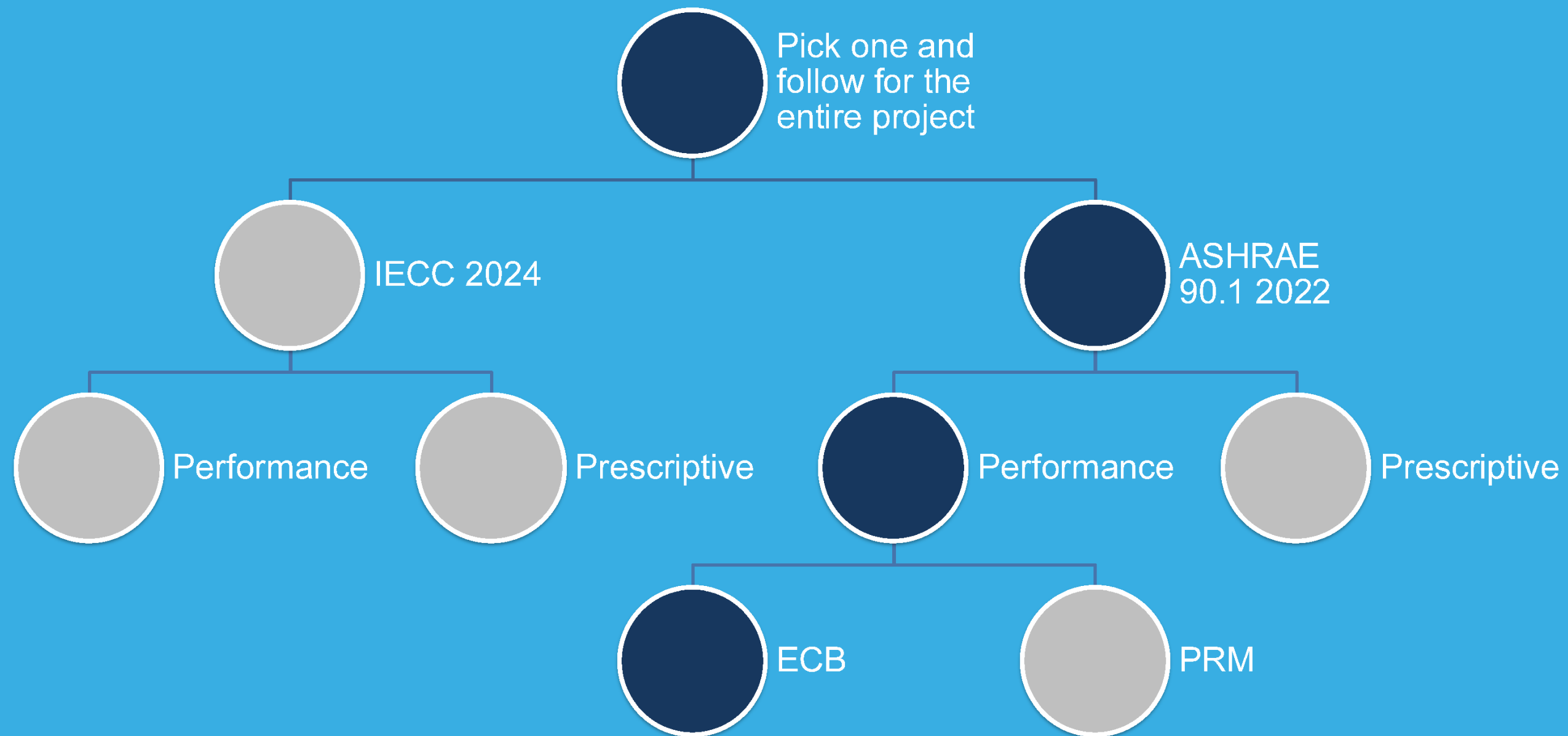
New energy codes implemented



# The past 50 years



# Compliance Paths



# Envelope Backstop

ASHRAE 90.1-2022

## Nonresidential buildings:

Proposed Envelope Performance Factor (PEPF) cannot exceed the Baseline Envelope Performance Factor (BEPF) by more than 7%. For COMcheck, this means that the proposed building's envelope should not fail by more than 7%.

## Multifamily residential, hotel/motel, and dormitory buildings:

Proposed Envelope Performance Factor (PEPF) cannot exceed the Baseline Envelope Performance Factor (BEPF) by more than 15%. For COMcheck, this means that the proposed building's envelope should not fail by more than 15%.

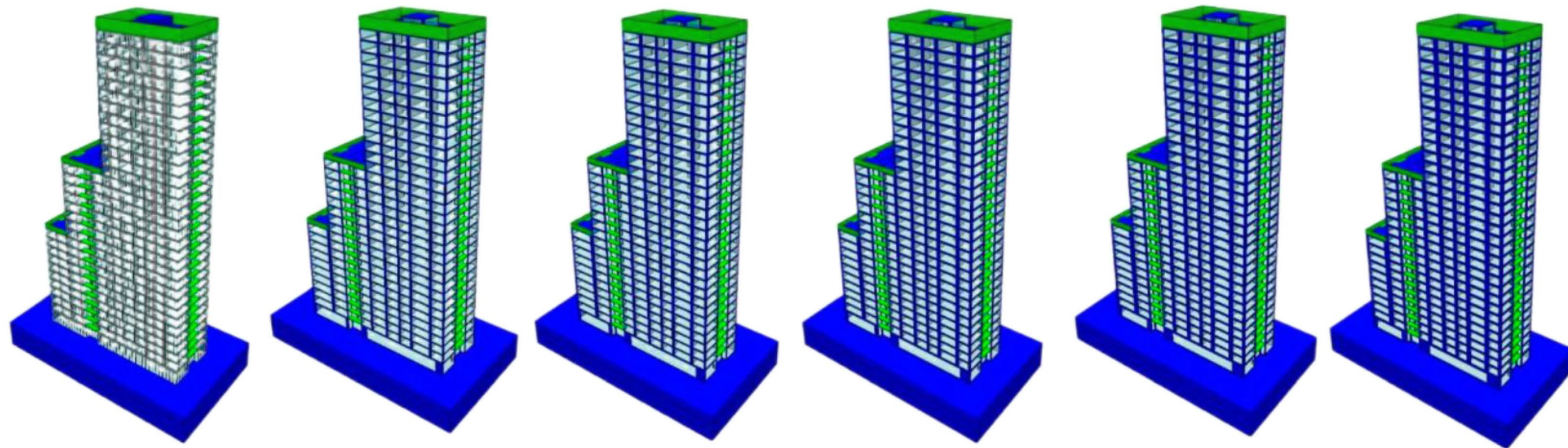
# Implications for Facade Design

The introduction of envelope backstop has direct implications for how facades are designed and evaluated as mentioned below:

- Window to wall ratio becomes more tightly linked to compliance outcomes.
- Glazing performance improvements are necessary but may not be always sufficient to meet compliance requirements
- The ability to rely on MEP system efficiency as a compensating strategy is reduced

# Methodology

Overall Recommendation

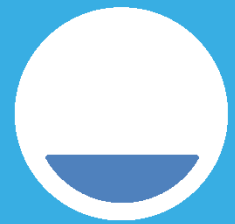


Change WWR  
Check Backstop

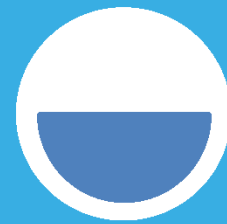
System Sizing

Check Overall  
Compliance

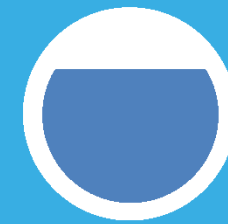
First Cost + Maint Cost  
+ Energy Cost LCCA



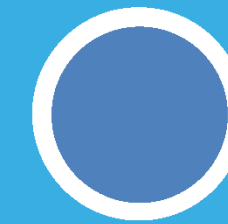
**Developing the base  
model and iterations**



**Mechanical System  
Sizing Based on  
Resulting Loads**



**Whole-Building  
Performance  
Compliance**



**Life Cycle Cost  
Analysis (LCCA)**

# Steps for analysis

*Approach and steps for the  
study*

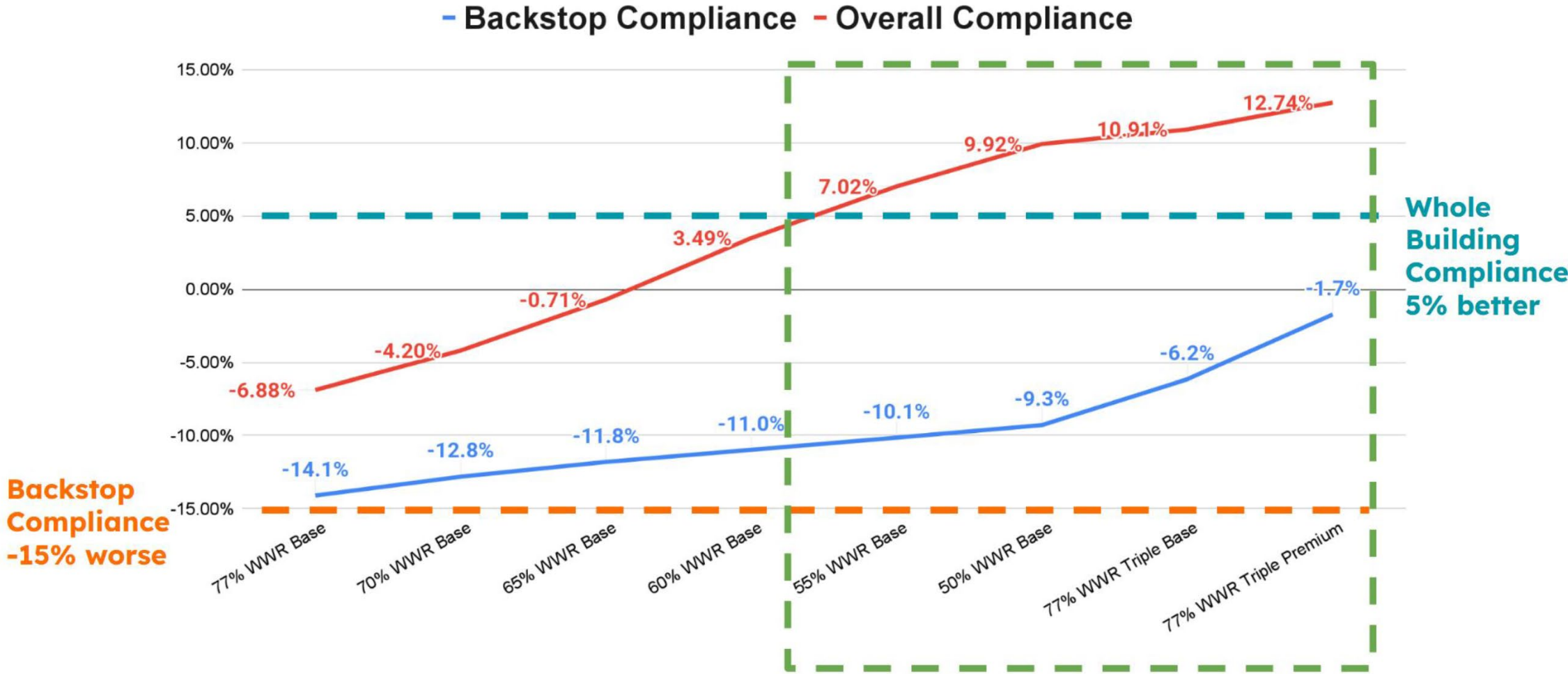
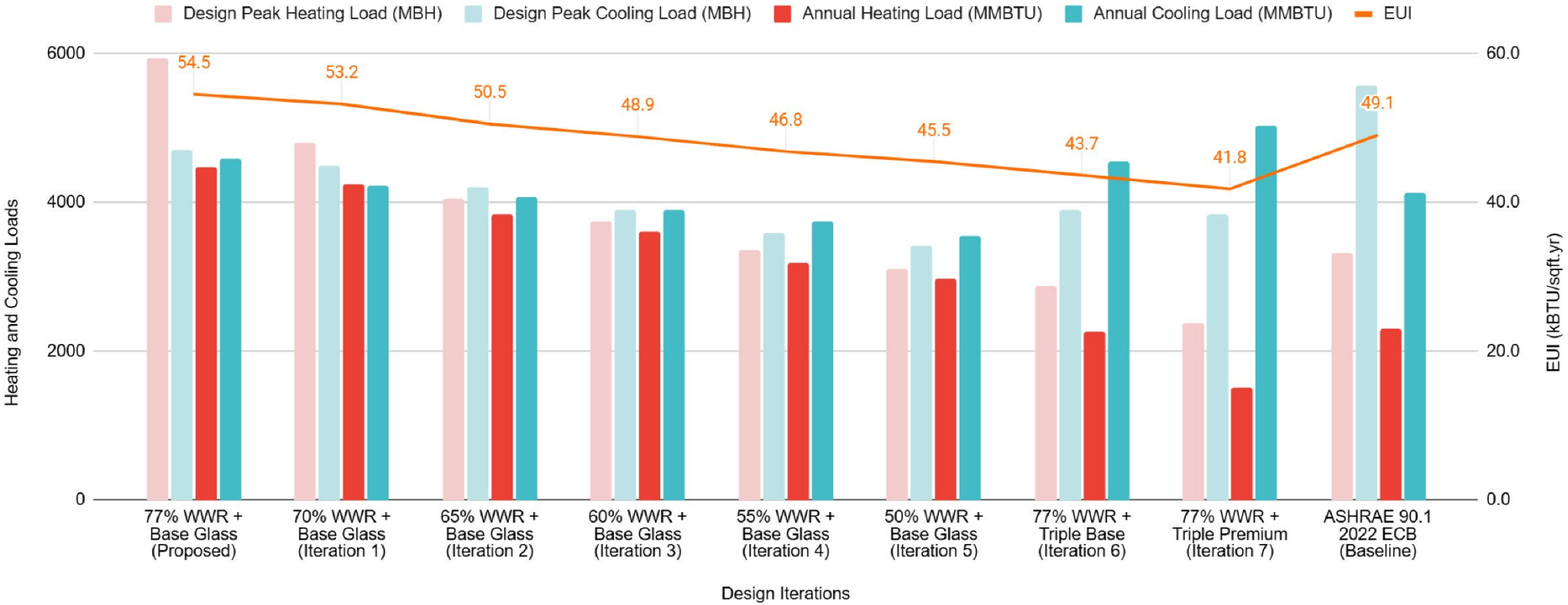
The study was conducted in four key steps on a series of iterations of a model and was evaluated for energy use, building heating and cooling loads, system sizing, as well as associated cost.

# Cities studied

That have adopted new energy codes



# Chicago, Illinois



# Analysis of the models in Chicago

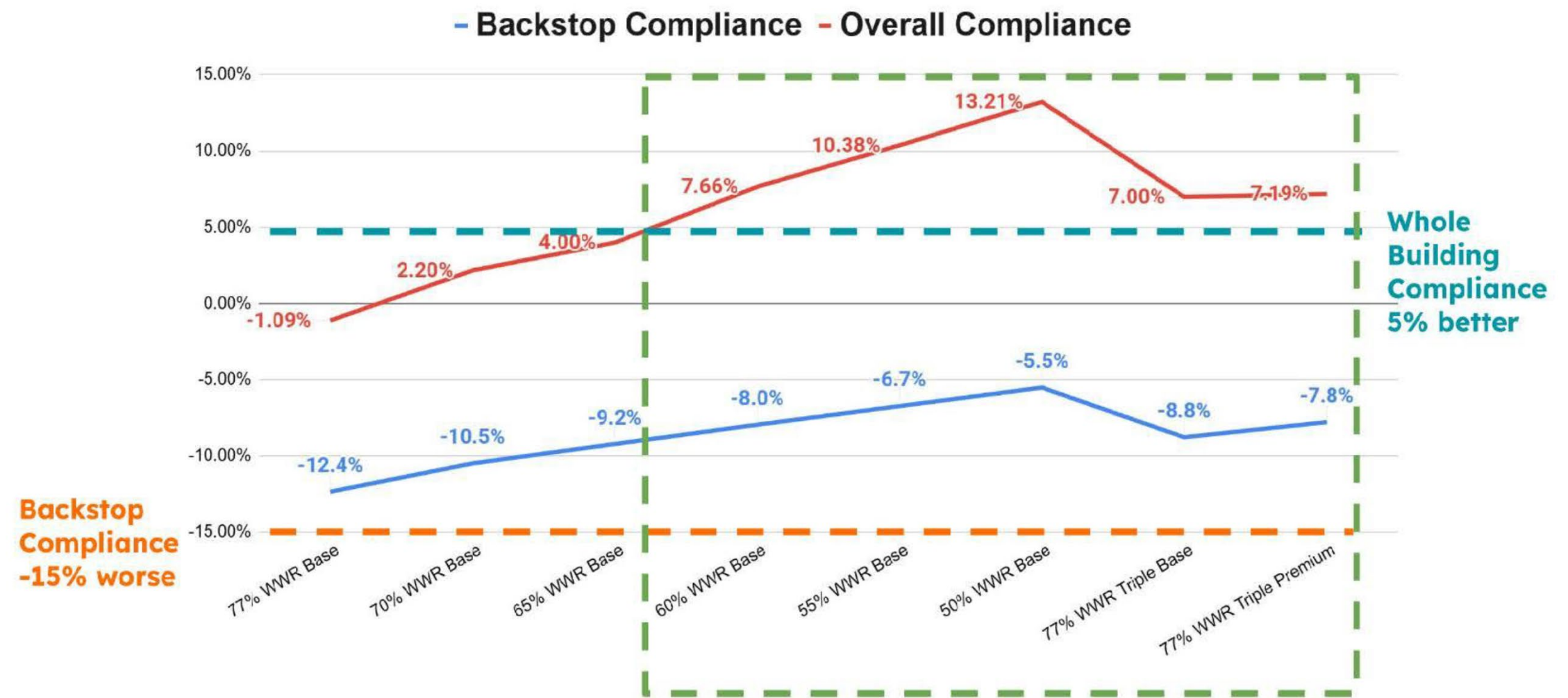
complying with envelope backstop does not necessarily mean complying with whole building energy requirements for high-WWR designs

while the base model and Iterations 1 through 3 (maintaining a WWR between 77% and 60%) successfully satisfied envelope backstop requirements, they failed to meet whole-building performance criteria which required the proposed design to be 5% better than the baseline.

In contrast, Iterations 4 through 7 achieved compliance with both the envelope backstop and whole-building energy requirements. Notably, these iterations demonstrated a marked improvement in envelope backstop performance, with margins shifting from -6.2% to -1.7%. These findings indicate that implementing Triple Premium glazing allows for larger window-to-wall ratios while still adhering to both essential compliance frameworks.

# Austin , Texas

In Austin, a broader range of scenarios achieved both envelope backstop and overall compliance, beginning with Iteration 3 and continuing through Iteration 7



# Phoenix, Arizona

The compliance data for Phoenix reflects similar patterns observed in Austin, specifically regarding the compliance percentage dip in Iteration 6 and the peak compliance achieved in Iteration 5.



# Implementation

## 400 N Elizabeth, Chicago

Implementing Triple glazing in 400 N Elizabeth helped the project balance the loads of heating and cooling on the geothermal loop and future proof the design through the new energy code for the second tower



# END



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