National Leadership Grants - Museums

Sample Application MG-255674-OMS-24
Project Category: Collections Stewardship

Environment & Culture Partners

Amount awarded by IMLS:	$632,741
Amount of cost share:	$0

Environment and Culture Partners (ECP) will research the financial, energy, and greenhouse gas emissions impacts from environmental conditions within museum spaces, both where collections are stored and exhibited. The project will examine spaces managed at temperature and relative humidity broader than common practice to identify appropriate conditions where changes in practice can save money, energy, and reduce emissions. Building upon a previous IMLS project, ECP will partner with the New Buildings Institute to work with eight museums virtually and through site visits. The project will develop three representative energy models and a free online dashboard to support museums in deciding environmental parameters and protocols to achieve energy and carbon savings.

Attached are the following components excerpted from the original application.

- Narrative
- Schedule of Completion
- Digital Product Plan
- Performance Measurement Plan
- Data Management Plan

When preparing an application for the next deadline, be sure to follow the instructions in the most recent Notice of Funding Opportunity for the grant program to which you are applying.

Environment & Culture Partners

MIN/MAX: The Relationship Between Energy, Carbon, and T/RH Parameters in Collecting Institutions

Introduction

Environment & Culture Partners (ECP) is applying for a two-year grant to examine the financial, energy, and carbon impacts of broadening parameters for Temperature and Relative Humidity (T/RH) in museum spaces where collections are stored or exhibited. This project is a partnership with New Buildings Institute (NBI), and a direct result of previous research by NBI and ECP, Culture Over Carbon.

MIN/MAX: The Relationship Between Energy, Carbon and T/RH Parameters in Collecting Institutions (MIN/MAX) examines the energy use at eight institutions that store and exhibit art and material culture, and have spaces managed at T/RH parameters broader than the common practice of 70°F/ 50% RH (24°C/ 50% RH), often referred to as Plus/Minus or "Min/Max". This energy assessment and modeling project explores the practice of broadening T/RH parameters to identify any appropriate environmental conditions for collections under which changes in practice can save money and energy, and reduce harmful greenhouse gas (GHG) emissions while maintaining standards of care for art and material culture.

We expect to find that, under certain protocols and parameters, and by climate region, broader parameters provide pathways for saving energy and reducing carbon emissions while sustaining high quality collections standards. Collecting institutions across the country will benefit from applying these findings as they work with their collections and facilities staff and advisors on mechanical management of systems for collections care and make decisions about energy efficiency and conservation responsibilities. This project benefits not only museums and their materials, but also the climate for the long-term health and safety of living beings, communities, and cultures.

Project Justification

Which program goal and associated objective(s) of National Leadership Grants for Museums will your project address?
This project addresses IMLS Program Goal #3: it advances the museums field's ability to identify new solutions that address high-priority and widespread collections care or conservation issues, and Objective 3.3: to research an aspect of management, conservation and preservation of collections that is broadly relevant. We ask the 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 struggling economy, and a deteriorating global climate system?* In the process, this project improves the ability of museum professionals to be ever-better stewards of the nation's collections by caring for them effectively and efficiently while potentially reducing harmful impacts on a global climate that increasingly threatens collections and structures. This research provides critical data and guidance for participating institutions and the rest of the museum field as they pursue informed decision-making, bolstering the science with energy and building systems data, and scaling response in a way that can reverse what appears to be the "Min/Max" stall.

What field-wide need, problem, or challenge will your project address and how was it identified?
"Min/Max" commonly refers to the temperature and relative humidity ranges recommended for museum collections environments that recognize both a difference in requirements for types of collections items and their materials, and the frequent inability of institutions to conform to standards set in the 1970s, the unwavering 70°F/ 50% RH (24°C/ 50% RH). It has been called "The Plus/Minus Dilemma," calling out that adoption has been uneven despite substantial advances in conservation science providing valuable and appropriate alternatives to 70/50. Engineer Jeremy Linden recommends the alternative term of "Min/Max" because it reflects not the variances of conditions created by the mechanical systems, but the potential variances appropriate for the materials in the objects, the focus of museum conservation and care. This project does not re-examine current conservation science on the appropriate conditions for specific materials; instead, it accepts that evidence-based research conducted by conservators, and explores the questions of whether and when there are energy savings through the use of the parameters appropriate for objects, often but not always, wider than 70°F/ 50% RH (24°C/ 50% RH). For some museums the complexity of implementing flexible guidelines rather than a clear, set protocol has meant they default to the "we-have-always" approach. This project will develop a supportive decision-making tool, based on data modeled on actual experience and conditions.

But first, the museum field needs deep research into the energy use related to these shifts, and to understand the demands that strict humidification and temperature control puts on systems and buildings through the energy it takes to run them. The museums participating in this study understand that pursuit of 70/50 is frequently unachievable or

unsustainable from a mechanical or building structure point of view. Some have been making conservator-led changes to conditions requirements; most struggle with poor-performing equipment damaged by the strain of 70°F/ 50% RH (24°C/ 50% RH) or that were never able to achieve those parameters but run as if they could. Some are working with engineers or facilities managers using the established materials science, but they have too little energy and mechanical data, and few organizations have the funding to conduct such research alone.

The idea began forming during the 2019 Western Museums Association Annual Conference, where the session on sustainability was packed. During the question-and-answer period, the curator at the Frye Art Museum in Seattle asked ECP's CEO "where is the [museum] profession on broadening temperature and relative humidity (RH) ranges?" Immediately, others in the room asked for more information. We agreed that for the sector to implement varying T/RH ranges, the curators, registrars, exhibit designers, and art handlers need additional signals and validation to take to museum leadership for accelerating action. Since that meeting, ECP has participated in three efforts that demonstrate that the sector will benefit if it has reliable, broadly-accessible research and information on energy and equipment consumption related to T/RH: Culture Over Carbon (COC), Frankenthaler Climate Initiative (FCI), and staff research for journal articles. First, COC was a 2021–2023 IMLS National Leadership Grant research project where ECP collaborated with NBI. NBI developed a "sensitivity analysis" for subtypes of museums to identify the greatest opportunities for improvement. The team identified typical high, medium, and low drivers of energy use and GHG emissions, with humidity control standing out as a likely suspect. The research showed that, of all types of museums among the 139 studied in the grant, art museums have the greatest Energy Use Intensity (EUI) per square foot of museum building, by a significant margin (larger than zoos, aquariums and gardens with their life support systems), followed closely by history museums with their collections. EUI is an indicator of potential for improved efficiencies and use reductions if the systems and practices in place could be examined closely. In COC, the institutions with humidity controls typically set targets between 35 to 55%, and many institutions reported multiple zones with varying humidification requirements. Typical temperature setpoints ranged from 69 to 73°F. However, the art museums typically indicated using a tighter band of temperature and humidity ranges. MIN/MAX responds to that likely driver of high energy use and GHG emissions, based on what NBI learned from the data and from conversations with the 47 art museum buildings and their staff in that study. Second, FCI is ECP's work with RMI (formerly Rocky Mountain Institute) and the Helen Frankenthaler Foundation. With ECP's co-management, FCI has awarded $10M since 2020 in 175 grants to visual arts museums and schools for energy efficiency and clean energy projects; two additional grant cycles will occur through 2025. Many awardees stated that they use or wish to use broader parameters, often applying for funds to support the purchase and installation of building monitoring systems or for adjustments and/or improvements to their HVAC systems to implement the protocols and reduce energy use. Participants in both COC and FCI have asked ECP about the potential energy savings associated with wider parameters and similar interventions, and some are already making the changes. Third, in exploring a journal article on "Min/Max" lack of adoption and the potential for energy savings (late 2019 to early 2020), Sutton and Shapiro independently interviewed nearly thirty researchers and cultural heritage professionals on this topic and found that the energy research had not been conducted but would complement others' research. (See subsequent question "how does this differ?") Sutton and Shapiro concluded that the variables among institutions' spaces, buildings and collections, and among the habits and individual legalities associated with loan agreements, added sufficient uncertainty to interfere with adoption in most locations. It's a case of too many "known unknowns." The uncertainty forces each museum to fund either staff or consultants to guide the process of aligning T/RH parameters with the capacity of the buildings and mechanical systems. This is unaffordable to many. The research will define under what conditions broader parameters safely save energy, equipment, GHG emissions, and money, so institutions can save money to fund conservators and facilities managers as they identify best protocols and to monitor the conditions.

Who is the target group for your project and how have they been involved in the planning?
To benefit that broader group of professionals not yet adopting these practices, the target group is museum staff that already manage T/RH with policies that allow for broadening parameters under the guidance of staff monitoring collections or professionals who advise them on this topic in some manner. Each worked with ECP as either a participant in COC where they shared energy data and management details, and/or received an FCI grant where their projects and reporting provided the same. These buildings may be purpose-built as museums or not, but they maintain collections in storage and exhibits, use mechanical systems, and have already broadened parameters either at times during the year,

for specific exhibits, or in collections storage. Within those museums, we are involving facilities managers, conservation professionals and conservators, and collections managers as appropriate who can monitor both the energy use and the collections conditions during the project. The prerequisite for this project is current use of broader parameters in exhibitions or storage as they are able (seasonally or based on collections materials). This avoids any delays or partner losses due to internal debates over the practice. The seven confirmed participants are (letters attached): American Swedish Institute (MN), Eiteljorg Museum (IN), Kentucky Museum at Western Kentucky University (KY), Museum of Modern Art (NY), New Orleans Museum of Art, (LA), Tacoma Art Museum (WA), and Spencer Art Museum at the University of Kansas (KS). We are pursuing a museum in an arid climate for the eighth spot. The new director at an interested New Mexico museum is considering joining. If they choose not to, we will include another from the region.

Who are the ultimate beneficiaries for this project?
The beneficiaries are the collections and museums, as well as their staff and consultants supporting them, who all need more information on the benefits of a shift to wider parameters. By conducting this deep research, we answer questions about savings of energy, equipment and carbon, and contribute to improved consulting and design efforts because that work at each museum is strengthened by the models and evidence developed through this project.

How will the museum field benefit from your project?
We will provide reliable, actionable data and case examples that are applicable within professional standards in a financially sustainable manner. The data can be used to strengthen funding applications for capital projects. Where there are energy savings, there will be money savings to reinvest in collections care, building management, programs, and salaries. By engaging museums that are well-recognized, trusted, and representative of those most affected by the "Min/Max" issues, we are establishing a highly visible cadre of institutions leading by example. The museum field can capitalize on the courage, confidence, and experience of these institutions as they build institutional buy-in during their own decision-making process.

How does this proposed project differ from, complement, or build upon existing theory, scholarship, and/or practice?
Previous research has not blended conservation, institutional sustainability and climate change in its remit. This project builds on the International Institute of Conservation (IIC), Association of Art Museum Directors (AAMD) and Bizot Group proposals and the foundation of materials science by addressing the concerns of energy use, equipment life, and carbon footprints that conservation science alone cannot answer. This project accepts documented materials science research on the impacts on objects of T/RH and its changes, and how that indicates the conditions under which broader parameters are acceptable for collections. It remains unevenly addressed despite its identification as a priority by leading organizations in reports from the International Council of Museums (ICOM), the IIC's Environmental Guidelines ICOM-CC and IIC Declaration (2014) and the Bizot Green Protocol (2015). The Bizot Group (the name for an international group of national art museum leaders) adopted the recommendations of major national museums to endorse and encourage this shift in a statement that called out addressed energy costs and carbon footprints:

- Museums should review policy and practice, particularly regarding loan requirements, storage and display conditions, and building design and air conditioning systems, with a view to reducing carbon footprints.
- Museums need to find ways to reconcile the desirability of long-term preservation of collections with the need to reduce energy use. Museums should apply whatever methodology or strategies best suit their collections, building and needs, and innovative approaches should be encouraged.

Though the Bizot Group recommendation is endorsed by the AAMD (which endorsed this grant application along with the American Alliance of Museums), and by the IIC, as well as many other associations, the broader parameters have been unevenly implemented in museums. Based on Sutton and Shapiro's interviews regarding this unevenness, reported hesitations are attributed to the uncertainty created by the uniqueness of each museum's building and systems, the requirements of loan agreements, and the difficulty in changing long-practiced behaviors (described earlier). The other two areas of concern are being addressed elsewhere: 1) The Getty Conservation Institute's Managing Conservation Environments (MCE) team conducted Anthropological research on human behaviors associated with these changes, with the work not yet published. They published in Spring 2023, *Conserving Art While Conserving Energy*, but the focus was

on couriers and monitoring objects during transport, not on the setpoints, 2) the barrier of loan agreements and adherence to historically professional standards was examined in an online International Climate Control Conference led by Ki Culture during December 2022 which concluded that "we are all on the same page about expanding protocols," but no action yet has been taken.

The energy aspects are not a new area of interest, there just has been any research in response to these calls. In 2007, in the Experts Roundtable for Sustainable Climate Management Strategies, Sarah Staniforth, National Trust (UK), explained that scientists were addressing an issue foreshadowed by the author of the flatline parameters of 70°F/ 50% RH which we struggle with today. She explained that Garry Thomson wrote in 1978:

> There is something inelegant in the mass of energy-consuming machinery needed at present to maintain constant RH and illuminance, something inappropriate in an expense which is beyond most of the world's museums. Thus, the trend must be towards simplicity, reliability and cheapness. We cannot, of course, prophesy what will be developed, but I should guess that it will include means for stabilizing the RH in showcases without machinery, use of solar energy for RH control in the tropics, improved building construction to reduce energy losses and extensive electronic monitoring (p. 249).

Ernest Conrad, an engineer focusing on care of collections, presented a paper at the conference: "Climate Control Systems Design and Climate Change," examining future concerns if the planet's atmosphere warmed by 1°C.

> In recent years new technologies have emerged to help keep the energy cost of dehumidification relatively low. Even so, for many institutions, the cost is more than they can afford. As more and more institutions decide to install dehumidification systems on a building-wide scale, such systems will increase the global use of energy. As a result, supply and demand forces in the open market will recognize this new demand, and the spiral of energy demand will help make energy costs soar. Also, there may well be a spiral effect of a global increase in energy consumption from increased air-conditioning demands for basic cooling (p. 4).

MIN/MAX provides missing evidence on energy-use, and systems and building design, so subsequent decision-makers can add the costs of energy, equipment and emissions to their information on materials conservation. The research with these sites expands current available evidence and eliminates the need for continued conjecture.

Project Work Plan

What specific activities will you carry out and in what sequence?
Step 1 (September 2024): Prepare management approach which begins with informing consultants, advisers, and museums and setting up payment processes with IMLS and project team members (in Gusto); developing a project plan and timeline including IMLS reporting milestones, and associated project materials, establishing a SharePoint worksite to share documents and materials including communications connections, scheduling year-one status meetings for Project team (monthly) and for Project Team, Advisors, museums (quarterly), and IMLS as determined together with the program office. Step one concludes with facilitation of a kickoff meeting with the Project Team (ECP, A2Efficiency, NBI, Foust) and NBI and A2E development and distribution of data collection description and process to museums.

Step 2 (October 2024-March 2025): Facilitate a kickoff meeting with the Project Team, advisors, and museums and introducing them to the project, team members, timeline, general expectations including communication, data collection process, SharePoint, and presentations, and case study development. Through March, members of the Project Team and Advisors will conduct virtual and in-person meetings to support the museums. Three in-person site visits will be made by members of the Project Team through March 2025 to examine actual conditions and practices (energy use, people and behavior, building construction, existing policies, etc.). The Project Team will work closely with these museums to ensure the correct teams and stakeholders are involved in both the virtual and in-person meetings. The three sites visited in person will be used as the basis of the energy models. A2E and NBI will also conduct a literature review of best practices related to energy modeling and begin development of the model as data begins to become available, as well as beginning to write the research's methodology. The quarterly collaboration meeting with Museums will focus on energy

Step 3 (April 2025-April 2026): Develop and Calibrate Model. Once data is shared from the museums, A2E begins modeling three prototypical museums (three in-person visit sites) based on building data and then calibrates based on delivered energy data. This is an iterative process that will be repeated with each museum, with more modeling likely occurring during the first year than the second. The first iteration of the model will be completed by fall 2025. NBI will also begin development of the Tableau-based Dashboard. ECP will facilitate a Mid-Project meeting in September 2025, schedule out year 2 meetings and communications, consider fall 2026 venues for sharing the results of MIN/MAX, and begin to develop a template for the Museum's case studies and outlining the final report with NBI and A2E. Then, A2E, NBI, and Museums will explore additional real-time shifts in monitoring (e.g., changing temperature and moisture controls) through November 2025. Through February 2026, museums have the option to implement these additional efficiency measures for which the Project Team will provide additional technical assistance as they trial the changes. Based on the changes made by the Museums, A2E continues to update the models and making revisions through April 2026. The quarterly collaboration with Museums will focus on project status updates and different topics (subject to change) such as discussing the different energy options and the process for developing and sharing case studies.

Step 4 (February-August 2026): Share and Communicate. Museums will develop their case studies with support from the Project Team, Advisors, and other Museums through April 2026. Museum Advisors and Museums, and a small group of curated stakeholders in the field will test and provide feedback on the Dashboard; updates will be made as needed by NBI. ECP will develop a communications plan and lead development of the final report with associated social media and publicity in August 2026. Denise Mix will copy-edit all the case studies and final report. The NBI communications team will design the final report and case studies while the NBI technical team completes development of the Tableau-based Dashboard. There will be two free live webinars, one hosted by AAMD and the other by Conserv, in summer of 2026 which ECP will coordinate. NBI will work with ECP to transfer hosting of the Tableau Dashboard too. A final meeting to close the project will occur with the Project Team, Advisors and Museums, and a final meeting with just the Project Team. This will include final documentation and a discussion of research successes and lessons learned.

What are the risks to the project and how will you mitigate them?
There are two important risks: 1) the potential for energy simulation models developed to be unrepresentative of actual museum conditions, and 2) the evaluation of inappropriate modifications to environmental control settings, equipment upgrades, and other energy conservation measures. The project design mitigates these by selecting a small cadre of committed museum partners who are already leading by example through research and energy reporting through the ECP programs: FCI grants or COC. The three representative museum models will reflect the building systems and operating conditions of the participating institutions and calibrated to their energy consumption patterns to reflect real-world museums, based on the research underway and existing COC information about museum energy use. When modeling the expanded conditions and potential system upgrades, the Project Team will limit the modeling scenarios to those that are feasible in the participating institutions to avoid overly optimistic or theoretical modeled energy savings, and those recommended by the curators and conservators for the objects and materials in those spaces.

Who will plan, implement, and manage your project?
ECP's leadership team will co-direct the project. Sarah **Sutton** has almost 40 years of experience in the museum field with nearly half that focused on sustainability and climate change with museums, increasingly on bridging the gap between museum and non-museum fields to accelerate change. She is the co-author of *The Green Museum: A Primer on Environmental Practice* (2008 & 2013). She and Stephanie **Shapiro**, ECP's Managing Director will coordinate activities, manage the timeline, support dissemination through case studies and webinars and writing, and coordinate the expert advisor team. Sutton leads on content; Shapiro leads on organization and project management. Shapiro brings 15 years of experience including work as a management consultant and Smithsonian Institution's Office of Advancement, and the George Washington University. She led the AAM's Environment and Climate Professional Network for three years and is a certified Project Management Professional through the Project Management Institute. The project is supported by ECP Program Manager Danielle **Sakowski** who is responsible for supporting data collection, organizing travel, on-site visits, project meetings, and promotion, and for coordinating schedules for five consultants, four advisors, the staff teams of

130 museums, and the ECP team. She graduated from the University of Washington Museology Program. ECP contracts with Denise **Mix** for all editorial services and will do so for this project. She has edited two of Sutton's books and currently works on the Climate Resilience Resources for Cultural Heritage Project that ECP leads with the Foundation for Advancement in Conservation (FAIC) Climate Resilience Resources for Cultural Heritage. (CRR).

What time, financial, personnel, and other resources will you need to carry out the activities?
This is a two-year project heavy on research time rather than material sources for fulfillment. It requires time and attention of three staff at each museum (a curator, conservator, and facilities manager); consultants' time for research, data collection and management, energy modeling, meetings, collections management policy review, and three site visits; and advisors' time for sharing fieldwide knowledge on related topics in engineering, building management, and conservation, reviewing all of the data and conclusions, and participating with others in preparing case studies, reports, and an article or presentation. The project budget covers the costs of staff and consultants, online meetings, travel to research sites and one conference, energy modeling, and stipends for advisors and participating museums.

Consultants: Collections Consultant Jerry Foust will represent collections concerns alongside the museums' curators and conservators. **Foust** has worked with ECP and NBI before on a climate planning project for The Henry Ford, and with ECP in developing the content for the CCRCH funded by the National Endowment for the Humanities (NEH). He has 20+ years of experience in collections related experience working as a collections manager, curator, archivist with the Michigan Maritim Museum, Chicago Jewish Archive, the Shel Silverstein Archives, Dumbarton House Museum, and Alexandria History Museum. Foust teaches graduate classes in museum collections management and climate action in museums at Georgetown University. **NBI** consultants will conduct the energy data analysis, technical interviews, and leading the reports and dashboard production. NBI will leverage its connections and deep market reach to share the project with the museum field and with external designers, policymakers, governments, utilities, and other stakeholders through venues such as the Getting to Zero Forum, ASHRAE, the American Council for an Energy-Efficient Economy (ACEEE) and the US Green Building Council (USGBC). The NBI team includes Alexi Miller (Director of Building Innovation), Kevin **Carbonnier** (Senior Technical Associate), and Mischa Egolf (Technical Associate). All three were key in COC project. **Miller** is a certified Professional Engineer (P.E.) with 17 years of engineering for HVAC, building energy design practices, and advanced building technologies. **Egolf** coordinated the energy data collecting and presentation, and summary materials design and dissemination for COC. The NBI team is supported by Neil **Bulger**, P.E., principal and founding partner of A2 Efficiency (A2E). He and Senior Consultant Michael Sawford will develop building energy simulation models to evaluate the energy, cost, and GHG impacts of various T/RH setpoint regimes for comparisons. For 15 years he has specialized in high-performance building design and energy modeling, assisting design teams in understanding building science and complex HVAC system tradeoffs.

Advisors: The four advisors are Chris Cameron, CFM, CEM; Keith Esarey, PE; and Robert Lambe, CFM, ProFM, and Melissa King. Each has significant experience in all or most aspects of museum energy systems and collections monitoring. **Cameron** was a Sustainable Preservation Specialist at the Image Permanence Institute (IPI) for 9 years. Here, he assisted 60+ institutions with evaluating collections environments and mechanical systems and establishing environmental monitoring programs. He has also hosted workshops and webinars on sustainability in cultural institutions. He is a Certified Project Manager, trained in HVAC refrigeration, and a Certified Energy Manager. **Lambe** is President of Facility Issues, an independent consulting firm that provides facility benchmarking programs and related services. He orchestrates the 20-year-old subscription-based benchmarking program for the International Association of Museum Facilities Administrators (IAMFA). **Esarey** is a Principal with McClure Engineering and has been responsible for project management and mechanical design for critical environment systems where the control of T and RH is an essential operational component. Museum clients include Missouri Historical Society, Springfield Art Museum, Missouri Art Museum, Colonial Williamsburg Archaeology Collections, Penn Museum of Archaeology and Anthropology, and others. **King** is a preventive conservator and VP of User Experience of Conserv. Before joining Conserv, King was a Graduate Fellow in Preventive Conservation Science at English Heritage, Graduate Intern in Preventive Conservation at the Smithsonian Museum Conservation Institute, and a Samuel H. Kress Fellow in Preventive Conservation at the National Museum of Natural History.

How will you track your progress toward achieving your intended results?

The Project Team (ECP, NBI, Foust, and A2E) will meet in early September to review the work plan, confirm ownership of deliverables and time/resource allocation, and set expectations for communication and reporting. They will meet monthly to review progress on deliverables and next steps, identify risks and develop mitigation plans. The work plan will be available on the team's SharePoint site, with changes to resources and timeline communicated in real-time. The project team and advisors will also meet [monthly?] to monitor initial findings, and review summary and concluding materials. All-participant meetings will be held quarterly to begin, review and conclude the project, and include data review, case study and presentation planning for focused work. Museum staff will meet individually and in groups with consultants, as needed, for collecting and reviewing data. ECP's Shapiro will track and monitor activity and progress against goals using a comprehensive project plan, open communication, and accountability measures. She will use SharePoint's management tools and create a dedicated work site for the team, as she has for COC and CRRC.

What is your theoretical framing?

While we are confident that broader environmental control settings will reduce energy use, there is no research on the energy, cost, climate, and collections impacts of changes to these conditions. This project examines the conditions under which current assumptions may be true, and the degree to which buildings, protocols, and climate settings influence the results. We will test this theory using a blend of models, interviews, onsite condition assessments, and actual energy data, enabling comparisons of individual situations and broader examples across the sampling. The development of representative prototype models based on real institutions will help increase the scale of impact of the project to the national scale and beyond while removing collections' exposure and museum efforts from extended research.

What are your research questions?

- What is the impact on energy use when management protocols for T/RH are broadened through drift, seasonal set points, material-based criteria, or other means?
- What is the impact of those energy use changes in terms of energy costs to the institution and carbon emissions on the planet?
- Under what conditions do beneficial impacts occur (lower costs, lower emissions, longer-lived equipment, stronger building performance)?
- Under what conditions are there additional costs, in terms of energy, cost, and GHGs?
- How is implementation of broader parameters affected by uneven implementation (as exhibitions change) or variable implementation (episodic, seasonal)?
- Can savings be confidently predicted based on protocols and building conditions, and by the local or regional cost of electricity and gas?
- What broad conclusions can we illustrate through case studies and collective experiences resulting from this project?
- What specific recommendations from topline data can we make, based on energy consumption, to add context to the current debate over pursuit of the current 70/50 guideline that no longer serves the field well?

What are your research methods?

This team will build three broadly informed and calibrated building energy models to quantify how art museums can reduce energy use, energy cost, and GHGs (both onsite and offsite energy sources) through broader ranges of environmental control setpoints and limited system upgrades. The project team will model energy savings from these operational changes and upgrades across a broad range of climate zones for each of the three prototypical museum models. This will estimate the savings potential for participating institutions and allow the project team to estimate the potential nationwide energy, cost, and GHG savings from these modeled improvements.

1) Sector-Specific Customized Prototype Energy Model Creation: A set of three prototype energy simulation models will be developed from real world case studies of participating institutions to quantify energy use at different T/RH setpoints and schedules. The models will be based on the actual physical characteristics, environmental setpoints, occupancy / operational schedules, mechanical equipment / systems, and other aspects of the eight participating museums and advisor / team member expertise. Models will be calibrated using measured energy use and operational data, creating a baseline model with typical, tighter environmental controls. The models will then be modified to estimate the energy

potential from expanded environmental controls and potentially other strategies such as HVAC equipment upgrades, electrification (e.g., transitioning from gas burning furnaces to electric heat pumps), envelope improvements, and operational schedule changes depending on feedback from museum staff and advisors.

2) Parametric Analysis and Nationwide Efficiency Assessment: The energy models will be used to quantify the potential energy savings, and GHGs and utility cost reduction opportunities from adopting expanded environmental controls and other strategies. We will evaluate impacts at the prototype level and extrapolate impacts to the national level evaluating models across all major US climate regions for both tight and expanded environmental controls, expanding the project's impacts far beyond the eight buildings contributing data to the project. We will develop a series of efficiency parameters to evaluate the change in energy use of each through parametric (carefully designed repeated iterative evaluation) energy modeling and data analysis. These inputs will include variables like location / climate zone as well as the various details of each scenario's specific T/RH setpoints, schedules, building characteristics, and mechanical equipment type / condition. By parametric analysis the team will be able to define the energy, cost, and GHG implications of expanded T/RH setpoints and other strategies across a wide variety of climate zones, museum building subtypes, and more variables. To cross-check and confirm the energy savings potential, we will develop key performance indicators and operational metrics for the field, such as HVAC energy usage, energy use per day, operating cost, and GHG emissions from the energy models for comparison with museums implementing expanded environmental controls

What is the relevance of your proposed research for current practice?
There are few formal studies or even anecdotes regarding the energy costs of any collections conditions parameters. The MFA Boston conducted a formal but limited (one-month) study in 2013, shutting off 50% of the HVAC supply and return fans each night for 12 hours (10pm to 10am). If the RH dropped below 40% or the T dropped below 18°C or above 25°C, the fans automatically turned on. The researchers concluded that coasting the air handlers results in 42% nightly reduction in consumption and cost, equivalent to a 21% reduction each day. The lower use during periods of system shutdown resulted in 40% savings of kWh (kilowatt-hour)/month. On average, during the study period, the air handlers were reactivated for 2.6 hours each night (Nunberg, et al, *Journal of the American Institute for Conservation,* 2016). Anecdotally, two examples from the Frankenthaler Climate Initiative grants program suggest savings. A major cultural center had been pursuing seasonal overnight shutdowns of the building management system, and that had led to savings of 20-35% in electricity costs per month while the storage spaces "largely maintained their temperature" (2017). Another applicant noted that it intends to alter existing systems and practices in a specific area of the museum where objects are stored and conserved to allow for gradual seasonal changes in temperature and humidity set points for the purpose of saving energy and money and reducing wear-and-tear on the HVAC system. The museum wishes to understand, through use of energy and collections monitoring, how expanding parameters to comply with the Bizot Protocol would be appropriate for their collection and their building. Those institutions, the cultural center, the major Midwest art museum, and the MFA Boston indicate that there is information to be discovered on energy use, building type, and collections parameters. However, they are inadequate for museums determining protocols.

What type of data will you gather for your research (separate from that in your Performance Measurement Plan)? How will you collect, analyze, and use the data?
A2E will conduct the modeling of energy impacts of adjusting T and RH setpoints in these museums. A2E uses energy simulation modeling software to develop and calibrate energy models using current T/RH setpoint regimes, then parametrically expand those setpoints to produce a suite of modeled results aligned with various options for expanded setpoint controls. NBI will use the modeled outputs for both baseline and multiple proposed cases to compare annual energy, operating cost, site and upstream GHG emissions, and peak demand implications. They will use the models to check for times when the expanded setpoints or schedules may impact the building's ability to recover to a typical setpoint. For example, expanded setback during unoccupied hours can cause slow temperature and/or humidity recovery time, resulting in some hours where the occupied-hour setpoint is not met.

Data about institutions' building vintage, energy equipment, setpoints and schedule, and other relevant information will be identified in a collecting sheet with instructions, and augmented through discussions with museum staff, three site visits, advisor consultation, and review of printed policies. Energy simulation tools may include Energy Plus or the Virtual-

Environment IES software. The modeling data will be collected and analyzed using typical data organization tools such as Excel and data visualization tools such as Tableau. The data will contribute to the MIN/MAX Dashboard and interactive tool allowing users to select conditions to examine energy, emissions and equipment savings for themselves.

Does your study require Institutional Review Board (IRB) approval? No.

How will you report and disseminate your findings? This is addressed in Project Results under *What models, tools, etc.*

Project Results

What are your project's intended results, and how will they address the need, problem, or challenge you have identified?
There is significant funding for energy efficiency in the Federal Government's the Inflation Reduction Act (IRA) and the Bipartisan Infrastructure Law (BIL) that will be deployed in the next five to ten years. This project provides reliable information for museums planning investments that could be sources through IRA and BIL programs. Both the field and society benefit from reliable climate investments that slow the progress of climate change.

The result is expanded confidence in managing the invisible interactions of energy use, equipment, and collections care through manipulation of T/RH conditions. This study and the recommendations for efficiencies will have implications for museums' HVAC system choices and operations. This information will help museums as they develop climate action pathways that reduce their carbon footprint to comply with expanding codes and regulations, publicly demonstrate responsibility for resources, and/or survive financially in a challenged economy. With energy costs being the second-largest part of museums' budgets after staff, savings here are critical, but the staff cannot make them confidently without understanding where the savings lie. This knowledge will help any collecting institution with mechanical controls blend energy savings opportunities with conservation science for a better result for collections and the planet.

How will the knowledge, skills, behaviors, and/or attitudes of the target group change as a result of your project?
This project significantly expands the reliable data available to conservators and facilities managers as they make decisions in setting protocols for collections care by providing case examples from eight museums, and then three models calibrated to that research that offer even more case examples. This information will build confidence among institutional leaders considering shifting protocols if they were reluctant to change before, and it will strengthen the case for following the science already called for by the sectors' professionals.

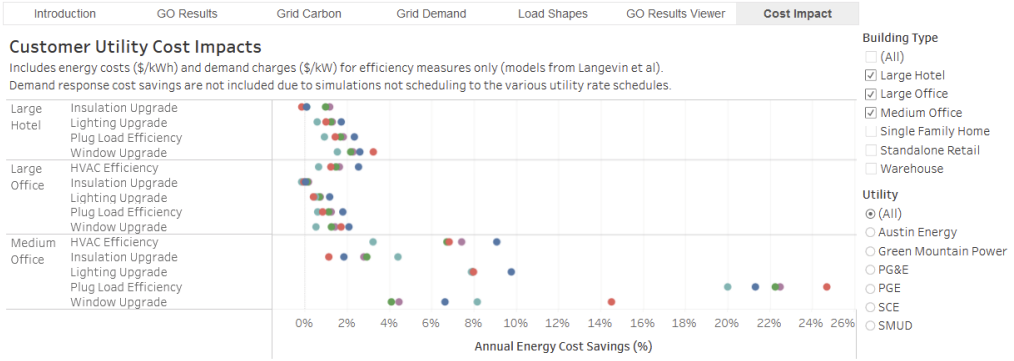
What models, tools, research findings, and/or services will result from your project?
Factsheet: A two-page factsheet summarizing the project and describing key findings, much like the attached materials from COC. This document will encourage interested institutions or organizations to access the MIN/MAX Dashboard, and explore the implications of expanding setpoints or adjusting other operational practices.

Case Studies: We expect 4 to 8 case studies to be developed by participating museums, mostly individually but some anonymized and collected, depending upon institutional interest and the energy story to tell. These will be hosted on the museums' own websites and those of ECP and NBI for at least five years.

Publications: The team members will submit an article proposal to *Curator: The Museum Journal*, and participants will be encouraged to submit detailed articles to *Papyrus*, the magazine for IAMFA, and *Museum*, the magazine for AAM. NBI and ECP will provide a social media kit for participants that promotes the webinars and the published results.

MIN/MAX Webpage: ECP will host a public page for project outputs, and resources for stakeholders including the Tableau iframe for the Dashboard. The page will be updated with the latest information and sector materials during the project and be maintained for at least five years after the conclusion of the project.

MIN/MAX Dashboard: An interactive web-based Tableau dashboard to help viewers explore the energy, cost, and GHG impacts of multiple T/RH setpoint and schedule scenarios across various climate zones, building sub-types and/or characteristics (examples: mechanical equipment, vintage, construction materials, schedules, etc.). This design will be similar to other dashboards developed by NBI and will include areas for user inputs, filtering, and other interactive features to explore the data (Ex.: https://public.tableau.com/app/profile/kevin8000/viz/BETRforschools/UpfrontCosts).



Sample Tableau dashboard plotting annual energy cost savings results from modeling research. Users can customize the view (e.g., select model, climate zone, modeled scenario) and navigate to other views plotting other results (e.g., GHG savings or energy savings)

End-of-project webinars: Two free live webinars, one hosted by AAMD and one by Conserv, (Aug 2025) since the data will not be ready for spring conferences. Webinars reach a broad national audience at no cost to them, avoid added carbon emissions and travel costs to in-person conferences, and capture recordings to store online for extended access.

How will you ensure that they are broadly adaptable and usable by other institutions and are widely disseminated?

For wide dissemination, ECP has already created the Climate Collaboration Agreement among many of the US national museum associations. This established path to far-reaching communication enables easy, broad dissemination of reports and webinar invitations. The publications, webinars and tools described above will be freely accessible through the ECP website and linked to the NBI and Conserv websites. ECP and NBI will promote all the resources to their professional contacts (estimated audience 6,000 institutions), and museum and conservation association websites in the US reaching even more professionals. NBI will create a blog post providing an overview of the project, geared to inform engineers, architects and designers, conservators, and collections managers. Case studies will describe the collection and building design where specific protocols were tested, and results will be provided through numbers, commentary and data visualization. Conservators and facilities managers will describe the project experience and results in terms that peers can recognize and use in the same manner they apply materials science information already. The MIN/MAX Dashboard will ensure that users can drill down to their relevant building subtype, climate zone, etc., and evaluate the cost, energy, and GHG implications of various T/RH scenarios (see earlier sample image). This dashboard will be made freely available and will be published with accompanying documentation. Since current materials science demonstrates that collections conditions are and will remain highly particular to collection needs, storage formats, and building settings, these findings are expected to be broadly adaptable by conservators and facilities managers working together.

How will you sustain the benefit(s) of your project beyond the conclusion of the period of performance? Both NBI and ECP are nonprofits dedicated to exactly this work, and Conserv has a broad and reliable customer base. They will continue to promote this work and continue research and action as the nation continues to reduce its carbon emissions. In the near term, ECP commits to sharing these results through NYC Climate Week in September 2025 after the project ends. ECP has a platform through America is All In, allowing it to reach multiple sectors with news of the cultural sector's climate action. The planned publications will debut after the project is complete. *Curator* has an international circulation of 13,500 online and in print, reaching a variety of practitioners within a wide range of museum types, most of which manage collections. Blooloop also has an international audience for the cultural sector and will promote and circulate the results of the project. Post-completion we will encourage participants to share case study summaries as an article in IAMFA's *Papyrus*, and through NBI's national Getting to Zero Forum, which shares work reducing carbon emissions from buildings by working with policy makers, designers, building owners, and systems manufacturers. All the materials described above, including the dashboard, will be housed on the ECP website for at least five years, only lapsing after that time should they become obsolete for some currently unforeseen reason.

Year 1: September 2024 to August 2025													
Step	**Activities**	**Sep-24**	**Oct-24**	**Nov-24**	**Dec-24**	**Jan-25**	**Feb-25**	**Mar-25**	**Apr-25**	**May-25**	**Jun-25**	**Jul-25**	**Aug-25**
1 to 4	Monthly project management and status meetings (Project Team)	Kickoff											
1 to 4	Writing: ECP newsletter updates (2 in year 1; 1 in year 2; case studies, public and IMLS reports)												
1 to 4	Quarterly collaboration and status meetings (Project Team, advisors, museums)		Kickoff			Data + Policy Check							
1	ECP prepares to kickoff project (e.g., sets up payment systems, SharePoint worksite, schedules meetings, etc.)												
1	A2E and NBI develop and distribute data request list of information needed from museums (e.g., building information, protocols of energy use, and energy data)												
2	A2E, ECP, Foust, NBI conduct virtual meetings with individual museums to support data collection												
2	Project Team conducts in-person visits to three museums to examine actual conditions and practices (people, policy, building construction)												
3	A2E creates the building energy models and calibrates it based on data collected with NBI and documents research methodology												

Year 2: September 2025 to August 2026													
Step	**Activities**	**Sep-25**	**Oct-25**	**Nov-25**	**Dec-25**	**Jan-26**	**Feb-26**	**Mar-26**	**Apr-26**	**May-26**	**Jun-26**	**Jul-26**	**Aug-26**
1 to 4	Monthly project management and status meetings (Project Team)	Kickoff											
1 to 4	Writing: ECP newsletter updates (2 in year 1; 1 in year 2; case studies, public and IMLS reports)												
1 to 4	Quarterly collaboration and status meetings (Project Team, advisors, museums)		Kickoff			Data + Policy Check							
3	A2E, NBI, and museums explore additional real-time shifts in monitoring (e.g., changing temperature and moisture controls)												
3	Museums trial implementation of additional efficiency measures (optional)												
3	Project Team provides technical support to museums as they trial and implement additional efficiency measures												
3	NBI develops Tableau-based Dashboard												
3	A2E updates models based on museums' trial implementation of additional efficiency measures and makes final revisions based on any new information												
4	Museums develop case studies in collaboration with Project Team and advisors												
4	Advisors and Museums test Dashboard, in addition to additional curated group												
4	Project Team develops final project report and recommendations, and Tableau visual dashboard												
4	Webinars and conference: Team + participant representatives										Webinars		
4	A2E and NBI work with ECP to transfer hosting, knowledge transfer, and documentation to ECP												
4	Outline and propose articles for Curator, IAMFA's Papyrus, Blooloop, and other outlets as identified during the project												
4	Project Team communicates final report and results through newsletters, social media, networks (e.g., national culture associations, NBI's Net Zero Now Twitter Conference)										Net Zero Now Twitter		

DIGITAL PRODUCTS PLAN

Type: What digital products will you create?

The team will create several types of digital products. These can be organized by project step: first, data collection; in the middle, evaluation and analysis and building the data model; and finally, findings and recommendations.

During steps 1 and 2 of the project the team will gather quantitative and qualitative data to assess and make consistent key information about the museum facility's performance data (energy, water, and other parameters) and relevant physical characteristics (size, equipment, condition, etc.). This information will be primarily gathered in the form of spreadsheets (Microsoft Excel) and data-sharing via ENERGY STAR® Portfolio Manager® (ESPM). Microsoft Word and PowerPoint will also be key tools.

In step 3, the A2E and New Building Institute teams will perform analysis to evaluate the energy, cost, and climate impacts of indoor environmental condition choices in participating museums and will develop energy analysis models to expand that assessment beyond the specific participating museums to facilitate providing broader sector-scale findings and guidance. Digital products produced during this stage will include the parametric energy modeling, spreadsheets and other electronic documents, energy modeling input and output files, data visualizations using Tableau including charts, graphs, and interactive dashboards, and summary reporting. The energy three energy models of specific museum sites will be developed by A2 Efficiency (A2E), using available information on building architecture, mechanical and electrical systems, and building usage along with thermal controls and setpoints. Energy models will be built with either EnergyPlus or the Virtual-Environment IES software. Both present state of the art, physics-based simulation environments using the most advanced heat transfer calculations and ability to evaluate detailed building mechanical systems.

In step 4, the project the team will develop digital products including charts, graphs, reports, an interactive web-based dashboard using Tableau, and potentially other resources. Key tools in this phase include Excel, Word, PowerPoint, Adobe Acrobat, and Tableau. The interactive web-based and free Tableau dashboard will help viewers explore the energy, cost, and GHG impacts of multiple T/RH setpoint and schedule scenarios across various climate zones, building sub-types and/or characteristics (examples: mechanical equipment, vintage, construction materials, schedules, etc.). This design will be like other dashboards developed by NBI and will include areas for user inputs, filtering, and other interactive features to explore the data (Ex.: https://public.tableau.com/app/profile/kevin8000/viz/BETRforschools/UpfrontCosts). The Dashboard will ultimately be managed and hosted by ECP, and this knowledge transfer will occur during the final six months of the project [See digital products plan for additional information].

Availability: How will you make your digital products openly available (as appropriate)?

Digital products developed under this project will be released publicly and free of charge. The project summary report and fact sheet which will include charts, graphics, renderings, etc. will be released publicly, in addition to the case studies developed by the Museums. Some market-oriented guidance material will be copyrighted by New Buildings Institute. The team anticipates providing these materials freely for commercial and noncommercial use, with attribution. Some building-specific recommendations and guidance will also be delivered to participating institutions. Because this information may be developed in part based on confidential information (e.g., energy and systems performance data), this information will not be released to the public unless all holders of input data agree to do so in writing. Documents and the website will be designed to be Section 508 accessible and to align with relevant guidelines by the Federal Agencies Digital Guidelines Initiative (FADGI). All digital products for public dissemination will be viewable by standard web browsers and common, free software such as Adobe Reader. **The goal of the team is to leverage information from a variety of sources, including both public and private data streams, and then to anonymize or trim the private data so that all research outputs (products) can be shared as broadly as possible to maximize the project's impacts.**

The report and related content will be hosted on the Environment and Culture Partners' (www.ecprs.org) website and project webpage, New Buildings Institute (www.newbuildings.org) and/or Getting to Zero Forum website(s) as well as other team members' sites including A2E.

Access: What rights will you assert over your digital products, and what limitations, if any, will you place on their use? Will your products implicate privacy concerns or cultural sensitivities, and if so, how will you address them?
New Buildings Institute will retain copyright to certain public-facing documents to ensure that their content remains intact and that key messages, guidance recommendations, etc. are not compromised by unauthorized revisions. These documents will be released publicly for free alongside a coordinated publicity push to maximize their sharing. Public-facing documents will be made freely available for commercial and noncommercial use, with attribution.

The team expects to analyze facility characteristics, energy, water, and other performance data of participating Museums. This information may be confidential and will not be publicly released in an identifiable fashion (i.e., will be anonymized and/or aggregated) unless the specific facility representative agrees to do so in writing. Interim digital products including most Excel energy data and facility condition data as well as the energy simulation modeling input and output files will primarily be used to inform and generate findings and recommendations to be disseminated in the public-facing digital products.

To the extent that research is conducted using energy or other data specific to an institution, that institution must approve in writing the use of said data in an identifiable manner. The team expects to use this type of information to develop conclusions that are not tied to any specific institution and to share those conclusions publicly. This project will not require approval from internal approval boards or institutional review board(s).

Sustainability: How will you address the sustainability of your digital products?
All public-facing digital products developed under this grant will be made freely available online, and otherwise as discussed in this Plan, for a period of at least five (5) years after the completion of this project and archived in storage for at least 10 years afterward (further discussed in the Data Management Plan). These digital products may be used and reused by libraries, archives, museums, and the public freely for commercial and noncommercial use, with attribution. All public-facing and interim digital products (non-public-facing digital products) will be stored on New Buildings Institute's internal servers for a minimum of 5 years after project completion and archived in storage for at least 10 years afterward. This is standard practice for New Buildings Institute and additional funding is not needed to ensure this sustainability. Internal team data repositories managed by ECP will be managed on an as-needed basis following the project completion.

Applicant Name: Environment & Culture Partners

Project Title: MIN/MAX: The Relationship Between Energy, Carbon, and T/RH Parameters in Collecting Institutions

Performance Measure	**Data We Will Collect** (e.g., counts, costs, weights, volumes, temperatures, percentages, hours, observations, opinions, feelings)	**Source of Our Data** (e.g., members of the target group, project staff, stakeholders, internal/ external documents, recording devices, databases)	**Method We Will Use** (e.g., survey, questionnaire, interview, focus group, informal discussion, observation, assessment, document analysis)	**Schedule** (e.g., daily, weekly, monthly, quarterly, annually, beginning/end)
Effectiveness: The extent to which activities contribute to achieving the intended results	The Project Team will review quality of the energy and building data submitted by the Museums, and continuously assess the modeling results; and make adjustments as needed. Adjustments to methodology can be made as needed due to the iterative nature of the project in order to confirm the acquired data's sufficiency for practical conclusions and reliable modeling. The Advisors and Museums will review the Dashboard NBI builds, in addition to a small group of cultural sector professionals. A survey will collect feedback on its ease of use and ease of acquiring information. Changes will be made as needed. The Advisors will also contribute to and provide feedback on all publications.			
Efficiency: How well resources (e.g., funds, expertise, time) are used and costs are minimized while generating maximum value for the target group	ECP's Shapiro will work with Powers Accounting on at least a monthly basis to manage and monitor the budget and execute payments on a schedule determined during Step 1 of the project. In addition, an audit will be performed at the end of each year. The Project Team will meet monthly (and additionally as needed) throughout the project to review the project's progress, timeline, allocation of resources and funding. If expertise gaps are identified, the team will work together to fill them, and mitigate any issues or risks related to the timeline. The Project Team will meet with the Advisors and Museums quarterly for progress updates (like the above) and collaboration. Information related to the project, data collection, site visits, and all project activities will be shared within the first two months of the project when the project plan and SharePoint workspace are created. ECP's Shapiro and Sakowski will manage the workstreams and be in constant contact with team members sharing reminders, action items, and updates.			
Quality: How well the activities meet the requirements and expectations of the target group	Meetings: The scheduled beginning meeting establishes communications protocols that will lead to cleaner data from the museums and reasonable expectations by the consultants. Meetings: Meetings will occur between the project team and Museums to review energy and building data, and the meetings of all team members for reviewing the energy data and conclusions in context with additional technical review by the experts, creates a continuous feedback process to ensure fulfilling expectations of actionable, understandable data. Calibration: This process of periodically comparing the developing energy models to the reference data of actual energy use and conditions at the museum ensures the quality of the modeling results.			
Timeliness: The extent to which each task/activity is completed within the proposed timeframe	ECP will continually update and monitor the schedule of activities and project plan in SharePoint to keep the project on schedule, keep the project team, Advisors, and Museums engaged and on task, and allow for regular updates on next steps and expectations. ECP will orchestrate the writing process in step 4 (final 5 months) setting regular deadlines for outlines, drafts, and completion.			

INSTITUTE FOR MUSEUM AND LIBRARY SERVICES
DATA MANAGEMENT PLAN

Data Overview

- Identify the type(s) and estimated amount of data you plan to collect or generate, and the purpose or intended use(s) to which you expect them to be put.
- Describe the method(s) you will use, the proposed scope and scale, and the approximate dates or intervals at which you will collect or generate data.

This project will involve the collection of facility performance data (energy, water, and other parameters) as well as facility characteristics (size, equipment, condition, etc.) by Environment & Culture Partners (ECP) and New Buildings Institute (NBI). This information will be used to characterize energy/GHG savings opportunities and to define recommended strategies to reduce energy/GHG impacts. Energy data will be collected via ENERGY STAR® Portfolio Manager® (ESPM) and additional building information and data will be collected via a spreadsheet. ESPM is owned and managed by the U.S. Environmental Protection Agency and is free for users to input and share data.

Three energy models of specific museum sites will be developed by A2 Efficiency (A2E), using available information on building architecture, mechanical and electrical systems, and building usage along with thermal controls and setpoints. Energy models will be built with either EnergyPlus or the Virtual-Environment IES software. Both present state of the art, physics-based simulation environments using the most advanced heat transfer calculations and ability to evaluate detailed building mechanical systems.

NBI will build an interactive web-based and free Tableau dashboard to help viewers explore the energy, cost, and GHG impacts of multiple T/RH setpoint and schedule scenarios across various climate zones, building sub-types and/or characteristics (examples: mechanical equipment, vintage, construction materials, schedules, etc.). This design will be like other dashboards developed by NBI and will include areas for user inputs, filtering, and other interactive features to explore the data (Ex.: https://public.tableau.com/app/profile/kevin8000/viz/BETRforschools/UpfrontCosts).
The Dashboard will ultimately be managed and hosted by ECP, and this knowledge transfer will occur during the final six months of the project.

Sensitive Information

- Will you collect any sensitive information? This may include personally identifiable information (PII), confidential information (e.g., trade secrets), or proprietary information.
- If so, detail the specific steps you will take to protect the information while you prepare it for public release (e.g., anonymizing individual identifiers, data aggregation).
- If the data will not be released publicly, explain why the data cannot be shared due to the protection of privacy, confidentiality, security, intellectual property, and other rights or requirements.

The team expects to analyze facility characteristics, energy, water, and other performance data at various facilities. This detailed information may be confidential and will not be publicly released in an identifiable fashion (i.e., will be anonymized and/or aggregated) unless the specific Museum representative agrees to do so in writing.

Requirements and Dependencies

- What technical (hardware and/or software) requirements or dependencies would be necessary for understanding retrieving, displaying, processing, or otherwise reusing the data?
- How can these tools be accessed (e.g., open-source and freely available, commercially available, available from your research team)?

A2E has licenses for and will build the energy models with either EnergyPlus or the Virtual-Environment IES software.

In general, Microsoft Excel will be sufficient to perform other data analytics and free for non-profits, web-based, Tableau will be used for the Dashboard which NBI and ECP have access to.

ESPM is owned and managed by the U.S. Environmental Protection Agency and is free for users to input and share data.

Documentation

- What documentation (e.g., consent agreements, data documentation, codebooks, metadata, and analytical and procedural information) will you capture or create along with the data?
- Where will the documentation be stored and in what format(s)?
- How will you permanently associate and manage the documentation with the data it describes to enable future reuse?

Such documentation will be collected electronically and stored on Environment and Culture Partner's internal cloud. Public-facing documents will be shared via project partner websites listed below.

Post-Project Data Management

- What is your plan for managing, disseminating, and preserving data after the completion of the award-funded project?
- If relevant, identify the repository where you will deposit your data.
- When and for how long will data be made available to other users?

Data will be stored internally on ECP's cloud for up to 5 years; A2E and NBI for up to 2 years after the projects' completion, and archived in storage for at least 10 years afterward (ECP).

The report and related content will be hosted on ECP's website as well as other team members': www.newbuildings.org, and www.ecprs.org.

Name of repository: Environment and Culture Partners Microsoft 365 cloud / URL: N/A

Review and Monitoring

- When and how frequently will you review your Data Management Plan?
- How will the implementation be monitored?

This data management plan will be reviewed on project kickoff and at the completion of the project. The implementation is relatively simple and will require only minimal monitoring; quarterly reviews will be conducted throughout the project, with subsequent annual reviews along with other ECP's institution-wide data management plan as well as in conjunction with NBI and A2E.