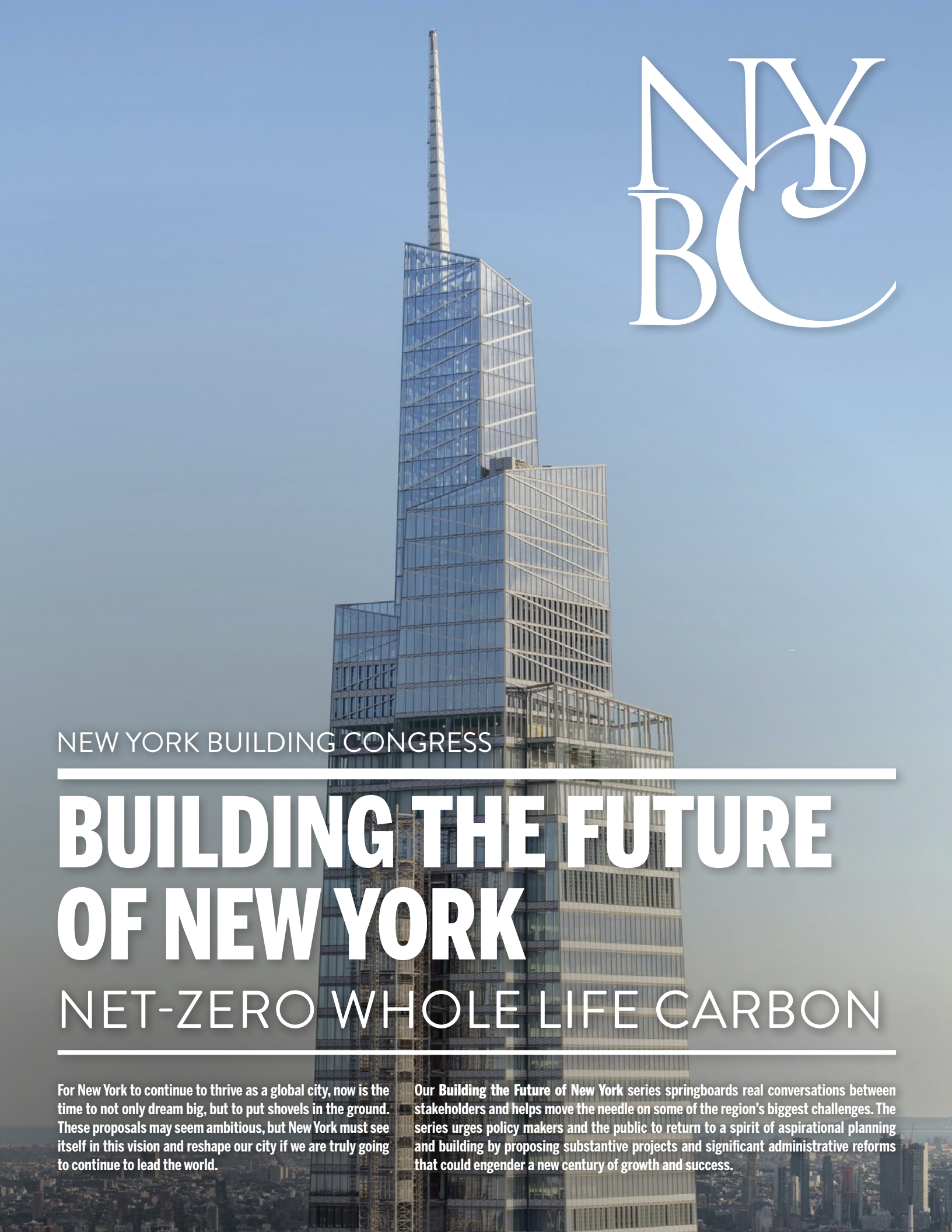


NEW YORK BUILDING CONGRESS

BUILDING THE FUTURE OF NEW YORK

NET-ZERO WHOLE LIFE CARBON

For New York to continue to thrive as a global city, now is the time to not only dream big, but to put shovels in the ground. These proposals may seem ambitious, but New York must see itself in this vision and reshape our city if we are truly going to continue to lead the world.

Our **Building the Future of New York** series springboards real conversations between stakeholders and helps move the needle on some of the region's biggest challenges. The series urges policy makers and the public to return to a spirit of aspirational planning and building by proposing substantive projects and significant administrative reforms that could engender a new century of growth and success.

True Net-Zero

To achieve carbon neutrality by 2050, New York must take a whole life approach to decarbonizing the building sector. New York City and State should not only continue to drastically reduce operational carbon but also focus on lowering embodied carbon – the emissions associated with the materials and construction processes used throughout a building's lifetime.

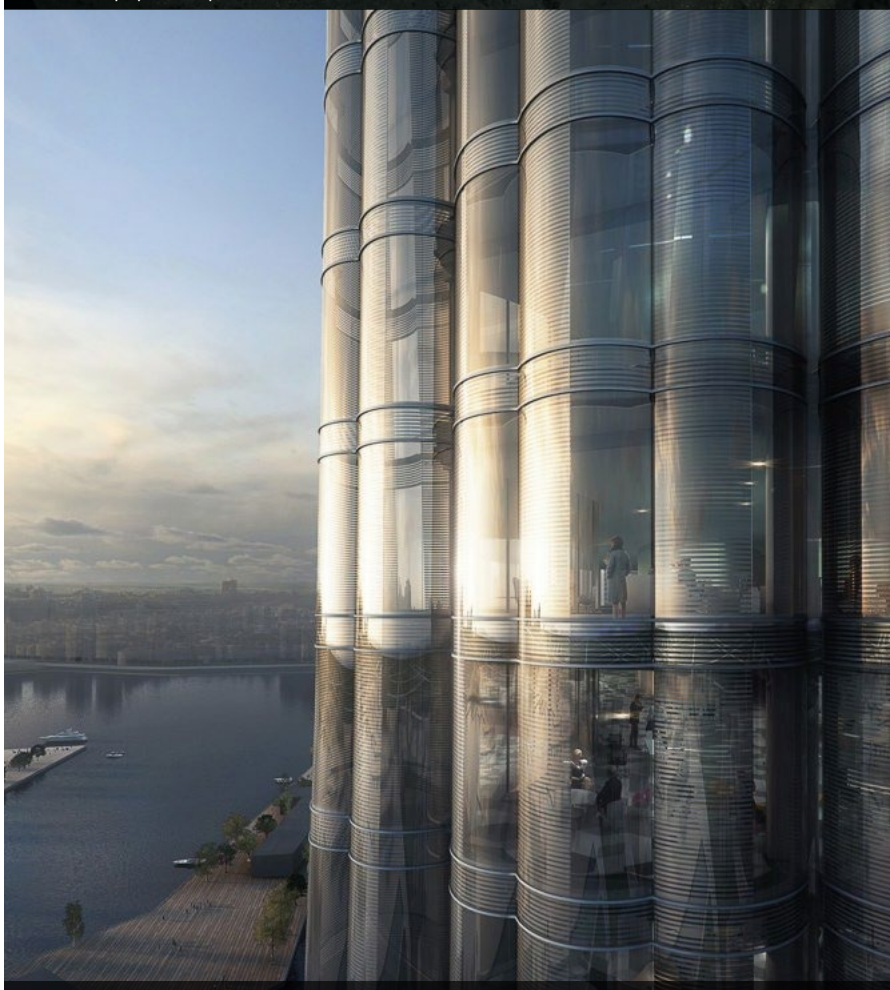
Carbon Neutral New York

As climate change continues to harm the environment and human health, New York is determined to significantly reduce greenhouse gas (GHG) emissions, the main driver of this phenomenon. The excess of GHGs in the atmosphere have led to more frequent and intense extreme weather events, loss of polar ice and rising sea levels. To prevent the worst effects of climate change, the Intergovernmental Panel on Climate Change warned that by mid-century the amount of GHGs produced must be equal to the amount removed from the atmosphere.

Faced with this urgent need to address both the causes and effects of climate change, New York City and State have committed to carbon neutrality by 2050 with the City placing particular focus on the building sector. Compared to the rest of the country, where transportation accounts for the majority of GHG emissions, New York City's approximately one million buildings contribute over 70 percent of citywide emissions. For that reason, the building industry must drastically rethink how it approaches design and construction.

In 2021 alone, the New York Building Congress estimates New York City will add nearly 100 million square feet of floorspace, including new construction and major alterations.

Skanska developed a series of low-carbon concrete mixes, Green Concrete, with reduced carbon emissions of up to 50 percent. Credit: Skanska



HOK is exploring building envelope designs that use less carbon-heavy materials, including the Circadian Curtain Wall and Structural eXterior Enclosure. Credit: HOK

A Whole Life Approach

New York has championed sustainable construction, built forward-looking green buildings and adopted some of the world's most ambitious climate targets. While New York has led particularly on reducing operational carbon emissions, the growing threat of storms like Sandy and Isaias requires us to increase the pace and scope of these efforts. Both the City of New York and the building industry must now take a whole life approach – one that reduces the energy a building uses daily as well as targets carbon emitted throughout its construction.

As we continue to reduce operational carbon, which are the emissions associated with the energy used to operate a building, embodied carbon will become a growing share of total emissions. The World Green Building Council (WGBC) defines embodied carbon as encompassing the emissions associated with:

1. Materials production and construction
2. Materials and processes needed for maintenance, excluding operational carbon
3. Deconstruction and demolition

More specifically, these three stages emit:

1. Upfront carbon
2. Use stage embodied carbon
3. End of life carbon

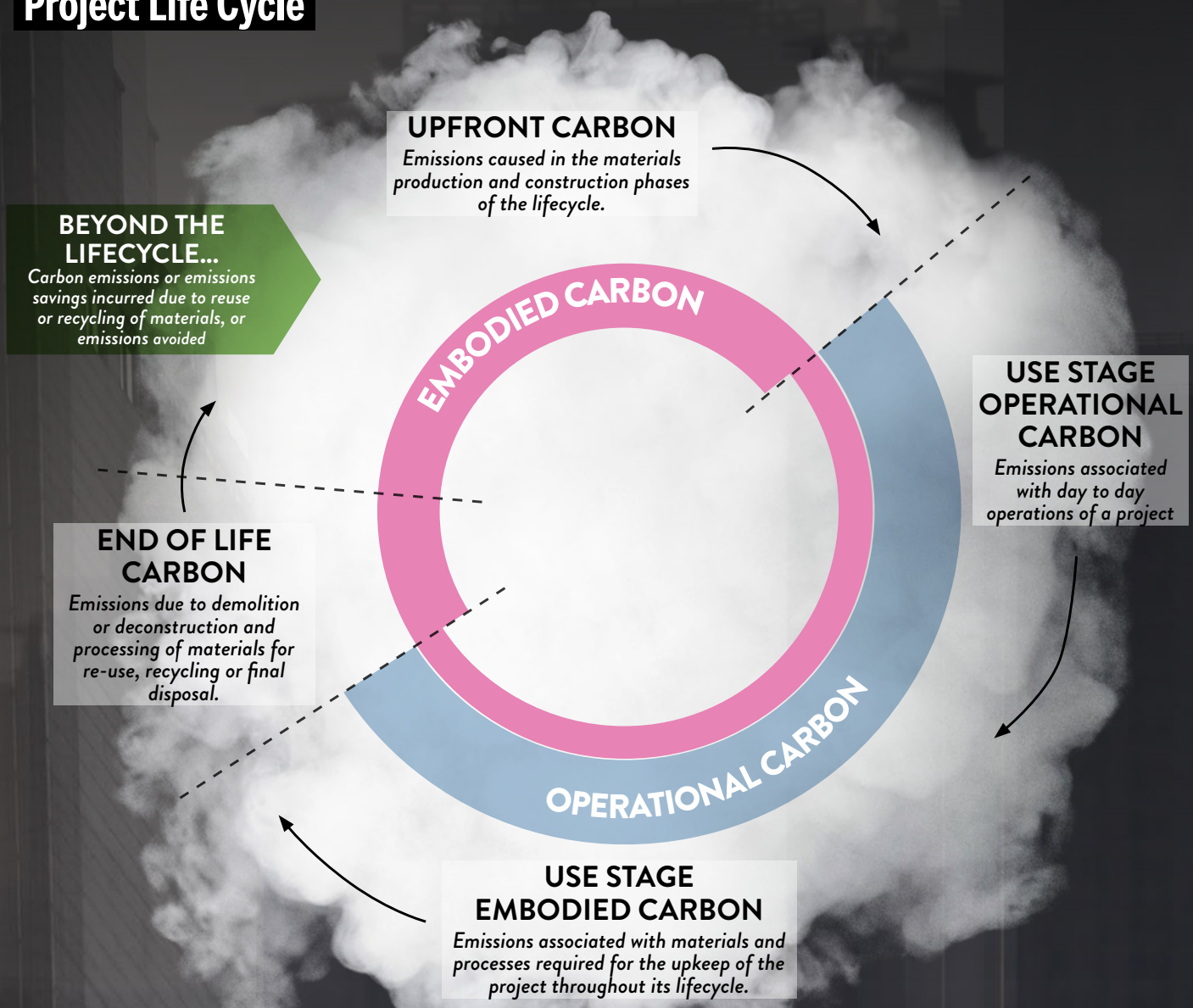
New York will have to adapt its mindset to address embodied carbon and cultivate an ecosystem of individuals and organizations willing to question how we build, what we build and where we build it. Taking a whole life approach to carbon will be challenging, but it will foster a circular economy, create good jobs and support the long-term economic and environmental health of the city. It will also once again establish New York City as the global leader in this climate emergency. Between now and 2050, embodied carbon is anticipated to account for more than half of total carbon emissions from all global new construction.

Rather than settling for a more energy-efficient building sector, New York and the industry can establish the blueprint for a net-zero whole life carbon future – both the ambition and ability are here. This is an opportunity to reach full decarbonization.

Serious damage in the buildings due to impact from Hurricane Sandy in Brooklyn.

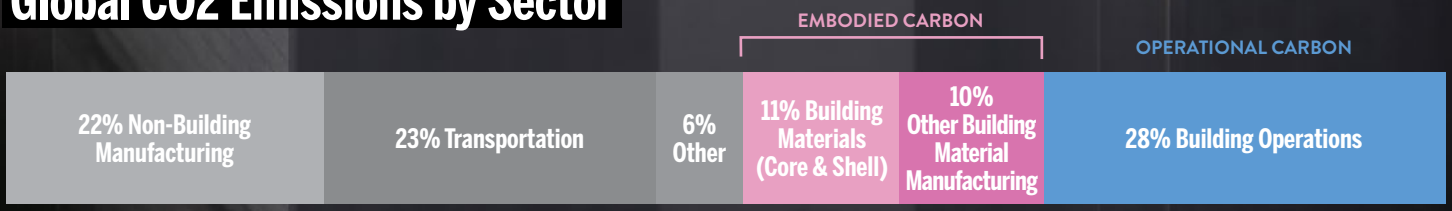
Preparations for Tropical Storm Isaias in lower Manhattan. Tubes filled with water are placed along the streets to prevent flooding. Credit: Steve Sanchez, DDC and EDC.

Project Life Cycle



Adapted from Bringing Embodied Carbon Upfront, World Green Building Council

Global CO2 Emissions by Sector



Adapted from 2019 Global Status Report, Global Alliance for Building and Construction (GABC) and Architecture 2030.

Operational Carbon

A whole life approach requires that New York maintain its aggressive reduction of operational carbon, while also tackling embodied carbon. The public and private sectors have made substantial progress in decarbonizing operational emissions and must continue to do so.

The City of New York committed to reduce GHG emissions from the building sector 40 percent by 2030 and 80 percent by 2050 (80 x 50), relative to 2005 levels. Emphasizing the role of energy-efficient buildings and renewable energy in reducing GHG emissions, the City passed the Climate Mobilization Act (CMA) in 2019. The package of legislation is comprised of:

- **LL92 & LL94** requiring green roofs or solar photovoltaic systems on certain buildings;
- **LL95** mandating large buildings post a building energy efficiency grade;
- **LL96** creating the Property Assessed Clean Energy (PACE) financing program;
- **LL97** establishing emissions limits for large buildings;
- **LL98** providing guidelines for large wind turbines.

To meet 80 x 50, the City commissioned a series of studies to determine different pathways to lowering carbon, including *Carbon Neutral New York: Modernize, Reimagine, Reach*. The two-year study, released in April 2021, was led by the NYC Mayor's Office of Sustainability, ConEdison and National Grid with the input of several dozen advisors, including the Building Congress. It shows how New York City can achieve its carbon goals by increasing renewable energy, reducing emissions in the building and transportation sectors and transitioning to low-carbon fuels.

Around the same time as the CMA passage, New York State enacted the Climate Leadership and Community Protection Act (CLCPA). This legislation requires the state to lower GHG emissions by 40 percent by 2030 and 85 percent by 2050, relative to 1990 levels, as well as to achieve 70 percent of electricity from renewable sources by 2030 and 100 percent by 2040. New York State Energy Research and Development Authority (NYSERDA) has been instrumental in creating a blueprint for how the State can reach these goals. NYSERDA manages a host of programs supporting the design, construction and retrofitting of energy-efficient buildings and the creation of renewable energy supply and storage.

Rudin Management reduced energy consumption 45 percent at 560 Lexington Avenue when it retrofitted the structure with more energy-efficient building systems and used Nantum OS for real-time energy management. Credit: Rudin Management

Local Law 97

One of the most ambitious regulations on building emissions in the world, LL97 institutes a carbon cap on buildings larger than 25,000 square feet. There are approximately 50,000 of these buildings in New York City, which account for a third of citywide emissions. It also establishes the Office of Building Energy and Emissions Performance within the NYC Department of Buildings (DOB) to oversee the CMA's implementation. By 2024, the first iteration of emission limits is anticipated to impact the highest-emitting 20 percent of large buildings. By 2030, more stringent caps are projected to target 75 percent of large buildings and will represent a collective 40 percent reduction in citywide building emissions. The City determines the annual emission budget for each building using historic data related to building size and use. Every year a building exceeds its budget, it will be fined per metric ton of additional emissions.

To comply with LL97, building owners are focused on using less energy by making operations and maintenance improvements and reducing energy waste. They are also switching to cleaner energy sources, although all currently available sources in the state have some emissions associated. To make climate goals attainable, New York must build modern energy infrastructure and upgrade the electrical grid. As alternative pathways to compliance, buildings can use carbon offsets, purchase Renewable Energy Credits (RECs), apply for hardship waivers or receive emissions limit adjustments. Carbon offsets can only cover up to 10 percent of a building's budget in the first compliance period, however, and RECs are not guaranteed to be affordable or in high supply. LL97 also mandates the Mayor's Office of Sustainability complete a study determining if a carbon trading program is an appropriate alternative pathway.

The private sector has continued to reduce its operational emissions in tandem with these City and State actions. The Urban Green Council (UGC) calculated that GHG emissions from 3,200 of the city's largest properties declined 23 percent from 2010 to 2019. Buildings included in the dataset consistently reported on energy and water performance in accordance with LL84 of 2009, The Benchmarking Law. UGC found cleaner electricity and steam drove 40 percent of that decline, and fuel switching and energy efficiency improvements caused the remainder.

When looking at some of the most common green building rating systems, New York City has approximately 1,350 Leadership in Energy and Environmental Design (LEED) Certified buildings; 1,050 A Grade Energy Star buildings; and 115 Passive House Certified buildings. Energy Star, a program run by the U.S. Department of Energy and the Environmental Protection Agency, is used for compliance with the CMA's LL95, and an A grade means a building performs in the top 15 percent of similar buildings.

Building on the Past: Passive House

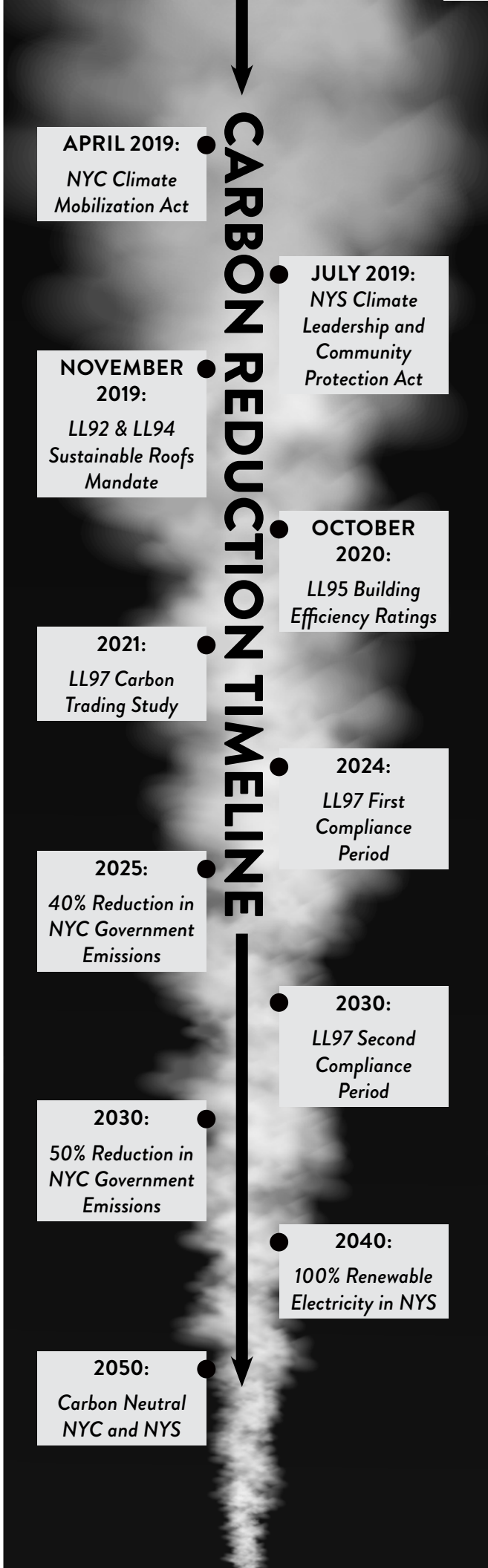
Emerging from the oil shortage of the 1970s, the passive house standard is a set of principles for energy efficient buildings that require minimal heating and cooling. Passive buildings, ranging from single-family homes to skyscrapers, primarily rely on their envelope rather than mechanical systems to maintain comfortable indoor environments. Passive buildings are more resilient and affordable in the long-term compared to standard construction. They consume less energy, retain consistent temperatures for longer during power outages and require smaller mechanical systems, which opens space for renewable energy equipment or building amenities.

The main principles of passive house design are:

- **Airtightness** limiting gaps that create drafts and allow in moisture;
- **Continuous insulation** increasing thermal performance and often reducing outdoor noise;
- **Thermal bridge-free construction** strategically placing windows and doors and installing thermal breaks in high thermal conductivity areas;
- **High-performance windows and doors** often including triple-glazed panes and orientation based on the sun; and
- **Energy recovery ventilation** exchanging heat and moisture through a membrane to exhaust indoor air and bring in filtered outdoor air.

425 Grand Concourse

Since 2012, when the first passive house project in New York City was completed, the design standard has increased in popularity throughout the city. Of the now approximately 115 projects, 425 Grand Concourse, at 300,000 square feet, is the largest passive house development in North America. Designed by Dattner Architects, 425 Grand Concourse creates 277 units of affordable housing and when it opens later this year, is expected to use 30 percent less energy than if it was built using traditional construction methods.



Embodied Carbon

To truly live up to the spirit of its building decarbonization mandates, New York and its building industry must also address the emissions released during manufacturing, transportation, construction and demolition. Stakeholders should consider the following ideas as they begin the conversation on how New York can reduce embodied carbon alongside operational emissions.

Procedures and Regulation

Engage Stakeholders: When developing and implementing low-carbon policies, the City of New York should work closely with the building industry, consult stakeholder groups and, where possible, support existing initiatives. This will ensure new policies are effective, minimizing negative externalities and expanding upon the expertise of others. The City and its stakeholders should also be transparent with communities and public officials. A collaborative approach may initially be time intensive, but it will create ownership over policymaking and help develop a broad coalition of supporters.

Set Whole Life Carbon Targets: New York should update its climate action plan to include an assessment of and goals for reducing citywide embodied carbon emissions. This will elevate whole life carbon initiatives in the public discourse, confirm the importance of embodied carbon reduction and ensure policies are aligned with a comprehensive framework. The City and State could look to WGBC's vision of decarbonizing building sectors as a model:

- By 2030, all new buildings, infrastructure and renovations will have at least 40 percent less embodied carbon with significant upfront carbon reduction, and all new buildings must be net-zero operational carbon.
- By 2050, new buildings, infrastructure and renovations will have net-zero embodied carbon, and all buildings, including existing buildings, must be net-zero operational carbon.

This approach has been endorsed by the NYC Mayor's Office of Sustainability and Building Congress members including AECOM, Google, JLL, Schneider Electric, Skanska, SOM and WSP, among others.

Encourage Embodied Carbon Assessments: New York should encourage developments to not only calculate and report on operational carbon, but also embodied carbon, including a project's materials and energy used over its lifetime. New York may favor a consistent method of measurement, like what Energy Star uses for energy efficiency ratings, or it could approve a range of Life Cycle Assessment (LCA) software. It will also have to determine how emissions associated with the transportation of building materials are calculated and weighed in embodied carbon assessments.

Gensler's design for the Ford Foundation Center for Social Justice's renovation focused on conserving materials and resulted in a 91 percent embodied carbon savings. Credit: Gensler

A policy like this will be increasingly feasible as assessment tools come to market and mature. For instance, Thornton Tomasetti last year released Beacon, an open-source plugin for Autodesk's Revit, to visualize a project's embodied carbon by material type, building element and floor level. The firm is actively incorporating feedback to improve the product, including adding architectural analyses and integration with other tools.

Share Best Practices: To increase awareness of and support for embodied carbon reduction strategies, the public and private sectors must share data, technical expertise, best practices and case studies. This may include the City creating a centralized database on low-carbon projects so that architects, engineers, contractors, developers and owners can benchmark their projects against comparable building types and policymakers can determine reasonable embodied carbon goals. It may also mean industry organizations hosting workshops and training sessions or firms publishing educational materials and highlighting successful projects, which will lower the informational barrier for others making low-carbon choices.

NYSERDA selected Dekalb Commons as a Buildings of Excellence Award winner, in part because of its embodied carbon reduction measures across multiple material sectors. Credit: Magnusson Architecture and Planning

The Circular Building was built to satisfy Circular Economy principles. Credit: Arup.

Zoning and Land Use

Establish Carbon Intensity Zones: New York City could identify Carbon Intensity Zones, based on the embodied carbon impacts of construction required to develop on that land, and provide guidance on what building typologies are best suited for each zone. For example, if a plot of land has unstable, soft or deep soil, it may be more appropriately developed as a park or open space; whereas, an area with soil well-suited for construction could be prioritized for development. Such a policy would require the City to calculate the effect of zoning on carbon emissions, establish carbon targets for each zone and consider other features, such as existing land use and transportation accessibility.

Link Land Use to Carbon Sequestration: By pairing existing resiliency initiatives to carbon capture, the building industry and local government can advance several environmental goals at once. Green spaces being landscaped for stormwater management can also be designed for carbon sequestration by implementing strategies like increasing the functional diversity of plants and preserving natural areas. These same strategies can also advance parks and open space creation, natural land preservation, flood protection, air quality improvement and urban heat island mitigation.

Promote Prefabricated and Modular Construction: Within specific districts or zones, such as those where accelerated onsite construction would be beneficial, the City could prioritize short-term-use buildings that are prefabricated or modular. Depending on a building's type and expected duration of use, prefabricated and modular construction could be more appropriate than traditional means. Structures built using these methods have a higher likelihood of being deconstructed and reused because of their "plug and play" building components. They also have the additional benefits of reducing material waste, minimizing the number of deliveries to the site and being cost and time efficient.

Waste and Circularity

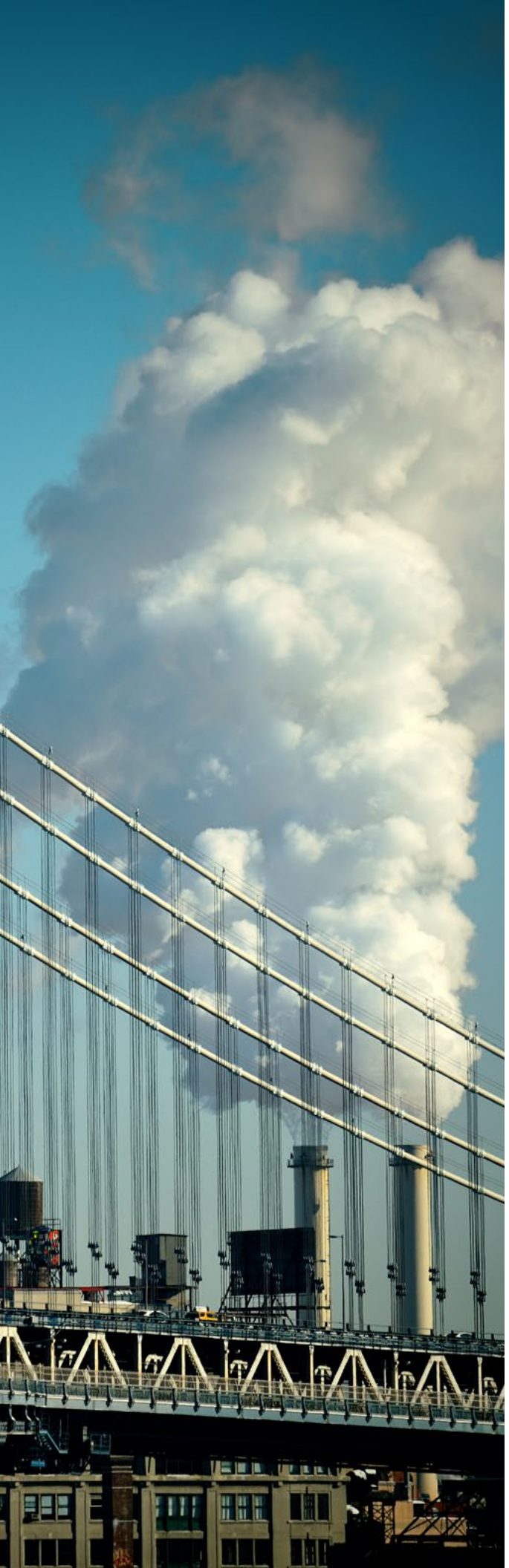
Adopt Sustainable Materials: Where possible, New York should use building materials that are durable and long-lasting, salvaged or recycled, carbon sequestering or manufactured with renewable energy. According to the Carbon Smart Materials Palette, some of the examples of reducing embodied emissions by material type are:

- *Cement:* Selecting different mixes based on use, designing for material optimization;
- *Steel:* Using recycled steel or steel from electric arc furnaces;
- *Wood:* Sourcing from sustainably managed forests, prolonging carbon storage;
- *Gypsum board:* Specifying lightweight products, eliminating waste material; and
- *Insulation:* Using natural materials and blown-in applications.

In an urban area of tall buildings, the City and DOB could stimulate the use of wood by adopting the 2021 International Building Code and International Fire Code, which allow for mass timber buildings up to 18 stories.

Design for Disassembly: To minimize material waste, buildings and infrastructure can be designed so that their components can easily be disassembled, reused and recovered. Although this approach to end-of-life structures – those being deconstructed and demolished – requires substantial planning in the early design phases, Design for Disassembly has the potential to dramatically change how waste is conceptualized. It considers the carbon cost of first-use materials and the value of recycled materials. When these qualities are quantified, a building's deconstruction may become more attractive than its demolition.

LERA is providing services for 581 Grant Ave, a mixed-use affordable housing development in East New York employing modular construction techniques. Credit: FullStack Modular



Funding and Financing

Develop Procurement Guidelines: The City of New York and private firms can use their purchasing power to stimulate the low-carbon market. As part of the procurement, they could use carbon-based criteria for awards by asking contractors to disclose Environmental Product Declarations or another form of carbon measurement for primary building materials such as concrete, steel and glass, as well as the carbon emissions associated with material transportation. Skanska, which helped develop the open-source Embodied Carbon in Construction Calculator (EC3), has begun including embodied carbon calculations its project proposals. Clients can now evaluate design alternatives based on potential carbon emissions.

If a policy like this was implemented, there must be a way to report material and transportation emissions. Purchasing parties should also ensure smaller companies remain competitive in the bidding process. Concurrently, the City could offer incentives to manufacturers to accelerate the development and verification of low-carbon products.

Expand PACE Financing: New York approved PACE financing as part of the CMA to help support costs of the retrofits mandated under LL97. This allows the City to offer low- or zero-interest loans for property owners who make capital investments in energy efficiency and renewable energy. The PACE program could be expanded to cover embodied carbon reduction strategies, including prefabricated construction, efficient materials or waste commitments. Property owners would not have to make prohibitively expensive upfront investments, and the City would earn back its money over time through a special assessment or charge on the property tax bill.

Expedite Permitting for Low Carbon Projects: DOB could prioritize low-carbon projects by offering a shortened approvals process or reduced fees for applications that fall within a certain threshold of carbon performance. This would encourage smaller firms with less organizational capacity or access to capital to pursue low-carbon projects. It may cost more upfront to train and hire staff or procure materials and technologies, but it will pay off in the long term with expedited permits and other assistance.

Value Carbon Performance in Construction: Beyond the above recommendations, the City should pursue a multifaceted approach to incentivizing low-carbon construction by offering tax abatements, density bonuses and carbon performance grants and certifications. For instance, projects that demonstrate a whole life or embodied carbon reduction greater than a certain threshold could increase their floor-area ratio. Existing programs focused on energy efficiency could also be models for structuring and implementing programs for embodied carbon. While this is not an exhaustive list of strategies, the underlying goal should be the same: to place value on embodied carbon reduction and promote the importance of the whole life cycle of carbon in the fight against climate change.

Building on the Past: Mass Timber

One of the most traditional construction materials, timber is reemerging as a "third way" to build with the lowest carbon footprint of comparable materials. Wood is not only a renewable resource, but its growth sequesters carbon and combats environmental degradation. In the 1800s, most buildings were made from wood, but following urban fires and fueled by the skyscraper race, steel and concrete took over the supply market. Over the past three decades, however, innovations in timber technology have improved fire safety performance and led to growing mass timber industries, primarily in Europe, Australia and parts of the U.S. with historically strong wood industries and government support.

Mass timber refers to a range of wood products such as cross-, glue laminated-, nail- and dowel-laminated timber. Cross-laminated timber has been the most popular mass timber product for cities because it is strong enough for tall structures. It is also lighter than concrete and requires less construction waste. Being lightweight also makes wood an attractive material for adaptive reuse projects where additional stories can be built without changing foundations. As the role model for tall buildings in the U.S., New York City can develop leading strategies for mass timber in dense, urban environments.

Credit: StructureCraft

T3 Atlanta

Beyond fire safety, acoustics are another common challenge in mass timber construction. The same qualities that make wood attractive, its weight and structural characteristics, also make it harder to reduce sound transmission. After studying how to improve noise control, Cerami provided the acoustic design for seven mass timber structures in the U.S. and Canada, which perform on par or even better than concrete and steel buildings. One of these buildings, Timber, Technology and Transit (T3) Atlanta, included DLR Group as architect of record and was the largest mass timber building in the U.S. when it was completed in 2019.

NEW YORK BUILDING CONGRESS

100 YEARS

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The New York Building Congress, a broad-based membership association celebrating its 100th year, is committed to promoting the growth and success of the construction industry in New York City and its environs.

COVER: Compared to similarly sized buildings, One Vanderbilt has one of the lowest carbon footprints. The project team, including SL Green, Tishman Construction, KPF, Gensler, JB&B and Severud Associates, ensured the skyscraper would consume less energy and be built with sustainable materials and construction processes. One Vanderbilt has a 1.2MW cogeneration system, a 90,000-gallon rainwater management system and high-performance glazing. It was built using recycled content in the structural steel, reinforcing steel and concrete mixes; a 75 percent recycling rate for construction demolition and waste; and a tracking system to measure the use of locally sourced materials.