PON 5180 - Round 2 - Attachment A2

Challenge Area 2: Carbon Negative Buildings

Demonstration, introduction and scale up of carbon negative products in New York State that support building energy efficiency.

I. Introduction and Motivation

Reducing the energy used in buildings is a top priority for New York State in achieving the goals of the Climate Act and key to supporting affordability and reliabiltiy of the electric grid. There is increasing recognition that products and materials used in buildings, can have negative consequences for global warming and the environment. This section explains the three major motivating factors for this Innovation Challenge: 1) Building energy use, 2) Building embodied carbon and 3) How building products can help achieve negative emissions, supporting New York State's 2050 net zero emissions goal.

Building Energy Use and Associated Emissions. Buildings, as a sector, are the largest share of greenhouse gas (GHG) emisions in New York State, about 120 MMt CO_2e/yr, 32% of the New York State total.[1] In New York City, buildings are responsible for about 70% of GHG emissions.[2] Efficiency improvements reduce GHG emissions, utility bills, reduce stress on the power grid, and potentially avoid costly energy infrastructure needs.[3] Modeling from New York's Climate Scoping Plan sugests that widespread improvements to building envelopes (air-sealing, insulation, and replacing poorly performing windows) can reduce energy demand from buildings by 30-50%. If applied to 5-7 million buildings across New York State, these improvements could reduce as much as 10% of statewide GHG emissions. As space heating is increasingly electrified via heat pumps, reducing the energy needed to heat an occupied space alleviates challenges with electrical systems and grid demand. As extreme heat waves increase[4], an energy conserving building that requires less energy to cool also alleviates grid stress and increases occupant safety.

***Building Embodied Carbon*.** Embodied carbon of a building refers to the GHG emissions associated with manufacture of products and materials, construction, use, and end-of-life[5]. About one third of a building's total emissions over its useful life are due to materials and products, primarily from resource extraction, manufacture and transportation. A significant estimate for New York is that 15% of the GHG emissions from New York State's building sector are due to Hydrofluorocarbons (HFCs) from building equipment and foam insulation. Such estimates have motivated policy and overall goals

[1] https://climate.ny.gov/-/media/Project/Climate/Files/NYS-Climate-Action-Council-Final-Scoping-Plan-2022.pdf
[2] https://council.nyc.gov/data/green/
[3] Avoided costs estimates in https://gebroadmap.lbl.gov/
[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] https://rmi.org/embodied-carbon-101/; 1 - Embodied Carbon 101 - Carbon Leadership Forum

nationally[6,7,8,9], in New York State[10,11] and at private organizations[12] to set maximum thresholds on the embodied carbon from building and construction materials. This has important implications for manufacturers, architects, builders, residents, and other stakeholders, suggesting future market opportunity may depend on embodied carbon and reporting requirements of Environmental Product Declarations (EPDs)[13,14].

Carbon Negative: Negative Emissions and Carbon Sequestration. The goals of New York State's Climate Act include zero GHG emissions on a net basis by 2050.[15] This includes a minimum reduction in gross emissions by 85% and allows for 15% to be offset by atmospheric carbon dioxide removal, or negative emissions. The majority of negative emissions currently are due to forest growth, as trees grow by absorbing carbon dioxide from the atmosphere. Relatedly, forest products from New York State are also estimated to play a role by providing long-duration storage of carbon in the product, and forest management that supports forest regeneration. A significant increase in forest area would be required to achieve this 15% goal, motivating interest in alternative strategies that may also involve engineered technology to capture atmospheric CO_2. The large volume of material needed for buildings provides an opportunity for a climate solution by substituting high emissions products with negative emissions alternatives.

II. Current Barriers and Needs for New York State

A top priority for New York State is the reduction of energy demand of the building sector. This also represents one of the largest market opportunities for suppliers of products and services and where demonstrating new products can spur early adoption and market transformation. State, national, and private purchase decisions increasingly seek low embodied carbon. Research suggests that cost-competitive carbon negative building products are being used[16], but have limited availability, limited case studies on performance comparisons with incumbent products, and uncertainty on scalability that

[6] Federal Buy Clean Initiative | Office of the Federal Chief Sustainability Officer
[7] Decarbonizing the U.S. Economy by 2050: A National Blueprint for the Buildings Sector | Department of Energy;
[8] Interim IRA LEC Material Requirements - used in Pilot May 2023 (gsa.gov)
[9] Bringing embodied carbon upfront. Coordinated action for the building and construction sector to tackle embodied carbon | Circular Cities and Regions Initiative (europa.eu)
[10] https://ogs.ny.gov/greenny/greenny-specification-lower-carbon-concrete
[11] New York Executive Order 22: New York City Executive Order 23
[12] Climate Action – SOM; Embodied Carbon Reduction Roadmap - Arup; Climate and Environment | Lendlease ; Embodied Carbon - World Green Building Council (worldgbc.org)
[13] https://sftool.gov/plan/402/environmental-product-declarations-epds
[14] https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr.html
[15] Scoping Plan - New York's Climate Leadership & Community Protection Act (ny.gov)
[16] Transforming Existing Buildings from Climate Liabilities to Climate Assets - RMI ; Embodied Carbon Initiative - RMI

depends on feedstock supply. Meanwhile, many product manufacturers are uncertain of the potential market opportunity for low-embodied carbon products in New York State.

This Challenge Area seeks solutions that bridge a gap in the increasing interest and demand for low carbon products across New York State, overcome barriers of uncertainty regarding product performance, emissions, costs, codes and standards, help to match supply and demand with additional benefits to rate payers.

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 articulate how introducing a product into the New York State market, increasing market share, or optimizing manufacturing will benefit end users via reduced costs, improved building energy efficiency, reduced GHG emissions, and increased carbon sequestration inside New York State.
- The proposal must either introduce a new product into NYS that is not currently available, or, if available, the scale up of the product will result in lowering embodied carbon of buildings compared with use of commonly available products and increase carbon sequestration/negative emissions inside New York State.
- For products already manufactured and sold in New York State, projects may also include a scope that lowers product embodied carbon through optimizing manufacturing process efficiency and/or formulation. Any changes to formulation should be incremental and fall within the scope of a demonstration project. See definitions of “Product Development” and “Demonstration” in the PON Summary document, as well as the TRL/CRL Calculator (Attachment D).

All proposals must address all of the following in their approach

- Utilize a product that supports building energy efficiency in retrofits or new construction, such as thermal insulation, air sealing, window improvements, etc.
- Be applicable to key NYS markets and building typologies for residential housing such as multi-family, single-family, low-income, affordable housing
- Include negative emissions and sequestration of carbon in at least one element of the product supply chain, such as by converting biomass grown from photosynthesis into a form of long-term storage, avoiding atmospheric release

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- Seek to reduce overall embodied carbon compared with competing products
- Meet requirements listed in the Attachment C2 – Statement of Work Template

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

- Design strategies to lower barriers for integration of low to carbon negative building materials in the retrofit and new construction process, these can include computational modeling to increase efficiency, advanced pre-fabrication, and assembly to lower installation cost, including approaches that are amenable to deconstruction/ disassembly to increase product and material lifetime.
- Use of business models to lower the cost of using carbon negative materials and products, emphasizing lowering barriers to adoption and deployment of existing low-carbon products.
- Products using “low-grade wood”, organic waste, or agricultural residues that often have low economic value and result in GHG emissions, but could be converted into durable carbon storage and have significant volumes in NYS.
- Products that passed codes and standards in other markets (for example, Canda, Europe), but have not yet transitioned to the target market in NYS, or may need to be demonstrated, validated, and certified for a larger variety of building typologies to expand the market potential.
- Novel assemblies are allowed, so long as sub-components (e.g., insulation, frame, sealing, windows) have passed standard test requirements for some building typologies.

Specific end-uses and examples may include but are not limited to:

- Building insulation for retrofits and new construction
- Structural insulated panels that can be paired with pre-fabrication and minimally disruptive onsite assembly, in retrofits and new construction
- Novel types of materials that can achieve greater carbon negativity and can meet or exceed current thermal, safety and environmental benefits of
    - Gypsum, drywall, preferably with higher R-value than current products, cost competitive, and with sufficient fire protection
    - Oriented strand board
    - Window frames, coatings, emissions of frame and the overall Insulating Glazing Unity (IGU)
    - Air-sealing materials, vapor barrier, weather stripping

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

- Projects that seek to cover costs of sourcing energy with lower carbon intensity (such as wind, solar).

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

IV. Supplemental Materials

This section is intended to provide additional references and may be relevant. This is not a comprehensive list, but rather is intended to provide a foundation to orient proposers to complementary initiatives of NYSERDA and other organizations.

Relevant NYSERDA and NYS efforts

- Empire Building Challenge Projects - NYSERDA
- Winners - NYSERDA – Buildings of Excellence Program
- Advanced Buildings Program - NYSERDA
- Carbon Neutral Buildings Roadmap - NYSERDA
- New reports highlight findings on cost effective retrofit solutions - NYSERDA
- Residential Building Stock Assessment - NYSERDA
- New Construction & Development - NYSERDA
- Clean & Resilient Building Codes - NYSERDA
- Governor Hochul Announces $20 Million Awarded to Advance Climate-Friendly High-Rise Building Retrofits in New York State | Governor Kathy Hochul (ny.gov)
- Multifamily Building Programs - NYSERDA
- GreenNY Council Working Groups | Office of General Services

Relevant National Efforts - United States Department of Energy

- Advanced Building Construction Projects | Department of Energy
- HESTIA | arpa-e.energy.gov
- Building Envelope Campaign | Better Buildings Initiative (energy.gov)