Continuing Climate Action and Resilience Work in the Museum Field

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September 7, 2025

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IRA/BIL: Direct Pay remains

Safe Harbor Day July 4, 2026

Geothermal and big batteries remain

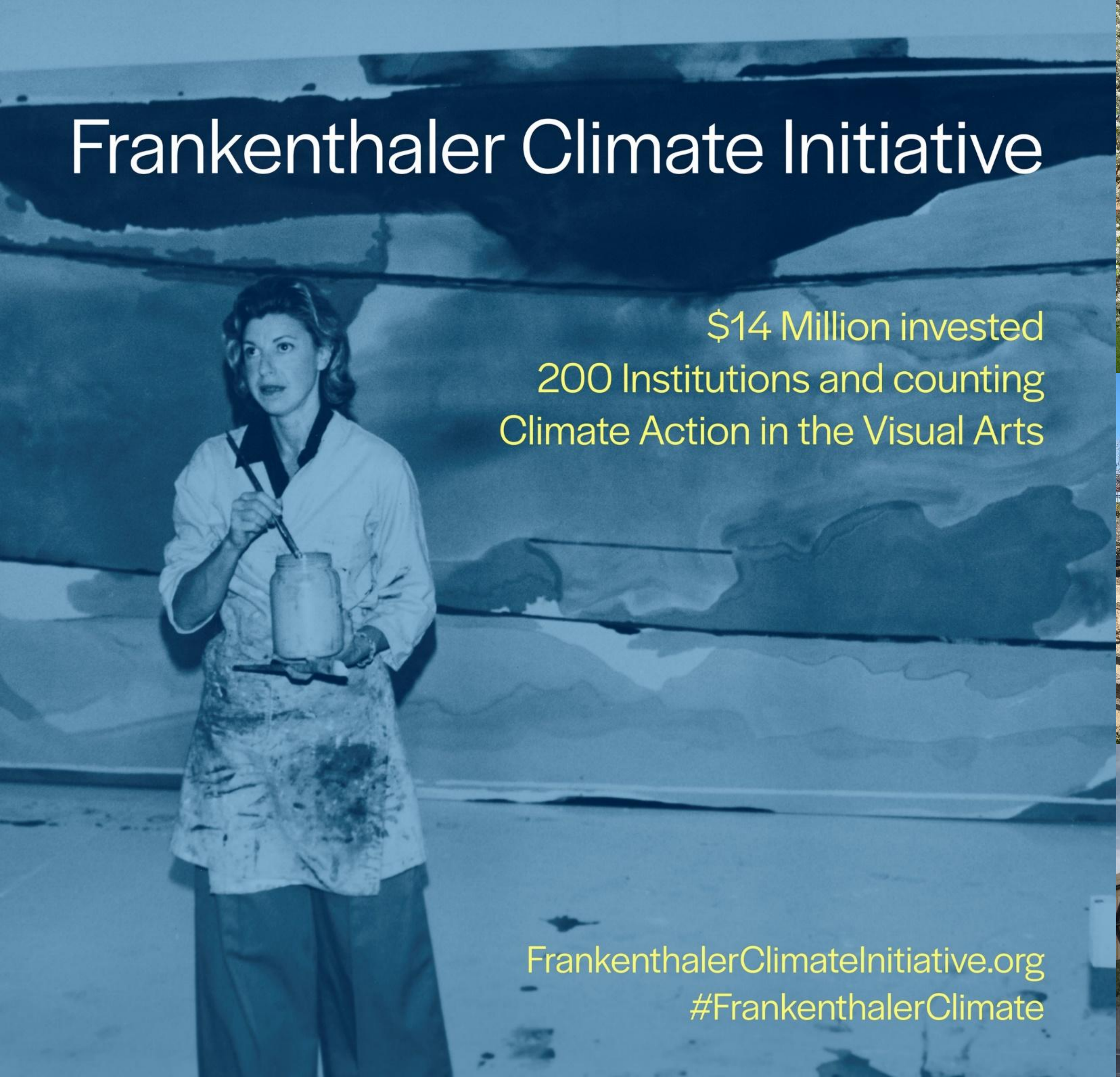
Watching Energy Star Portfolio Manager’s final disposition

Museum agencies are still standing

In all cases there could be disclosure requirements, so read the fine print

Frankenthaler Climate Initiative

$14 Million invested
200 Institutions and counting
Climate Action in the Visual Arts



FrankenthalerClimateInitiative.org
#FrankenthalerClimate

Helen Frankenthaler in her East Eighty-third Street studio, New York, in front of "Hybrid Vigor" (1973, in progress), 1973. Courtesy Helen Frankenthaler Foundation Archives, New York. Photograph by Edward Youkilis. Artwork © 2024 Helen Frankenthaler Foundation, Inc. / Artists Rights Society (ARS), New York

Min/Max: The Relationship Between Energy, Carbon and T/RH Parameters in Collecting Institutions

Background

Terms

Plus/Minus or “Min/Max”

*The practice of maintaining temperature and relative humidity (T/RH) parameters **broader** than the common practice of **70°F/ 50% RH** (24°C/ 50% RH).*

Min/Max reflects the variances of conditions created by mechanical systems **AND**
the potential variances appropriate for materials.

Bizot Green Protocol

…is composed of guiding principles, guidelines relating to climate controls and a series of handbooks to provide evidence, shared practice and tools.

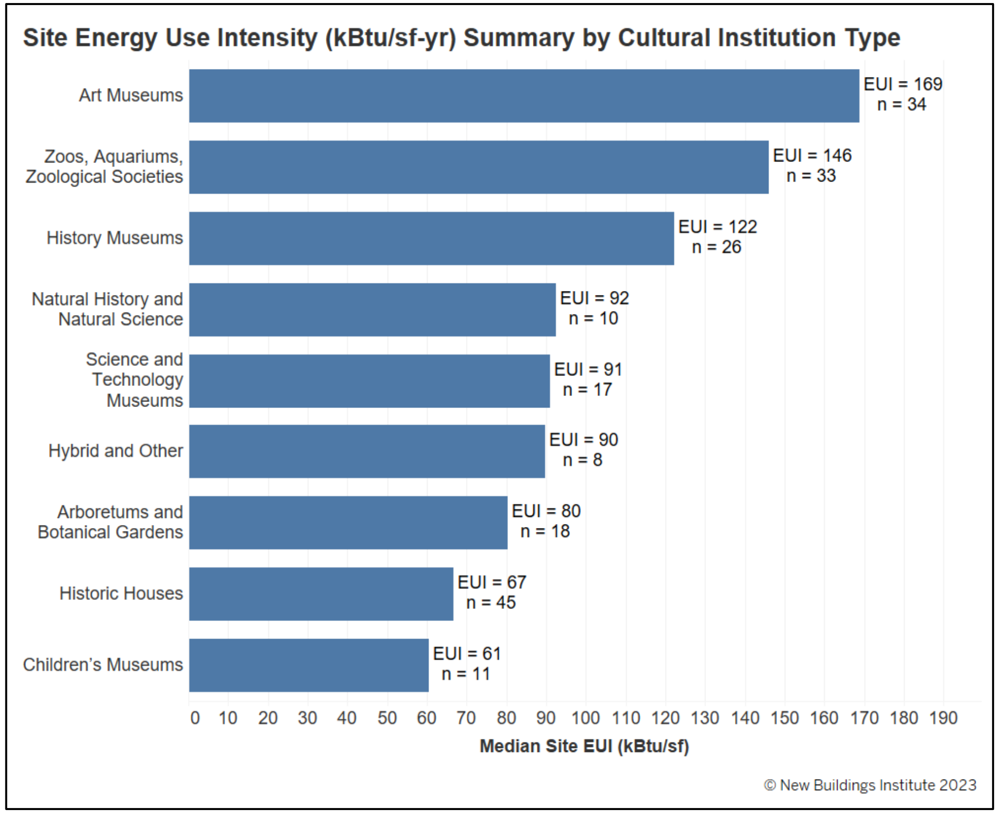
The Bizot Green Protocol 2023, p.3

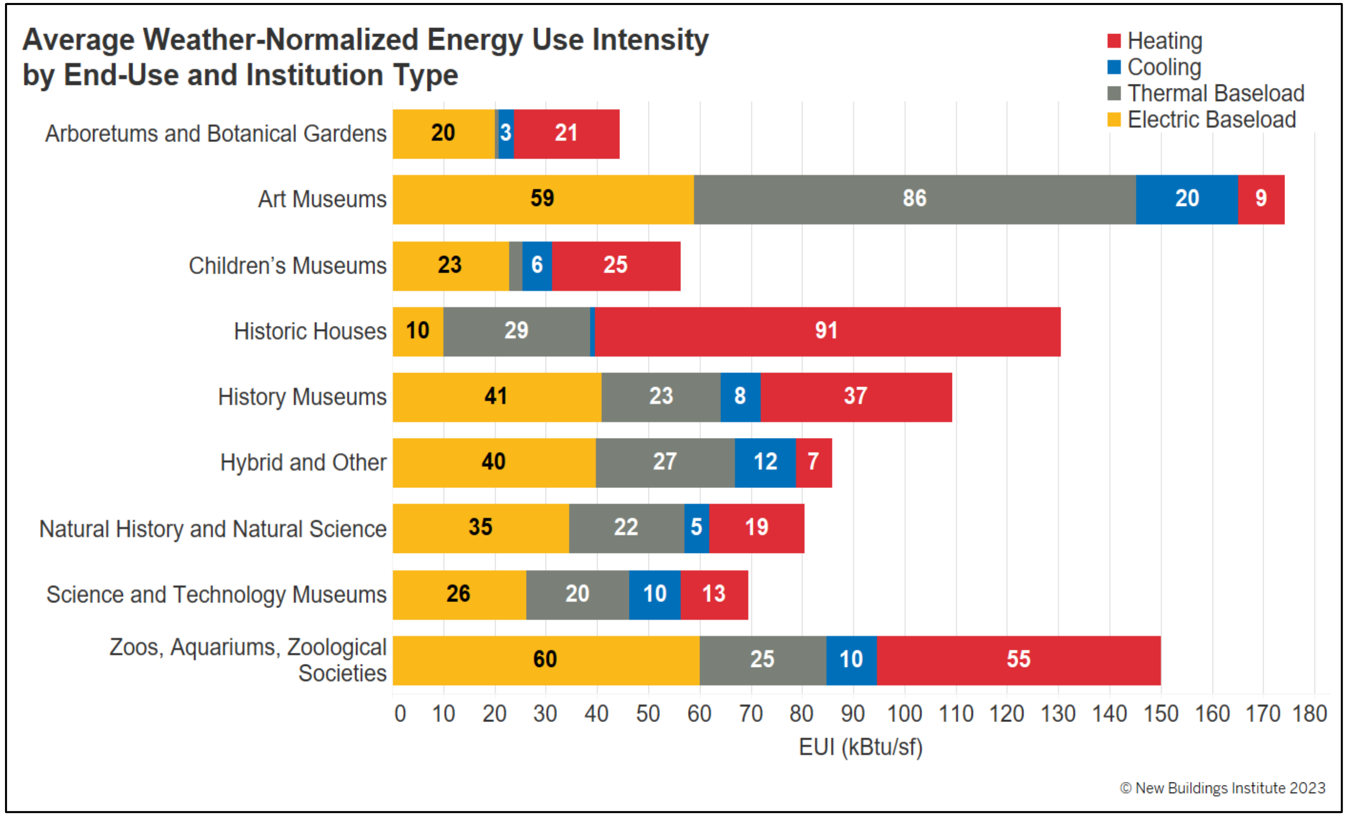
Culture Over Carbon: Understanding the Impact of Museums' Energy Use

- IMLS-funded national research study (2021–2023).
- Awarded to New England Museum Association and conducted in partnership by Environment & Culture Partners and New Buildings Institute.
- Resulted in the creation of the **cultural sector's first in-depth energy use analysis** and the **first estimate of the sector's energy impacts on climate**.

- Culture Over Carbon report, 2023

The research from Culture Over Carbon identified **art museums** as having the **highest energy use intensity** (EUI) out of eight other museum and cultural organization types, which **equates to higher energy costs and operational carbon emissions**.





Min/Max: The Relationship Between Energy, Carbon and T/RH Parameters in Collecting Institutions

IMLS National Leadership Grant (2024–2026) for national research study

Conducted by Environment & Culture Partners (ECP) with:

- partners at New Buildings Institute (NBI),
- collaborators at A2 Efficiency (A2),
- and an advisory team of experts in museums, object conservation, and energy efficiency and building performance.

Examines energy use at eight art museums:

- in varied climate regions of the US,
- that store and exhibit art and material culture,
- and have spaces managed at temperature/relative humidity (T/RH) parameters broader than the common practice of 70°F / 50% RH.

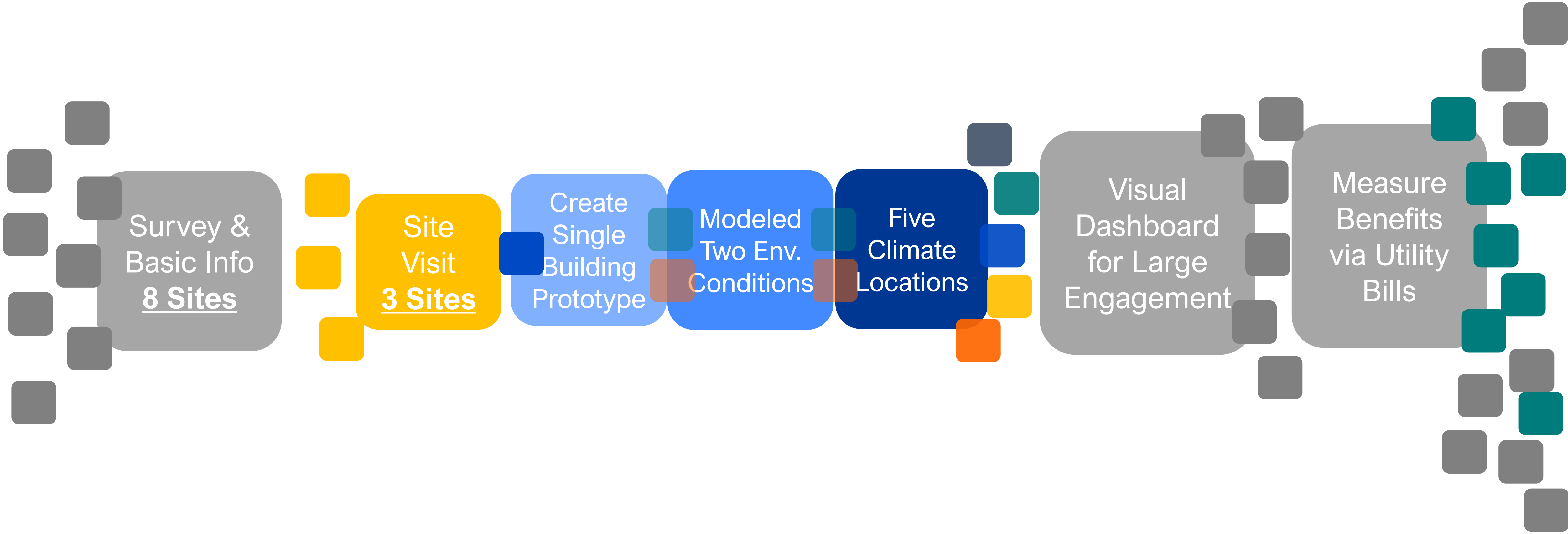
Project Goals

- Identify appropriate environmental conditions for collections under which changes to practice can **save money and energy and reduce harmful greenhouse gas emissions while maintaining standards** of care for art and material culture.
- Develop **free decision-making tools** for professionals and organizations.
  - Energy dashboard, based on data modeled on actual experience and conditions
  - Case studies of project participants
  - Report, Factsheet, and Recommendations

Min/Max Research Project

Data-driven Approach

Approach


Survey & Basic Info
8 Sites
Site Visit
3 Sites
Create Single Building Prototype
Modeled Two Env. Conditions
Five Climate Locations
Visual Dashboard for Large Engagement
Measure Benefits via Utility Bills

Targeted survey questions isolate important details

Occupancy patterns

- Staff and visitor hours
- Special events

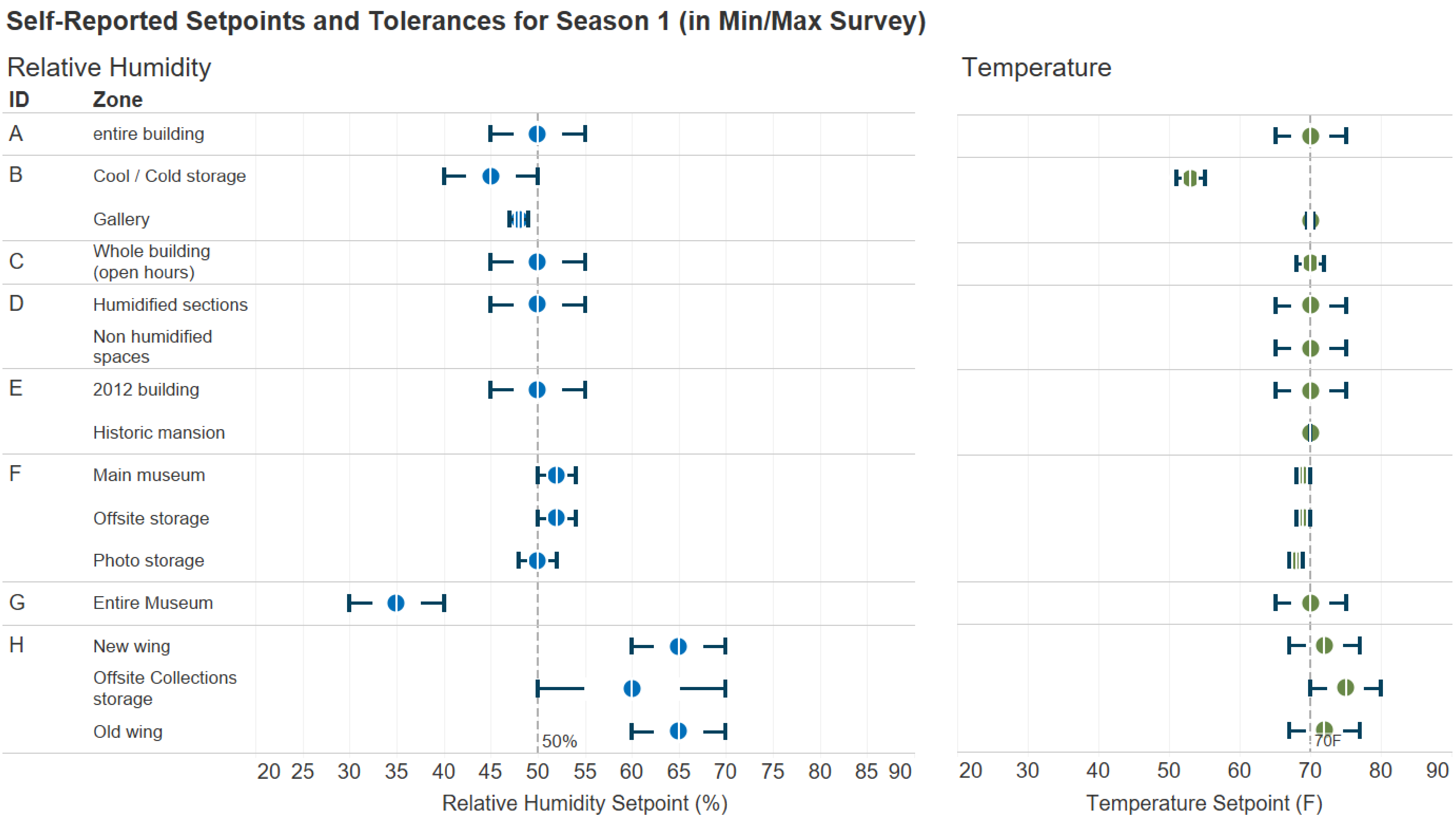
Building attributes

- Envelope
- HVAC equipment + zoning
- Collections monitoring equipment

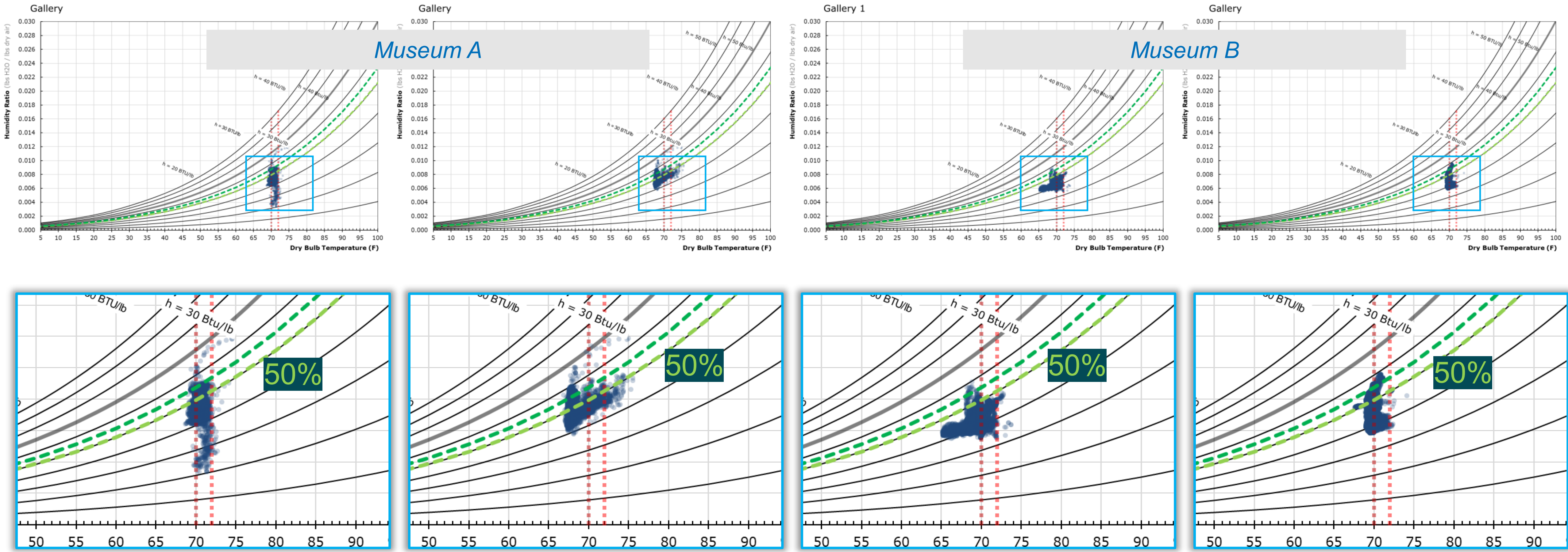
Operations

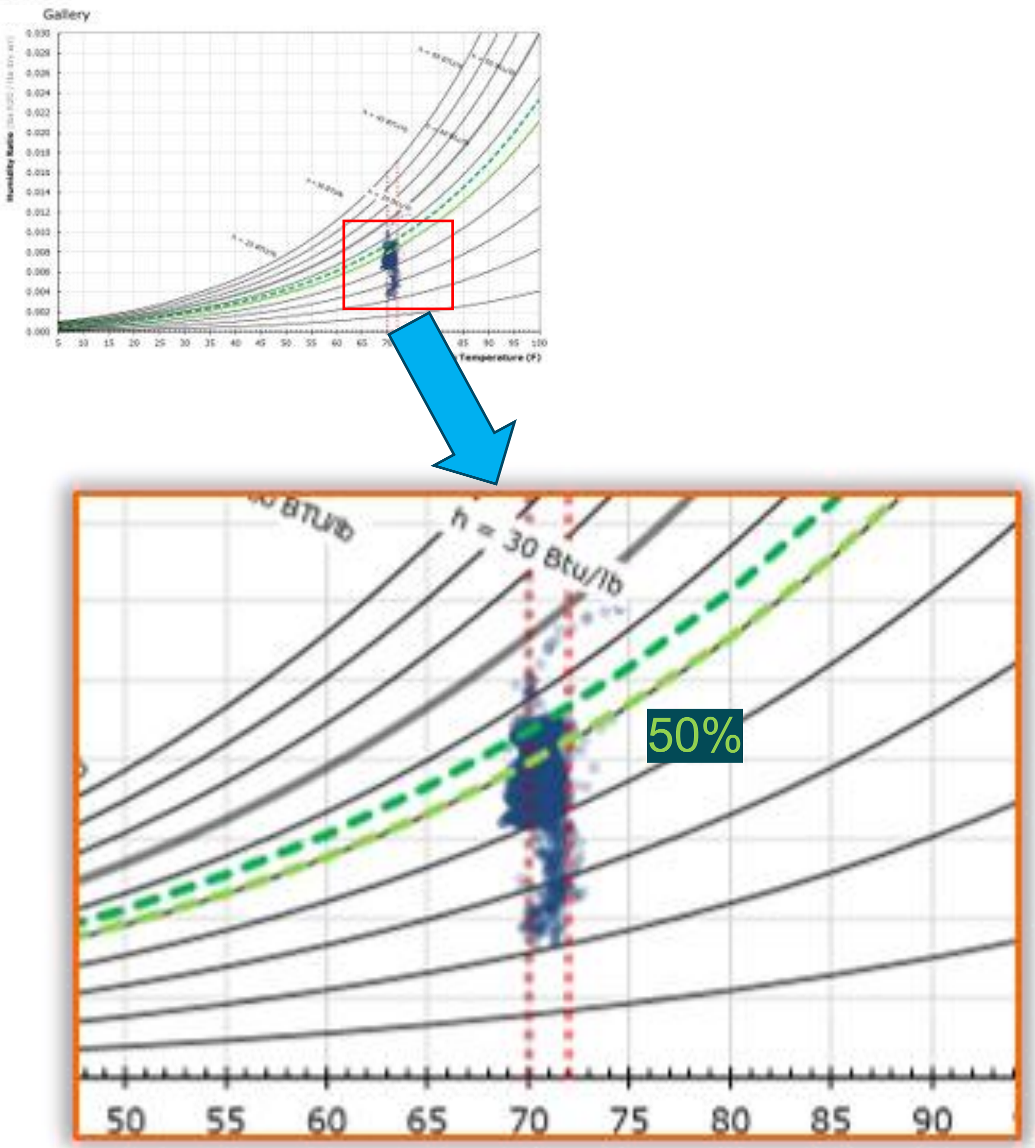
- T/RH setpoints and schedules
- Data monitoring + management
- Policies (energy, environmental controls)

Comparing responses graphically offers insights

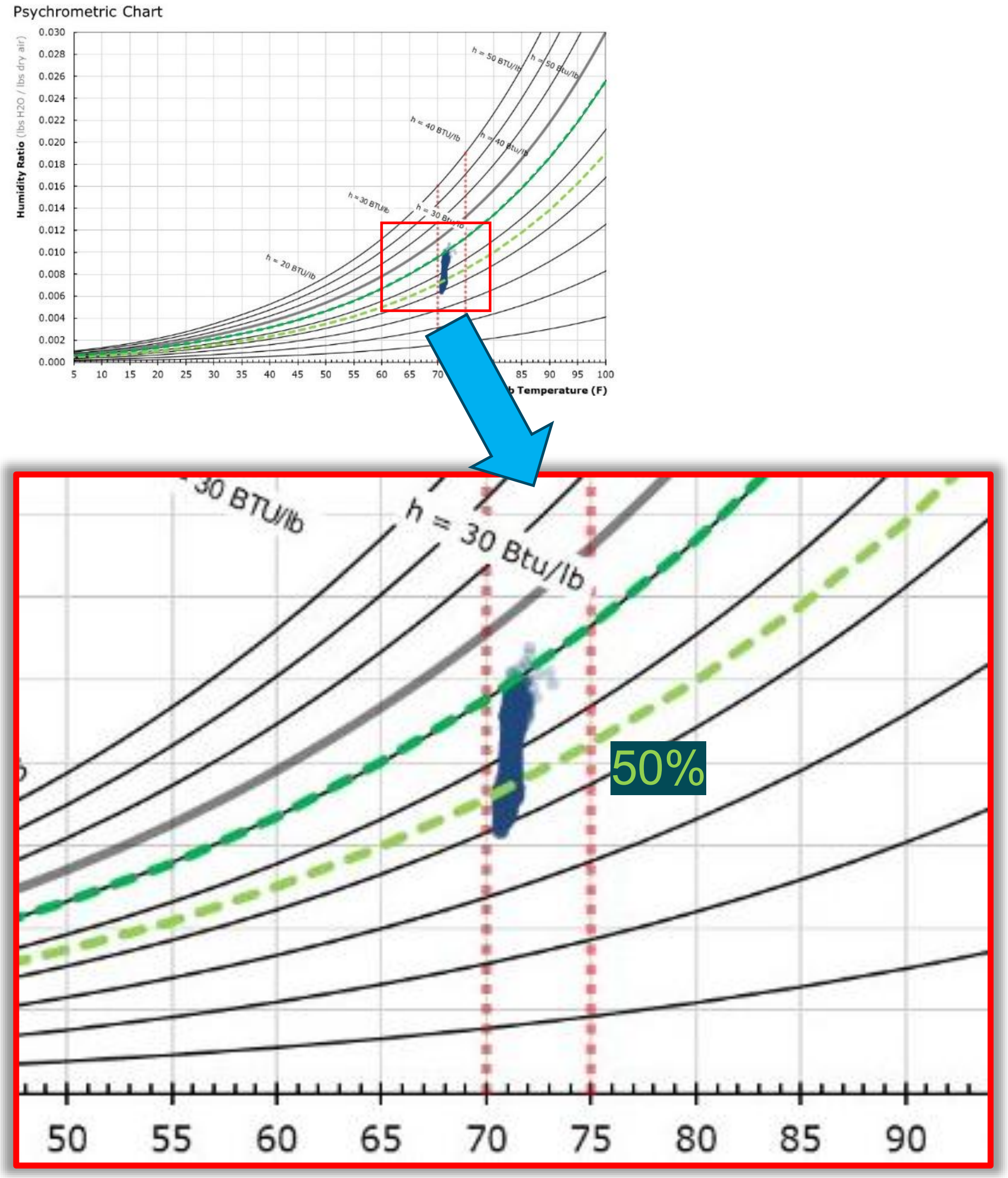


Actual Museum Gallery Conditions



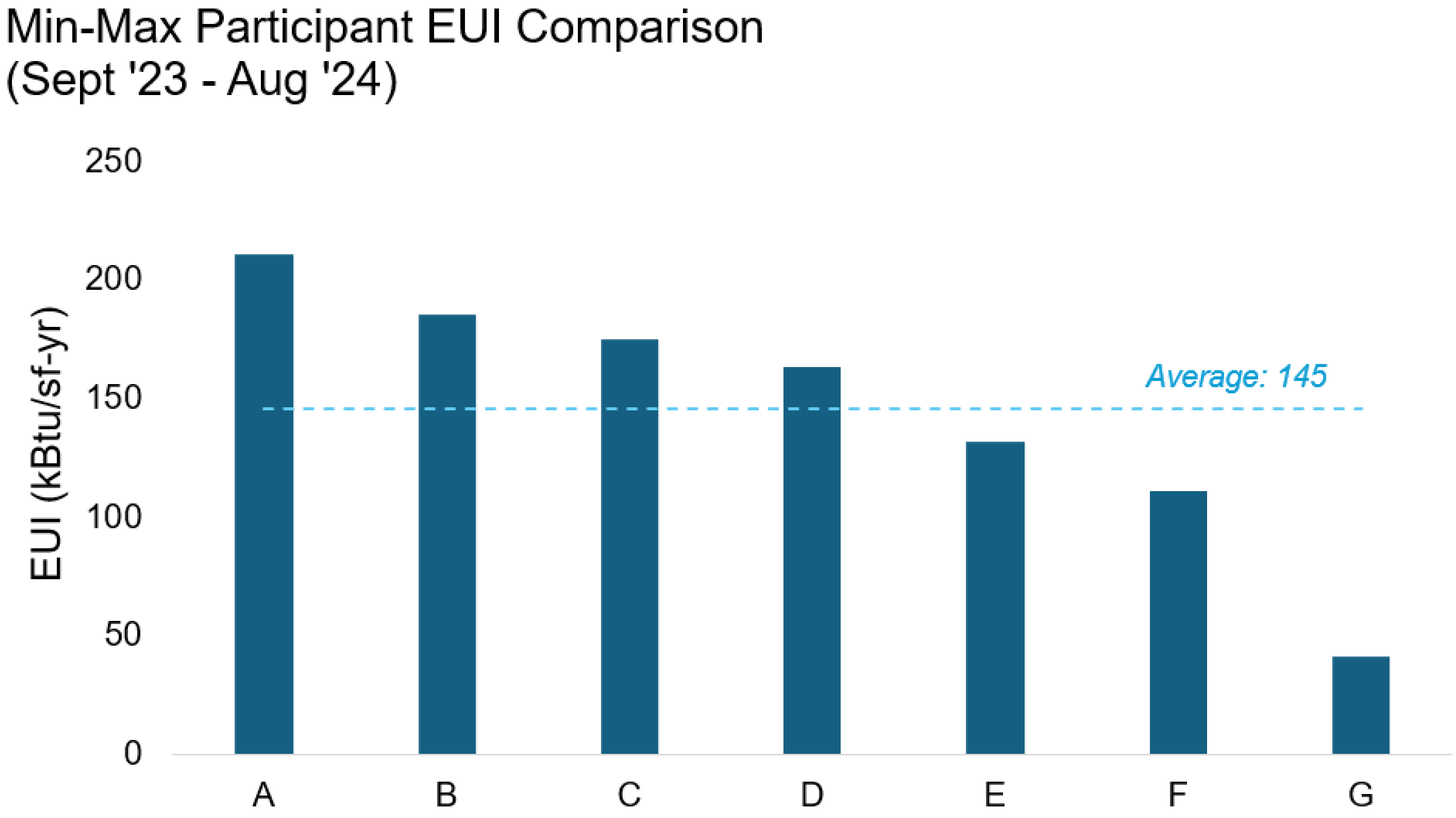


Actual environmental conditions in museum partner collection space



Modeled broadened environmental setpoints 40%–60% RH, 72–75ºF

Energy data provides a top-line comparison



How can the sector quantify the energy and cost savings of different parameters?

- **What we know**
  - Energy and cost savings have been demonstrated in individual cases, and...
  - ...Every building is unique

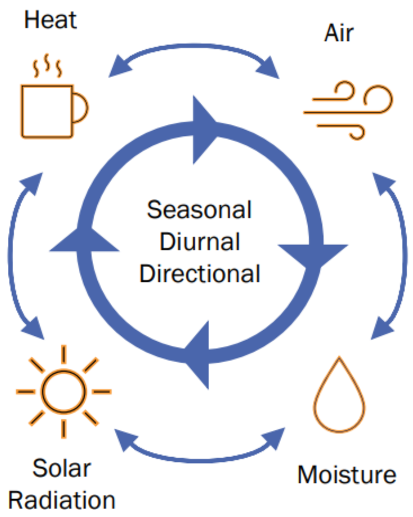
- **What we are hoping to do**
  - Establish a methodology that provides more tailored insights by grouping key museum characteristics

It turns out that exploring broadened T/RH reveals a lot of other questions and ideas.

Through review of **museum participant data**, paired with observations from the 3 **site visits**, we've found several **emergent themes and considerations** that intersect with questions and opportunities about broadened T/RH parameters.

Buildings | **Operations** | **Staff**

Building Condition Context



Systems & Equipment

Dataloggers

- Critical indicator of a room's suitability for collections.
- Alert to drastic fluctuations in T/RH.

HVAC

- HVAC condition and age may impact broadened parameters.
- Centralized HVAC may limit broadened parameters.

Envelope

Internal space impacts

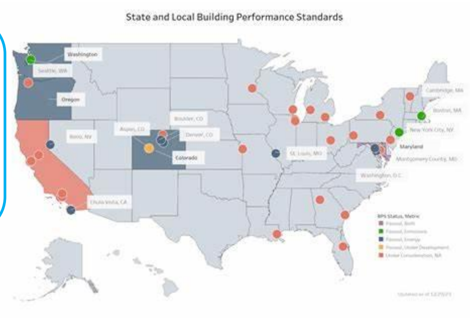
- Examples: Water leaks (moisture), pests, airtightness
- Impact: Can increase energy consumption – HVAC working harder to counteract issues

Basic building design awareness

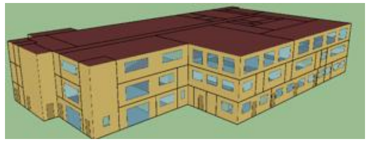
- Example: gallery locations in relation to doors
- Impact: The building is a system, vs a set of isolated pieces – consider how this plays into upgrades.

What is a building energy model?

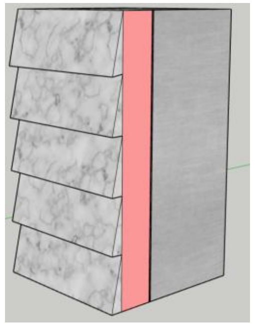
(1) Location & Climate



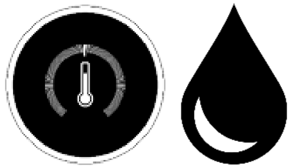
(2) Building Shape



(3) Building Skin



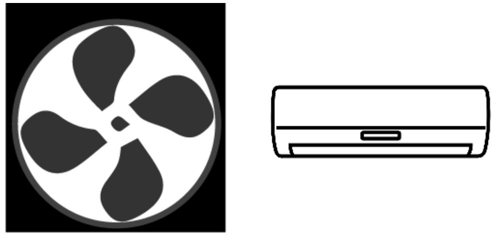
(4) Indoor Environment



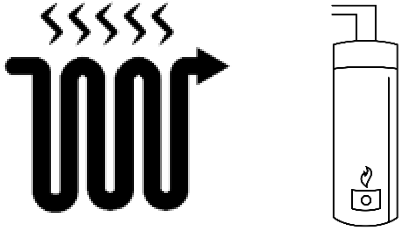
(5) Schedules

(6) Usage & Internal Equipment

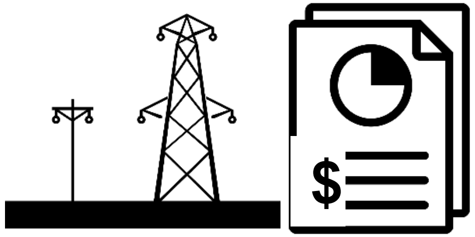
(7) Air HVAC



(8) Water HVAC

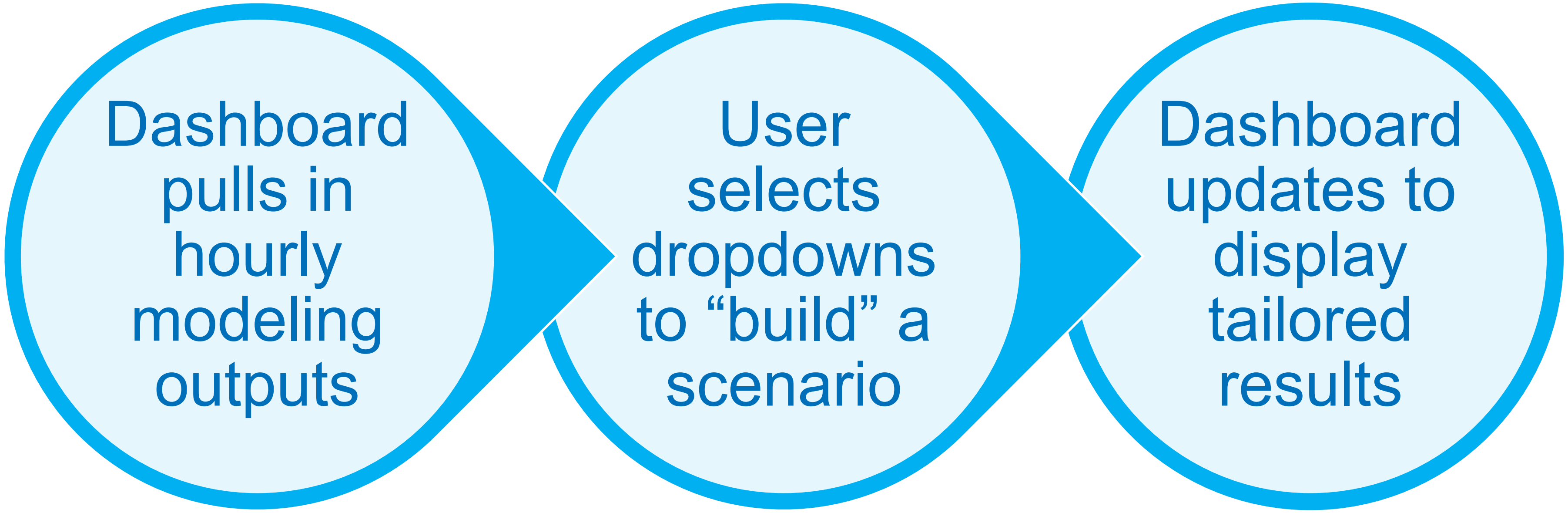


(9) Generation, Utilities & Emissions



Interactive visual dashboards allow users to leverage our results for their building(s)

- How it works (generally):

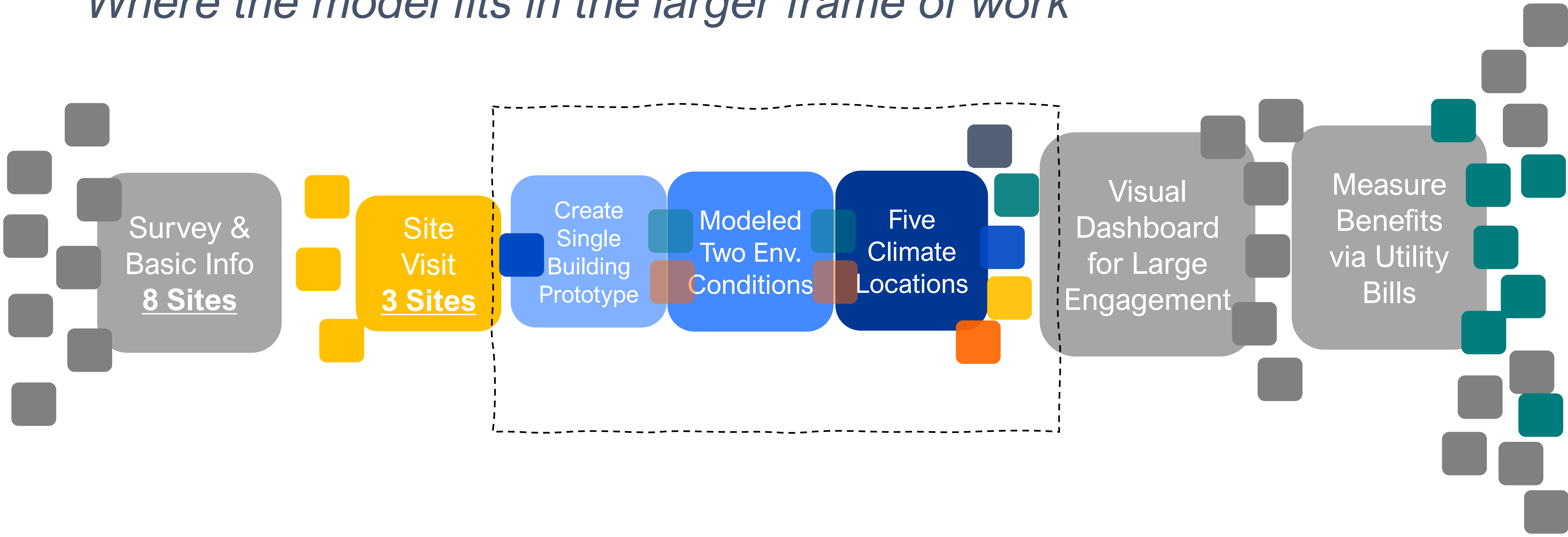


Min/Max Research Project

Building Energy Model, Assessment and Preliminary Results

Min Max Project Assessment Process

Where the model fits in the larger frame of work



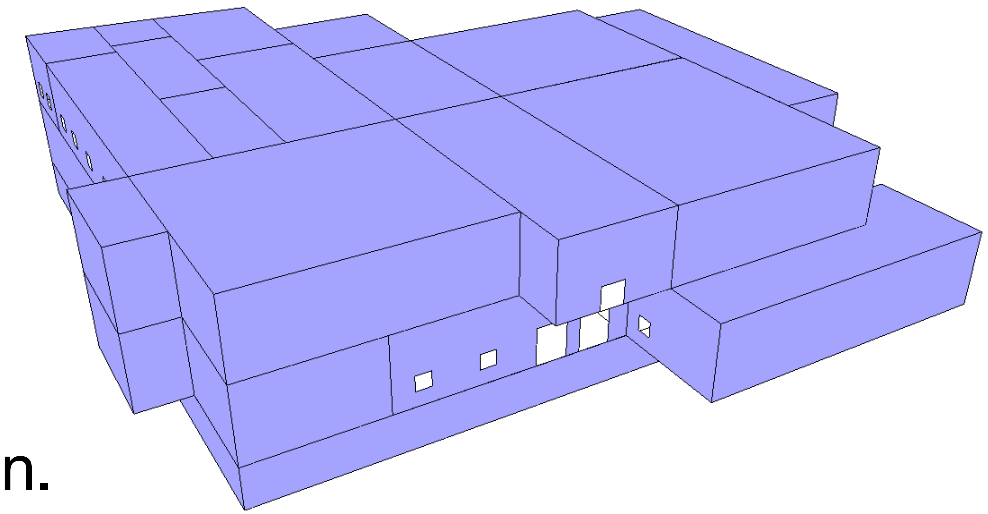
Single Building Prototype Building Energy Model

Benefits

- Simulates the physical environment over a whole year.
- Allows for detailed HVAC system configurations and system controls.
- Accounts for unique attributes, people patterns, events.

Limits

- Only represents one potential building configuration.
- Assumes systems always work as configured.
- Uses typical weather as opposed to a specific year of actuals.



View of prototype footprint (75,000 sf)

Energy Modeling Plan: 5 Climate Zones

Climate Zones

1. Chicago
2. NOLA
3. NYC
4. SEATAC
5. LAX

Energy Modeling Plan: Environmental Criteria

Standard Control

“70ºF at 50% RH”

70ºF
47%–50% RH

→

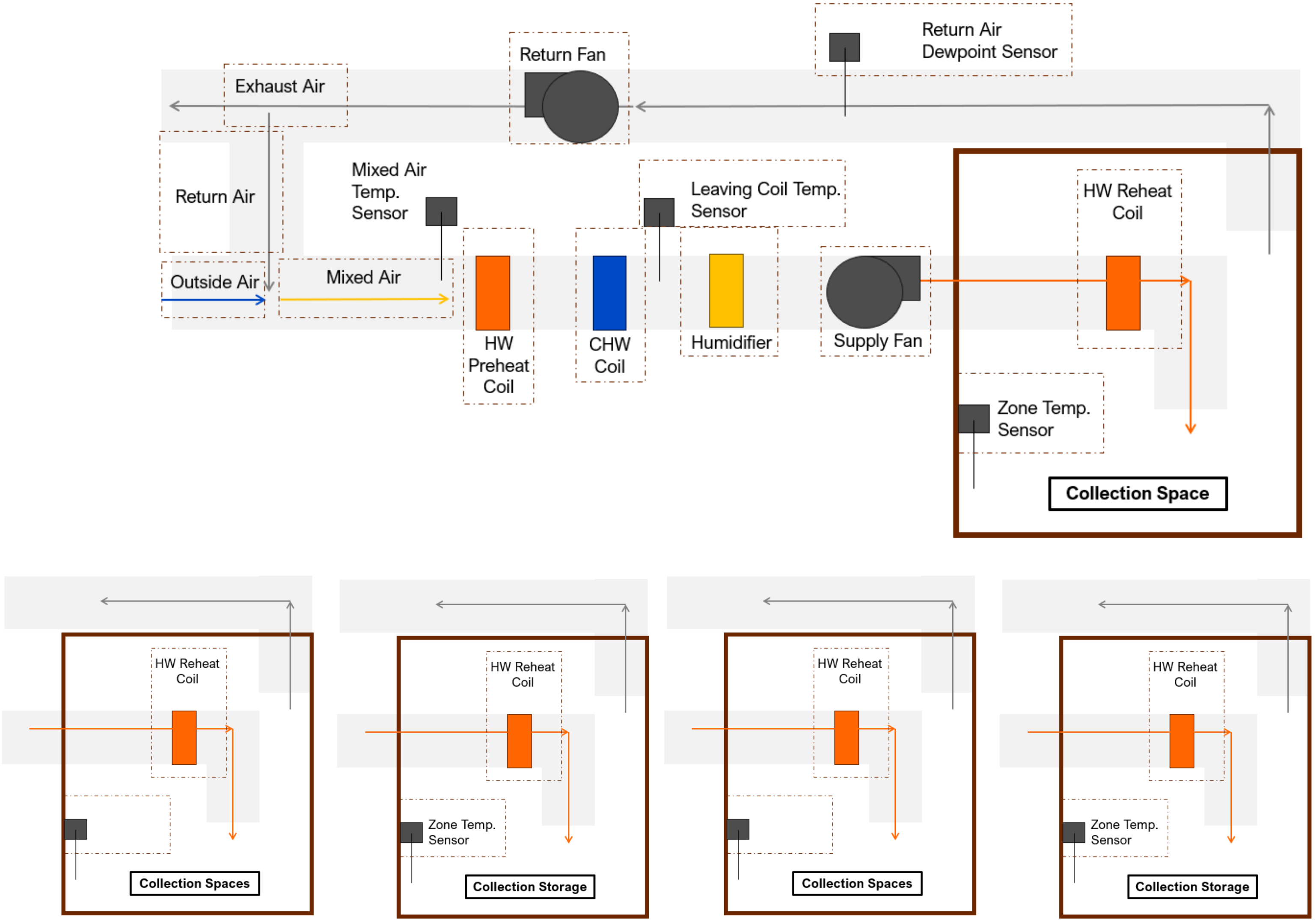
Broadened Control

“Expanded”

70–75ºF
42%–55% RH

Energy Modeling Plan: HVAC System Configuration and Control

- Large constant volume system serving multiple spaces
- Centralized Dehumidification & Humidification
- Humidity Controlled by Return-Air Condition (average of rooms)
- Room (zone) Re-Heating (controls temperature)



Results – Energy and Cost

Example results – single location

Attribute	Annual Gas Energy (kBtu)	Annual Electric Energy (kBtu)	Site EUI
BASE	9,148,986	3,386,125	167
BROAD	8,252,596	3,156,336	152
Savings	896,390	229,789	15
Savings %	9.8%	6.8%	9.0%

Energy Enduse	Annual Energy BASE	Annual Energy BROAD	Savings kBtu	Savings %
Interior Lighting (kBtu/h)	804,169	804,169	-	0%
Receptacle Equipment (kBtu/h)	319,323	319,323	-	0%
Space Heating & Reheating (kBtu/h)	7,128,492	6,517,538	610,955	9%
Humidification (kBtu/h)	2,020,493	1,735,058	285,435	14%
Service Water Heating (kBtu/h)	-	-	-	0%
Space Cooling (kBtu/h)	1,311,306	1,093,067	218,240	17%
Heat Rejection (kBtu/h)	-	-	-	0%
Interior Central Fans (kBtu/h)	818,009	818,004	5	0%
Exhaust Fans (kBtu/h)	234	234	-	0%
Pumps (kBtu/h)	132,605	121,061	11,545	9%

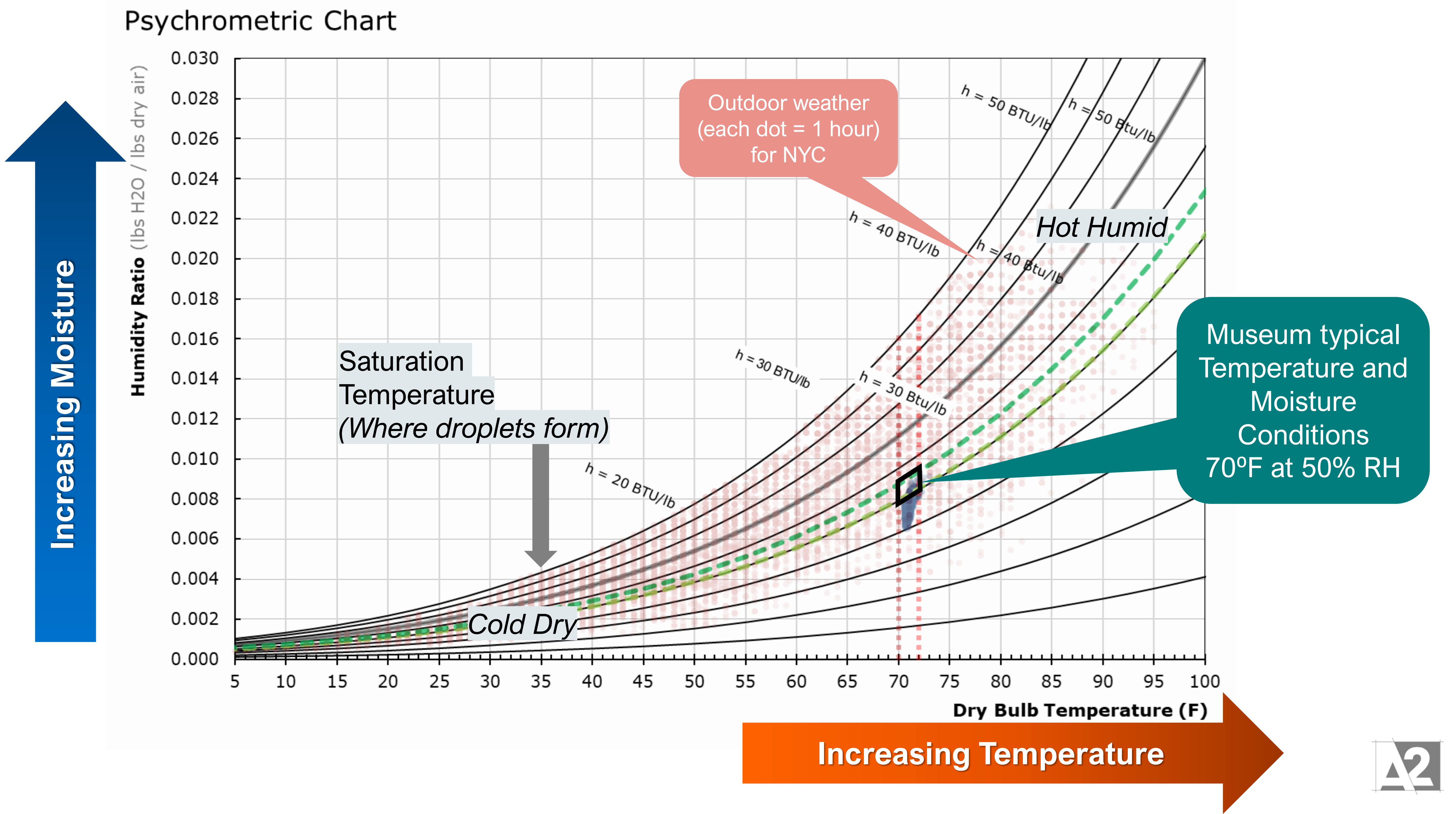
Energy Savings Results

Climate Location	Whole Building % Energy Savings	Whole Building % Energy Costs Savings	Annual Cost Savings per SqFt
Chicago	8%	7%	$ 0.09
SEATAC	10%	9%	$ 0.15
NYC	9%	8%	$ 0.38
NOLA	14%	11%	$ 0.40
LAX	15%	13%	$ 0.33

$/kWh and $/therm for each specific location based on either basic online research or provided utility bills by participating sites – these rates are flexible and can be easily updated or customized

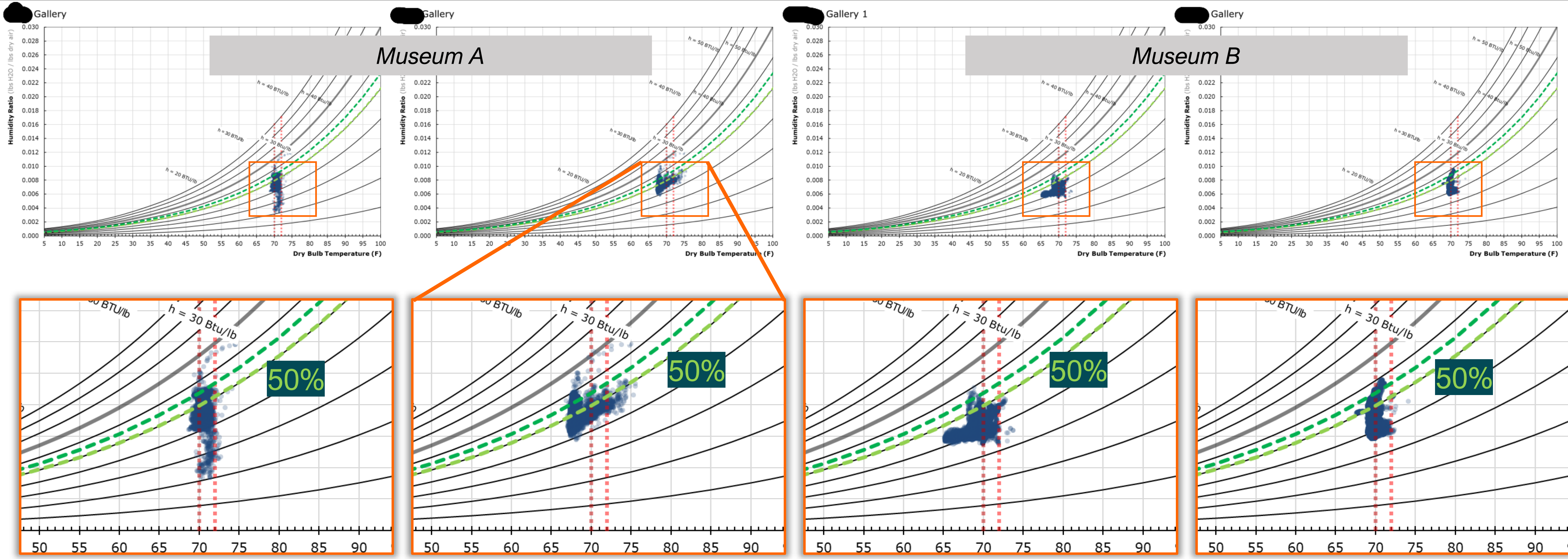
Results – T/RH

EFFICIENCY



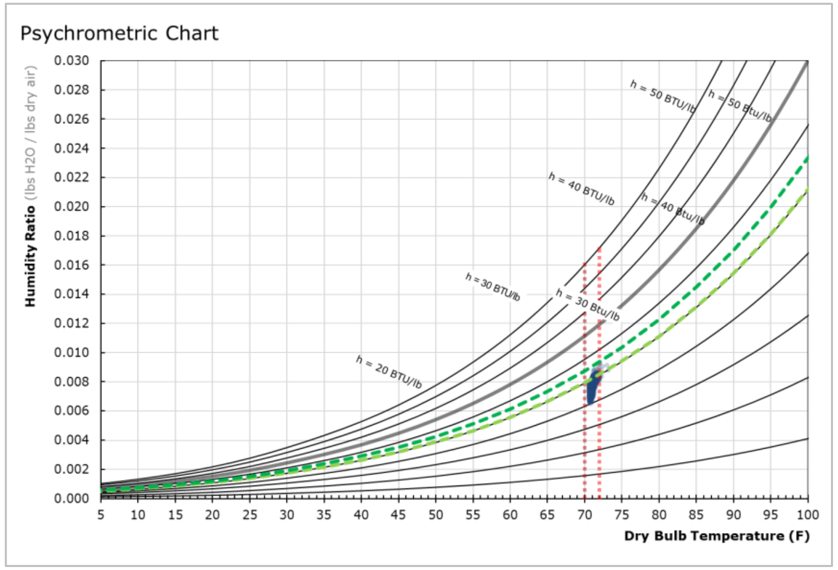
Psychrometric Chart
Increasing Moisture
Humidity Ratio (lbs H2O / lbs dry air)
0.030
0.028
0.026
0.024
0.022
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Dry Bulb Temperature (F)
Increasing Temperature
Outdoor weather (each dot = 1 hour) for NYC
h = 50 BTU/lb
h = 50 Btu/lb
h = 40 BTU/lb
h = 40 Btu/lb
h = 30 BTU/lb
h = 30 Btu/lb
h = 20 BTU/lb
Hot Humid
Saturation Temperature
(Where droplets form)
Cold Dry
Museum typical Temperature and Moisture Conditions
70ºF at 50% RH

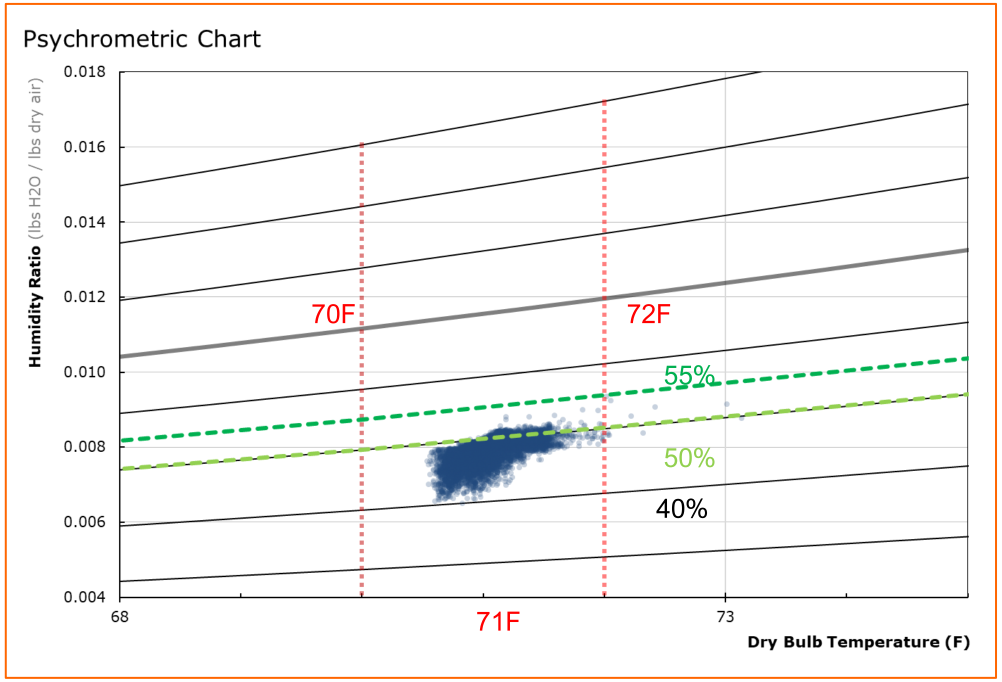
Data From Field Sites



Logger data from two field sites for different galleries shows a spread of operating conditions around 70ºF and 50% RH, most sites maintaining 68–72ºF. Moisture values show at or below 50% RH with several sites at 40% RH frequently.

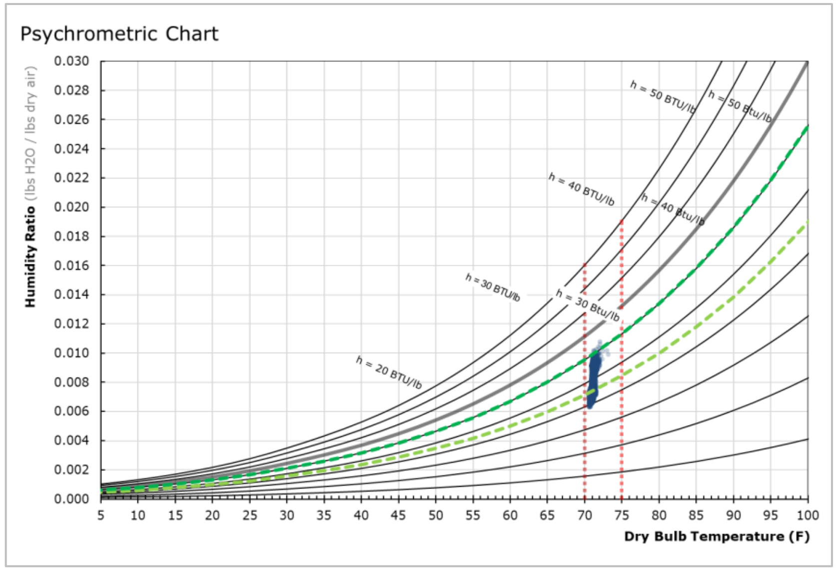
Base Parameters Case

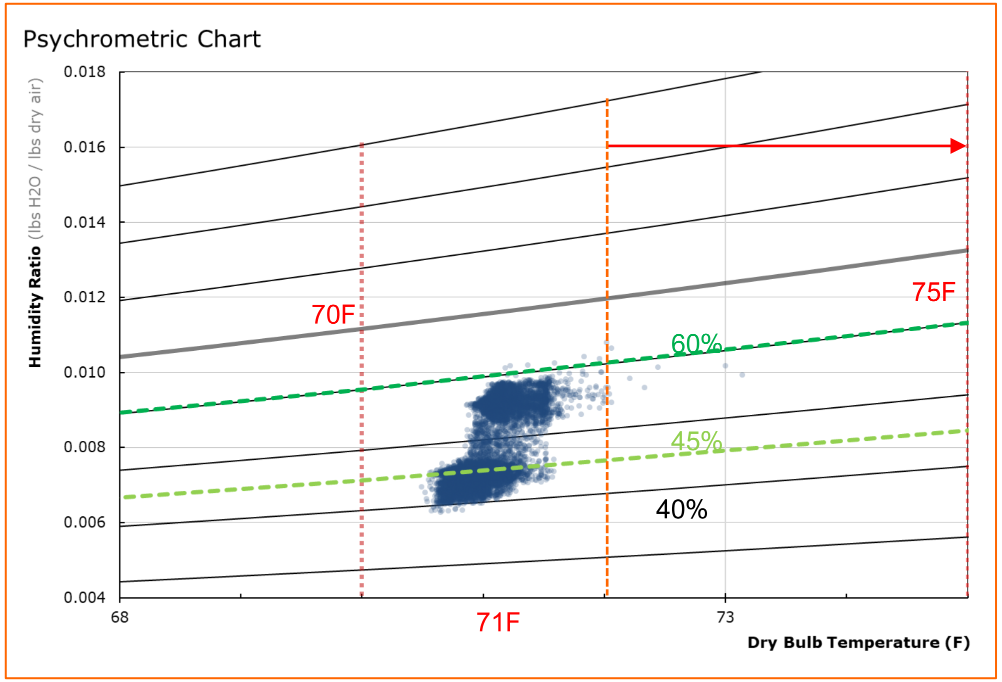




Similar results from the model as observed in field sites, temperature is maintained, moisture tends to be at or below the setpoint.

Expanded Parameters Case





With expanded operating parameters moisture tends to be more spread, up to 60% down to 40% RH.

Little to no change in indoor temperature due to HVAC Constant Air Volume Configuration.

Min/Max Research Project

Interactive Visual Dashboard

Min Max: The Relationship Between Energy, Carbon, and T/RH Parameters in Collecting Institutions

About the project

Min/Max is a national research project funded by an Institute of Museum and Library Services (IMLS) National Leadership grant led by Environment & Culture Partners in partnership with New Buildings Institute and with support from A2 Efficiency. The project explores the practice of broadening temperature/ relative humidity (T/RH) parameters beyond the outdated practice of 70°F/ 50% RH, to identify any appropriate environmental conditions for collections under which changes in practice can save money and energy, and reduce harmful greenhouse gas emissions while maintaining standards of care.

About this dashboard

This dashboard summarizes the modeled results of broadening parameters in a prototypical museum. The building energy models were built based on real-world data collected through the course of the Min/Max project.

A more detailed description of the modeling process and assumptions can be found in the User Guide.

Click Here to Access the Dashboard

nbi new buildings institute   Environment & Culture Partners   Institute of Museum and Library Services

References
[1] https://www.eia.gov/electricity/data/browser/ and https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_a.htm
[2] https://portfoliomanager.energystar.gov/pdf/reference/Emissions.pdf

Summary of modeled energy savings associated with broadening parameters

Impact of Expanded Parameters on Energy Consumption

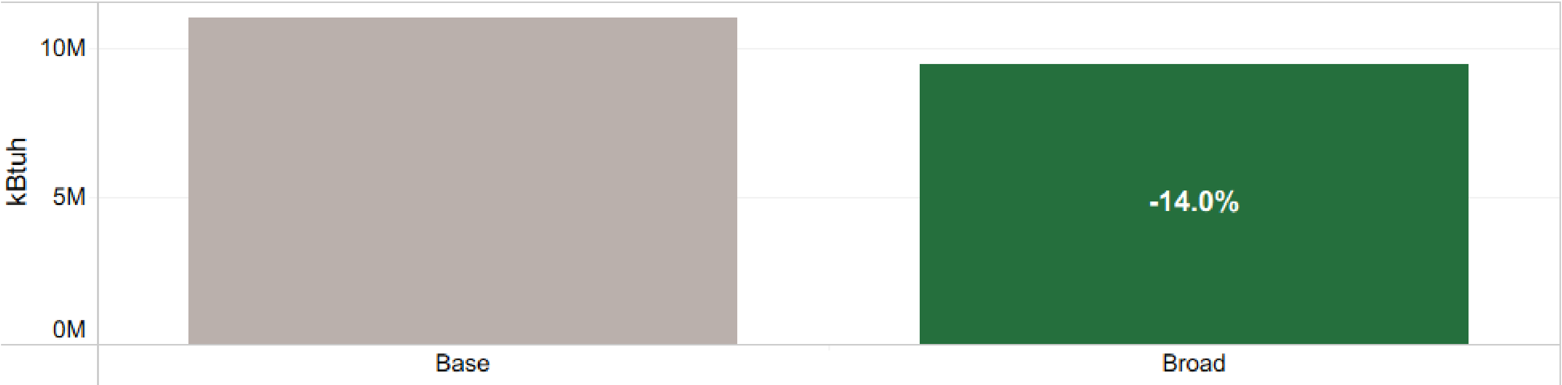
The graphics below show the impact of broadening T and RH parameters on building energy use. The first graphic shows the total annual energy consumption, and the lower bar charts isolate the electric (left) and gas (right) consumption. Use the dropdown menu to select the location you want to see.

Select Climate Region: New Orleans, LA

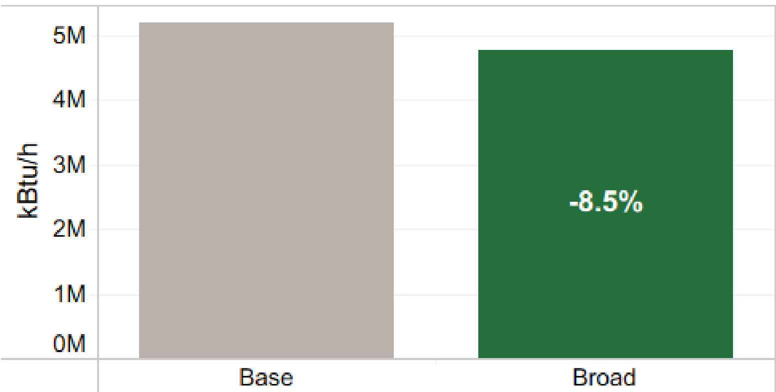
Energy Use Intensity (EUI)

Base	Broad
147	127

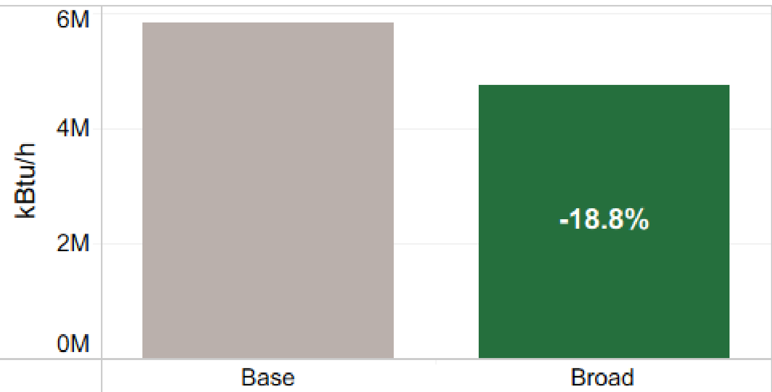
Total Combined Annual Energy (kBtu/h)



Total Annual Electric (kBtu/h)



Total Annual Gas (kBtu/h)



Return to Start

Next View

How specific building energy use might change under a broadened scenario

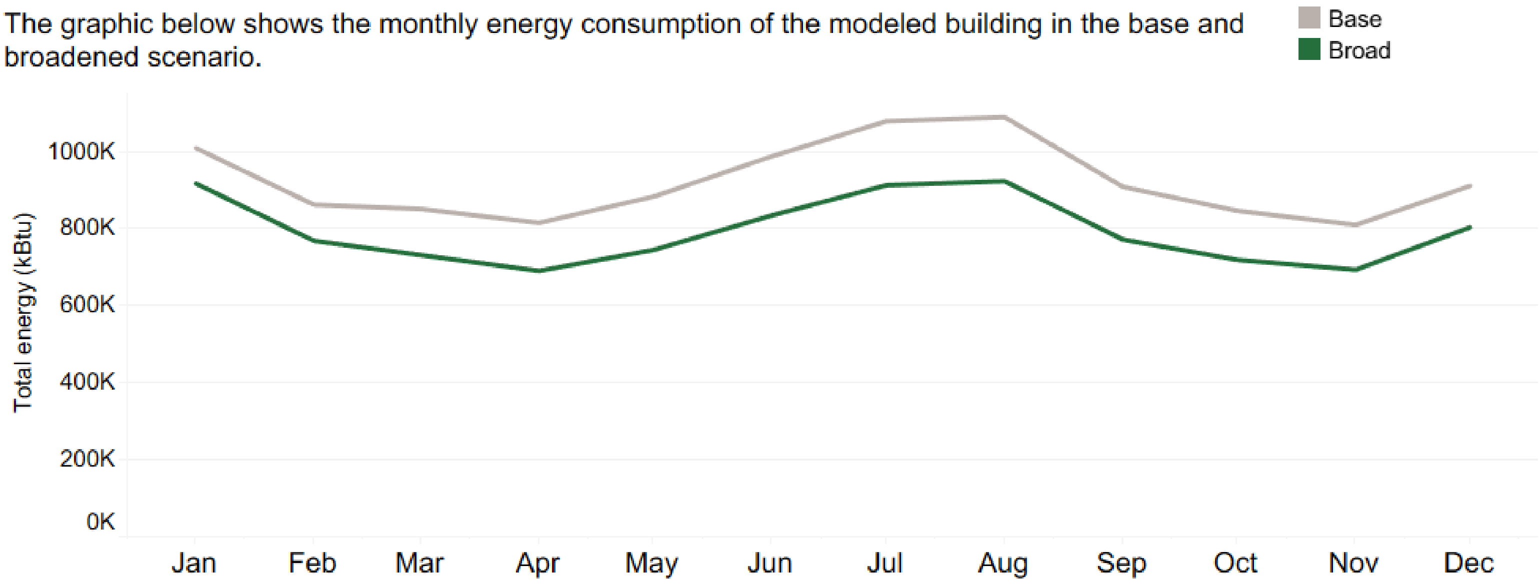
Impact of Expanded Parameters on Energy Consumption

The table below shows the impact of broadening T and RH parameters on specific types of building energy use, as a percent reduction.
Use the dropdown menu to select the location you want to see.

Select Climate Region: New Orleans, LA

% Difference in Space Heating (kBtu/h)	-19%
% Difference in Humidification (kBtu/h)	-21%
% Difference in Space Cooling (kBtu/h)	-14%
% Difference in Pump Energy (kBtu/h)	-10%

The graphic below shows the monthly energy consumption of the modeled building in the base and broadened scenario.



Previous View

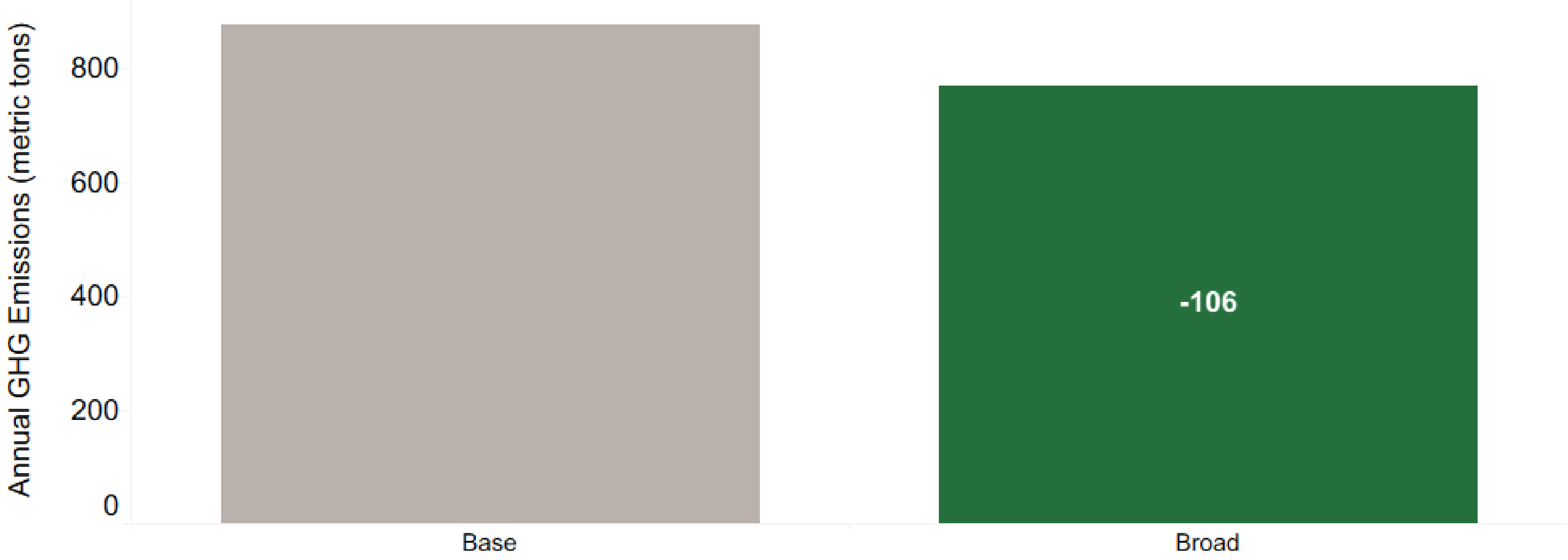
Next View

GHG view

Impact of Expanded Parameters on Energy Consumption - GHG Emissions

The table below shows the estimated GHG emissions avoided due to the modeled T/RH broadening scenario.Emissions factors are taken from ENERGY STAR Portfolio Manager's Greeenhouse Gas Emissions Technical Reference [2].

Select Climate Region: New Orleans, LA



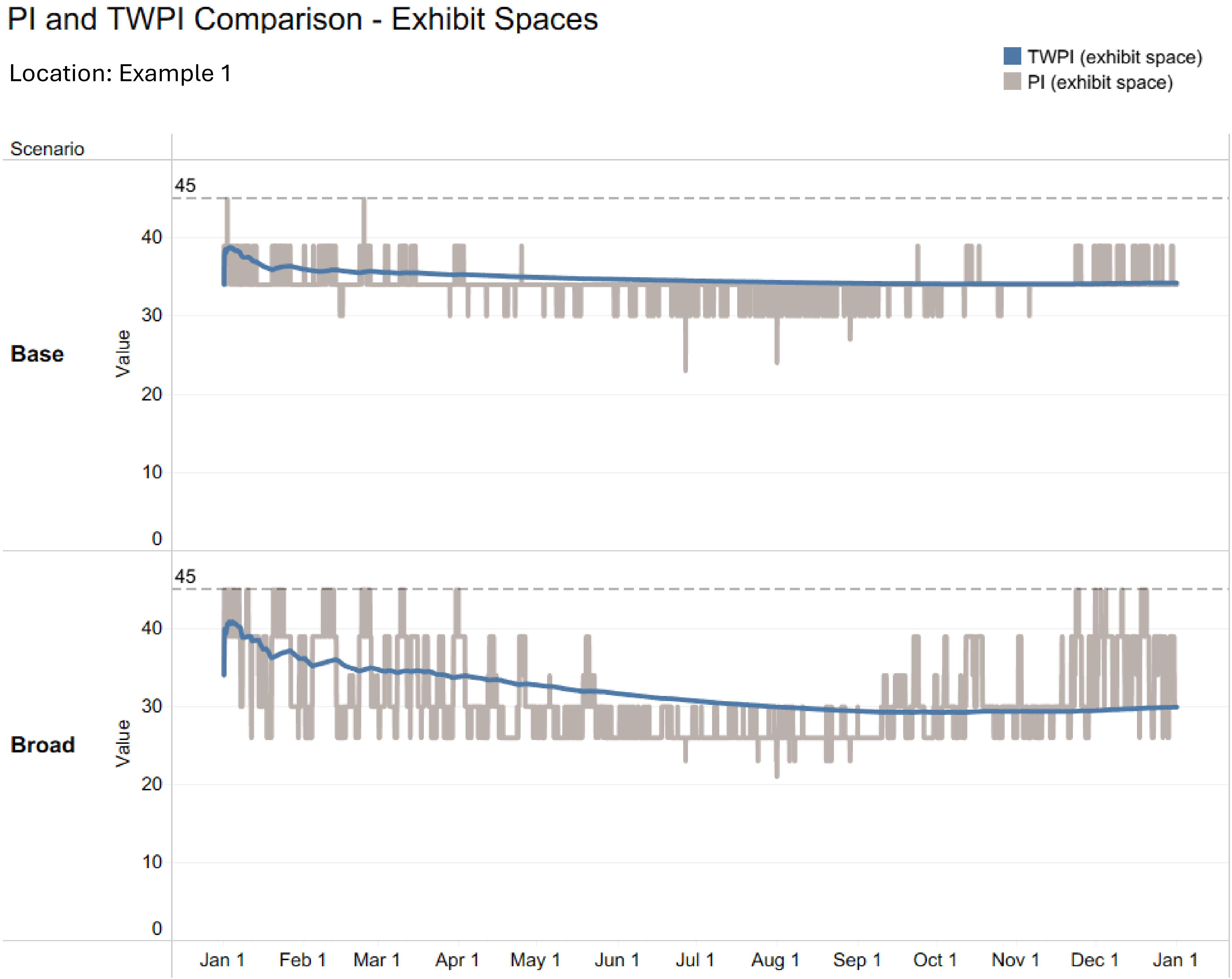
Savings equivalent to: **(14)** homes' energy use for one year

GHG equivalencies are taken from the EPA's calculator here:
https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Previous View

Next View

In development: preservation metrics view



The Case for Climate Resilience

Resilience

The ability to recover effectively and to successfully adapt to challenges through flexibility and adjustment to external and internal needs.

Definition adapted from the U.S. Climate Resilience Toolkit by the Climate Resilience Resources for Cultural Heritage project

“The most important action you can take is with others.”

Edward Maibach, Director
George Mason University Center for Climate Change Communication

Collective action nurtures the conviction that change is possible.

Leverage your *Friends From Before*

Social networks are significant indicators of resilience, and we are good at fostering social settings and networks

Know each other

Know strengths, abilities, needs, and capacity

Understand how to work together

Have enough trust and confidence to adapt

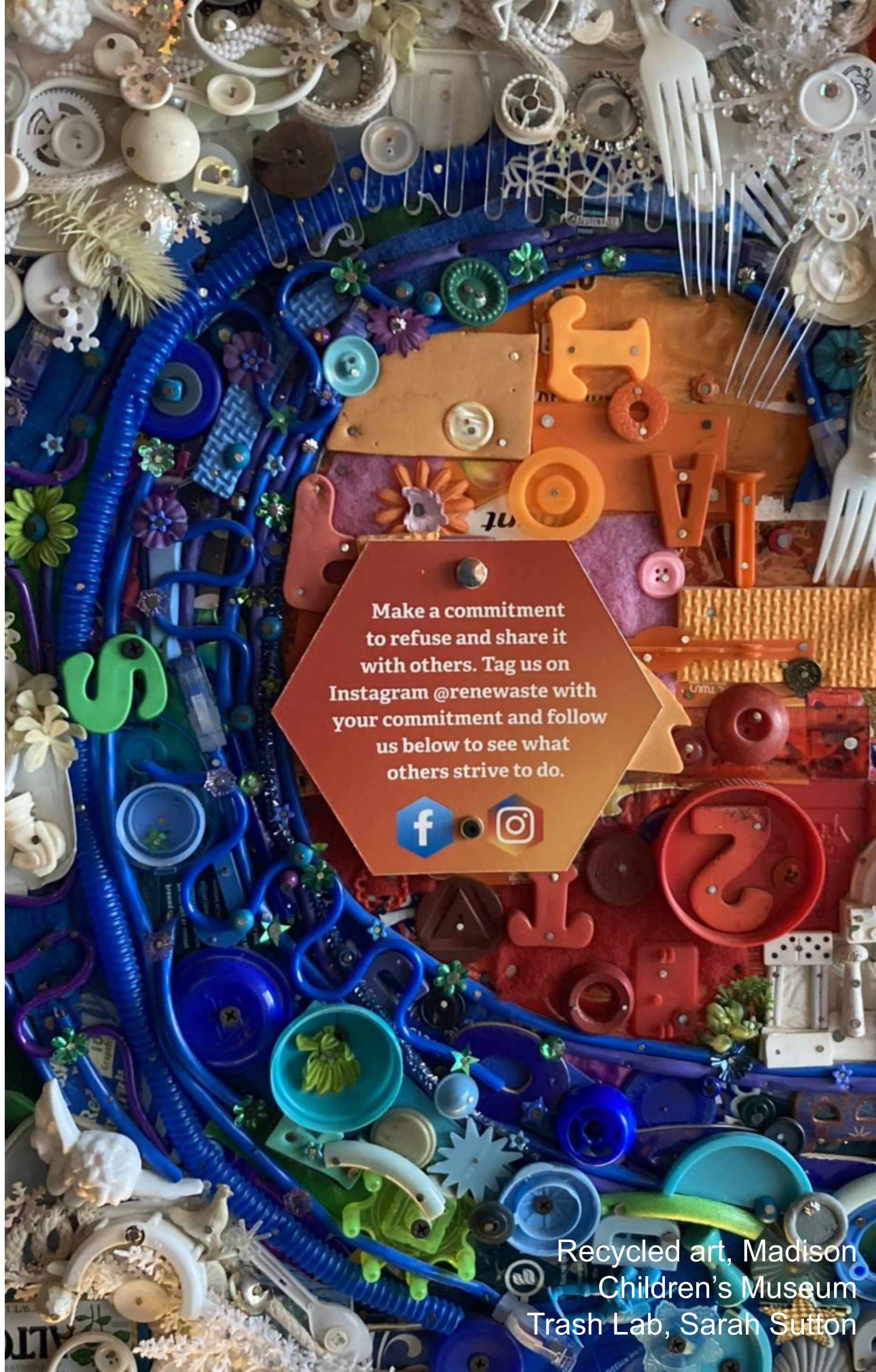
Quickly and thoroughly respond to a crisis

Museums as Second Responders

No one can weather devastation alone; networks of ***Friends from Before*** are critical. Consider:

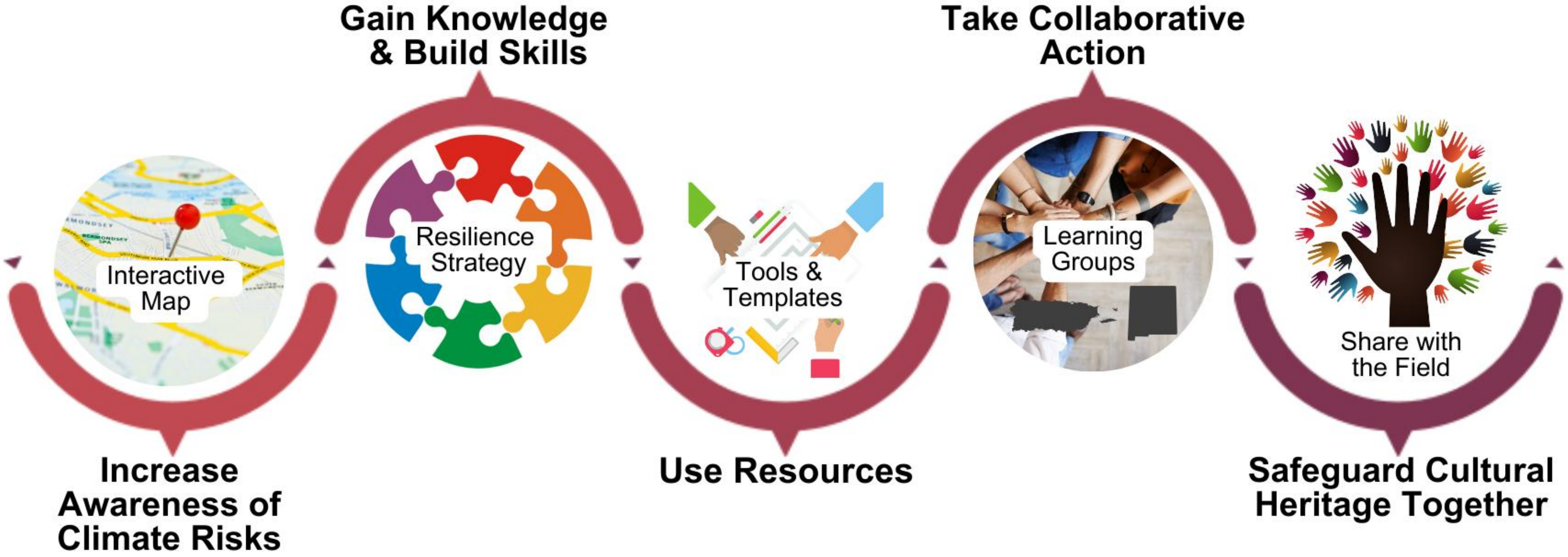
- **Materials warehouses**
  Supply depots and caches
- **Cultural heritage response networks**
  National Heritage Responders hotline
- **Emergency response**
  EMS and community emergency response teams
- **Mutual aid plans and partnerships with MOUs**
  Access to trucks, freezers, conservators, suppliers, sandbags

Even when more hopeful than informed, available but unneeded, these instill hope and inspire more action.



Recycled art, Madison Children's Museum
Trash Lab, Sarah Sutton

Climate Resilience Resources for Cultural Heritage
a project of Held in Trust



The Resources

1. Climate Resilience Strategy Approach and Guide
2. 8 Learning Modules and Exercises to Build Climate Resilience Strategy
3. Hazard Risk Assessment Map with Site-level Reports
4. Site-level Vulnerability Assessment Survey
5. Recommendations and templates for forming and sustaining Learning Groups
6. Examples of Climate Resilience in Action from the Learning Groups

Climate Resilience Strategy: Approach and Components

Discovery

- **Executive Summary**
- **Introduction**
  Why, how, who, etc.
- **Methodology**
  Includes: team members, resources used, how you developed the baselines, discovery, implementation, and prioritization processes, and community conversations

Plan, Design & Develop

- **Baseline findings**
  Conduct Assessments: Climate, Community, and assessment
- **Vulnerabilities and Risks**
- **Resilience priorities and focus areas**
  Examples: business, structure, landscape, mechanical systems, collections management, emergency and disaster response, community engagement, etc.

Finalize Strategy

- **Implementation**
  Process, timeline, cost, human and material resources. This includes working-the-plan reporting resources.

Maintain & Share

- **Dissemination**
- **Annual Review and Update Schedule**
- **Appendices**
  Resources consulted, Map & site images, Contacts and participants, and Bibliography and endnotes

Build Resilience as a Community: Learning Groups

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LIGA DE ARTE

MAC

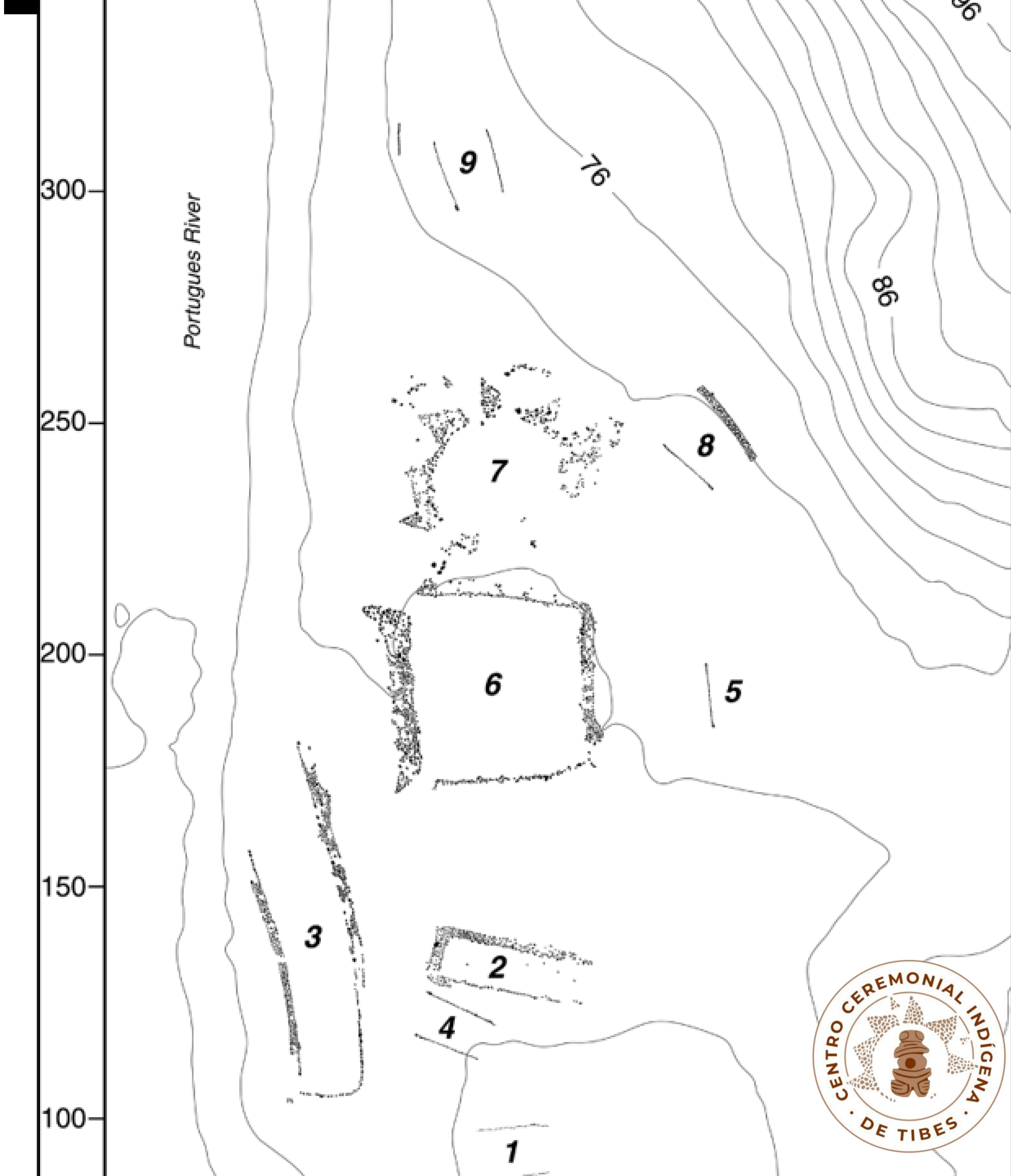
NEW MEXICO

MAXWELL MUSEUM OF ANTHROPOLOGY

MILLICENT ROGERS MUSEUM

MUSEUM OF INTERNATIONAL FOLK ART

Centro Ceremonial Indigena de Tibes



CENTRO CEREMONIAL INDÍGENA · DE TIBES ·

CENTRO CEREMONIAL INDÍGENA · DE TIBES ·

Resilience Strategy

- Reforestation of botanical garden
- Evaluation of construction of trenches to minimize water damage in archaeology area
- The reconstruction project is still under consideration by the municipality reconstruction office and FEMA
- Engage nearby community that is at high risk of disasters with few resources

CENTRO CEREMONIAL INDÍGENA DE TIBES

Sila M. Calderón Foundation
Centro para Puerto Rico

Historical Archives and Library


DigitalGlobe via Google Earth; Ricardo Arduengo/Agence France-Presse — Getty Images


DigitalGlobe via Google Earth; Ricardo Arduengo/Agence France-Presse — Getty Images

Impacts of Riverine Flooding, Hurricanes, and Sea Level Rise

- Access problems
- Power service and communications interruptions
- Service hours
- Building damage

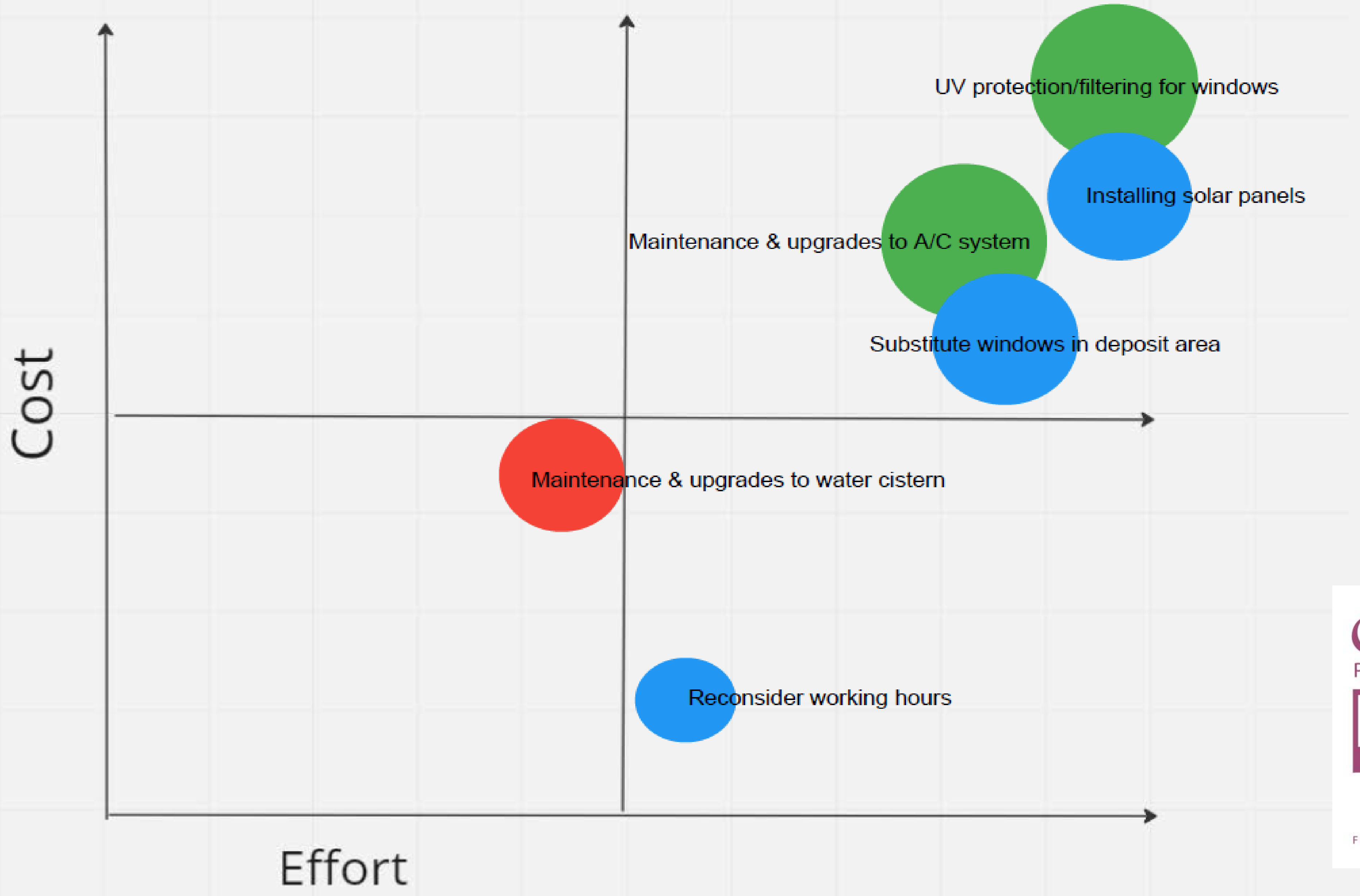
centro
PARA PUERTO RICO
Fundación Sila M. Calderón

Climate Resilience Resources for Cultural Heritage

Climate Risk Vulnerability Assessment Tool for Cultural Heritage
as adapted from the Heritage Preservation/Foundation for Advancement In Conservation
RISK EVALUATION AND PLANNING PROGRAM

Climate hazards that the Cultural Resources you are helping to protect may be vulnerable to.		Equation that calculates a relative vulnerability rating based on the likelihood of the hazard occurring, multiplied by the risk of the damage, to equal its vulnerability.					Describes how the hazard can affect the cultural heritage being
HAZARDS Recommendation: Evaluate hazards based on data from the Climate Risk Map's 2023-2040 Climate Check or NOAA Risk Time Period.		**Likelihood of Hazard (1-5)**	**multiplied by**	**Risk of Damage (1-5)**	**equals**	**Vulnerability Rating**	**Implications for Cultural Resources**
1	**INTERIOR**						
1a.	Fire (from, e.g., heat wave, lightning, wildfire)	1	x	5	equals	5	Destruction from extreme heat and combustion.
1b.	Ingress of smoke or gaseous pollutants (from, e.g., wildfire, strong wind, volcanic activity)	1	x	3	equals	3	Airborne particulates are hazardous to humans and wildlife, pollu system filters, and coat surfaces with abrasive materials.
1c.	Flooding/leaks (from, e.g., coastal flooding, hurricane, riverine, flooding, tsunami, winter weather)	4	x	4	equals	16	Water incursions arise from rising from the water tables, spilling driven in by wind, or leaking in through roofs where water cannot gutters and downspouts. The impacts are can be both immediat including structural damage and weakening, electronic systems mold growth on surfaces and in materials.
1d.	Mold and/or mildew (from, e.g., coastal flooding, hurricane, riverine flooding, tsunami, winter weather)	2	x	4	equals	8	
1e.	Explosion	1	x	2	equals	2	
1f.	Chemical spill	1	x	2	equals	2	
1g.	Damage due to unstable collections materials (e.g., nitrate film) (from, e.g., heat wave, lightning, wildfire)		x		equals	0	
1h.	Attack or infestation by vermin (rodents, bats, or birds) or insects		x		equals	0	
1i.	Loss of environmental controls resulting in unacceptable heat, cold or humidity levels		x		equals	0	Loss or disruptions in power are likely to interrupt mechanical sy deliver desired internal conditions. Passive controls or systems impacts of mechanical failures. Alternative temporary energy sou

FSMC / Risk: High Heat



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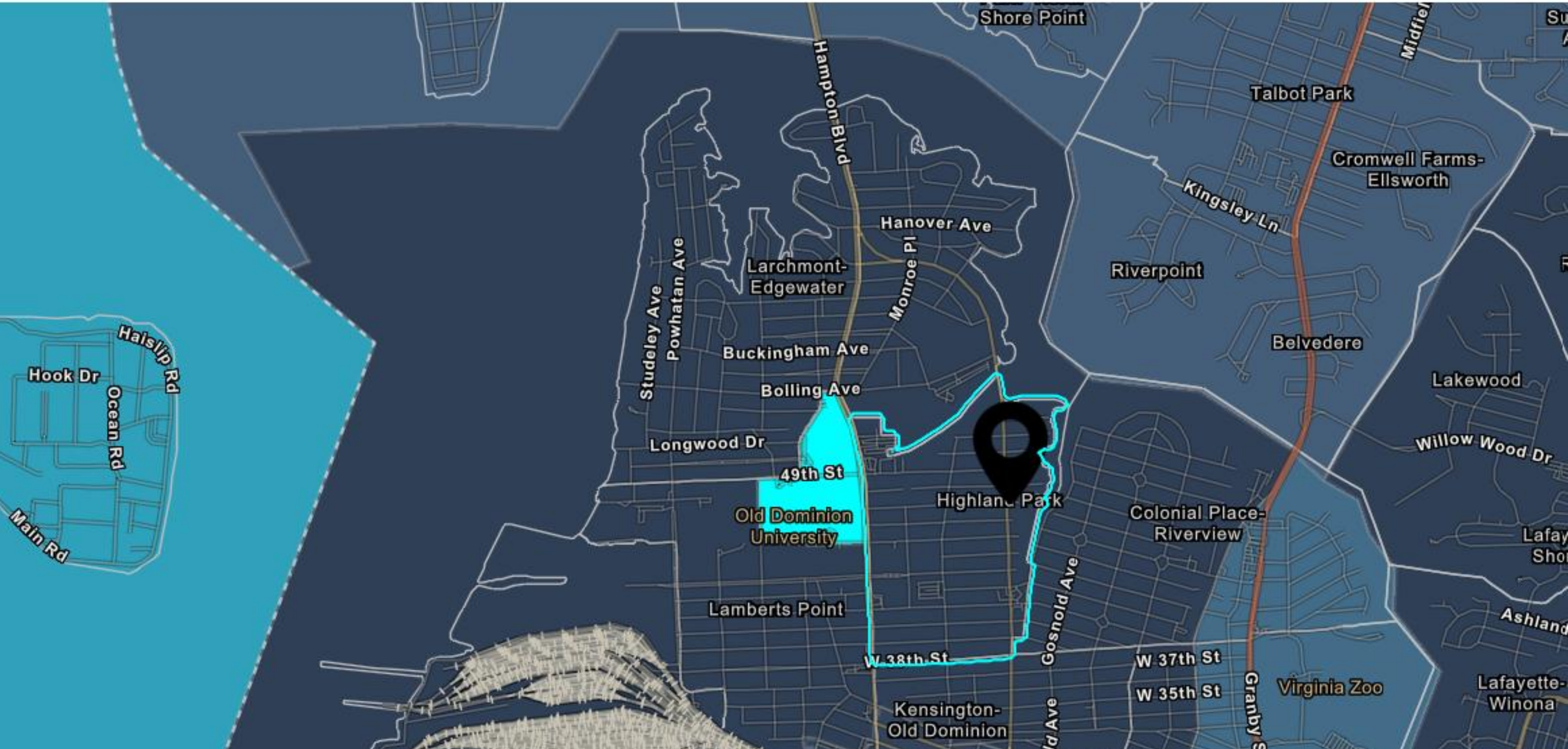
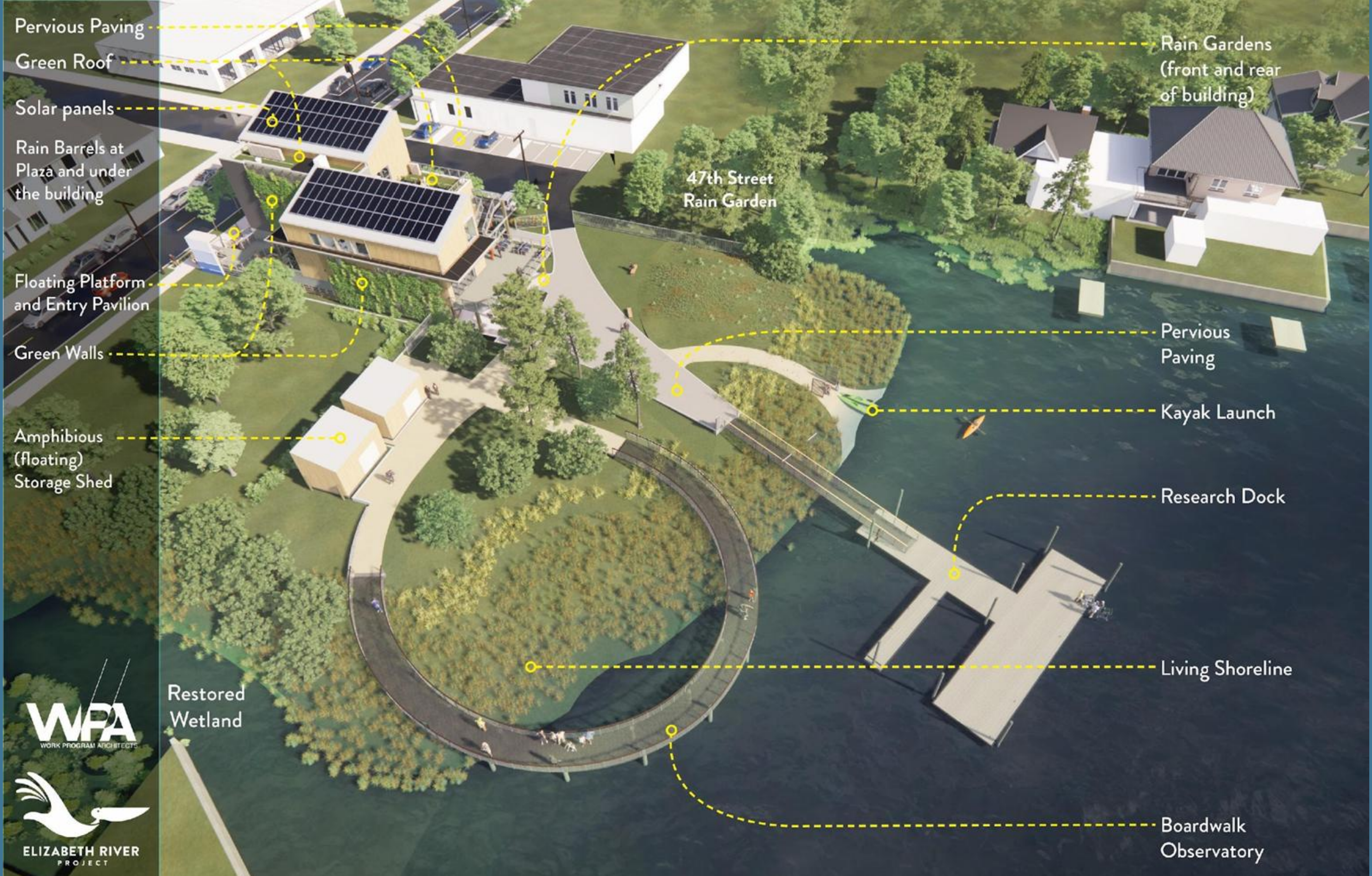
Resilience Strategy

- **Structure:** Consider UV protection and reinforcement for windows
- **Mechanical systems:** Upgrade HVAC and water cistern
- **Less reliance on electric grid:** Consider solar for backup power
- **Collections safety: U**pgrade HVAC and acquire backup power to decrease R/TH fluctuations
- **Community engagement:** Leverage space as a safe gathering area to provide fresh water and power

Ryan Resilience Lab




ELIZABETH RIVER
PROJECT



Pervious Paving
Green Roof
Solar panels
Rain Barrels at Plaza and under the building
Floating Platform and Entry Pavilion
Green Walls
Amphibious (floating) Storage Shed
Restored Wetland
47th Street Rain Garden
Rain Gardens (front and rear of building)
Pervious Paving
Kayak Launch
Research Dock
Living Shoreline
Boardwalk Observatory
WPA
WORK PROGRAM ARCHITECTS
ELIZABETH RIVER PROJECT

RESILIENCE

Elevated building with flood-resistant structure

Floating storage & front porch

Floating dock & sunlight permeable gangway

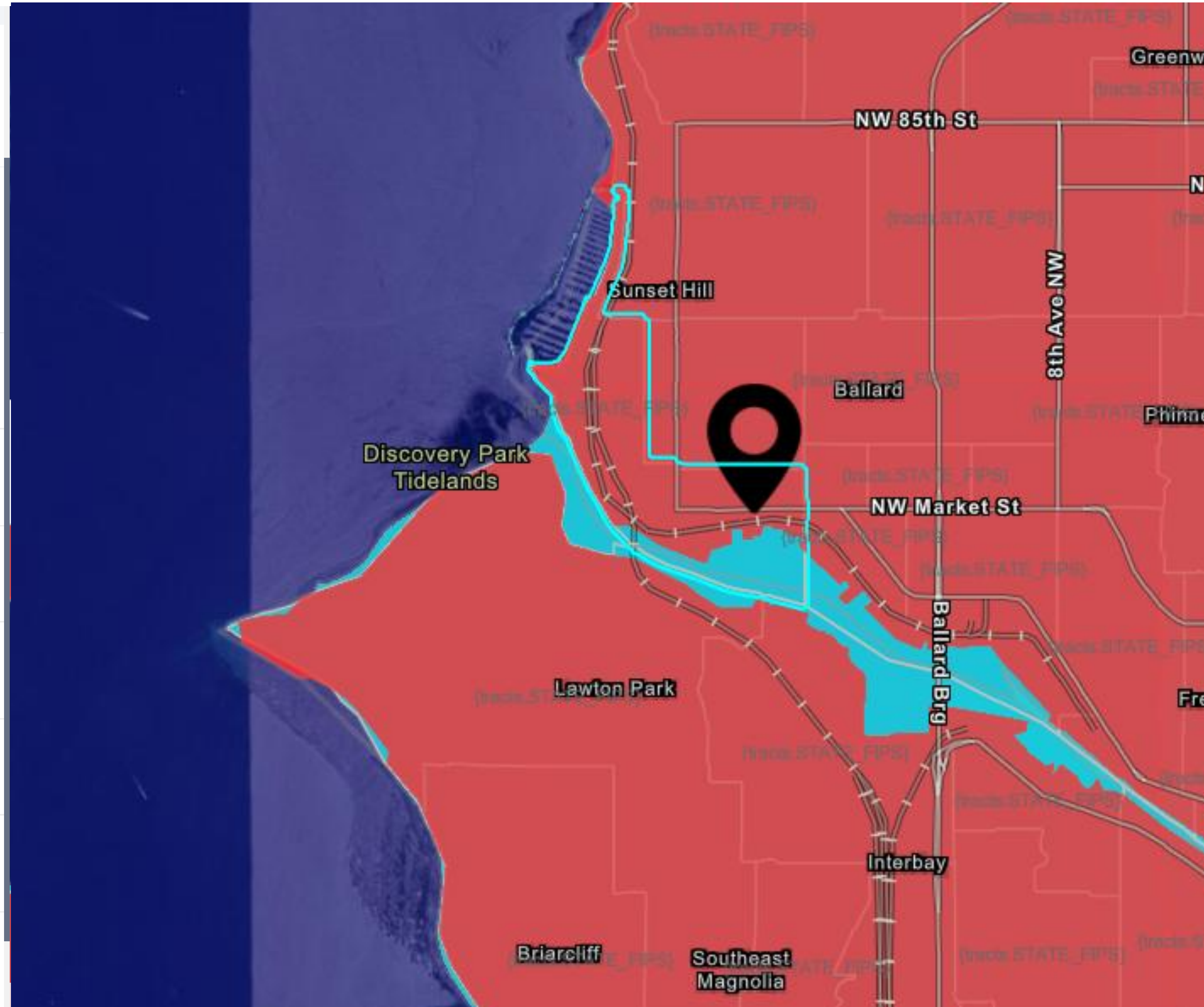
Building a culture of resilience

National Nordic Museum

Early Century (ClimateCheck)

Now - 2050

Active	Event	Severity	Open All
	Precipitation	Extreme	
	Tidal Flood	Very High	
	Heat	High	
	Fluvial Flood	High	
	Flood	High	
	Pluvial Flood	Significant	
	Drought	Significant	
	Fire	Relatively Low	



Photovoltaic Roof Design Plan for the National Nordic Museum

Courtesy of the National Nordic Museum

Resilience.CulturalHeritage.org

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FA IC foundation for advancement in conservation

Protecting Cultural Heritage

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Q&A