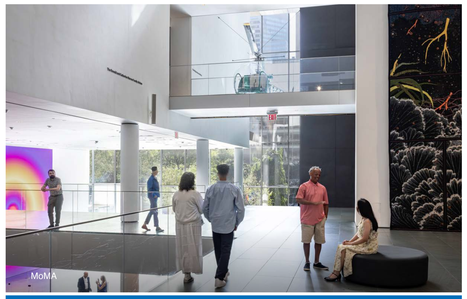


Cultural Buildings: Energy & Opportunity

Cultural institutions are uniquely positioned to engage the public in climate learning and show climate leadership.

Increasingly, these institutions are addressing energy use to further contribute to the wellbeing of the communities they serve.

However, cultural institutions face energy challenges not often encountered in other public buildings. Museum buildings include high occupancy levels, blends of both indoor and outdoor spaces, large open interiors that require conditioning, and intricate professional expectations such as strict operational temperature and humidity requirements.

Resources dealing with building energy use are often built around typical commercial building types such as office buildings and schools. They do not account for the operational realities of most cultural institutions, such as strict environmental requirements for collections and 24-hour space conditioning.

The current lack of a sector-specific energy benchmark and associated resources means museums lack:

- A clear way to understand building performance
- Meaningful comparisons to peer institutions
- Metrics that align with actual operations
- Tools that support informed decision-making about energy, emissions, and costs

New Buildings Institute (NBI) is working to develop tools that will better support the cultural sector. One such effort is the Min/Max project detailed here.

Where it Started: Culture Over Carbon

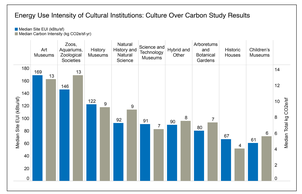
Culture Over Carbon, completed in 2023 by NBI and Environment & Culture Partners (ECP), shared the first in-depth review of energy use patterns in cultural institutions across the United States.

This study forms the foundation of the current work to help cultural institutions reduce their energy use and improve building efficiency.

Working with expert advisors, the joint NBI and ECP project team recruited 133 participants throughout the United States, capturing a variety of building sizes, cultural institution types, and building uses to provide quantitative and qualitative data. The team also conducted interviews and utilized public benchmarking data.

Art museums were found to have the highest energy use intensity (EUI) out of eight other museum and cultural organization types. The median site EUI for art museums participating in the study was 168 (kBtu/sf-yr), which is two to three times higher than the national median for other commercial/non-residential buildings such as libraries, offices, and schools. Using an in-house analytical tool, NBI determined that the high EUI was driven by significant thermal baseload, a measure of year-round energy use primarily attributed to fossil-fuel based loads such as reheating air for humidity control. These findings also pointed to art museums being tied with zoos and aquariums for the highest carbon use intensity (kg CO_2e/sf-yr) of all buildings in the study.

While the *Culture Over Carbon* study identified some recommended energy reduction strategies for art museums, the research team wanted to dig deeper into the potentially large impact of a physically simple but politically complex strategy: allowing more flexibility in temperature and relative setpoints, beyond the industry's existing strict standard practice.



More About Min/Max and 70/50 Controls

Min/Max: The Relationship Between Energy, Carbon and T/RH Parameters in Collecting Institutions (2024–2026) is a national research project funded by an Institute of Museum and Library Services (IMLS) National Leadership grant.

RESEARCH QUESTION:

What are the benefits of broadening T/RH parameters beyond the status quo of 70°F/ 50% RH (24°C/ 50% RH), particularly energy savings, in a time of high inflation, a stressed economy, and a deteriorating global climate system?

It is led by Environment & Culture Partners in partnership with New Buildings Institute and A2 Efficiency, with guidance from cross-sector advisors and eight participating art museums.

Many art museums and other collecting organizations set their HVAC systems to adhere strictly to 70°F/50% RH (70/50) with minimal to no deviation. This outdated practice is often unrealistic to achieve, and the attempt to do so increases costs, energy use, and carbon emissions. There have been substantial advances in conservation science and research that provide valuable and appropriate alternatives to 70/50: the Canadian Conservation Institute, the Getty Conservation Institute, Image Permeance Institute, and some European researchers have all shown that most objects are mechanically and chemically stable between 30% and 60% RH and within a range of temperatures, with some exceptions for very sensitive materials.

With other foundational advances like the Bizot Green Protocol, a few organizations in the sector are already managing their collections with broadened parameters, but most are not. The sector needs quantitative evidence and tools for wide-spread adoption.

Min/Max uses a data-driven approach and real-world testing to identify appropriate environmental conditions (i.e., temperature and relative humidity) for collections under which changes to practice can save money and reduce carbon emissions, while maintaining standards of care for museum collections. Results of the research will provide museum collections and facilities staff with a free suite of tools and materials to facilitate decision-making about changes to practice. This research benefits not only museums and their materials, but also the climate for the long-term health and safety of living beings, communities, and cultures.

The Modeled Impacts of Broadening T/RH Parameters

The team built a customized museum prototype building energy model to evaluate the impact of broadening temperature and humidity set point parameters.

The Min/Max model is based on building construction, space utilization, and mechanical systems typically found in U.S. museums and informed by site visits to museums participating in the Min/Max study. It was simulated in multiple climate zones across the U.S. in major urban areas with a high concentration of museum facilities.

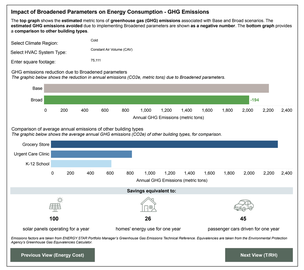
The model pairs each location with two common HVAC configurations (constant air volume—CAV, and variable air volume—VAV) and strict (Base, 70/50 24/7) and dynamic (Broad, generally based on the Bizot Green Protocol) environmental control parameters.

NBI used the model outputs to develop an interactive dashboard that allows users to understand the modeled impacts of broadening temperature and relative humidity (T/RH) setpoints. This tool provides cultural institution staff with a resource that can support conversations about how to better manage energy usage while preserving collections.

Most of the energy reduction from broadening T/RH setpoints can be attributed to a decrease in natural gas consumption, which is driven by lower heating and humidification energy.

The potential impact to collections was a key consideration in the analysis. The model showed **no episodes of risk** for any of the collections care metrics in any of the climate zones.

Broadened T/RH set points can reduce annual energy use in museums by 11–26%.



Check Out the Dashboard and Stay Tuned To Learn More

The interactive dashboard allows users to explore the results for a particular combination of climate zone, museum size (square feet) and HVAC type. Additional variables are included in specific dashboard views.

The dashboard has six views that provide data on Base and Broad T/RH setpoints:

- General energy use
- Energy end uses
- Energy cost
- GHG emissions
- T/RH
- Collections care

Use the QR code below to explore the dashboard.

This work is continuing! The project will conclude in **February 2027,** and will include the results of field-testing broadened parameters at several participating museums. This real-world data will corroborate the modeled findings and provide greater confidence to the sector.

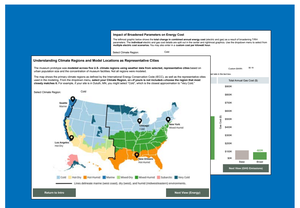
Upcoming materials will include:

Case studies documenting the **experiences of participating museums** implementing broadened T/RH parameters.

A comprehensive research report and factsheet summarizing the work and **findings across the project.**

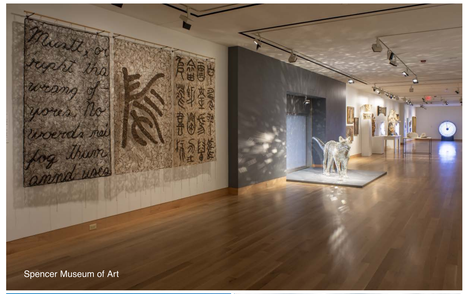
A **simple guide** for getting started with broadening parameters at a museum facility.

These materials will provide deeper insight into how environmental flexibility performs in practice and how it can be applied across the field.



Explore the Dashboard

newbuildings.org/resource/min-max-museums-dashboard/



Help Us Create Better Data for the Sector

A national data collection effort is underway to support future building performance analysis for the museum sector.

The results will be submitted to the U.S. Environmental Protection Agency (EPA), for potential analysis and development of a 1–100 ENERGY STAR® Score for museums and other cultural institutions.

We need a robust dataset that represents the nuances of sector. You can support the development of this valuable sector resource by sharing with your network.

Learn more about the National Museum and Cultural Institution Energy Survey

ecprs.org/national-museum-and-cultural-institution-energy-survey

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Sign Up for Our Newsletter

Receive updates about this project and NBI's other work in the cultural sector, and share this dashboard with any museum professionals in your network.

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