ИГЬЛП | March 2018 GГЕЕП |

ZONE GRENER

Urban Green Council

Urban Green Council is the New York affiliate of the U.S. Green Building Council (USGBC). Our mission is to transform NYC buildings for a sustainable future.

A nonprofit organization established in 2002, we believe the critical issue facing the world today is climate change. Our focus on climate change requires us to target energy and other resource management.

As we improve energy and other resource management, we can deliver a more resilient, efficient, healthy and affordable city.

Copyright

© 2018 Urban Green Council. All rights reserved.

Disclaimer

None of the parties involved in the funding or creation of Zone Greener—including Urban Green Council, its members, and its contractors—assume any liability or responsibility to the user or any third parties for the accuracy, completeness, or use of or reliance on any information contained in the report, or for any injuries, losses, or damages (including, without limitation, equitable relief) arising from such use or reliance. Although the information contained in the report is believed to be reliable and accurace, all materials are provided without warranties of any kind, either express or implied, including but not limited to warranties of the accuracy or completeness of information contained, merchantability, or the fitness of the information for any particular purpose.

As a condition of use, the user pledges not to sue and agrees to waive and release Urban Green Council, its members, and its contractors from any and all claims, demands, and causes of action for any injuries, losses, or damages (including without limitation, equitable relief) that the user may now or hereafter have a right to assert against such parties as a result of the use of, or reliance on, the report.

Acknowledgements

This work was made possible through the generous support of the Doris Duke Charitable Foundation and The New York Community Trust.

We would like to thank the many contributors to this report. New York City government officials provided thoughtful participation, especially staff in the Department of City Planning and the Department of Buildings, contributing significant time and creativity to this effort. Dozens of private sector participants either joined the working group, filled out our survey, spent time talking or meeting with us, and/or sent us ideas, analysis or materials. A complete list of participants can be found on page 25.

Front Cover: 1271 Sixth Avenue, Rockefeller Group International Inc.

URBAN GREEN COUNCIL

CONTENTS

Introduction	2
Zone Green	
What It Was	3
Original Zone Green Provisions	4
What It Accomplished	6
Where It Should Go Next	7
Case Studies	
Façades in Affordable Housing	11
Solar PV in Brooklyn	12
Re-Wrapping a Mid-Century Modern	13
Zone Greener Roadmap	15
Participants & Contributors	25

INTRODUCTION

Zoning regulations guide land use and development. They determine whether a building can be loft apartments or a factory. They regulate the size and height of buildings. They specify parking requirements and trees. And they also impact green building.

In 2012, the Department of City Planning enacted Zone Green, which amended the zoning resolution to remove barriers to green building. Built upon recommendations from the Urban Green-led Green Codes Task Force, Zone Green addressed issues ranging from wall insulation and rooftop equipment to heat pump condensers and accidental disincentives.

And it worked. Architects and developers report that Zone Green has changed the way many buildings are built. Walls are often better insulated on new masonry buildings. Practitioners are successfully utilizing provisions for solar shading, green roofs and the placement of outdoor condensers. Zone Green has enabled about 15 percent more solar projects to be installed in the city.

But new zoning challenges have arisen. There is growing awareness of the need to improve curtain walls and re-clad existing façades, issues that were not addressed in Zone Green. New solar strategies, such as roof-top solar canopies and battery storage, have also run into barriers.

To determine how Zone Green is performing and where it needs to go in the future, Urban Green launched Zone Greener. Forty private-sector experts participated in meetings and interviews, along with the Department of City Planning (DCP) and the Department of Buildings (DOB). This report provides the recommendations that emerged from these consultations. In an exciting development, before the ink could dry on this report, DCP implemented some of our recommendations by issuing interpretations to facilitate solar installations.



ZONE GREEN: WHAT IT WAS

Zone Green grew out of the 2008 NYC Green Codes Task Force, which Urban Green convened and managed at the request of the Mayor and the City Council Speaker. Its charge was to recommend how the city's existing laws and regulations could be changed to facilitate greener building practices.

The Task Force enlisted over 200 building professionals and, over the course of 18 months, delivered more than 100 actionable proposals to the city in 2010.

Many of the recommendations proposed new regulations or made others more stringent (such as requiring mold-resistant materials in bathrooms and the commissioning of new energy systems), but about a third proposed removing regulatory impediments to green strategies.

Such was the case for the majority of the Task Force's proposals relating to zoning. For example, the installation of solar panels was often prevented due to zoning height and volume limits. Effective solar shading was typically impossible to install due to limitations on extensions beyond the façade, and even green roofs were forbidden on buildings that had reached their height limits.

In addition, the fundamental metric controlling how much floor area a developer can build was having the unintended consequence of rewarding thin, flat and poorly insulated façades—an issue that the NYC Department of City Planning (DCP) raised prior to the launching of the task force. After the Task Force's proposals were released in early 2010, DCP decided to address the zoning impediments comprehensively. They gathered all the Green Codes Task Force proposals related to zoning and worked with experts to uncover others. Partnering with industry, including Urban Green, they crafted a broad set of amendments to the Zoning Resolution branded as "Zone Green."

This was a Herculean effort; these comprehensive changes had to be reviewed by all 59 Community Boards before being approved by City Council and the Mayor. Fortunately, it worked, and in December of 2012, Zone Green was incorporated into New York's Zoning Resolution.

The provisions of Zone Green fall into roughly seven buckets, summarized on the following pages.

ORIGINAL ZONE GREEN PROVISIONS

NEW WALLS

Issue: Buildings were being designed with thin, poorly insulated walls in order to maximize the usable space.

Resolution: Exempt up to 8" of wall thickness above 8" of thickness from being counted as part of the floor area, if the walls achieve the following criteria: the average u-factor of the wall (opaque wall and fenestration) must exceed the code's prescriptive average u-factor requirements by at least 10 percent, and the u-factor of the opaque areas of the wall must exceed the prescriptive u-factor requirement for opaque areas by 20 percent or more.

EXISTING WALLS

Issue: Building owners were often precluded from adding exterior insulation to their buildings due to a range of zoning restrictions.

Resolution: If the added wall thickness achieves an average R-value of 1.5 per inch, up to 8" of wall thickness, then exempt it from the floor area calculations and from rear and side yard open space regulations. Zone Green also includes additional details on how to comply given various constraints, such as the minimum required distance to the closest building.

SUN SHADES

Issue: Building owners could often not install effective solar shades because they could extend no more than 10" beyond the face of the building.

Resolution: Allow sun control devices and awnings to project 30" beyond the face of the building, including over required open areas and allow solid portions of the sun control devices to cover up to 30 percent of any façade.

SOLAR AND WIND

Issue: Solar panels and wind turbines could not be installed above the maximum permitted height on buildings.

Resolution: On flat roofs, allow solar panels to rise up to 4' above the maximum building height. Taller panels, with height limits that vary by zone, can be installed, so long as the area of the panels extending above 4' does not exceed 25 percent of the area of the roof; on sloped roofs, allow solar panels that are no more than 18" above the roof.

On buildings taller than 100', allow wind turbines up to 55' tall (including pole and rotor), and on waterfront buildings, allow wind turbines up to the smaller of 55' or half the height of the building.



GREENHOUSES

Issue: Rooftop greenhouses were often prohibited due to limits on height and floor area.

Resolution: Allow rooftop greenhouses in buildings without residential occupancies provided they are set back and no more than 25' high.

ROOFTOP EQUIPMENT

Resolution: Low-lying features, such as green roofs and decks, were not allowed on roofs that had exceeded their height limits.

Resolution: Allow up to 8" of insulation thickness to be installed, and allow green roofs and other stormwater detention systems, recreational decks, and skylights to be installed up to 3'-6" above the existing roof or the maximum height limit, whichever is higher.

MISCELLANEOUS MEP

Issue: Efficient mini-split units could not be installed because of limitations on where they could be located in residential yards. Also, there was a lack of clarity concerning electric vehicle charging stations and battery swapping facilities.

Resolution: For one- and two-family, allow A.C. condensing units to be permitted obstructions in required open areas. Allow vehicle charging in all parking areas, and allow charging or battery swapping facilities within commercial districts.

WHAT IT ACCOMPLISHED

Based on surveys and conversations with industry and city representatives, we learned that many practitioners in the design, real estate and solar communities are using Zone Green to improve building performance when feasible.



Number of Times Provisions Were Used

We asked our members and the Zone Green Working Group participants to share their experiences. The 17 survey respondents¹ reported on 70 projects that utilized Zone Green provisions a total of 114 times.

Zone Green seems to have a positive impact on affordable housing, which is often constructed with exterior masonry walls. This is the wall type that most easily benefits from the zoning area exclusion for new walls and already needs to meet the "green" standards set by state and city agencies. A typical supportive or affordable project using the exclusion could create about 2 percent more units—or up to 5 percent more on small projects.

Another source of information was New York State's Solar Ombudsman. Delving into records and speaking with solar installers, the Ombudsman estimates that 15 percent of photo-voltaic installations in the city utilized Zone Green. This represents 17 MW, enough to provide over 2,300 homes with solar, assuming an array size of 7 kW. Highlights from the survey include:

- All types of Zone Green provisions are being used, although the greenhouse provision was used the least, with only one respondent.
- The most commonly used provisions—about 80 percent of those utilized—were for new walls, solar energy systems, and rooftop equipment.
- A few practitioners are utilizing Zone Green frequently; others much more rarely. Of the 17 respondents, eight utilized the provisions on over five projects each, accounting for 83 percent of the reported provision use. It seems that once practitioners become familiar with the provisions and proficient at navigating the bureaucratic complexities, they use them repeatedly.

¹Due to the nature and size of the survey, small projects were likely under-represented and Urban Green did not hear from practictioners unfamiliar with Zone Green.

WHERE IT SHOULD GO NEXT

When Zone Green was developed, it focused on masonry walls rather than curtain walls. It also did not address emerging trends, such as the replacement of mid-century façades, hyper-efficient projects using Passive House techniques, or solar panels elevated to shade cars.

Fortunately, about half of these impediments can be tackled in the near term through clarifying interpretations, adjustments to processes or amendments to the Building Code. Unfortunately, the other half will necessitate changes to the Zoning Resolution and, in some cases, comprehensive studies, which will likely take years.

What follows is a summary of the main issues and proposed resolutions, with a complete list of technical proposals in the Roadmap on page 15.

Façade replacements. Roughly 130 million square feet of commercial space was built in New York between 1950 and 1970—much of it located in midtown and downtown Manhattan. This stock is coming due to be refurbished or redeveloped.

The buildings' mid-century façades were built when energy was cheap, using single-pane glass, thermally unbroken mullions, and uninsulated metal panels that created lots of leaks. Replacing these façades with modern curtain walls, which have double-glazing, insulation and tight construction, would save vast amounts of heating and cooling energy and be more resilient.

Re-cladding, as compared to re-building, would salvage most of the embodied energy of the original building and reduce construction-related disruption. But few building owners are replacing these façades. One reason is the extraordinary expense, which is hard to recoup—a problem that can't be helped. Other reasons include regulatory hurdles problems that could be addressed.

Expansion into sidewalks. The new façades, whether they are re-clads or over-clads, are thicker than the original walls. If the building was built to the lot line, the new façade would need to extend into the sidewalk space by 8" to 12", depending upon the project. Current rules allow a veneer no more than 4" thick to be added to buildings built before 1968. This is typically not enough for reclads, and there is no allowance for newer buildings. Fortunately, this impediment could be removed in the near term if DOB and DOT work together to increase the allowance, which is already in the works.

Zoning limits. The new, thicker façade replacements can run afoul of a host of zoning limits, including excess built area and extensions into required open spaces, plazas or sky exposure planes. In the near term, this could be resolved by clarifying the interpretation of Zone Green to allow extensions of up to 8" that meet the Zone Green thermal specs to be excused from all of these zoning limits. In the long run, Zone Green will need to be amended to allow up to 12" to be excused.

Impact of Zone Green on Curtain Walls

Zone Green requires the average u-factor of a building's envelope to be 10 percent better than the code's prescriptive requirements, which is not a lot. However, 10 percent vastly underrepresents the benefits because new curtain walls typically achieve just about half the prescriptive requirements for walls, trading off the rest for better performing, but less durable, HVAC and lighting. This means that the thermal resistance of a replacement curtain wall that achieves Zone Green will not be 10 percent more, but over 100 percent more than standard practice. The impact would be even greater for replacements of mid-century façades: a factor of 4 increase in thermal resistance as compared to the historic façades.



Achievable standard. These better-performing façade replacements can help the city achieve its 80x50 goals, but the more they cost, the less frequently they'll happen. This means that the Zone Greener requirements for replacement façades should probably be less stringent than the requirements for new façades. The city will have to work with industry to find the right balance between expense and stringency. Developing this standard and incorporating it into an amended Zone Green will be a long-term effort.

New curtain walls. More and more of New York's façades are using curtain wall construction, which may look like an all-glass building, a glass-and-panel building, or even mimic masonry. For a variety of reasons, including the relative thinness of curtain walls, it is far more difficult for developers of curtain wall buildings to accrue Zone Green benefits compared to masonry walls. This means that the city is seeing little in the way of improved wall performance from this large and growing class of buildings. Two specific adjustments to the original Zone Green requirements could put curtain walls on a more level playing field

with masonry walls. Since curtain walls were not considered at the time Zone Green was developed, there are very good reasons to consider making these changes:

The opaque portions. Zone Green specifies a requirement on the overall wall performance and a separate requirement on the performance of the opaque wall area, referencing the base code. The base code does not address curtain walls categorically—they are lumped in with metal buildings and then held to a higher standard than mass walls for their opaque portion. The result: curtain wall buildings aiming for Zone Green add interior knee walls-low walls that come up to the windowsill-to increase the thermal resistance of the opaque portion. These knee walls are expensive to build and prone to interior condensation and mold. Since the requirement on the overall wall drives its energy performance, the separate requirement on the opaque portion serves no ultimate purpose and reduces the designer's flexibility. In the long term this requirement (on the opaque portion) should be struck.

Wall thickness. For new walls, Zone Green allows up to 8" of wall thickness above 8" of thickness to be excluded from the zoning area if the building envelope achieves the thermal requirements. This effectively means masonry walls, typically around 16" thick, get a bonus. Curtain walls, which tend to about 8" thick, can't qualify. Therefore, a change should be made to Zone Green allowing for an exemption of up to 8" of wall thickness for conforming walls, without having to be in excess of 8".

Thermal performance of walls. Zone Green promotes envelopes with low thermal transmission, but it could have even greater impact if it addressed practices that undermine the walls' thermal performance and encouraged very-high-performing envelopes.

Thermal bridging. Walls are currently being granted Zone Green exclusions for projected thermal performance that they may not be actually achieving due to thermal bridges which can radically undermine the thermal resistance. This could be addressed in the near term if DOB changed its procedures to require 2-D modeling for walls that have two-directional heat flows and aren't appropriately addressed by the default standards. An example is the heat flow between the slab and the wall resting on the slab.

Next gen building envelopes. Zone Green encourages building envelopes to exceed the prescriptive requirements of code by a mere 10 percent. Most (non-Zone Green) curtain-wall buildings trade off the prescriptive envelope requirements for enhanced mechanical equipment, so Zone Green walls tend to be significantly better than typical walls currently being built. But walls could perform several times better than even Zone Green-com-



pliant walls, as evidenced by the new generation of Passive House projects in New York. The city should consider amending Zone Green and include a second tier with much more stringent envelope requirements and an increased zoning area exclusion to encourage the high-performance walls necessary to achieve 80x50.

Solar Energy Systems. NYC's constrained transmission lines reduce the city's ability to import renewable energy, so site-based solar energy systems need to play a real role in reducing demand and greening the city's electrical supply. Therefore NYC's 80x50 plan sets an ambitious target of 1,000 MW of installed solar capacity by 2030—roughly nine times the current amount. Installing that much solar on NYC's tight sites will require a relaxation of the zoning laws and interpretations.

Rooftop solar energy systems. New York City's rooftops represent a battleground of competing uses, including stair and elevator bulkheads, mechanical equipment, and wide walkways that provide firefighters with sufficient access. On small rooftops, this can leave precious little space for solar once these other requirements have been addressed—that is, unless you elevate the solar panels to create a canopy that floats above everything else.

At the beginning of the Zone Greener process, this elegant and increasingly popular solution could not be utilized on flat roofs in many of NYC's lower density neighborhoods (zones R1 through R5), because the canopies would extend beyond the sloped plane height limits above the roof. Similarly, elevated solar canopies had been limited to 25 percent of roof area on buildings that have reached their height limits, impacting larger buildings, especially those with complex massing.

Between the time of the Zone Greener conversations and the issuance of this report, DCP issued a memo to DOB with clarifying interpretations that help solve, or at least diminish, some of these problems. The interpretation of sloped planes raises the base of the planes by 4' to align with standard 4' Zone Green allowance on flat roofs, thereby providing much more allowable area for solar canopies. And buildings are

Left: 11 KW solar canopy installed on a flat roof in Brooklyn's Bedford Stuyvesant neighborhood. Canopies can increase solar capacity on flat roofs by as much as 200 percent. allowed to add solar above bulkheads to the 25 percent solar roof area limits. However, given the limited area of unshaded rooftop in New York City, changes to the Zoning Resolution itself may also be necessary, including an expansion of the area allowance beyond 25 percent.

Ground-mounted solar energy systems. When Zone Green was developed, the city did not anticipate that NYC building owners would want to install ground-mounted solar arrays or elevated solar panels to cover parking spaces. But now they do. The city will need to work with industry to study the desired uses and impact, and address this comprehensively in an amendment to the Zoning Ordinance—a process that will take years. In the meantime, some clarifying interpretations would help, such as allowing solar carports to be sited on residential properties wherever garages are allowed, and determining whether solar panels elevated above parking lots impinge on open space requirements.

Energy Storage Systems. Building owners are increasingly interested in installing battery storage systems on their properties, as this investment can ensure continuous power availability in the event of grid disruption. It can also generate savings and additional revenue through participation in utility demand management and reduction programs designed to lower costs, increase system reliability and improve environmental performance. Zone Green did not address batteries at all, whether they are located on roofs, within the building interior or on external walls. As with ground-mounted solar, this issue calls for the city to partner with industry on a study of energy storage systems and their potential impact on buildings and sites, followed by a comprehensive amendment to the Zoning Ordinance. Many of these same issues pertain to fuel cells.

DCP's Clarifying Interpretation Adds Solar Capacity

DCP recently issued a clarifying memo to DOB that raises the base of the sloped plane zoning limits in Zones R1 though R5, opening up much more roof area for cost-effective solar installations. How much, approximately? Urban Green calculates that Zones R1 through R4 and Zone R5 contain roughly 477 million and 172 million square feet of rooftop area, respectively. Assuming that roughly a quarter of the roof area in the less dense R1 to R4 zones is flat, and that roughly half of the roof area in the denser R5 zone is flat, and that the reinterpreted zoning would allow solar canopies to cover roughly 75 percent of each flat roof, this change could enable roughly 150 million more square feet of solar canopy. At an estimated 18 Watts peak power per square foot, this area could potentially supply 2,700 MW, or almost one quarter of NYC's peak power demand. If just 20 percent of this were developed, this one adjustment to zoning could result in as much peak power as a mid-sized power plant, significantly helping the city achieve its 80x50 goals.



Left: For buildings that have met their maximum heights, solar canopies can typically be installed in high density zones (green). But prior to DCP's new interpretations, this was effectively prohibited in the low density residential zones (red).

CASE STUDY: FAÇADES IN AFFORDABLE HOUSING

Two adjacent buildings recently completed in the Bronx, 411 East 178th Street and 4275 Park Avenue, utilized Zone Green provisions to improve aesthetics, thermal performance and the number of affordable housing units. Developed together by the non-profit Breaking Ground and designed by COOKFOX Architects, this residential community consists of 419 units of affordable rental housing and supportive housing.

COOKFOX designed a brick cavity wall with 3" of extruded polystyrene on the exterior of the block wall and 2 ½" to 5" of mineral wool insulation on the interior. Without Zone Green, this project would have lost precious floor area for its textured façade and extra insulation, ultimately translating into fewer housing units.

However, Zone Green allows projects that achieve high thermal performance to exclude up to 8" of wall thickness above 8", provided they achieve a thermal conductance of at least 20 percent less than code for the opaque portion and at least 10 percent less than code for the overall wall. Since this project's wall achieves 43 percent less and 27 percent less conductance respectively—and is thick enough to take full advantage of the exclusion—the project could exclude over 10,000 square feet. This allowed an additional 10 units of supportive housing and 11 units of affordable housing to be built.



Left: Diagrams showing how excluded wall area translates into more apartments.

Fig. 1: Detail of 8" of wall thickness excluded (red)

Fig. 2: Excluded wall thickness throughout building.

Fig. 3: Excluded wall thickness reassembled into floor area for 10 affordable apartments.

CASE STUDY: SOLAR PV IN BROOKLYN

Gateway Elton III consists of two new, affordable, energy-efficient buildings in the Spring Creek section of East New York, Brooklyn. Completed in 2017, they contain 302 residential apartments plus groundfloor retail, community space, indoor parking, WiFi lounges and other amenities. From its inception, Gateway III was designed to maximize the solar PV potential of its two rooftops. The project team included the developer Hudson Companies, Dattner Architects and solar designer and installer Bright Power.

The two buildings illustrate the benefits and limitations of Zone Green. The 6-story building, A1, was built to its maximum height limit per zoning. Here, Zone Green allowed for the installation of solar panels up to 6' above the roof. Due to various obstructions and FDNY access rules, only 25 percent of the roof could be covered with these low-lying solar panels. This left the total array at 65 kW.

The 8-story building, A2, had no solar height restriction, as it was not built to maximum zoning height. Therefore, the solar panels could be designed as a canopy, floating over the FDNY access routes and roof equipment. This resulted in 44 percent of the roof being covered and a solar capacity of 218 kW, over three times as much as was installed on A1.



Left: Panel plans for A1 (top) and A2 (bottom); Center: Elevated solar panels on building A2 at Gateway Elton III.

CASE STUDY: RE-WRAPPING A MID-CENTURY MODERN

This project proposed upgrading and repositioning a 460,000 square foot, 40-story midtown office building from the 1960s, including removing its existing skin and replacing it with a tighter, better insulated wall.

Such mid-century curtain walls tend to have extremely poor thermal performance, so re-wrapping them can represent a transformational improvement, as would have been the case here. The 1960s curtain wall, which had single-pane glass, aluminum mullions and spandrel panels, and no insulation, had an extremely high overall thermal conductance of U = 0.76. In contrast, the thermal conductance of the proposed wall, a double-glazed curtain wall with insulated glass opaque panels and thermally broken mullions, would have been less than a quarter as much: U = 0.179.

In addition to having much lower conductance, the newer curtain wall would have had less infiltration, since new curtain wall technology is much tighter. It also would have had less radiative heat transfer, as the coatings that are now standard have the ability to reflect heat.

OUT



PROPOSED PODIUM FAÇADE 46.89% VISION GLASS

Continued on following page.

URBAN GREEN COUNCIL

Unfortunately, this dramatic energy efficiency upgrade did not happen, in part because Zone Green was not designed to address the re-wrapping of curtain wall buildings. First, the new, better-insulated wall would have been thicker than the original wall, pushing the face of the new wall 7" outboard from the original face and extending into a required plaza. This is currently not allowed.

A second impediment involved the Zone Green requirement that the thermal conductance of the opaque portions of the wall be less than 80 percent of the code-mandated maximum. Because the code already places a high standard on the opaque portions of curtain walls, the "less than 80 percent" requirement could only be met by building insulated knee walls behind the insulated curtain wall panels. Such work is expensive and prone to construction errors because of the difficulty of coordinating between the curtain wall contract and the construction contract. And worse, knee walls are susceptible to condensation. Due of all of these issues, the building owner decided not to proceed with the project.

Below: Sections through existing curtain wall and proposed curtain wall.

Pink shaded area of curtain wall shows how new wall extends 7" outboard of existing face of wall. Note insulation behind spandrel panel supplemented with insulated knee wall.



EXISTING PODIUM FAÇADE

PROPOSED PODIUM FAÇADE

ZONE GREENER ROADMAP

Here, we delve more deeply into the issues presented in this report, detailing the policy changes or updates that will enable Zone Green to remain useful and effective. These tangible steps will allow New Yorkers to better build and retrofit sustainable buildings.



near-term resolution

Actions that can be taken quickly. These typically involve administrative actions, such as issuing clarifying interpretations, posting explanatory information, or coordinating rules between agencies, and do not require a lengthy legislative change.



Actions that were taken in response to the issues raised by the Working Group before the report was finalized. These entail a series of clarifying interpretations w.r.t. solar that were issued in a memo from DCP to DOB in February 2018.



Changes that will likely take years to enact. These typically involve actions, such as changes to the Zoning Resolution, that require legislation to be passed by the City Council. These proposed zoning changes would be citywide and would need to be heard by all 59 community boards, which is a lengthy and strenuous process.

GENERAL

1 Address unanticipated issues.

Issue: Amending the zoning resolution every 7 to 10 years is not sufficiently nimble to address the range of unanticipated issues that arise in the highly technical and rapidly-evolving areas of exterior walls, solar energy and energy storage.

Recommendation: When Zone Green is amended, include waivers in the sections on walls, solar energy systems and energy storage systems (similar to ZR 25-34 for parking) that would allow the Commissioner of DOB to approve projects that meet the intent of Zone Green, but can't conform with all zoning requirements.

Iong-term resolution

WALLS

1 Enhance clarity.

Issue: Many practitioners are not sure how to calculate zoning area exclusions for walls with complex geometries, nor do they understand the calculations that DOB requires to prove conformance with Zone Green.

Recommendation: DOB should post explanatory information on its website, including case studies showing how to calculate zoning area exclusions in a range of examples and the calculations necessary to prove conformance. They should also include case studies illustrating clarifying interpretations as they occur.

near-term resolution

2 Improve Thermal Bridging.

Issue: NYC is not getting the thermal performance it expects because the de-rating of ASHRAE Appendix A does not always correctly account for thermal bridging in curtain walls and window walls, or for clips in other wall types. Such bridging can reduce the effective resistance of walls by 10 to 20 percent, and up to 60 or 70 percent in some instances.

Recommendation: A) DOB to develop a Reference Guide explaining which wall types are and are not correctly addressed by Appendix A, including guidelines for 2-D modeling;

B) For Zone Green wall projects, DOB to require 2-D modeling (THERM or other) for non-Appendix A wall types; over time these requirements should apply to all projects;

C) DOB to post the Reference Guide online and develop trainings for staff and industry.

near-term resolution

3 Incentivize Next Gen Walls.

Issue: Zone Green rewards the creation of walls that perform slightly better than the prescriptive code requirements, but zoning is not encouraging the exemplary wall performance that we will need to achieve 80x50.

Recommendation: In the next iteration of Zone Green, include a second tier with a larger zoning area exclusion for wall performance that is considerably better than the prescriptive requirements—say in the range of half the code's prescriptive overall u-factor. Requirements and zoning area exclusions for this second tier to be developed by the Working Group tasked with determining the requirements for re-cladding or over-cladding. See Walls 9a-b and ZR 12-10 Def of Floor Area (12)(ii).

Iong-term resolution

4 Encourage bulkhead insulation.

Issue: Projects with high-performance envelopes, such as Passive House, are insulating bulkheads since they are part of their thermal envelope. In some instances, this insulation is counting against their allowances for permitted obstructions on the roof.

Recommendation: Issue a clarifying interpretation of Zone Green to exclude up to 8" of bulkhead wall thickness from the allowance for permitted obstructions, if:

- For existing walls the added wall thickness achieves > 1.5R/ inch
- For new walls, the building envelope, including the bulkhead, achieves the required u-factors

For more information, see ZR 23-62.

near-term resolution

5 Exclude parapets, bulkheads and penthouses from new story calculations.

Issue: The building code sets a limit of 33.3 percent for rooftop structures before they are considered a new story. Parapets, bulkheads and penthouses are included in this calculation, penalizing high-performance projects that are insulating bulkheads, penthouses and parapets (in order to prevent thermal bridging at the roof).

Recommendation: Issue a clarifying interpretation of Zone Green/Building Code to exclude up to 8" of insulated wall thickness added to existing parapets, bulkheads and penthouses from being counted as part of the aggregate area of rooftop structures, provided that the added wall thickness achieves R > 1.5/ inch. Also consider whether this exemption should be extended to cover new penthouses and bulkheads provided they comply with the Zone Green u-factor requirements. (There may be no need to extend this exemption to new parapets, as there are other methods for thermally breaking parapets that do not require thicker walls; however, these solutions may be unduly expensive.) See BC 504.3.

near-term resolution

6 Remove requirement on u-factor for opaque portion of walls.

Issue: To qualify for Zone Green, the average u-factor of walls must be no more than .9 times the code prescriptive value for walls (opaque and fenestration), and the average u-factor of the opaque portions of the walls must be no greater than .8 times the code prescriptive u-factor for the opaque portions.

The thermal conductance of the façade is determined by the overall u-factor, so the separate requirement on the opaque portion serves no purpose. But it does make it much more difficult for curtain walls to comply, since the code holds the opaque portions of curtain walls to a much higher standard than mass walls.

Consequently, this requirement leads to the building of insulated knee-walls behind curtain walls, driving up the cost of projects and risking condensation. **Recommendation:** Amend Zone Green to remove the separate requirement on the u-factor for the opaque portion of the wall. See ZR 12-10 Def of Floor Area (12) (ii)(1).

+ long-term resolution

7 Exempt up to 8" of wall thickness if overall u-factor requirement is met.

Issue: If a building complies with the Zone Green thermal requirements for the envelope, up to 8" of wall thickness above 8" of thickness can be exempted from the floor area. Since even quite efficient curtain walls can be fairly thin, it can be difficult to exempt much wall thickness, unless knee walls and other potentially problematic details are added.

Recommendation: Amend Zone Green to allow complying walls to exempt up to 8" of wall thickness, removing the requirement for it to be above 8". See ZR 12-10 Def of Floor Area (12)(ii).

+ long-term resolution

8 Require Minimum Solar Heat Gain Coefficient.

Issue: Despite achieving the good overall thermal resistance required by Zone Green, many buildings still do not have efficient façades because they have excess amounts of vision glazing that face west and south.

Recommendation: Amend Zone Green to require west- and south-facing walls with more than 40 percent vision glazing to achieve the prescriptive Solar Heat Gain Coefficient of code or to be shaded, with shading requirements to be determined. See ZR 12-10 Def of Floor Area (12)(ii)

+ long-term resolution

9a Set an achievable standard for upgrading walls.

Issue: Re-cladding or over-cladding mid-century buildings will result in dramatically better wall performance because new envelopes are much tighter, have at least some thermal breaks on their mullions and double glazing with low-e. But such façade replacements are rarely done because they are very expensive and it's

URBAN GREEN COUNCIL

difficult to recoup the investment. Holding replacement façades to the same standards as new façades in Zone Green could create an additional barrier to improvements—further discouraging such beneficial upgrades.

Recommendation: The city should convene a working group that would set an ambitious but achievable standard for existing wall upgrades to be included in the next iteration of Zone Green. Such a standard could be a set of prescriptive requirements, with a fixed wall performance standard that includes infiltration, solar heat gain and thermal conductance—or it could be a performance standard set in comparison to the wall it's replacing.

Projects that meet such a standard should be facilitated by zoning that exempts additional wall thickness from FAR, allowing thicker walls as a permitted obstruction in plazas and sky exposure planes; allowing such walls to extend into sidewalks, and other revisions. The current Zone Green over-cladding path, which exempts up to 8" of additional wall thickness provided it achieves an R-value of at least 1.5 / inch, should be maintained and updated. Its applicability to curtain walls should be assessed in particular. See ZR 12-10 Def of Floor Area (12)(ii).

Iong-term resolution

9b Relax requirements on improving existing walls.

Issue: The current NYS energy code requires walls that are being amended to be brought up to meet the current energy code. This affects all projects, not just Zone Green projects. Because it can be difficult to impossible to bring existing walls up to the new energy code, this requirement can deter improvements to existing façades.

Recommendation: Work to amend the NY State code to relax the requirements on improving existing walls, provided that under no condition could the overall u-factor of a building be increased.

The landmarks language in the IECC (which allows projects to be exempt from specific provisions in the energy code, provided that they file a report detailing why they could not comply with such provision) could be a model. See 2016 NYS ECCC, C503.1.

Iong-term resolution

10 Allow extensions into/over sidewalks.

Issue: Re-cladding or over-cladding of buildings typically necessitates extending into the sidewalk by 8", and sometimes up to 12", something that is not well-addressed by "revocable consent."

Recommendation: DOB and DOT to coordinate on developing an allowance for buildings that comply with Zone Green façade requirements or meet some other standard. See BC 3202.1.

near-term resolution

11a Clarify compliance requirements for re-cladding and over-cladding.

Issue: The Zone Green wall requirements were not created with the re-cladding or over-cladding of modern buildings in mind, especially curtain walls. So, it's not clear whether such projects, especially re-claddings, need to comply with the new building or existing building requirements.

b Clarify requirements for buildings exceeding the FAR.

Issue: Buildings near or above their FAR could be precluded from re-cladding.

c Allow extensions required setbacks.

Issue: Existing buildings could be precluded from re-cladding or over-cladding if doing so would extend over open spaces, plazas or sky exporsure planes. Examples of re-cladding and over-cladding projects suggest that additional wall thickness of 8" is generally necessary, with up to 12" needed for some projects.

Recommendation: Issue a clarifying interpretation of Zone Green for existing curtain walls that exempts from floor area and allows as permitted obstructions re-cladding or over-cladding that extends up to 8" beyond the original walls, provided that it complies with either the new or the existing wall provisions, e.g.:

- If the overall u-factor of the wall is < 0.9 the prescriptive requirement, and if the u-factor of the opaque portions is < 0.8 the prescriptive requirement, or
- If the opaque portions of the wall achieve an

URBAN GREEN COUNCIL

R-value of > 1.5/ inch, with a potential proviso that the percent vision glazing does not increase.

near-term resolution

Recommendation: Zone Green amended to exempt from floor area and allow as permitted obstructions, recladding or over-cladding that extends up to 12" beyond the original walls, provided it complies with the TBD requirements for re-cladding or over-cladding. See Walls 9a and 9b and ZR 12-10 Def of Floor Area (12).

Iong-term resolution

12 Facilitate piece-by-piece façade upgrades.

Issue: On existing buildings, it may only be feasible to upgrade one or two façades due to occupancy, required setbacks, or adjacent buildings; there are also cases where only part of a façade can be upgraded because of a fire escape or other impediment. Such partial upgrades are beneficial and should be facilitated.

Recommendation: Issue a clarifying interpretation that Zone Green FAR exclusions and permitted obstructions (See Walls 11a and 11b) for re-claddings or over-claddings of existing buildings do not need to be building-wide, but can be applied to individual façades or parts of façades.

near-term resolution



13 Incentivize interior insulation.

Issue: Adding insulation to the interior of a façade may be the best approach for improving the envelope performance of some buildings. However, doing so could reduce the usable floor area.

Zone Green does not currently allow buildings to recoup this area, creating a potential disincentive to this type of beneficial upgrade.

Recommendation: In the next iteration of Zone Green, consider a FAR exclusion for added interior insulation that meets the existing building requirements as per Walls 9a and 9b and increases the thickness of the wall. See ZR 12-10 Def of Floor Area (12).

Iong-term resolution

14 Encourage lot line wall insulation.

Issue: There is no mechanism for an owner to add insulation to the exterior of wall that abuts a lot line, largely because it extends over the neighboring property. This is a shame because these are prime candidates for improved insulation and there are many such party walls in the city.

Recommendation:

1. Clarify to which property the insulation accrues from a zoning perspective—the building or the neighbor. If it accrues to the neighbor, issue a clarifying interpretation that exempts up to 8" of additional wall thickness from the neighbor's FAR, from limits of the neighbor's rooftop permitted obstructions, and from sky exposure plane requirements, provided that such additional wall thickness achieves the required R > 1.5 / inch. (Assuming, of course, that the neighbor has agreed to allow this insulation above their building!)

2. NYC or NGO to work with industry to develop a standard agreement for an easement for building owners. It needs to address air rights, maintenance and removal of the additional wall thickness, etc.

3. NYC should also consider developing a program to assist building owners in adding exterior insulation to walls that abut parks and community gardens, perhaps by installing such insulation at no cost.

near-term resolution

BUILDING HEIGHT

1 Redefine and rewrite building height rules.

Issue: The building code defines building height as "The vertical distance from the grade plane to the average height of the highest roof surfaces." Zone Green allows up to 8" of roof insulation to be permitted obstructions on projects built before 2012, but not after. As codes have increased the required insulation on the roof, and with high-performance projects desiring to install even more, these BC and ZR requirements are constricting floor-to-floor heights.

Recommendation: DOB and DCP should develop consistent definitions, regulations and rules around building height that do not disadvantage buildings with deep roof insulation on both new and existing buildings.

One option would be to define the roof height as the top of the structural slab. Additionally, the limit of 8" should also be studied to see if it is sufficient for Next Gen efficient buildings, because tapered insulation is often required for drainage, and/or additional thickness may be required for pavers.

Iong-term resolution

MECHANICAL EQUIPMENT ON ROOF

1 Facilitate use of high-efficiency roof top HVAC equipment.

Issue: New, high-efficiency HVAC systems such as mini-splits, that avoid the through-the-wall penetrations of PTAC units, require more area on rooftops. But these can be difficult to locate on roofs when the allowances for permitted obstructions have been utilized by stair and elevator bulkheads.

Recommendation: DCP and Industry to partner on a study of the various types of highly-efficient mechanical systems that can be sited on rooftops to determine how to adjust the Zoning Resolution to facilitate their use. See ZR 23-62 (g).

Iong-term resolution

SOLAR

1 Define "Solar Energy System."

Issue: There is no definition in the building code or zoning resolution of a solar energy system. This can lead to conflicting interpretations of what is part of such a system.

Recommendation: Provide a consistent definition across the building code and zoning resolution that aligns with other code standards. It should include all structural, electrical, mechanical and plumbing equipment required for such a system, and include both photovoltaic and solar thermal systems.

Iong-term resolution

2 Define "Elevated Solar Energy System" and "Non-Elevated Solar Energy System."

Issue: Elevated solar energy systems, which are designed to allow people and vehicles to pass under all parts of them, may be subject to different code requirements than non-elevated systems. For example, FDNY allows elevated solar systems to cover roofs, since they allow FDNY to access to the entire roof.

Recommendation: Provide consistent definitions for elevated systems and non-elevated systems in the building code and the zoning resolution. These definitions should cover both roof-mounted and ground-mounted systems.

Iong-term resolution

3 Ease requirements for solar energy systems not pursuing NYS Property Tax Abatement.

Issue: Currently solar energy systems must meet the requirements established by NYS for qualifying for the Property Tax Abatement—rules that may be more stringent than necessary.

Recommendation: The solar energy industry should provide DOB and DCP with examples where the current rules are unnecessarily stringent and propose specific changes to the rules. Once this information has been provided, the agencies should consider what changes are warranted. See 1 RCNY 105-2.

near-term resolution

4 Clarify regulations for solar on projects that have non-conforming uses.

Issue: Solar energy systems were not typically being allowed on sites with non-conforming uses.

Recommendation: A clarifying interpretation was issued that solar energy systems on buildings with non-conforming uses are to be considered to be an "incidental alteration," as per ZR 12-10.

Such installations shall be subject to permitted obstruction regulations measured from the existing height of the building rather than maximum height of the applicable district.

resolution issued

5 Clarify requirements for large solar installations.

Issue: It is unclear whether, if a project installs solar panels over more than 50 percent of the project area, it is no longer an accessory use, thus requiring that an amended C. of O. be filed. Further, it is unclear how the 50 percent should be calculated.

Recommendation: An interpretation was issued clarifying that solar installations are allowed as an accessory to a primary use in any district without limitations on the proportion of lot coverage, provided that the bulk regulaions of the underlying districts would still apply. See ZR 12-10.

resolution issued

6 Inform the building community of evolving interpretations of zoning rules.

Issue: Interpretation of rules and zoning are not consistently conveyed to the building community, causing unpredictability, delays and expense.

Recommendation: Sustainable CUNY to post Case Studies that illustrate the evolving interpretations.

near-term resolution

7a Be proactive rather than reactive.

Issue: The field of solar energy and energy storage systems is rapidly changing. Rather than continually struggling to solve yesterday's problems, DOB and DCP need a process to inform them of upcoming issues in the field.

b Update NYC Electrical Code.

Issue: The National Electrical Code adopts frequent changes related to solar energy systems to accommodate rapid changes in the technology. Changes to the NYC Electric Code have not kept pace, resulting in systems that would meet the national code having to apply for specific approvals by the Electrical Advisory Board. This approval can be very lengthy and expensive.

Recommendation: Every two years, the city or an NGO should convene the relevant city agencies and the industry for education sessions on emerging solar and storage technologies along with a working group to discuss how such emerging technologies could be accommodated. In particular, the working group should propose changes to the NYC Electrical Code in line with the National Electrical Code updates, which could be adopted mid-cycle.

near-term resolution

8 Clarify sloped plan height limitations.

Issue: Sloping plane zoning limits severely restrict the areas where elevated solar energy systems (ESES) can be installed on flat roofs of many small buildings, making those applications unfeasible. Since ESES's are the best way to resolve complex FDNY access issues on such roofs, these restrictions are constraining solar capacity in vast areas of the city.

Recommendation: A clarifying interpretation has been issued by DCP that allows solar to extend 4' above the sloped planes and allows for additional solar in up to 6' above the sloped planes over 25 percent of the roof. This should go a long way toward solving the current issue.

resolution issued

Recommendation: If industry finds that the clarifying interpretation does not allow for enough installations, then the zoning resolution may need to be reconsidered and amended. See ZR 23-631.

+ long-term resolution



Right: Solar canopies that extend beyond the sloped plane height limits above the roof in lowdensity residential zones (R1-R5) are limited to 25 percent of the roof area. DCP's recent interpretation raises the planes by 4', considerably expanding the allowable area.

9 Allow ESES to exceed height limits over a greater area.

Issue: Elevated solar energy systems (ESES) are being limited in size because they are only allowed to exceed the project's height limits on 25 percent of each roof. Since solar energy systems are typically most effective on the tallest roofs, where they aren't shaded by the rest of the building, this effectively limits ESES coverage to 25 percent of the area of the tallest roof, disadvantaging buildings with more complex forms when compared to a simple extrusion.

Recommendation: An interpretation was issued clarifying that solar can be installed up to 6'-0" above bulkheads; this can be in addition to the 25 percent area allowance for each roof. See ZR 23-62 (m).

resolution issued

Recommendation: Explore a change to the Zoning Resolution that would allow buildings to install solar over 25 percent of the area that they could have covered if they were extruded to the height of their highest roof. (Along with the allowance for bulkhead coverage.) In addition, DCP should consider expanding the solar allowance beyond 25 percent, given the limited area of unshaded rooftop in NYC and perhaps removing the restriction altogether.

Iong-term resolution

10 Reassess restrictions on ballast block anchorage systems.

Issue: Ballast block anchorage systems for solar energy systems are not allowed on buildings > 100' tall. This restriction seems to have been inherited from limitations on ballasted roofs (which are a different system) rather than an engineering-based analysis. If ballast blocks cannot be used, the mechanical anchorage of the solar systems must penetrate the roof, making many solar installations unfeasible from an economic perspective.

Recommendation: DOB should engage a consulting structural engineer to assess what would be required for a ballast block solution for buildings > 100' tall and to establish appropriate requirements, submittals and limits to ensure safety. Presumably, the design of anchorage systems for solar, both ballasted and mechanical, should be submitted and stamped by a structural engineer.

How much difference could this make? Let's assume that reassessing this issue could enable solar to be installed on buildings between 100' and 200' tall. Urban Green calculates that buildings within this ranage account for roughly 50 million square feet of rooftop area. Assuming that solar could cover roughly 75 percent of this roof area, this change would result in a potential increase of 38 million square feet of solar. At an estimated 18 Watts peak power per square foot, this translates to 675 MW—roughly 5.6 percent of NYC's peak power demand. See RCNY 105-02 (e) (1) (ii) (F).

near-term resolution

11 Allow neighboring buildings to share front-to-back FDNY access paths.

Issue: On the roof of each building under 100' in height, FDNY requires a 6' wide clear path from the front to the back. On rowhouses, which are generally 18' to 25' wide, this reduces the available area for non-elevated solar panels by 24 percent to 33.3 percent.

Recommendation: Amend the Fire Code to allow neighboring buildings to share their 6' wide front-toback path, provided that path is directly adjacent to the building lacking a path. This would provide FDNY with its required access, while significantly increasing the potential area for solar panels. (Note the buildings would need to sign an agreement.) See Urban Green's *Building Resiliency Task Force*, No. 19. and FC 504.4 for more information.

near-term resolution

12 Clarify rules for installing ESES as carports on small residential properties.

Issue: The industry is unclear on the rules for installing Elevated Solar Energy Systems (ESES) which could serve as carports or the rules covering other solar arrays on small residential properties (R1 to R5).

Recommendation: A clarifying interpretation addressing the following: that ESES used to cover a car and/or driveway could be located on a garage and wherever a garage could be located on a site; and that solar energy systems can be located anywhere outside of required yards and open space, as long as it is within the allowable bulk envelope.

near-term resolution

13 Clarify ESES rules for various properties.

Issue: The industry is unclear on what is allowed in regard to solar canopies and arrays on multi-family residential, commercial and industrial sites, as well as whether or not solar installations count against the open space requirements, especially when they are ESES installed over parking lots.

Recommendation: A clarifying interpretation that

ESES used to cover car parking does not count toward lot coverage calculations.

near-term resolution

Recommendation: Allow ground mounted solar as a permitted obstruction in required yards.

Iong-term resolution

14 Update zoning rules for canopies and arrays on various sites.

Issue: Ground-mounted solar is a relatively new issue in NYC, so DCP has not had occasion to comprehensively study what the industry would like to install and how it should be regulated by zoning.

Recommendation: DCP and Industry should partner to study the various types of solar energy systems that people would like to install on all types of sites, including small residential, multifamily, commercial and industrial. This can inform which, if any, adjustments need to be made to the interpretations or to the Zoning Resolution. The study should include an assessment of whether the tree canopy requirements for parking lots in commercial and community facilities conflict with the installation of ESES over parking areas.

Iong-term resolution

ENERGY STORAGE SYSTEMS

1 Clarify exterior energy storage system rules.

Issue: As the NYC solar industry has matured, it is becoming interested in installing energy storage systems along with solar panels. It is not clear where energy storage systems are currently allowed on walls, roofs or sites (although they are not considered mechanical equipment and are therefore not permitted obstructions on roofs). Moreover, as with ground-mounted solar, DCP has not had occasion to comprehensively study what the industry would like to install and how it should be regulated by zoning. Similar issues pertain to fuel cells.

Recommendation: Issue a clarifying interpretation of where energy storage systems are currently allowed on sites, roofs and walls. See ZR 23-62 (g).

near-term resolution

URBAN GREEN COUNCIL

Recommendation: DCP and Industry to partner to study the various types of energy storage systems and fuel cells that people would like to include on all types of roofs and sites, including small residential, multifamily, commercial and industrial, and to see which, if any, adjustments need to be made to the interpretations or to the Zoning Resolution. See ZR 23-62 (g).

Note that any zoning allowances would not supersede FDNY requirements for safety or requirements for UL listing, which would independently apply.

Iong-term resolution

2 Amend interior energy storage system rules.

Issue: Unlike mechanical systems, energy storage systems are not excluded from zoning area calculations.

Recommendation: Amend the Zoning Resolution to treat energy storage systems like mechanical systems and exclude them from the zoning area. See ZR 12-10 Def of Floor Area (8).

Note that any zoning allowances would not supersede FDNY requirements for safety, which would independently apply.

Iong-term resolution

ROOFTOP GREENHOUSES

1 Revisit setbacks for greenhouses.

Issue: On buildings that have exceeded their height limits, Zone Green allowed for greenhouses, but they are required to set back 6' from the perimeter wall of the story immediately below on all sides. These setbacks make it difficult to impossible to create greenhouses of sufficient size on many properties or to design them so their structure aligns efficiently with the floor below.

Recommendation: DCP and industry to study the impact of the required setbacks and to consider relaxing them. See ZR 75-01 (e).

Iong-term resolution

PARKING LOTS

1 Allow permeable pavement in parking lots.

Issue: Currently, the surfacing material for parking lots must be 4" thick asphalt, cement or other hard-surfaced material. Porous pavement is allowed but must be approved by the DOB Commissioner, making for an arduous process.

Recommendation: DCP to amend this provision to allow permeable pavement as a surfacing material in parking lots, as of right. DOB and DCP to convene industry to determine the appropriate requirements for such permeable paving. In addition, DCP should consider adding a cool pavement requirement for parking lots. See ZR 25-65.

Iong-term resolution

THANK YOU TO OUR CONTRIBUTORS

Buildings Working Group City Government

Gina Bocra Department of Buildings

Cory Scott Herrala Landmarks Preservation Commission Staff

Monika Jain Department of City Planning

John Lee Mayor's Office of Sustainability

Derric Meister Sustainable CUNY; NYS Solar Ombudsman

Kate Mikuliak Department of Transportation

Jeremy Shannon School Construction Authority

Private Sector

Lois Arena Steven Winter Associates, Inc.

Daniel Bower Rockefeller Group

Alberto Fanceschet Permasteelisa Group

James Gainfort James R. Gainfort AIA Consulting Architects PC

Mark Ginsberg Curtis + Ginsberg Architects, LLP

Kristin Hopkins-Clegg Pelli Clarke Pelli Architects

Geoff Hurst The Related Companies

Nico Kienzl Atelier Ten

Trey Lindsay Skidmore, Owings, & Merrill LLP

Carol Loewenson Mitchell Giurgola Architects, LLP

Anthony Mastrolia SL Green Realty Corp.

Silverio Patrizi Thornton Tomasetti

Mic Patterson Schuco USA LP

Rafael Pelli Pelli Clarke Pelli Architects

Teel Riggs Heintges and Associates

Markus Shulte Arup Group Limited

Adrian Tuluca Vidaris, Inc.

Stas Zakrzewski ZH Architects ZONE GREENER: UPDATING NYC'S ZONING RESOLUTION

Solar Working Group City Government

Monika Jain Department of City Planning

Derric Meister Sustainable CUNY; NYS Solar Ombudsman

Elizabeth Skowronek Department of Buildings

Private Sector

Mark Cunningham Brooklyn SolarWorks

Lucie Dupas EnterSolar

Christopher Neidl Brooklyn SolarWorks

Other Contributors

Fatin Anlar FX Collaborative

Tria Case CUNY

Zach Craun COOKFOX LLP

Ilana Judah FX Collaborative

Evan Kaplan, Bright Power, Inc.

Clare Mifflin Kiss Cathcart Architects, PC

Henry Misas Bright Power, Inc.

Shanta Tucker Atelier Ten

Urban Green Council

Russell Unger Executive Director

Laurie Kerr Senior Policy Advisor

Christina Anjesky Managing Director

Christopher Halfnight Manager, Policy

Sheena Thiruselvan Manager, Communications

Chloe Woodruff Associate, Communications