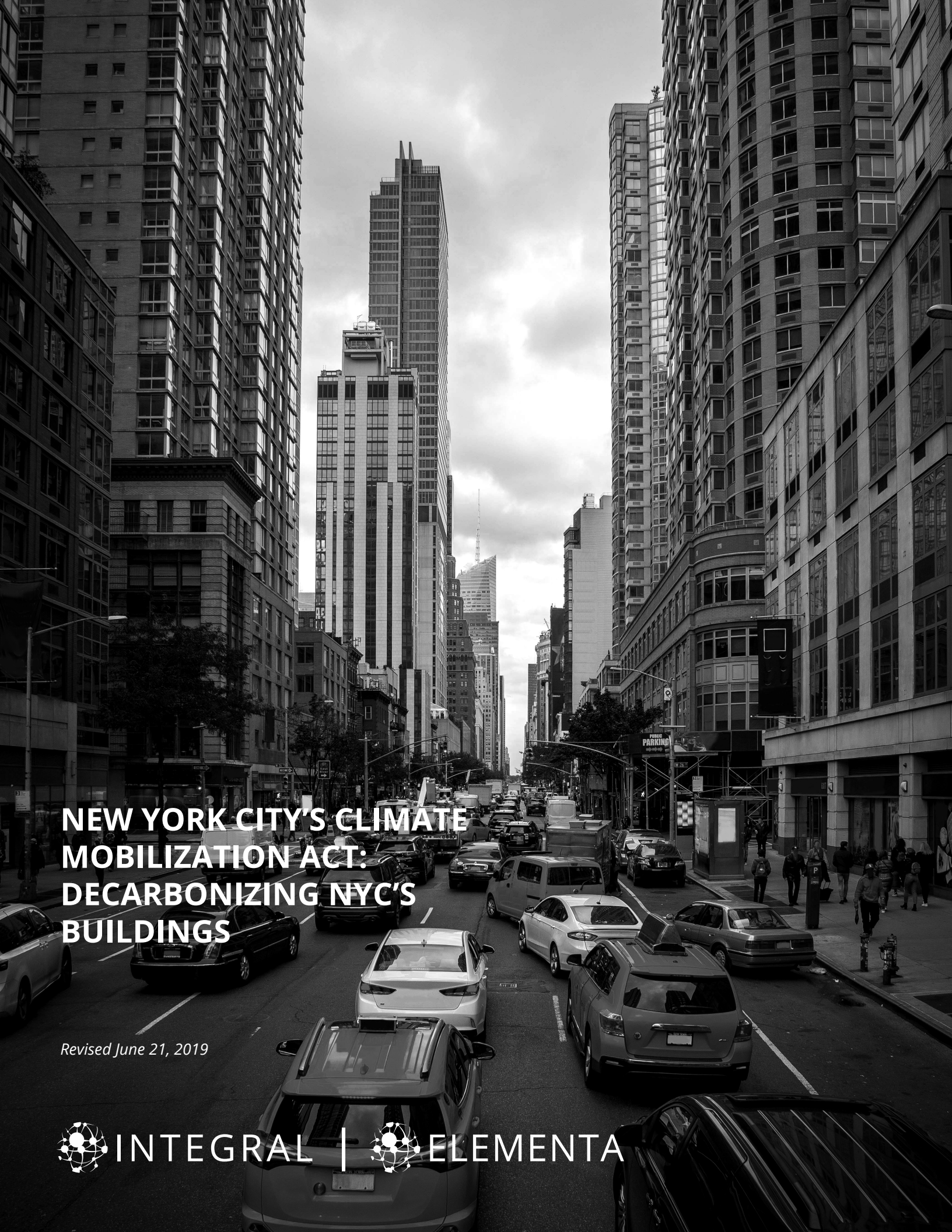

NEW YORK CITY'S CLIMATE MOBILIZATION ACT: DECARBONIZING NYC'S BUILDINGS

Revised June 21, 2019

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NEW YORK CITY'S CLIMATE MOBILIZATION ACT: DECARBONIZING NYC'S BUILDINGS

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Overview

NYC buildings resulted in over 60%[1] of all greenhouse gas emissions in New York City, according to 2017 data. Therefore, in order to meet its commitment to reduce greenhouse gas emissions by 80% by 2050, the city must take an aggressive stance toward decarbonizing the city's existing buildings. The new NYC building emissions law, introduced on April 18th, 2019, provides a roadmap for decarbonization, setting emissions targets for 2024, 2030, and 2050.

This white paper briefly summarizes this new legislation, its immediate impact and outlook, and discusses Elementa Engineering's unique position to assist with the decarbonization of our existing building stock as NYC prepares to respond to this law.

What Is The New Legislation?

The new NYC building emissions law[2] will set up a new office to oversee building energy and emissions performance and sets limits for carbon emissions resulting from building energy use. The new law takes effect in 2024, with more stringent caps on emissions taking effect in 2030 and 2050. These incrementally more aggressive reductions targets put the city on a path toward achieving a 80% reduction by 2050.

Any building that exceeds the stipulated emissions cap will need to implement comprehensive retrofits, show alternate compliance through mechanisms such as renewable energy credits, or pay a penalty based on the difference between actual and stipulated emissions in tCO_{2e}/yr multiplied by $268. The law affects over 3 billion square feet of building area, including over 50,000 commercial and multifamily buildings that are over 25,000 ft^2. In general, any building that is required to report energy and water use as part of the NYC Benchmarking Law is subject to the new building emissions law.

1 Inventory of NYC GHG Emissions

2 Legislation Text

What Does It Mean For The Building Stock?

To put this in perspective, Figure 1 below shows a representative sample of 1,000 actual NYC large office buildings, arranged in increasing order of reported GHG intensities [3]. The horizontal lines show the incremental emissions caps and illustrate that roughly 20% of the buildings will exceed the 2024 limits, an additional 60% will exceed in 2030, and practically all existing buildings will need to be upgraded by 2050. The blue dotted line in the chart also shows that while buildings designed to today's energy code [4] are better than 2024 targets, they must achieve at least 22% savings beyond the current energy code to meet the 2030 limits.

For an average large office building, this level of performance roughly translates to an energy use intensity (EUI) of roughly 50 kBTU/ft^2/yr, depending on what fuels are used. This is fairly stringent, but not unreasonably aggressive.

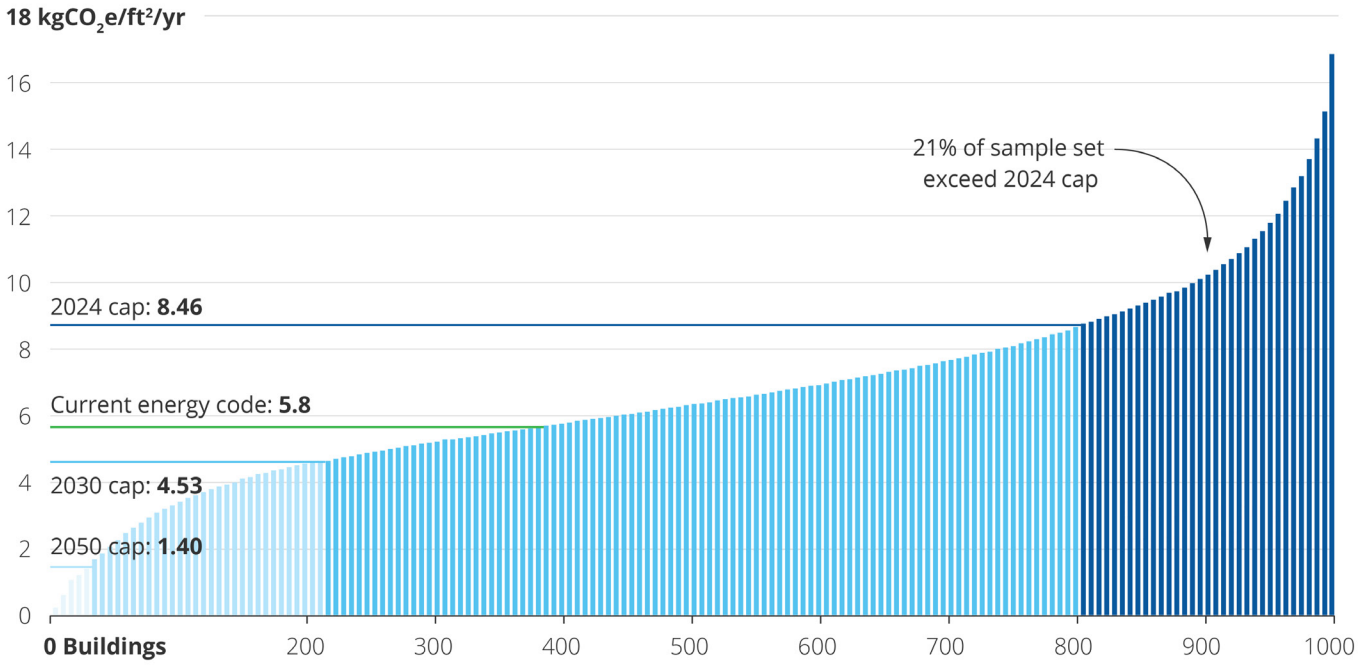

Figure 1: 2017 Reported GHG emissions intensity for 1,000 representative NYC Large office buildings compared to stipulated limits for calendar years 2024, 2030 and 2050 for commercial office buildings under the new NYC building emissions law.

3 NYC Data Disclosure & Reports

4 Commercial Prototype Building Models

What Will This Do For NYC?

Figure 2 below shows the distribution of buildings by GHG intensity. The values are based on 2017 Local Law 84 emissions disclosures[5]. The graphs show that over 40% of the current NYC building-related GHG emissions result from only the 20% highest-emissions intensity buildings, which will be affected in 2024. The next 60% of the buildings, which result in roughly 50% of current emissions, will need to be addressed by 2030 for the overall emissions to reduce by 40%. Finally, an entire building-stock upgrade by 2050 will reduce the emissions by about 80%.

Note that although this analysis incorporates a small sample of NYC buildings - only about a tenth of the total affected area - the calculations include a representative set that excludes any outliers and erroneous data and should present a reasonable overall outlook.

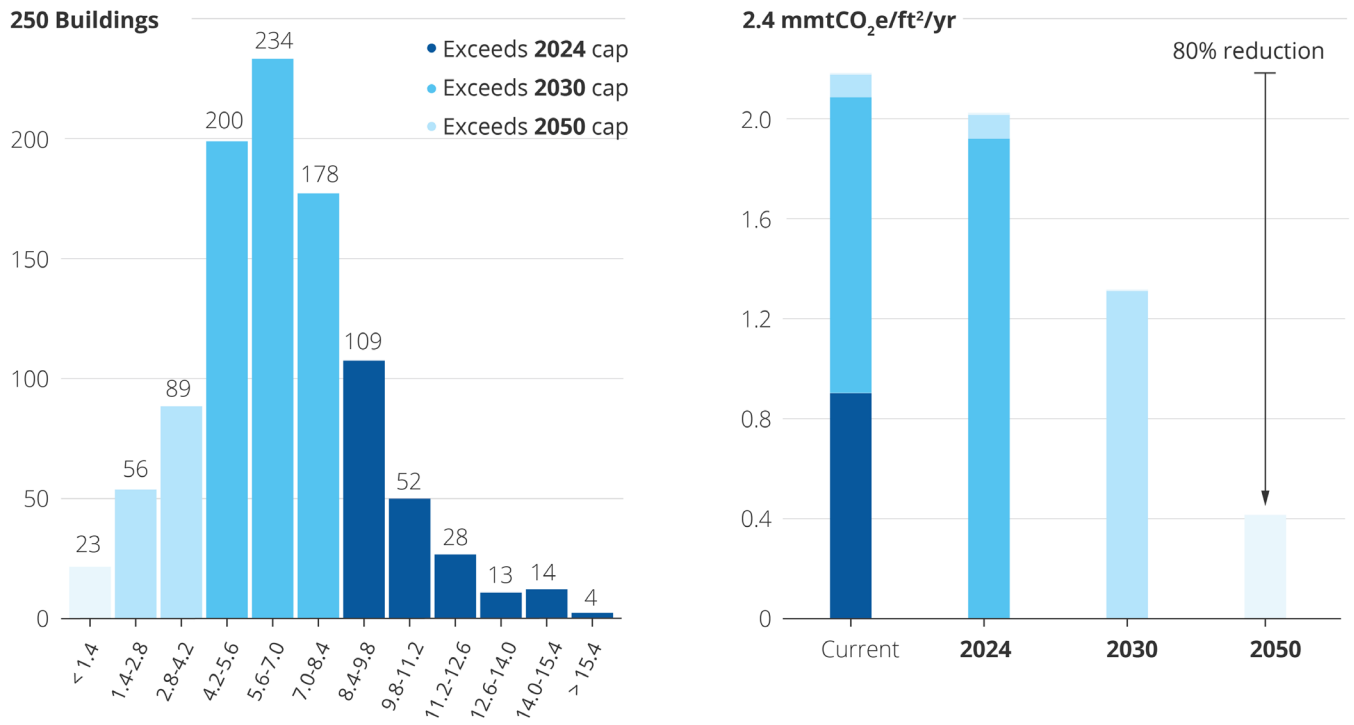

Figure 2: Number of buildings with different GHG emissions intensity ranges in 2017 (Left) and total building GHG reduction projection with future upgrades (Right).

5 NYC Data Disclosure & Reports

What If My Building Is Already "Green"?

The limits pertain to actual energy performance translated to carbon emissions based on stipulated factors, not comparisons to hypothetical baselines or simulated scenarios.

To illustrate the impact of this approach, consider a 2.25 million ft^2 commercial skyscraper in midtown Manhattan. The building is LEED Platinum certified and disclosed a GHG emissions intensity of 13 $kgCO_{2e}/ft^2$ in 2017 with an operating EUI of 210 $kBTU/ft^2/yr$. Ignoring any exemptions that the building might be eligible for, the 8.6 $kgCO_{2e}/ft^2/yr$ emissions cap stipulated by the new law in 2024 will translate to this building exceeding the limit by 9,900 tCO_{2e}/yr, or a total annual penalty of over $2 million. If the building performance does not improve, the penalty could increase to nearly $7 million in 2050.

Figure 3 below shows this building's current annual emissions and the stipulated future incremental limits, along with the potential penalties if the building takes no action.

Figure 3: Projected annual penalty with increasingly stringent emission caps for an example large office building, ignoring any exemptions that the building might be eligible for and assuming no performance improvement, or change in legislation calculation methodology in the future.

How Can the Existing Buildings Be Retrofitted?

The law stipulates that building owners need to demonstrate that the annual emissions from their buildings are lower than the mandated targets. To appreciate the effect of different energy conservation measures, Figure 4 shows different retrofit strategies, mapped according to their estimated first costs and potential for emissions reductions.

Depending on the magnitude of required reductions for a given building, and the reductions achievable with individual measures, multiple retrofits will need to be implemented in combination across a large number of buildings over the next 5-10 years.

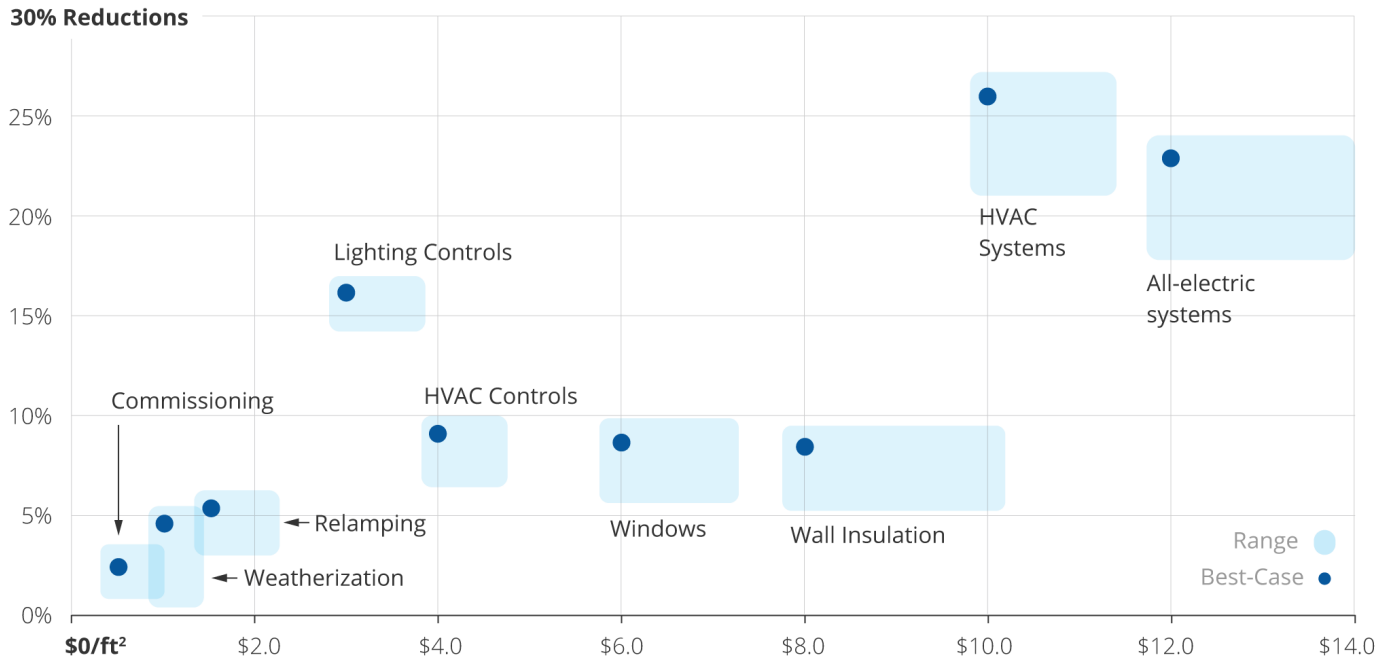

Figure 4: Potential range of achievable emissions reduction with different energy conservation measures and the associated first cost ranges depending on building specific existing conditions.

Note that these magnitudes are only indicative and the realized savings for any building will depend on building-specific factors. Given the fact that the cost-benefit ratio ($-spent / %-savings) is considerably different for different measures and because the magnitude of achieved savings from a set of strategies is not always additive, the cost to achieve the same level of savings can be appreciably different in different buildings.

How Much Will It Cost to Retrofit My Building?

The first cost for achieving the stipulated emissions cap will of course depend on the magnitude of required savings as well as the specific existing conditions of a given building. Depending on the combination of retrofit strategies that is most relevant for the building, the first cost to achieve the same level of savings could be different for different buildings. Figure 5 shows the range of simulated first costs (in light blue) for different emissions reduction targets based on multiple models of different existing building characteristics and different combinations of retrofit strategies. The dark blue line represents the maximum potential savings achievable with each dollar invested for retrofits.

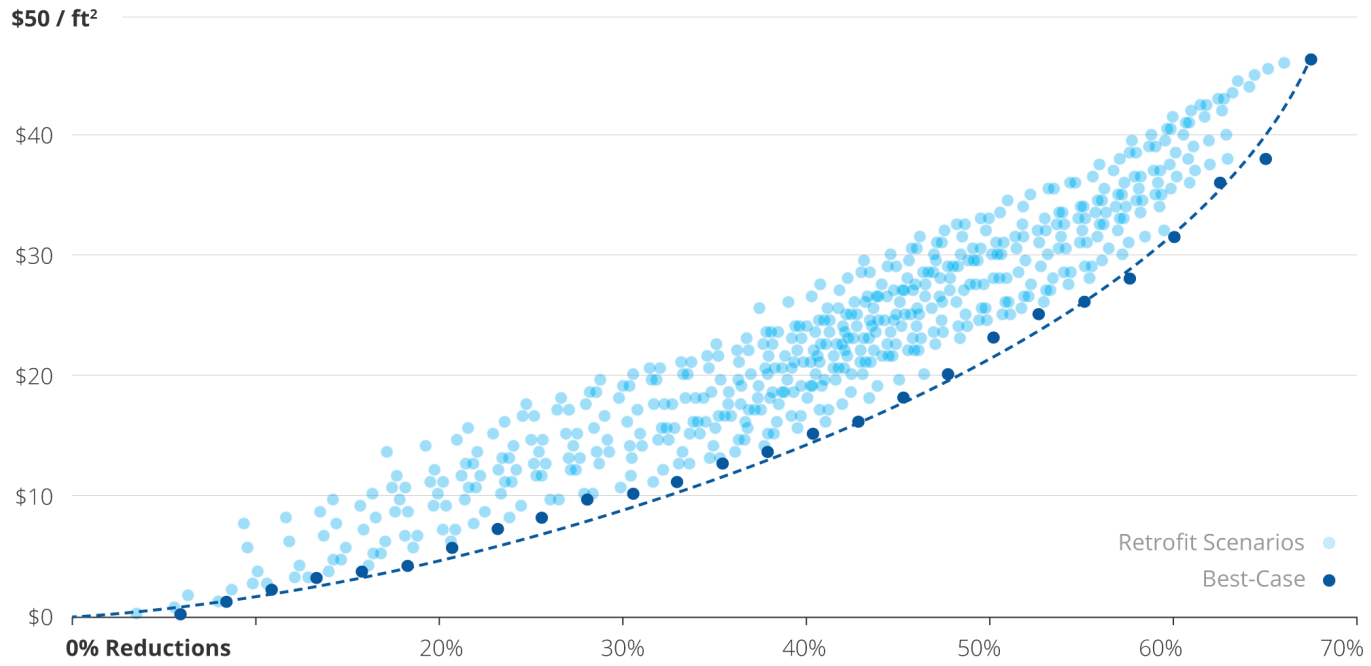

Figure 5: First cost ranges for implementing different retrofit strategies for a given emissions reduction target.

The chart illustrates that there are multiple pathways to achieve lower level reductions, less than 5%, at relatively little cost. However, to achieve deeper reductions, at the level needed by some buildings to achieve the 2024 and 2030 targets, there are only a limited number of higher cost pathways. For intermediate scenarios, especially for target reductions between 20% and 60%, there are multiple available options. If not optimized for specific conditions, the first costs of retrofits can vary by a factor of 2.

What Does this Mean for NYC?

For the 1,000 representative office buildings that were evaluated for this study, Figure 6 shows that roughly 20% will need to incorporate energy conservation measures by 2024. In some cases, these buildings will need to reduce their emissions by up to 50%. This number increases significantly by 2030, with an additional 60% buildings required to reduce emissions, some by over 70% from current levels. Figure 6 also shows the magnitude of first costs ($/ft^2) associated with implementing the highest benefit-cost retrofits in these buildings to achieve the target reductions.

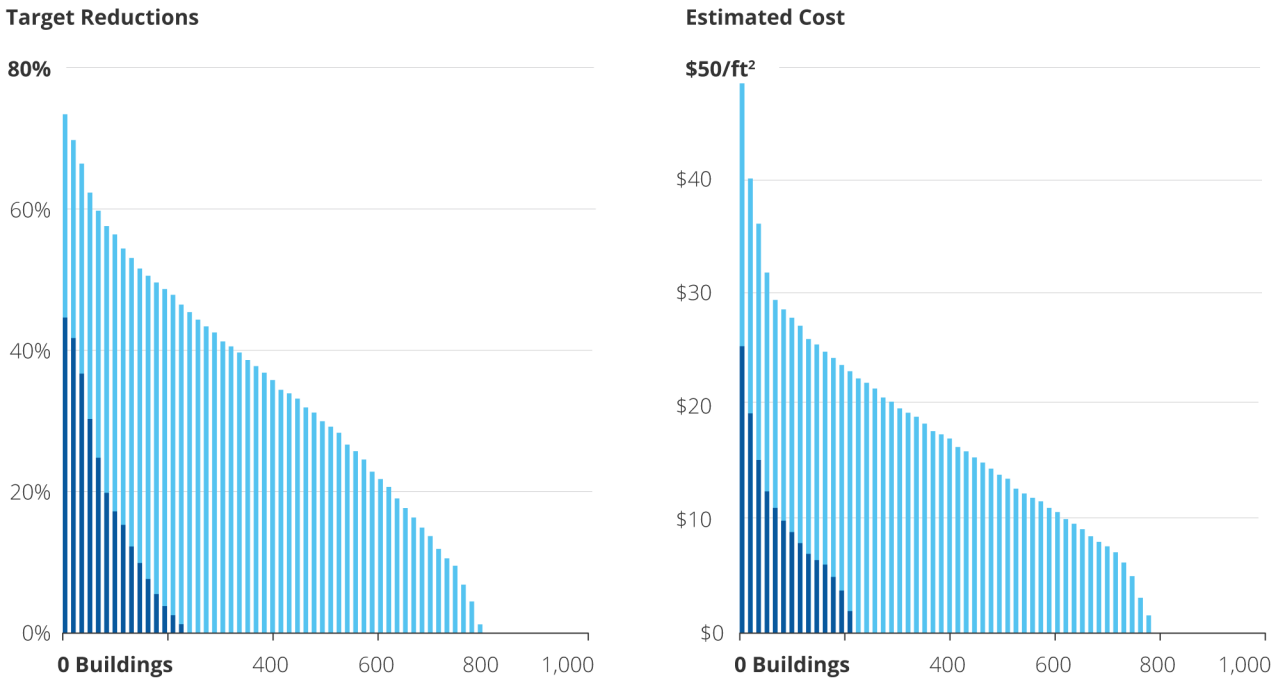

Figure 6: Required emissions reduction for number of buildings by 2024, and by 2030 within the studied sample set of 1,000 large commercial office buildings (Left) and associated $/ft2 costs of retrofits (Right).

Based on these estimates for the 1,000 analyzed buildings that represent roughly 3 million ft^2 of medium and large office buildings, the average cost of retrofits across this building stock translates to roughly $0.86/ft^2 in 2024 and increases to $17.5/ft^2 by 2030. When extrapolated to the 1.58 billion ft^2 of affected commercial buildings in NYC, **energy efficiency projects in commercial buildings could draw over $4 billion in investments by 2024, and over $25 billion over the next decade.** Note that these estimates are based on broad-brushed assumptions of the retrofit measures that will be required, the first costs of these retrofits, and that all buildings that fail to comply with the law will implement retrofits such that they comply with the stipulated emissions limits.

What Can Elementa Do?

As a mission-driven group pushing the boundaries of decarbonization planning and implementation, backed by a cutting-edge deep-green engineering practice, we are uniquely positioned to assist building owners and design teams in responding effectively to this new law. With a staff mix of global leaders in energy, climate and sustainability consulting, we have the vision and technical know-how to turn ideas into reality.

We are prepared to address any questions, and to conduct a thorough review of existing conditions that would inform the ultimate development of decarbonization scenarios. We recognize that such plans must be effective from a lifecycle cost perspective; technically sound and reliable in providing long-term but also flexible low-carbon solutions; and resilient to a multitude of external risks such as those related to climate change, availability, and affordability of zero carbon fuels and other energy sources.

We appreciate that the solutions involve many complex interrelations and interwoven analyses in order to find synergies and avoid incompatibilities; and we work with the project teams to establish a clear set of objectives, and to understand accurately the key drivers, constraints, and opportunities before starting detailed analyses.

Once the objectives have been set by the team Elementa can make recommendations on the level of building investigation required, whether that be a simple walk through assessment or review of documentation, ASHRAE audit, or the systematic process of retro commissioning as required per Local Law 87. These investigations are key to identifying drivers of energy use in the building and informing the path to reducing the building's carbon emissions.

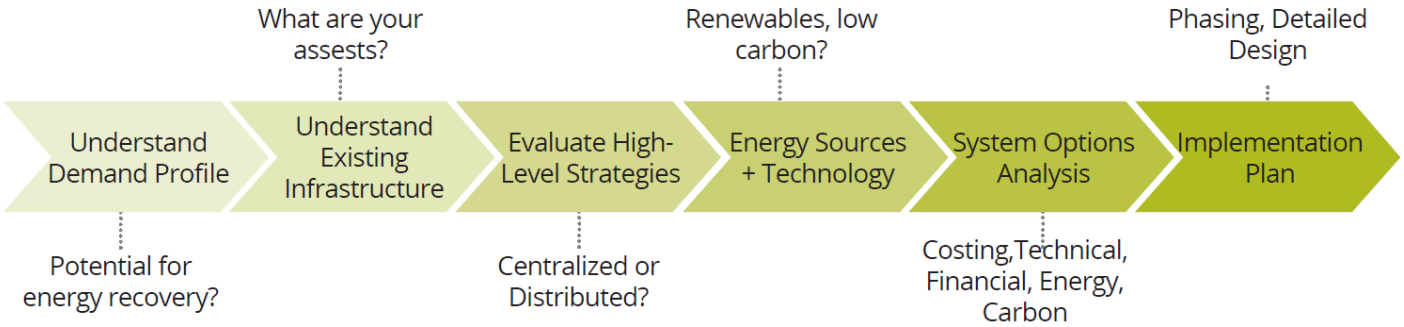

Figure 7: Different steps of analysis towards development of a decarbonization plan after synthesizing background research for key drivers, constraints and opportunities.

What Makes Elementa Uniquely Positioned?

Elementa and Integral Group have developed in-house planning tools designed specifically for assessment and implementation of comprehensive retrofitting programs for existing buildings. Using a combination of detailed engineering models & machine-learning algorithms, our framework develops a prioritization plan by real-time evaluation of specific energy efficiency measures, and rapid estimation of potential energy and emissions reductions, significantly reducing the cost-to-client of setting up detailed energy analysis models.

In addition, this framework expands the point-in-time analysis capabilities of traditional energy modeling platforms by employing automated and flexible rapid-response workflows that estimate the potential impact of different strategies on an ongoing basis.

It enables the refinement of the decarbonization scenarios and provides assessments to determine whether different pathways have an appealing total cost of ownership. Our lifecycle-cost models continuously iterate and filter the options to decide on the recommended scenario, through the course of the action plan's implementation.

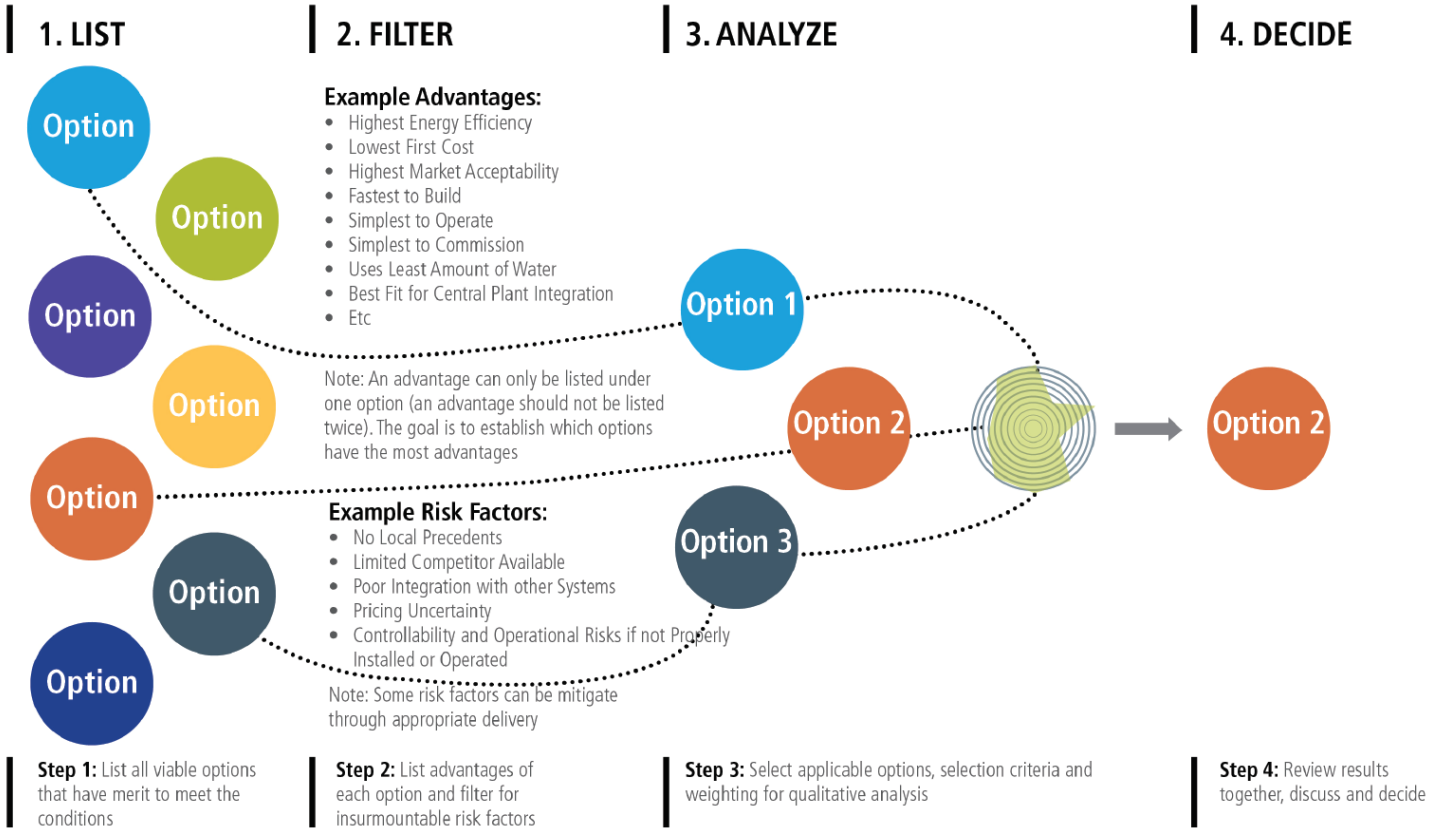

Figure 8: A visualization for how we approach the development of decarbonization scenarios for existing building projects after taking into account a multitude of factors.

What Differentiates Elementa and Our Work?

We believe that the key to delivering successful decarbonization plans is the development of date-specific and dynamic implementation plans for projects. Too often these types of plans are developed as a simple list of actions without a more advanced strategy and a clear path to implementation based on specific timelines and deliverables.

We apply our real-world expertise in creating decarbonization plans, coupled with our engineering expertise, to ensure that the actions are feasible to achieve while still being as ambitious as needed. We model a mix of short, medium, and longer-term actions after conducting a thorough review of current commissioning, operations and maintenance, measurement and verification, and energy education and outreach programs.

Through the findings from our analysis, we provide infographics and prepare an Energy and Emissions Model, similar to Figure 9 below, for use on an ongoing basis. This turns what has historically been a static process that quickly becomes outdated, into an active opportunity to consistently improve goals and outcomes and adapt to changing conditions.

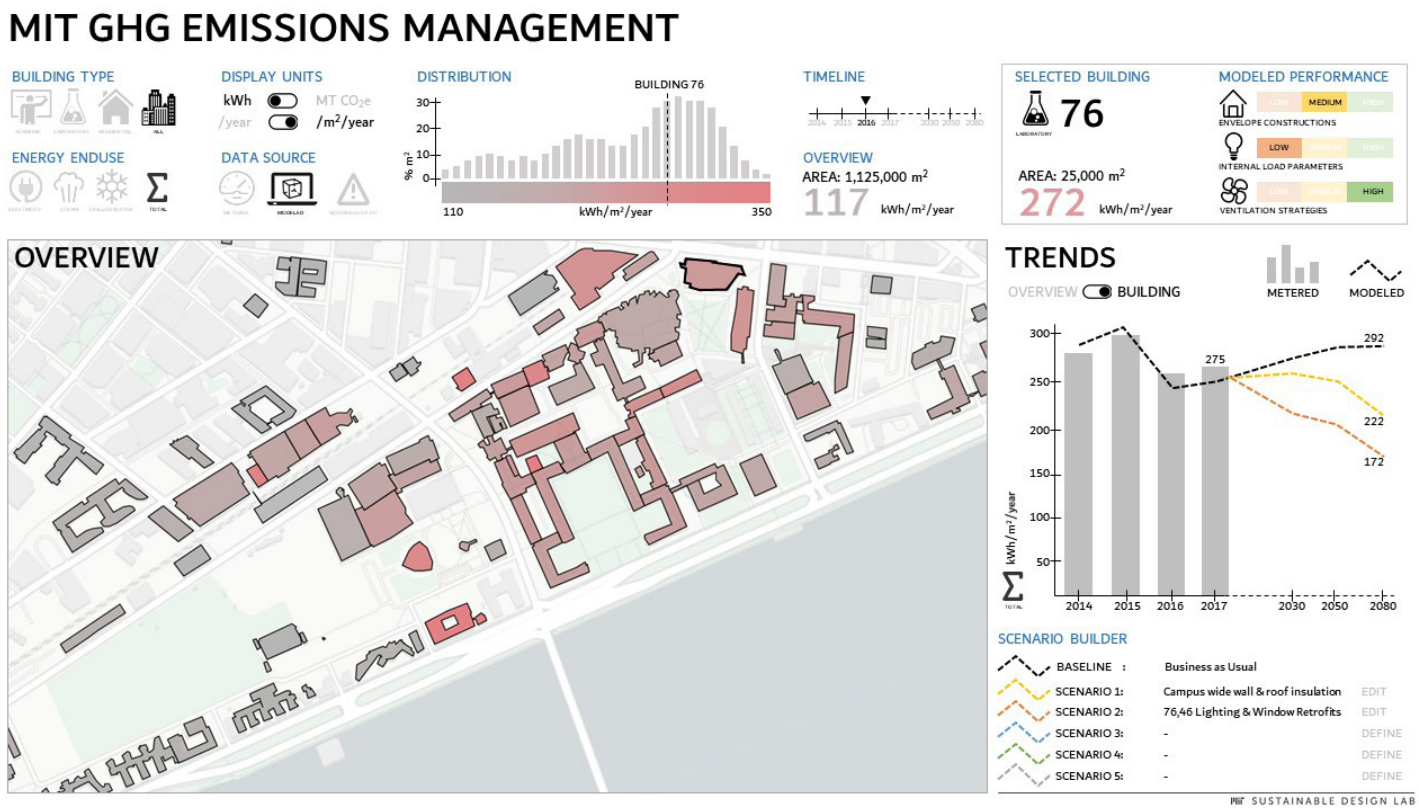

Figure 9: Graphic User Interface for an example web-based Energy and Emissions Model developed for the campus of Massachusetts Institute of Technology (MIT) in Cambridge, MA. The platform allows users to design and analyze future scenarios, manage their building emissions over time, and track their performance.

Closing Thoughts

As NYC works to find the most effective pathways to decarbonize our building stock, Elementa Engineering is uniquely positioned to draw from our strong mission and history of decarbonization planning and implementation; from our staff that include global leaders in energy and sustainability consulting; from being backed by cutting-edge deep-green engineering practice; and our differentiating analytical frameworks that keep current with the technological advancements and allow for faster and better decision making.

Through our strategic partnership with Integral Group, Elementa is one of three founding signatories to join the WGBC's Net Zero Carbon Buildings Commitment. We have committed to Zero Scope 1 and 2 emissions by 2020 across our fifteen office locations globally, continuing to actively promote opportunities for net zero carbon on all our projects, by removing technical, financial and perceptual barriers to adopt this goal.

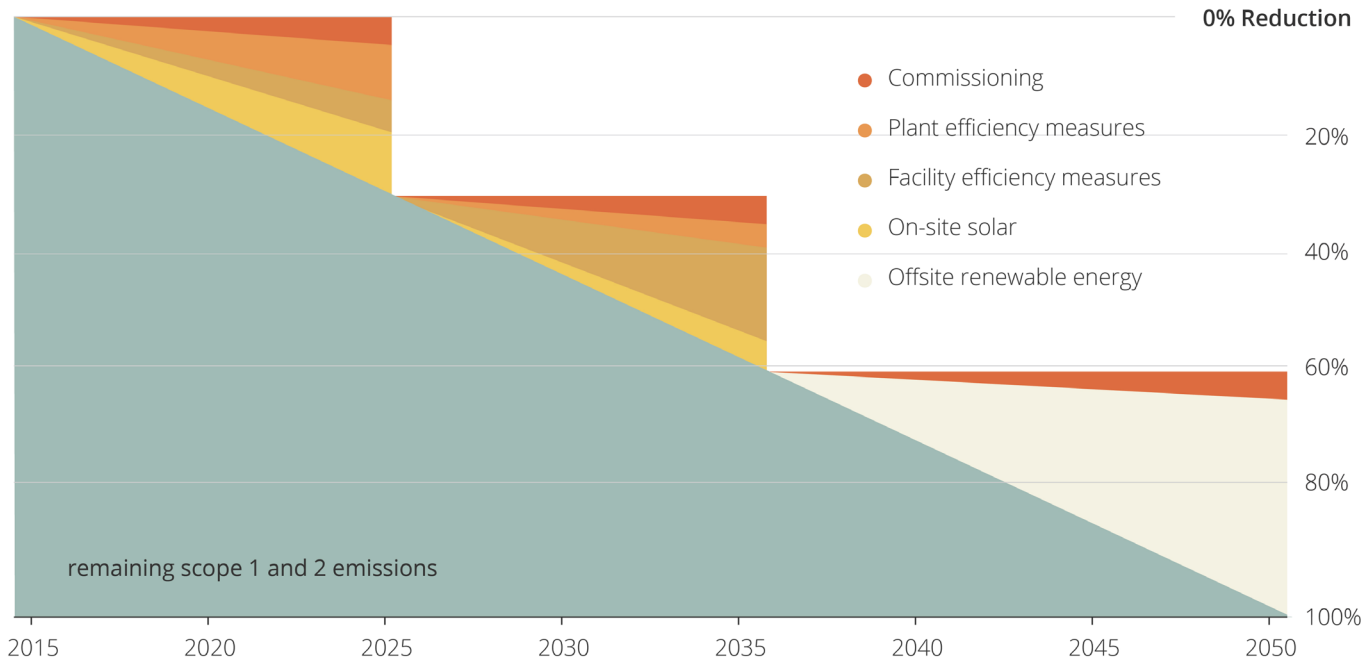

Figure 10: An example decarbonization plan showing potential GHG emissions reductions by implementing three primary points on the pathway – energy conservation, renewable energy, and transformational strategies.

We are thrilled to be an active participant at the beginning this groundbreaking legislation, and look forward to assisting owners, administrators, designers, facility managers or any decision makers - of a single building or large portfolios - to develop platforms that assess, plan and track the effectiveness of their building energy use, operating energy costs, and greenhouse-gas emission reduction strategies as NYC responds to this law in earnest.

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