PON 5180 - Round 2 - Attachment A1

Challenge Area 1: Innovations in Green Cooling

Research, development, and demonstration of tools, technologies and strategies that increase adoption, performance, and benefits of nature-based approaches to passive cooling, resilience, and reliability in extreme heat.

I. Introduction and Motivation

Extreme heat is a leading cause of death among hazardous weather events in the United States.[1] Extreme heat severly affects the health and well-being of residents across New York State.[2,3] The impacts of extreme heat are projected to become more pronounced[4] with rising temperatures and as heat waves become more intense, frequent, and longer in duration due to climate change.

Across NYS, climate change is already increasing the severity, duration and frequency of extreme heat events.[5] By the 2050s this rate could increase to up to eight heat waves[6] per year in some regions of New York State. According to the New York Independent System Operator's 2023-2032 Comprehensive Reliability Plan, the increased occurrence of heat waves and extreme heat waves are key risk factors to grid relability.[7] Beginning in summer 2025, there is projected to be a reliability need within New York City primarily driven by a combination of forecasted increases in peak demand and the assumed unavailability of certain energy generation assets in New York City affected by the "Peaker Rule". This suggests that heat waves pose risks to grid relability over the next ten years.[8]

More frequent and intense extreme heat events and rising temperatures driven by climate change have a disproportionate impact on disadvantaged communities, and more broadly are worsened by socio-economic, environmental, age- and health-related conditions, and other factors that increase risks, especially to vulnerable groups.[9] People of color, Indigenous People, unhoused people and people living in institutional settings, older adults, infants and children, pregnant women, and people with chronic illnesses are

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[1] National Weather Service, Weather Related Fatality and Injury Statistics

[2] https://www.health.ny.gov/environmental/emergency/weather/hot/

[3] https://www.nyc.gov/assets/doh/downloads/pdf/environmental/climate-health-profile-report.pdf

[4] Implications of Increasing Household Air Conditioning Use Across the United States Under a Warming Climate - Obringer - 2022 - Earth's Future - Wiley Online Library

[5] 2014 ClimAid Report, https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Environmental/ClimAID/2014-ClimAid-Report.pdf

[6] Defined as periods of three or more consecutive days above 90°F in https://dec.ny.gov/environmental-protection/climate-change/effects-impacts/extreme-heat

[7] Short-Term Reliability Process Report: 2025 Near-Term Reliability Need, https://www.nyiso.com/documents/20142/39103148/2023-Q2-Short-Term-Reliability-Process-Report.pdf/

[8] Short-Term Assessment of Reliability: 2023 Quarter 2, https://www.nyiso.com/documents/20142/16004172/2023-Q2-STAR-Report-Final.pdf/5671e9f7-e996-653a-6a0e-9e12d2e41740

[9] Development of a heat vulnerability index for New York State - ScienceDirect

especially vulnerable. Race and ethnicity, socio-economic status, and lack of language proficiency in particular increase vulnerability.

New York State has prioritized addressing current and future impacts of extreme heat. Accordingly, New York State is developing initiatives to keep residents safe during extreme heat events, prepare New York's diverse communities for future impacts of climate change, and leverage existing and new initiatives to enhance resilience, build local capacities, and reduce inequities.[10]

II. Current Barriers and Needs for New York State

Prior work supported by NYSERDA[11], and more recent studies[12,13], suggest that nature-based approaches to cooling (trees, green roofs, green walls, agriculture, and other ways to introduce vegetation) are highly effective, but need a significant increase in scale to provide appreciable mitigation of urban heat islands and other co-benefits. Despite ongoing efforts and case studies[14,15,16], vegetation is present on a very small percentage of the feasible area, particularly in heat vulnerable communities in New York City[17], and other New York State cities[18], where it can offer the greatest potential benefits. In addition, tools that enable an accurate ability to predict benefits and optimize the design of a landscape[19] or building[20] are needed to assist developers and local communities in implementation where a multitude of strategies may need to be combined[21].

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[10] Information contained within introduction principally adapted from Department of Environmental Conservation (DEC) Extreme Heat website, https://dec.ny.gov/environmental-protection/climate-change/effects-impacts/extreme-heat; Extreme Heat Action Plan - NYSERDA ;

[11] https://www.nyserda.ny.gov/-/media/Project/Nyserda/files/Publications/Research/Environmental/EMEP/NYC-Heat-Island-Mitigation.pdf

[12] Peak Electric Load Relief in Northern Manhattan: An Exploratory Data Analysis - Hildegaard D. Link, José Pillich, Yehuda L. Klein, 2014 (sagepub.com)

[13] Characterization of intra-urban spatial variation in observed summer ambient temperature from the New York City Community Air Survey - ScienceDirect

[14] https://www.epa.gov/green-infrastructure/reduce-urban-heat-island-effect

[15] https://www.epa.gov/green-infrastructure/overcoming-barriers-green-infrastructure

[16] https://www.epa.gov/green-infrastructure/economics-green-infrastructure

[17] Examining the distribution of green roofs in New York City through a lens of social, ecological, and technological filters - Ecology & Society (ecologyandsociety.org)

[18] Downtown Syracuse residents disproportionately affected by 'heat island' phenomena (dailyorange.com)

[19] Evaluating the cooling effects of green infrastructure: A systematic review of methods, indicators, and data sources - ScienceDirect

[20] Green roofs save energy in cities and fight regional climate change | Nature Cities

[21] Nature-based cooling potential: a multi-type green infrastructure evaluation in Toronto, Ontario, Canada - PMC (nih.gov)

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Section III provides challenge requirements that each proposal must addresss, as well as examples of eligible approaches that can address barriers detailed above. While not exhaustive, the list is intended to provide examples of novel approaches that can be combined in a given project to overcome barriers to scalability and replicability.

III. Challenge Requirements and Examples of Eligible Approaches

Challenge Requirements

All proposals must address all of the following in their approach

- Make use of, or be applicable to the use of vegetation, as in green infrastructure, such as trees, grasses, shrubs, green roofs, green walls, crops, that grow using light, water, and CO_2 via photosynthesis. The cooling effect being driven by a combination of evaporation, reflected sunlight, shading, and alteration of the transport and properties of thermal energy in the environment.
- Explain a path to be economically self-sustaining in the market after NYSERDA funding, by overcoming one or more key barriers to scalability, such as cost (for example, $/unit, where "unit" is tree or square footage of roof area), performance (such as automation, maintenance, cooling/area), and/or other means; see examples of eligible approaches.
- Include a quantitative estimate of energy related benefits that include cooling (reduced demand for cooling energy). Optional are heating related benefits, such as via thermal insulation (considered a co-benefit).
- Explain co-benefits and how they can be evaluated qualitatively or quantitatively, such as gallons/year reduction of storm water, air quality via reduced particulate matter, human health and economic value streams, such as food, circular business models[22], and aesthetics.
- Regardless of the starting stage, all projects must include a demonstration stage as part of the Phase 2 project scope, in which results are evaluated by an independent 3rd party. When possible, demonstration projects should be located in heat-vulnerable disadvantaged communities.
- Meet requirements listed in the Attachment C1 – Statement of Work Template.

Examples of eligible approaches include, but are not limited to one or more of the following:

- New Design/Modeling Tools for Landscape Optimization for Cities and Municipalities and Building level implementation
  - Improved accuracy of predictive modeling and design tools

[22] New York City's Food Waste and the Circular Economy | Columbia University School of Professional Studies

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  - Use of software tools enabled by satellite data, artificial intelligence, 3D urban models, digital twins, and other algorithms
  - Optimization of the entire city landscape or municipality where combinations of green, grey, and blue infrastructure are needed that can enable reliable and turnkey solutions for developers and local communities

- New business models to reduce reliance on public funds, which may include incorporation of multiple value streams (urban agriculture, educational facilities, solar + green roofs, circular economy from food waste to feedstock)

- Approaches and tools that address tendencies for inaction, or lack of inclusion, such as new models for engagement and inclusion of disadvantaged and heat vulnerable communities

- New Technologies and Approaches for Implementation such as:
  - Integration of automation for watering and water retention, functional in all seasons
  - Automation of optimized design for location specific cooling to minimize AC loads and lower local air and surface temperature
  - Enabling more streamlined incorporation of green space in hard-to-reach areas, such as vertical surfaces, where more conventional vegetation, such as trees, are not feasible, and that may also provide insulating benefits

- Approaches that build upon and enable existing investments within New York State to become more cost-effective, scalable, and with a greater number of benefits accruing. This can be achieved through the following:
  - Teaming with other community-led green infrastructure projects
  - Teaming with other existing State and federal programs, such as recent USDA awardees in New York State, to leverage these resources by ***adding a new scope*** that enables greater impact and replicability

Ineligible approaches - projects not eligible for funding under this Challenge:

- Covering costs for conventional tree planting or vegetation installation programs or projects

For questions regarding eligibility, contact the NYSERDA Designated Contact listed in the PON Summary document at NatCarbon@nyserda.ny.gov

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IV. Supplemental Materials

This section is intended to provide additional documents and literature regarding Challenge Area 1. This is not a comprehensive list of literature, but rather is intended to provide a foundation for further research into the current challenges, impacts and benefits of green cooling approaches and technologies.

Table 1. Supporting documents and literature by relevant sectors

Sector	Additional Literature and Materials
Health	We Built a Whole-of-Government Strategy to Fight Extreme Heat (fas.org) Urban heat: an increasing threat to global health | The BMJ Hot weather and heat extremes: health risks - The Lancet The Effects of Coexposure to Extremes of Heat and Particulate Air Pollution on Mortality in California: Implications for Climate Change - PubMed (nih.gov) Urban Heat Island Monitoring and Impacts on Citizen's General Health Status in Isfahan Metropolis: A Remote Sensing and Field Survey Approach - PMC (nih.gov) Frontiers | Spatiotemporal mechanism of urban heat island effects on human health—Evidence from Tianjin city of China (frontiersin.org) Assessing the effects of urban heat islands and air pollution on human quality of life - ScienceDirect Pacific Northwest heat wave continues this week with no end in sight | CNN Overheating and passive habitability: indoor health and heat indices: Building Research & Information: Vol 44 , No 1 - Get Access (tandfonline.com)
Energy	Prior work by NYSERDA: https://www.nyserda.ny.gov/-/media/Project/Nyserda/files/Publications/Research/Environmental/EMEP/NYC-Heat-Island-Mitigation.pdf

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	Compound Climate and Infrastructure Events: How Electrical Grid Failure Alters Heat Wave Risk - PubMed (nih.gov) Recent heat waves show the US power grid is not ready for climate change - Vox Electric grid climate change resilience | McKinsey Effect of varying ambient conditions on the performance of air conditioner using evaporative cooler | Journal of the Brazilian Society of Mechanical Sciences and Engineering (springer.com) A Comparison of an R22 and an R410A Air Conditioner Operating at High Ambient Temperatures (purdue.edu)
Agriculture/ Forestry/ Environment	Home - i-Tree Planting Calculator (itreetools.org) NYC_GreenRoofs_Summary.pdf (nature.org) Green Roofs Towards Circular and Resilient Cities | Circular Economy and Sustainability (springer.com) Ten Innovations in North America's Green Roof and Wall Industry (livingarchitecturemonitor.com) Green Roof Innovation and Research: Challenges and Opportunities (linkedin.com) Vertical Greening Systems for Acoustic Insulation and Noise Reduction - ScienceDirect Acoustic insulation capacity of Vertical Greenery Systems for buildings - ScienceDirect
Information Technology/ Artificial Intelligence/ Machine Learning	How AI can help predict climate extremes | IBM Research Blog Food waste and the complexity of New York City's garbage (phys.org) [PDF] Controlling Weather Field Synthesis Using Variational Autoencoders | Semantic Scholar Green Stormwater Infrastructure Siting Tool – MAPC About GIFMod | Green Infrastructure Flexible Model

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