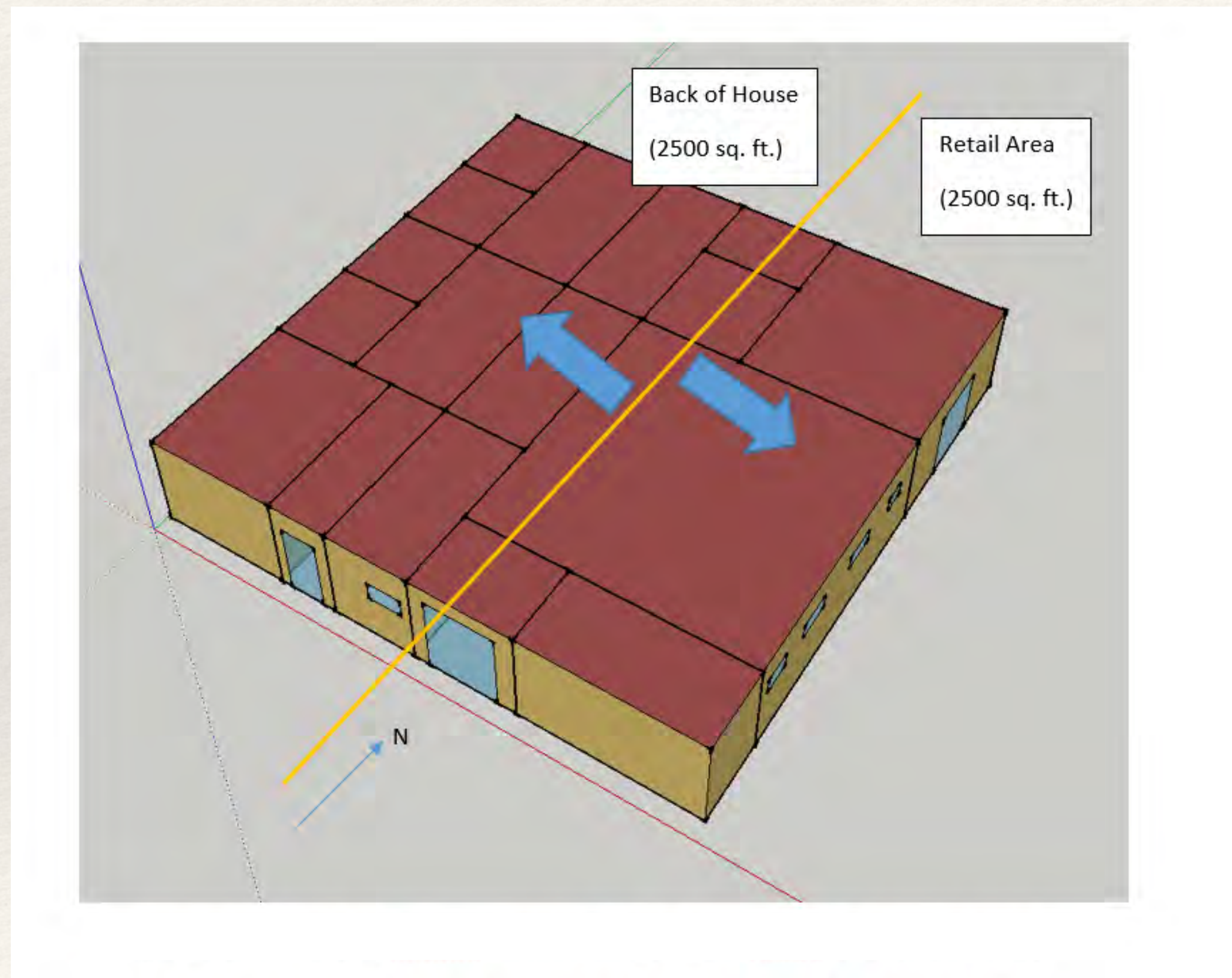


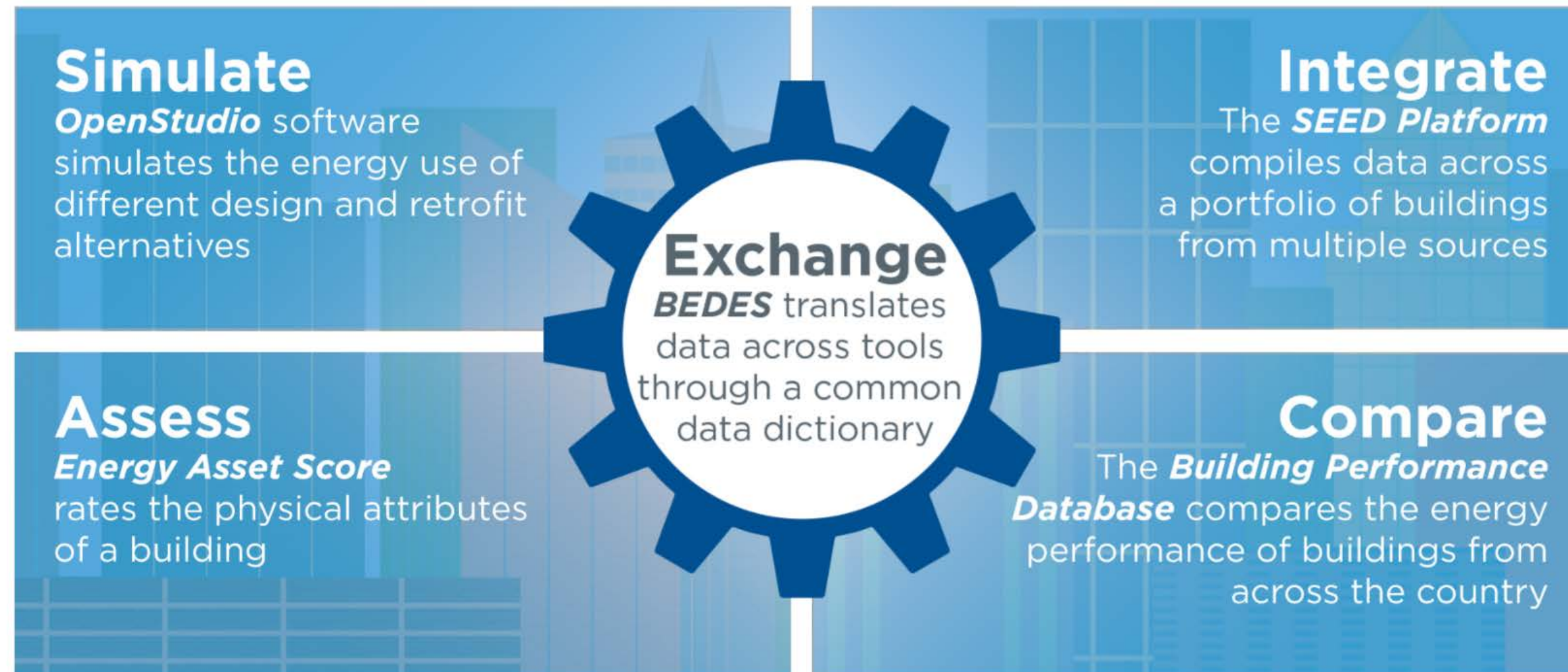
# Massive 'Parametric' EnergySimulation Study



## Parameters

WindowToWallRatio	[0.4,0.8]	2
Building Rotation	[0]	1
Thermostat Schedules (Heating)	["Retail HtgSetp", "Constant 22C"]	2
Thermostat Schedules (Cooling)	["Retail ClgSetp", "Constant 22C"]	2
Infiltration/Construction Quality	["Tight", "Avg", "Poor"]	4
Gas Burner Efficiency	[0.5,0.95]	2
LPD	[1.5,1, 0.25]	3
EPD	[2.5,1.5, 0.5]	3
Glass Properties	["U-4.54 SHGC 0.20", "U-4.54 SHGC 0.30", "U-1.42 SHGC 0.39", "U-1.42 SHGC 0.50"]	4
Exterior Wall R-Value	[5,20]	2
Exterior Roof R-Value	[10,40]	2
		9,216
	60 cores	153.6
	hours @ 100s per simulation	4.266666666666667

## Analysis Tools Ecosystem



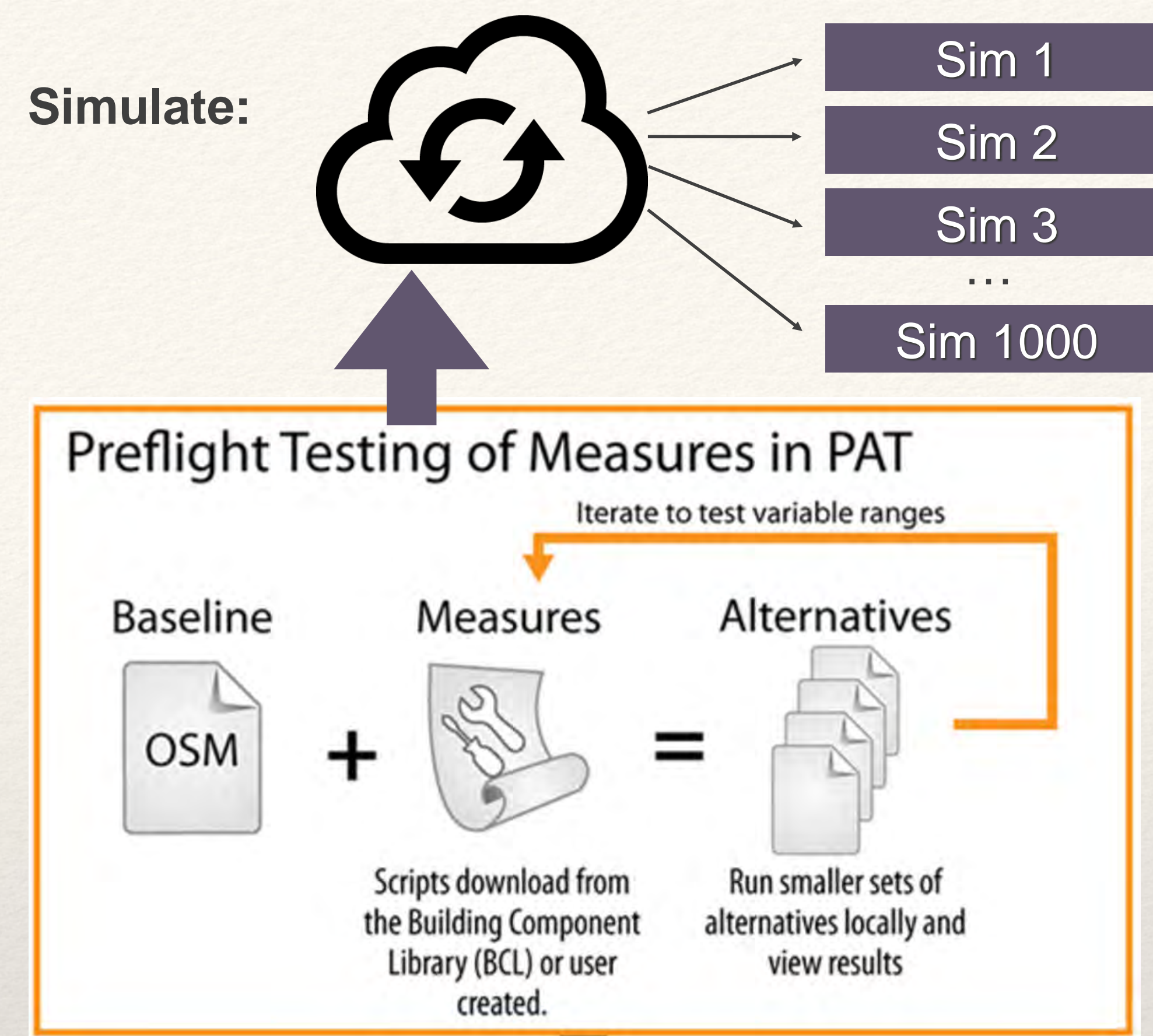
### The Department of Energy's Vision

Create a set of interoperable tools that provide insight on building energy performance and drive action in the market.

Freely-Available DOE Platform

# Leveraging State of the Art


Simulate:



Investigating the Ecosystem

GitHub, Inc. [US] | https://github.com/NREL

This organization Search Pull requests Issues Marketplace Explore

 National Renewable Energy Laboratory  
Golden, CO | http://www.nrel.gov

Repositories 138 People 528 Teams 111 Projects 1

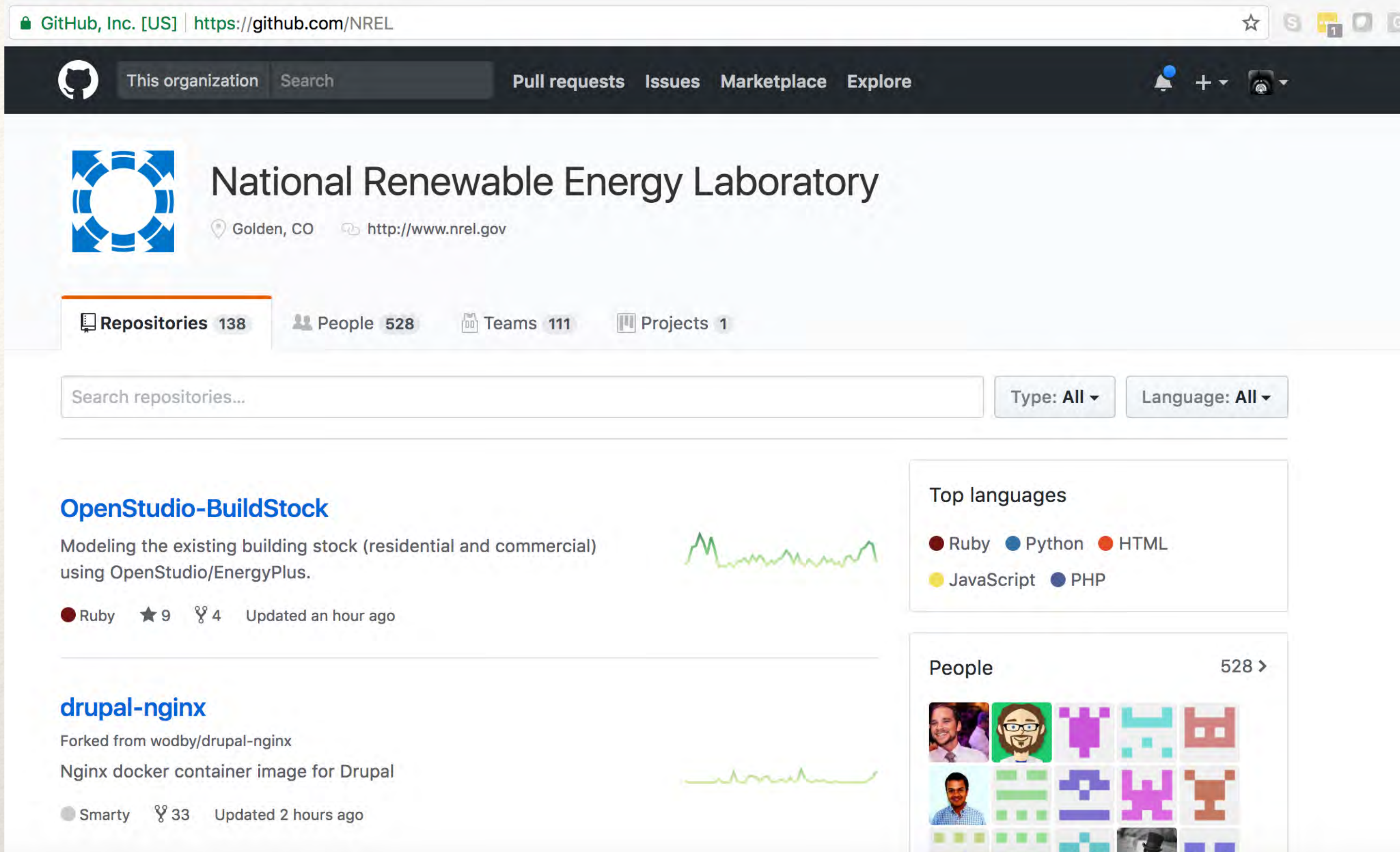
Search repositories... Type: All Language: All

**OpenStudio-BuildStock**  
Modeling the existing building stock (residential and commercial) using OpenStudio/EnergyPlus.  
Ruby 9 stars 4 forks Updated an hour ago

**drupal-nginx**  
Forked from wodby/drupal-nginx  
Nginx docker container image for Drupal  
Smarty 33 forks Updated 2 hours ago

Top languages  
Ruby Python HTML  
JavaScript PHP

People 528 >



## NREL Github:



## OpenStudio-Server:

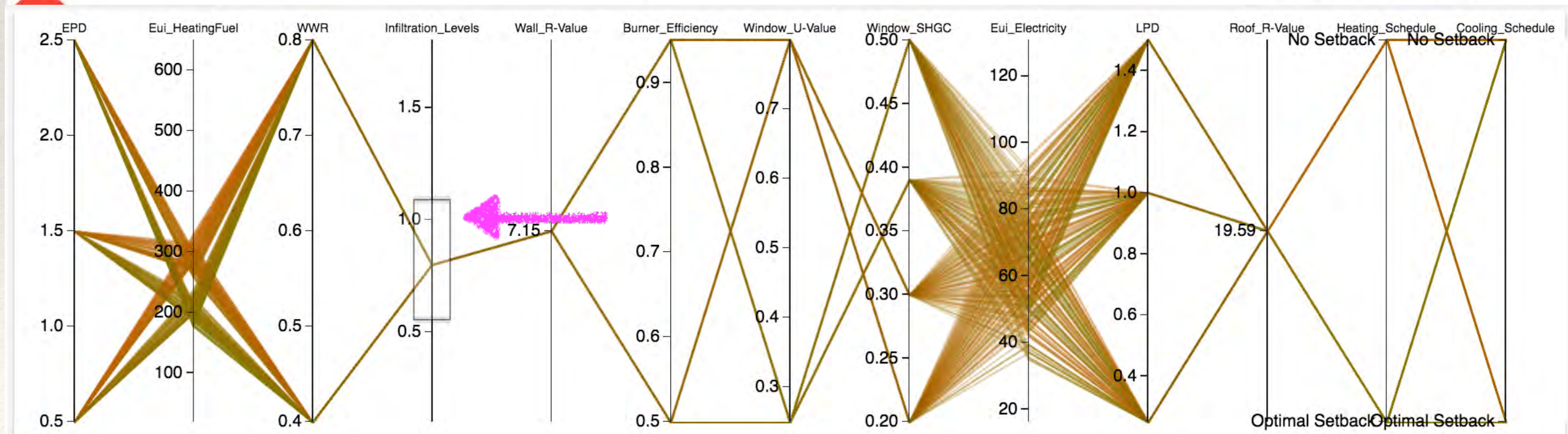
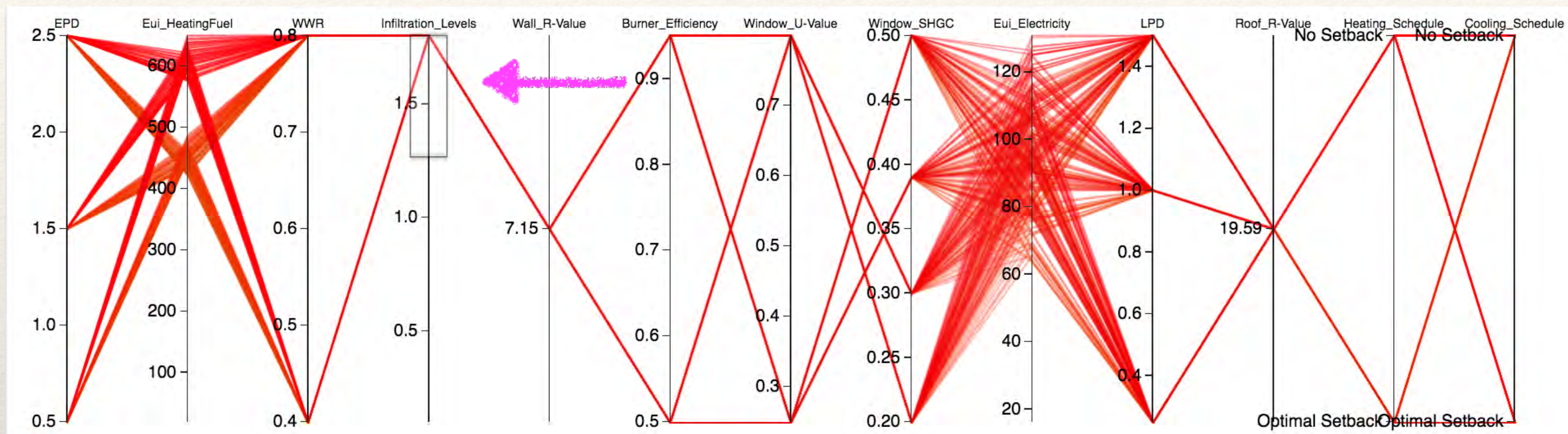
- Open-Source license with few commercial restrictions
- Allows for easy integration in the cloud.
- Use as many parallel machines as you can afford.
- Estimate costs ahead of time for costs.

NREL

# Free Open Source Software

Investigating the Ecosystem

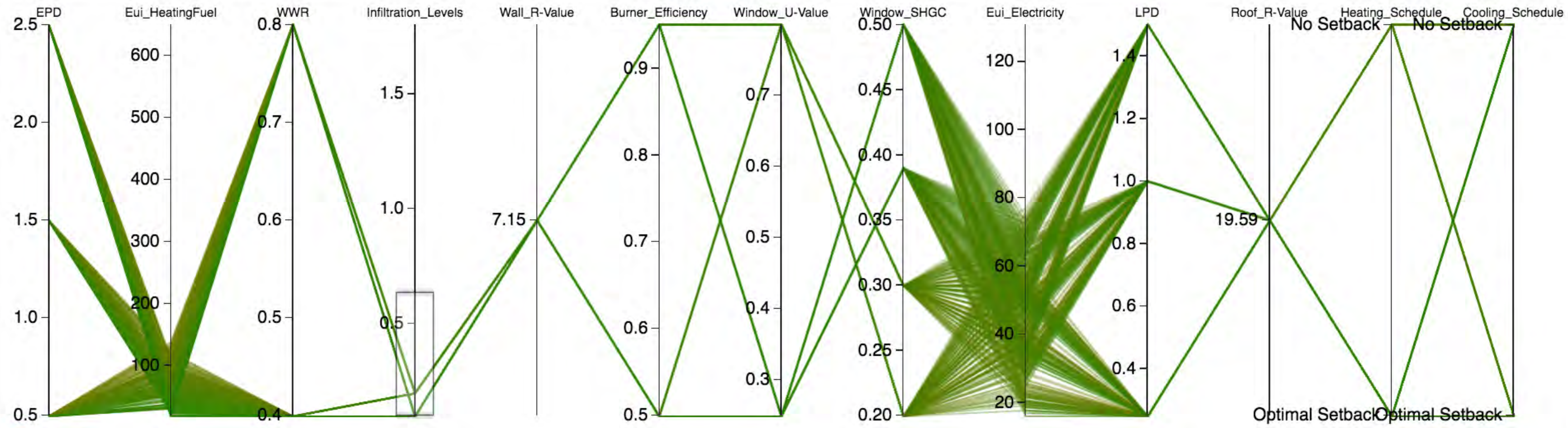
# Simulation Results of High Infiltration (in this case) did not Reflect the Portfolio



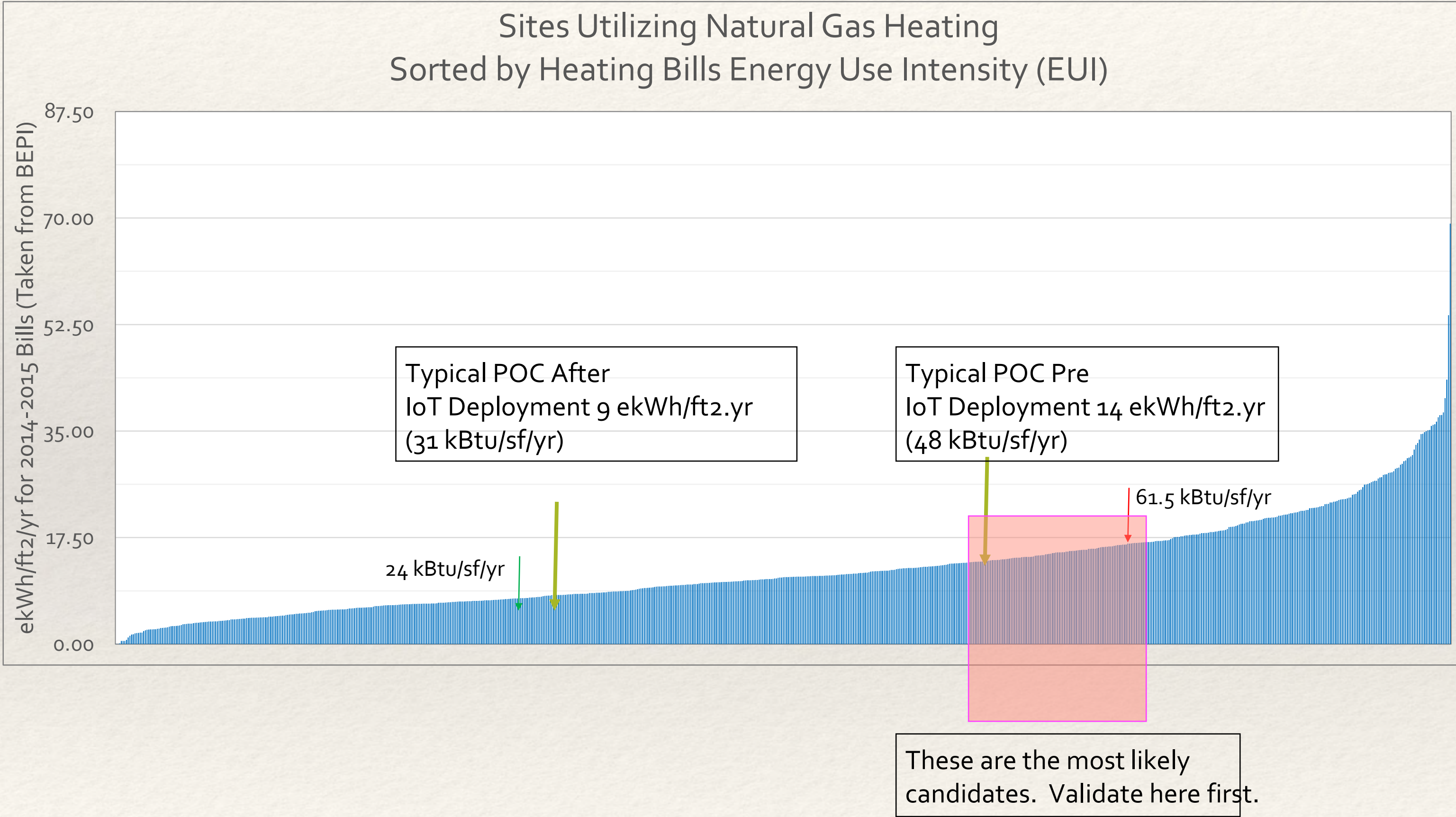
## The Portfolio Heating Bills

- average ~ 35 kBtu/sf/yr
- maximum ~ 200 IBtu/sf/yr





# Picking New Locations: Finding The Right Selection of Candidates



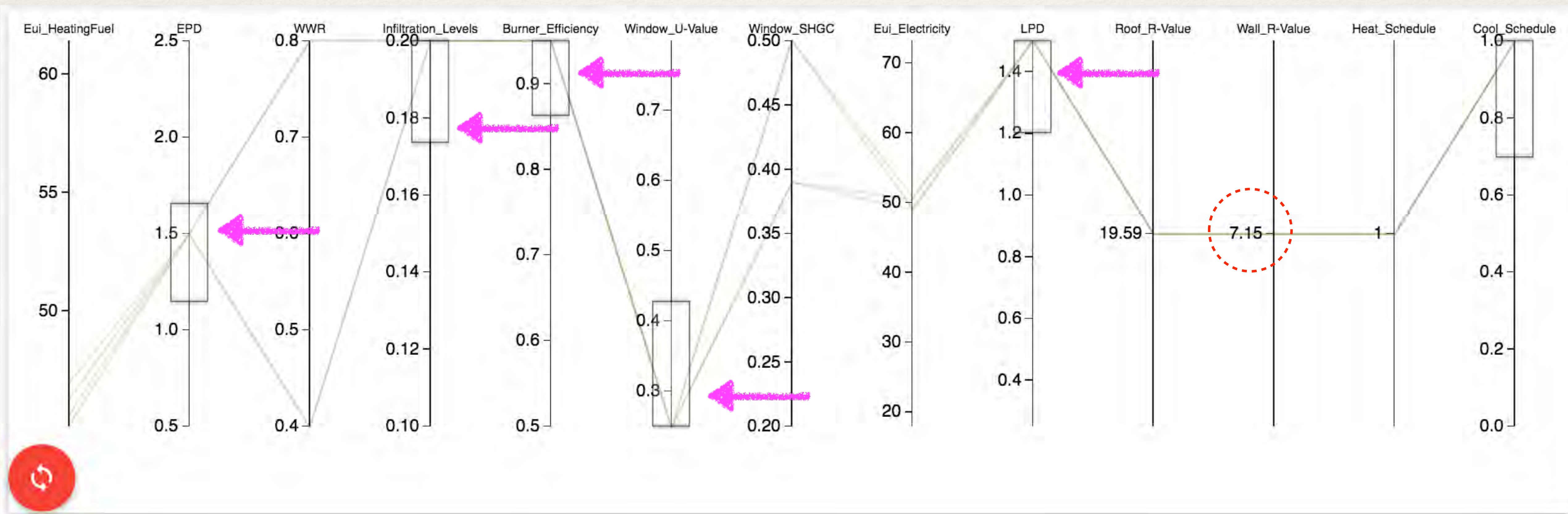
## A Risk Mitigation Exercise

Question 1:

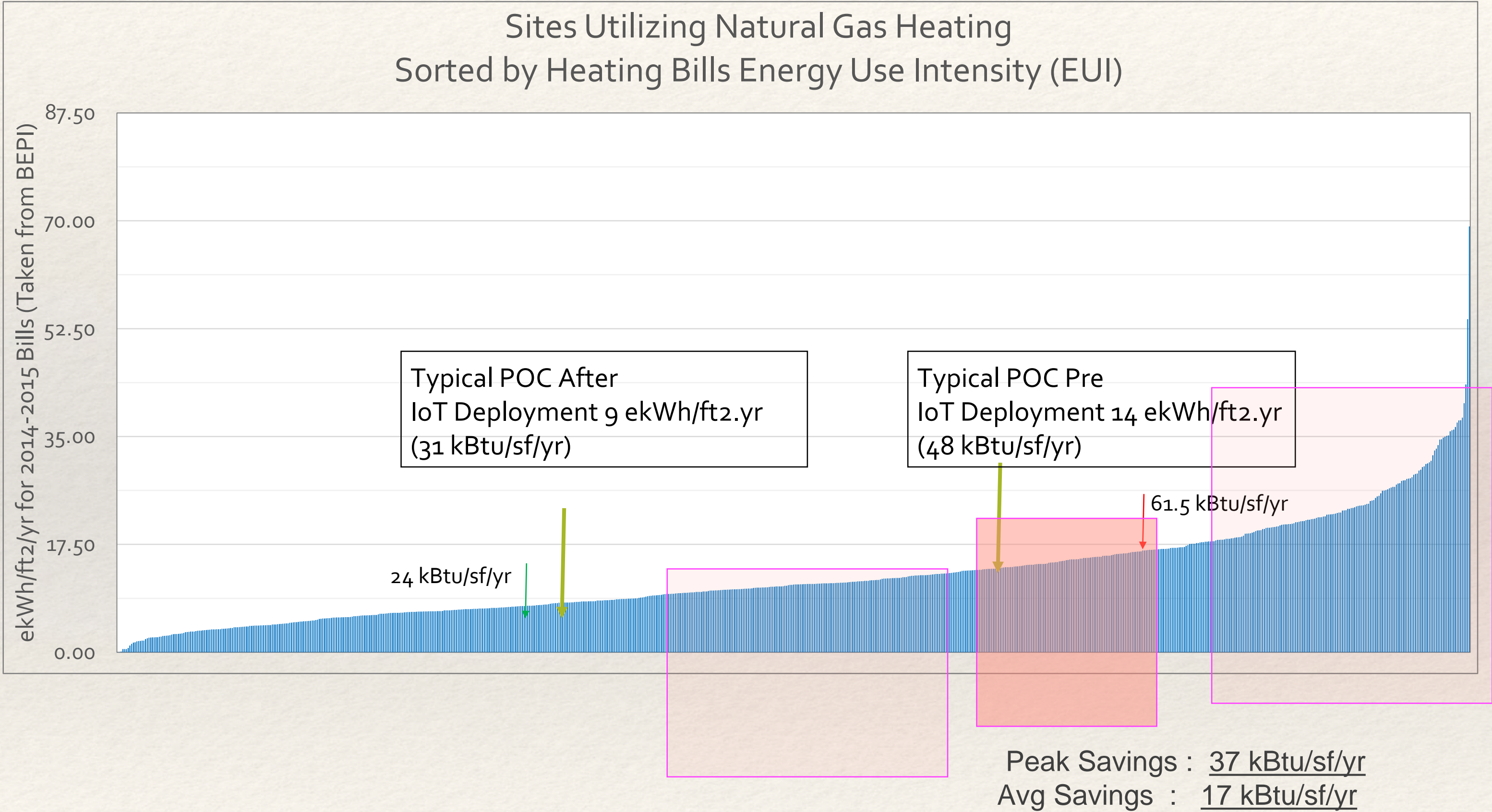
If we choose buildings within a given range, can we confidently and rationally explain what is *\*most likely\** driving energy consumption using the data?

# It is Possible that a Building is Controlling Properly... and get a High EUI

4 Times out of 9000+ simulations.....



# Picking New Locations: Finding The Right Selection of Candidates



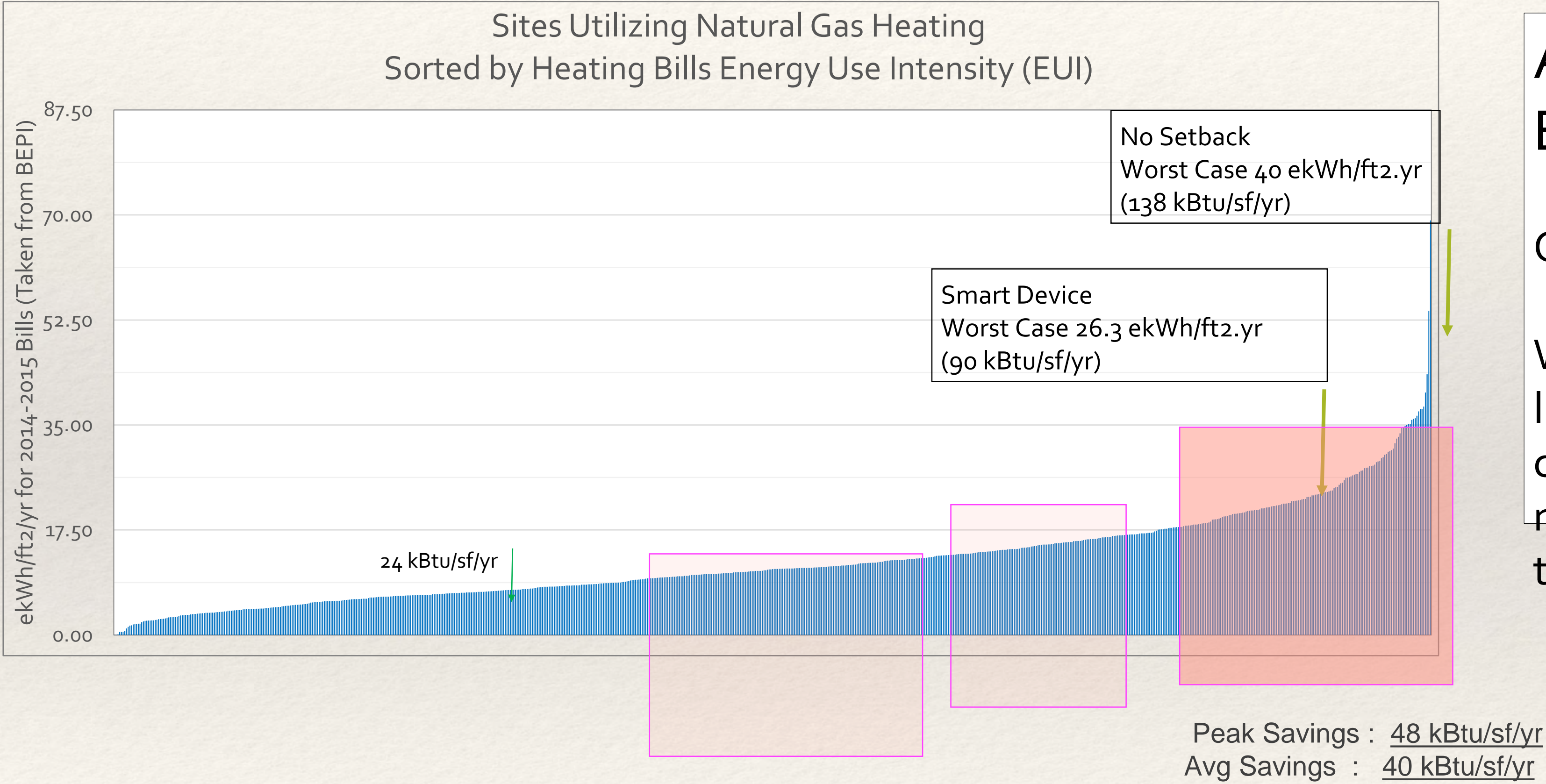
## A Risk Mitigation Exercise

Question 2:

What will the savings be like in other area comparing good control vs. no setback of the thermostats?



# Picking New Locations: Finding The Right Selection of Candidates

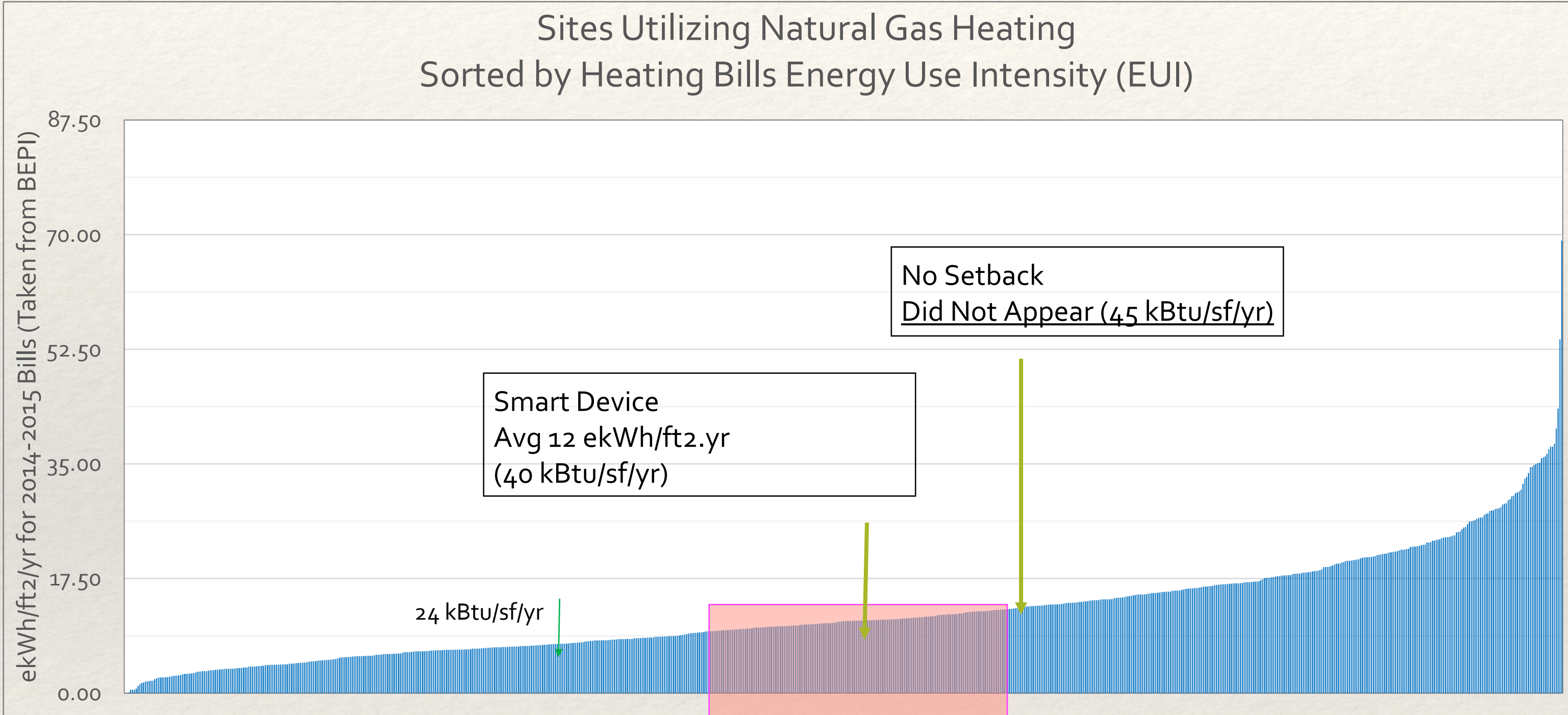


## A Risk Mitigation Exercise

Question 2:

What will the savings be like in other area comparing good control vs. no setback of the thermostats?

# Picking New Locations: Finding The Right Selection of Candidates



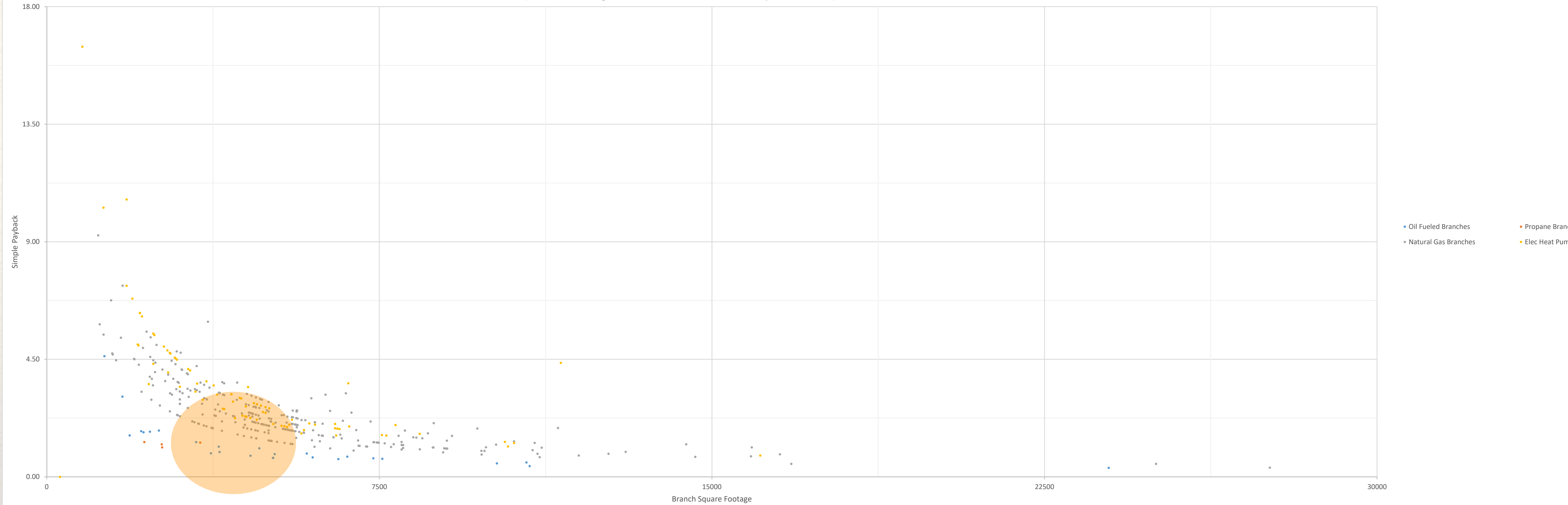
Peak Savings : 16 kBtu/sf/yr  
Avg Savings : 10 kBtu/sf/yr

## A Risk Mitigation Exercise

Question 2:

What will the savings be like in other area comparing good control vs. no setback of the thermostats?

Simple Payback for Branches vs. Branch Square Footage  
(Before Factoring in Maintenance and Deferred Capital Purchase)



## Payback Analysis (Finally)

# Making the Business Case

Avg 3 yr - energy only payback  
Estimated 25% natural gas savings per yr  
Estimated 2.5% electricity savings per yr