Image courtesy of NYU Center for Urban Science and Progress

This map depicts large buildings in Lower Manhattan and west Brooklyn required to comply with Local Law 97 carbon emissions reductions.

Conquering Carbon

Facade designs are key to meeting stringent New York City carbon reduction requirements

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By Barbara Horwitz-Bennett

In what is being described as the most ambitious climate legislation for buildings enacted by any city in the world, New York City is requiring large buildings to progressively ratchet down their carbon emissions starting in 2024. By 2030, approximately 50,000 buildings, 25,000 square feet or larger, must reduce their emissions by an aggressive 40 percent, from a 2005 baseline, or face steep fines.

"There are plenty of cities crafting impactful legislation around the built environment's role in climate change, but no piece of legislation is as far-reaching as the emissions limits in Local Law 97," reports Adam Roberts, director of policy, American Institute of Architects AIA New York.

While the road to 2030 compliance will be challenging and costly, the city will ultimately be looking at a savings of more than 5.3 million metric tons, the carbon equivalent of the entire City of San Francisco's annual emissions.

"This is a very comprehensive approach. We do not know of any other city that has adopted that scale of carbon savings," explains John Mandyck, chief executive, Urban Green Council, New York whose organization worked hand in hand with the city in drafting the new legislation.

Though Local Law 97 (LL97) from the Climate Mobilization Act impacts less than 4 percent of the city's buildings, they represent nearly 60 percent of the city's building

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Learning Objectives
After reading this article, you should be able to:

1. Explain New York City Local Law 97 in large buildings and its framework of carbon reduction replacing energy efficiency as the key sustainability metric.
2. Identify key issues and shortcomings with older building facades, and review design tools and strategies for facade and building envelope retrofits.
3. Recognize how enhanced thermal performance and airtightness can significantly boost energy efficiencies in facades.
4. Describe the concept of carbon trading where densely populated buildings can purchase emission credits from buildings that are below the carbon cap.

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area and account for more than two thirds of greenhouse gas emissions.

"We have to take aggressive action and we have to focus on the buildings that are the largest polluters," explains Gina Bocra, AIA, LEED Fellow, Department of Building's Chief Sustainability Officer, New York.

The legislation is also unique in that it addresses carbon reduction, as opposed to energy efficiency. Whereas architects are used to measuring their sustainable designs by energy use, they will need to broaden their perspective to account for the source of this energy.

"Energy sources have varying carbon intensities depending on grid region and fuel source," explains Michael Woods, senior project manager, Perkins and Will, New York. "Carbon, on the other hand, is a measure that casts a wider net over the thermodynamic processes at play and also speaks to the way cities everywhere will be measuring the impact of buildings within the broader context of climate action plans."

Erik Olsen, managing partner, Transsolar KlimaEngineering, New York, further qualifies the significance of this climate legislation by the fact that it impacts the largest city in the United States, targets existing buildings, and is outcome-based.

Putting things in perspective, the legislation completely changes the cost-benefit analysis for envelope retrofits for existing buildings. Whereas previously, it was hard to justify costly envelope retrofits based on energy savings alone, now, with fines factored in, it is much easier to make the case for investing in the building facade.

To better understand the difference between an outcome-based code and traditional codes that are linked to a simulated energy modeling comparison to a baseline building, Olsen explains that the former approach is not well correlated to actual building performance as a lot can happen between design simulation and actual operational performance. This can be caused by a number of factors, including:

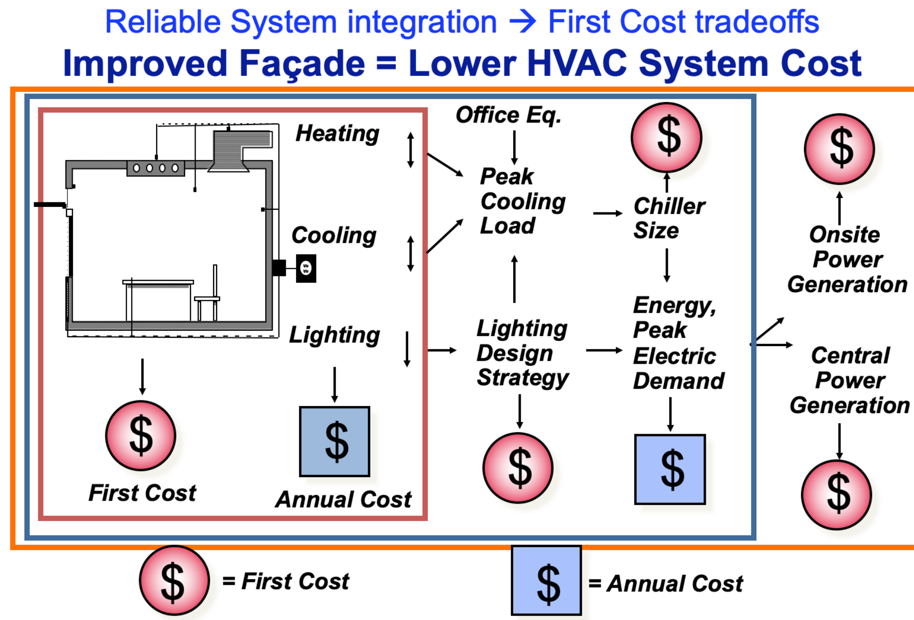
- Not accounting for all energy losses in the building such as thermal bridging
- Inaccurate assumptions/inputs
- Simulation tools not calibrated to real building performance
- Value engineering
- Poor installation
- Building operation modeling does not take into account variables like human behavior and building operator training.

"So, with our typical simulation-based code compliance system (IECC/ASHRAE 90.1 etc.), we do not know, nor have to justify to a code official, that what we built performs how we expected it to perform," he explains.

On the contrary, with LL97's ongoing regulation of carbon emissions, the design team's scope extends beyond the certificate of occupancy to building operation and training occupants.

"This means that design teams are forced to deal with issues like thermal bridging, which are not adequately addressed by conventional codes or performance evaluation standards, but can cause significant energy gaps in real performance. It also means that commissioning of building envelopes will be widespread to ensure the quality of installation is achieved," says Olson.

Image courtesy of Lawrence Berkeley National Laboratory



Improved building facade designs can enable savings via reduced lighting consumption and HVAC equipment and loads.

TARGETING THE FACADE

While there are many measures that building owners can take to slim down their carbon profile such as switching to LED lighting or installing integrated control systems, many agree that facade improvements are key to achieving LL97 compliance, particularly with stricter requirements going into effect in 2030.

To put things into perspective, Bocra points out that 75 percent to 80 percent of New York's large buildings should be able to meet 2024 carbon levels with relative ease, but before 2030, around 80 percent of these buildings will need significant retrofits and likely facade work.

"Facades are a key part of carbon deduction and energy efficiency reduction because they are, arguably, the most important part of a building's energy efficiency strategy from a holistic standpoint," explains Atilio Leveratto, vice president, CallisonRTKL, New York.

"Robust facades will lead to greater energy efficiency and less robust facades will lead to greater energy loss, all which have carbon implications," agrees Mandyck.

In fact, air infiltration, heat loss, and solar gain through the facade account for up to 43 percent of a commercial building's lighting, cooling, and heating loads.

"Improving facades is critical to compliance with LL97," concurs Roberts. "Updating facade elements will keep buildings better insulated, making them more energy efficient. Technological upgrades to HVAC systems alone are not enough to ensure compliance, as those improvements must be supplemented by better-quality facades."

Tied into daylighting/lighting and HVAC systems, the building's level of air infiltration, heat loss and solar heat gain, will directly determine how much energy is required to heat, cool, ventilate, and light the interior. And this has significant ramifications on older New York buildings.

"The facades on most have been compromised in terms of maintaining a consistent thermal and air barrier. With the settling and structural movement that typically happens over time, exacerbated with extreme temperature fluctuations, as the permeability of a façade increases, air pathways are created," explains Tommy Zakrzewski, PhD., director of integrative energy engineering, HKS Inc., Chicago.

"These air pathways, often cracks through building materials and individual construction components, increase undesirable infiltration. In many instances, infiltration can account for 30 percent to 50 percent of the heat lost or gained in structures that are not completely airtight.[1] Furthermore, excess air leakage through the facade can also de-rate the effective R-value of insulation by up to 60 percent.[2] Thus, the integrity of the facade plays a key role in meeting the aggressive emissions and carbon reductions in LL97," he states.

In fact, the U.S. Department of Energy estimates that 40 percent to 50 percent of a building's heating and cooling loads can be decreased by a high-performing enclosure. "Reducing these loads in turn has the compounding effect of downsizing mechanical equipment and lowers carbon emissions even further," adds Woods. "These kinds of synergistic opportunities between the architecture and building systems are essential for achieving ambitious carbon reduction goals."

Offering her perspective, Façade Tectonics Institute President Helen Sanders, Ph.D., expects that improving envelope performance in existing buildings—particularly those with old, single-glazed, non-thermally broken, leaky facades–will become an important strategy to achieving both the near-term 2024 targets and the longer-term 2030 targets.

In addition to improving efficiencies, a higher-performance building enclosure will boost occupant comfort, indoor environmental quality, and resiliency to better survive severe weather events.

Last year, New York City Mayor Bill de Balasio made a widely publicized statement that the city would introduce legislation to ban glass and steel skyscrapers in the fight against global warming, setting off a wave of backlash in the building community. In reality, LL97 does not seek to eliminate glass and steel facades. However, it does require them to meet a more stringent energy standard.

"With a high-performance building envelope, it is possible to create glass skyscrapers without compromising energy performance and still deliver the quality of space in terms of expansive views that developers want in order to market to tenants, and with sufficient daylighting and thermal and visual comfort to support a productive, healthy indoor environment," says Sanders. "A win–win–win for the planet, the building owner and the occupants."

HOW DESIGNERS CAN PREPARE THEMSELVES

As owners begin working to get their buildings up to par, architects, engineers, facade designers, and contractors will have a significant role to play in helping buildings meet these LL97 carbon reduction standards.

In terms of preparation, Stephen Selkowitz, affiliate, building technology and urban systems, Lawrence Berkeley National Laboratory, Berkeley, California, advises designers to start by deepening their understanding of the role that the facade plays in both energy impacts and occupant comfort/satisfaction. Then they should better familiarize themselves with the technological options available, and not just glazing, but shading and daylighting controls/management as well. "Some of the best available options are sometimes difficult to ferret out," he explains.

Further, Bocra points out that there are some limitations to the U.S. Environmental Protection Agency portfolio manager's tool which owners typically use to report to us in their annual energy benchmarking.

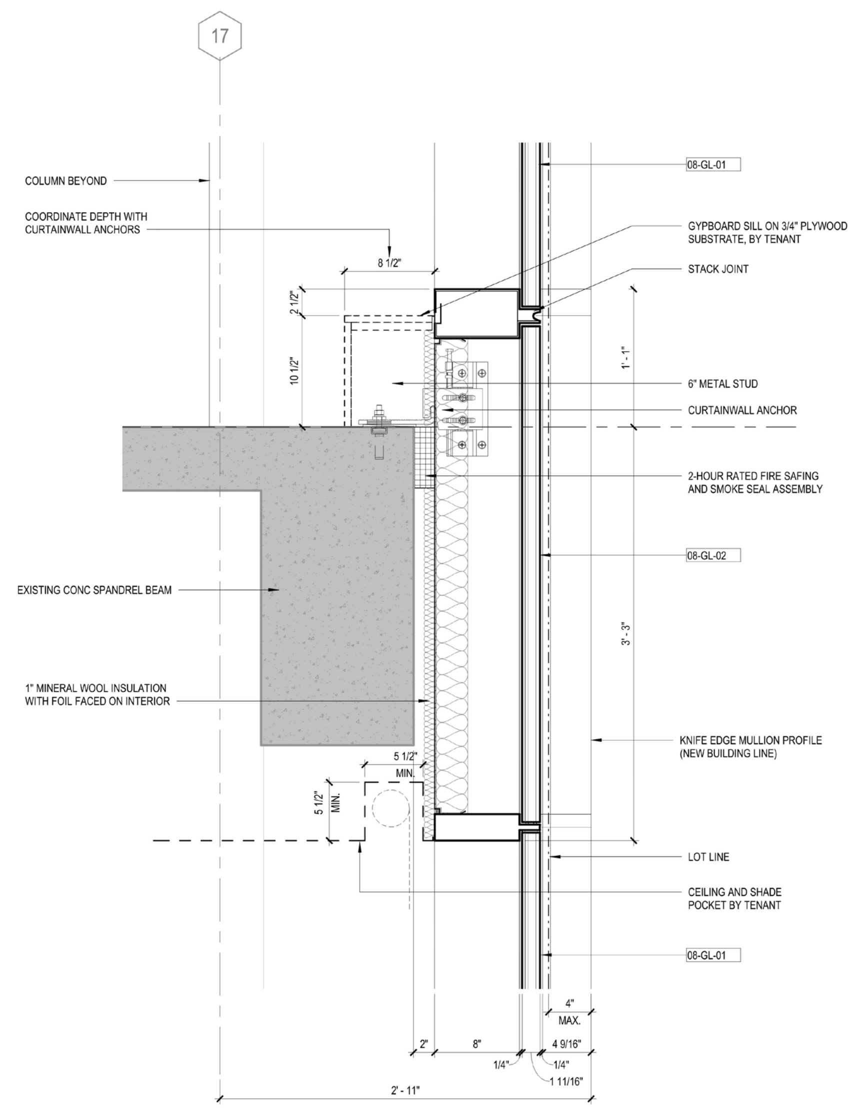


Image courtesy of Perkins and Will

Utilizing Perkins and Will's Simulation Platform for Energy-Efficient Design (SPEED) program, the optimal combination of window-to-wall ratio and glazing type on the south facade of a New York City building is analyzed.

Consequently, it is very helpful to engage with an architect or an engineer "to dig into the details of how they're calculating their greenhouse gas emissions and fully understand where are the sources of the excess emissions in their buildings and then translate that into the opportunities that are going to help them move forward the fastest," she says.

"To be in the best position to discover these ideal design solutions, this likely requires an integrated approach where a team of multi-disciplined professionals—with expertise in energy modeling, facade engineering, and thermal analysis—create a comprehensive delivery method that will see these projects through from start to finish," adds Leveratto. "Having the ability to make decisions quickly about materials, thermal properties, modeling, and mockup will be key to finding the highest performing facade with the biggest impact to the building systems, while also taking into consideration the design aesthetic," he explains.

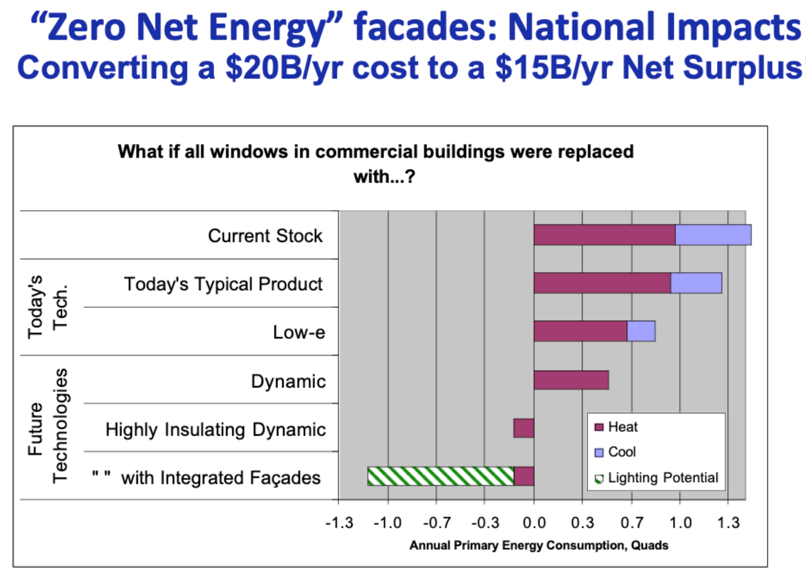
Along these lines, Perkins and Will recently developed a new modeling tool called SPEED, Simulation Platform for Energy-Efficient Design. The tool was designed to significantly help reduce building energy use and carbon emissions at the earliest stages of design. While more suited for new construction, the tool will have relevance for many kinds of projects—once a new building receives its certificate of occupancy, it immediately falls under Local Law 97 requirements, so all New York City projects moving forward must consider carbon.

"SPEED gives design teams the power to rapidly model hundreds, even thousands of building scenarios—taking into account variations in sizing, massing, stacking, and orientation—to identify the highest-performing configurations," explains Woods. "This includes configurations of the building envelope."

Beyond carbon emissions and performance, Brandon Andow, PhD, RA, senior building performance analyst, EYP Architecture & Engineering, Denver, notes that the building facade is a "confluence of conflicting issues that span building physics and human comfort." He further explains that heat transfer, water vapor transport, and advection are not easily intuited by designers and often defy rules-of-thumb.

For instance, designers may be looking to replace single-pane glass with double-pane insulated glazing, but if the non-thermally broken frames are left in place, the

Image courtesy of Lawrence Berkeley National Laboratory



With advanced glazing and integrated facade technologies, U.S. commercial building window energy use can be converted from a $20 billion/year cost to a $15 billion/year surplus.

facade will still exhibit poor thermal performance and struggle with air infiltration.

"Architects and engineers will need to evolve their skill sets to effectively make decisions that increase the energy performance of facades and improve occupant comfort, all while avoiding moisture problems, navigating cost pressures, and reimagining one of the most recognizable skylines in the world," says Andow.

Along these lines, some educational resources include courses offered by AIA New York's Committee on the Environment and New York Passive House. Other groups offer spaces for professionals to exchange knowledge and ideas on facade retrofits and other elements of LL97 compliance. In particular, Max G. Wolf, AIA, P.E., CPHD, LEED AP, associate, SOM, recommends NYC's Retrofit Accelerator, and the Building Energy Exchange, which hosts classes in Passive House design and THERM.

Personally, Wolf decided to become a Certified Passive House Designer and has spent time honing his skills in THERM, an LBNL 2D heat transfer modeling, and WUFI dynamic hygrothermal analysis. While professional modelers inevitably need to be brought in to perform these complex calculations, Wolf is now in a better position to work more effectively and efficiently with these consultants.

Mandyck further advises architects and engineers to transition from an energy to a carbon mindset. While these two metrics are sometimes used synonymously, they are very different things. For the most part, buildings do not emit carbon, they use energy, primarily in the form of electricity. That electricity may come from a fossil fuel electrical plant hundreds of miles away where carbon is emitted, but the building owner is now being held responsible for that.

"Before now, the playbook was all about energy, but now it is carbon. This is a big transition that we are going to have to make," Mandyck explains.

He adds that as power plants become more renewable, this puts less pressure on the building design, so designers will need to pay more attention to the electrical grid.

GETTING STARTED

Fortunately, New York City building owners do have a strong starting point in considering where to make LL97-related upgrades. The city's Benchmarking Law has been requiring owners to calculate and submit their energy use levels on an annual basis for close to a decade. Consequently, they already have some useful data for analyzing energy use patterns.

"Benchmarking systems are the first step in outcome-based codes, and form the reporting infrastructure and provide the data which can create a basis for the adoption of carbon emission targets for existing buildings," says Sanders.

Wolf brings up another important point which is strategically analyzing the retrofitting of the building envelope so that the

HVAC systems can be adjusted appropriately. "Without first properly upgrading an otherwise conventional envelope, nearly all changes to HVAC and possibly other building systems have a good chance of being grossly oversized, mis-coordinated, and wasteful of money, energy, emissions, and space.

Another diagnostic tool is utilizing drones for facade assessments, in particular, infrared imaging. "Before any energy efficiency measures are considered for a facade, an assessment must be made to determine the thermal integrity of all barrier systems," explains Zakrzewski. "This type of assessment will be invaluable with identifying areas of the building facade where insulation has degraded—and in some instances omitted during construction—and highlight any air infiltration/exfiltration."

Even without a drone assessment, a common issue with older buildings is likely leaky windows. Consequently, window replacement would be considered a low-hanging fruit for upgrades.

"Countless New Yorkers live in older buildings that have not had their windows replaced in years," relates Roberts. "Installing new windows can often be done in an occupied unit, making it less inconvenient than more significant facade improvements."

Owners may also consider newer window retrofit technologies such as a highly compact, lightweight glass/glazing retrofit system that mounts to the existing glass, creating a hermetically sealed insulating gap that performs like that of a factory-made insulating glass unit. Because there is no window removing/replacement involved, it can be done without disrupting building operations or occupants. Further, the technology is less expensive and faster than a conventional window retrofit, and provides a better return on investment.

Another cost-effective strategy is reducing the thermal conductivity of the exterior wall. One way to accomplish this is to reduce the glazing area with retrofit mullions and applied films, suggests Andow.

"We are looking at a better balance between transparent and opaque surfaces that meet Local Law 97 energy efficiency goals while maintaining the benefits of fully-transparent buildings," adds Leveratto.

At the same time, Sanders points out that reducing the glazing does not automatically mean that the enclosure will offer better thermal performance. "Thermal bridging—which is often not accounted for in building energy modeling—can degrade the walls' thermal performance levels by more than 50 percent, and contributes to a gap between perceived performance and actual performance," she explains.

"In fact, in some situations, facades with larger continuous windows can have a higher performance than those with smaller glazed areas because of thermal bridging issues. As a result, decisions related to window-to-wall ratio and actual delivered energy performance are not straightforward."

Selkowitz agrees, pointing out that a well designed envelope can, in fact, support a larger percentage of glazing. Case in point, The New York Times Building incorporates floor-to-ceiling glass and fixed external shading, but also employs a state-of-the-art automated interior shading system for solar and glare control, and a dimmable, tunable electric lighting system responsive to daylight. A post occupancy study reported high levels of occupant satisfaction and energy consumption levels that were lower than the calculated use from a code-compliant, 40 percent glazed facade.

Another source of thermal loss is curtain wall spandrel panels, which have traditionally gotten by under the radar by qualifying as a prescriptive approach to code compliance. Backing this up with some numbers, Andow says the opaque areas of a curtain wall should meet a current energy code baseline thermal conductivity of 0.064 Btu/hr.ft^2.F. However, the highly conductive aluminum framing means the thermal performance of spandrel areas bottom out at around 0.2 Btu/hr.ft^2.F. This translates to thermal performance levels that are three times less than that required by the building code.

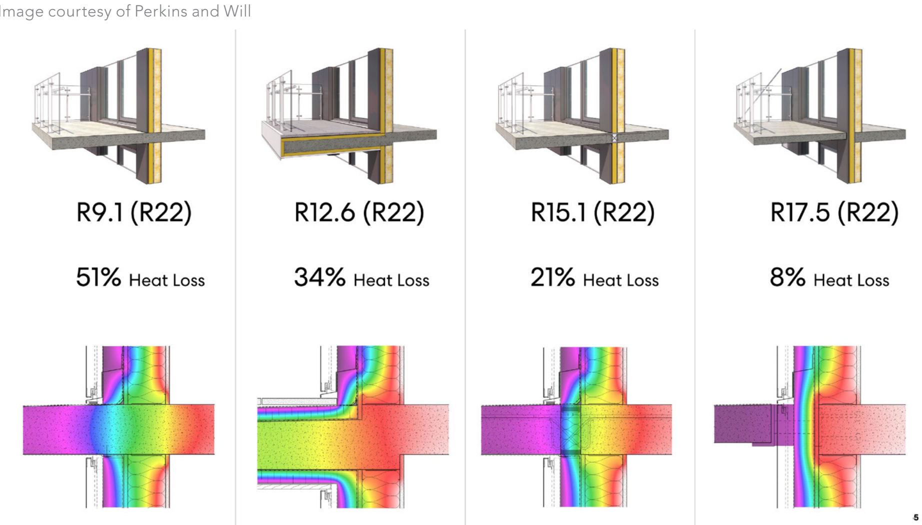
DIGGING DEEPER

Getting back to Zakrzewski's suggested facade assessment approach, a next logical step might be to air seal the building envelope as this will improve comfort, air quality, and reduce energy consumption. "Depending on the age and quality of the insulation, it could also be replaced with higher performing material and in many cases, could serve as an air barrier improvement. However, detailed engineering analysis is recommended so that the enclosure performs as expected and a problem is not created, i.e. condensation," he adds.

Wolf recommends taking things a step further and pushing the envelope to get it as close to Passive House performance as possible. In New York City's 4A climate, this means ≤ 0.6 ACH airtightness at 50 Pa, between R-30 to R-40 for opaque walls and around R-8 or better for glazing.

In evaluating retrofit facade strategies, Woods points out that zoning and real estate pressures can make things more difficult as thicker or deeper facades mean less usable square footage per floor, and if not married to reduced height restrictions, fewer rentable square feet. "In the case of existing buildings, lot lines and set-back, along with sky exposure plane requirements, challenge many effective solutions on the available space. Real

Image courtesy of Perkins and Will



Exposed slab edges and balconies can reduce the effective thermal performance of a building envelope by up to 50 percent. Adding insulation and designing thermally broken details has the potential to improve the overall envelope thermal performance by 40 percent.

estate is big business that lives at the edges of maximum allowances when it comes to floor area ratio and zoning square feet," he says.

With this in mind, Woods recommends decreasing thermal bridging, adding exterior insulation, and providing exterior sun shading as viable retrofit strategies. Regarding the former, he explains that exposed slab edges are prevalent in modern New York City apartment buildings forcing heating systems to fight hard to overcome escaping heat in the winter. Consequently, he predicts that perimeter heating might soon become a thing of the past.

While adding insulation on the exterior can boost thermal performance, it can be complicated when buildings are built right up to the property lines. Recognizing this difficulty, the city is working on some allowances here.

"In this way, New York City's new building regulations creates a 'carrot' to encourage facade improvement by allowing the owner to add height to their building," says Schober.

REPLACING THE FACADE

While quite costly, in order to comply with Local Law 97 carbon levels by 2030, many buildings, particularly older ones, will require a full facade upgrade.

"This facelift brings an updated architectural character as well as opening the door for thermally improved glazing systems, opaque rainscreen cladding with thermally improved brackets and a continuous insulation layer, and carefully designed details that mitigate thermal bridging," says Schober.

Owners may also want to consider building-integrated photovoltaics as opaque cladding, as window shading devices, or incorporating into the glass itself. These solutions will require wiring, AC/DC conversion and perhaps energy storage.

Offering some background on why aging New York City facades are in need of retrofits, Mic Patterson, PhD., LEED AP, ambassador of innovation & collaboration for the Facade Tectonics Institute, explains that the mid-20th century tall curtain wall buildings were largely experimental in nature and very little consideration was given to their extended durability as the buildings themselves were only expected to operate for 20 to 30 years.

"Now, 50 to 60 years later, these buildings are still in service and badly in need of facade retrofits," he says. "Because their original design failed to recognize and accommodate the need for future retrofit, the renovation team is often left with very few options beyond stripping the entire facade system from the building and replacing it with a new one."

When reglazing the facade, Vivian Loftness, professor and former school of head of architecture at Carnegie Mellon University in Pittsburgh, recommends selecting the highest thermal resistance/R values with no thermal bridges—i.e., Passive House standards—and maximum airtightness, the highest visible transmission/VLT possible—greater than 60 percent—and the appropriate shading coefficient/SHGC by climate and facade orientation without compromising visible transmission.

"While you might want to have low solar gain on the east and west facades, you may also want high solar gain on south facades for free solar heating in cooler climates, adding fixed or seasonal shading devices for summer," she says.

Taking things a step further, building teams can overclad the entire building, a common best practice in Europe.

While a facade facelift or a full building overclad are highly effective carbon reduction strategies, cost and disruption to ongoing building operations are significant obstacles.

Further, if owners decide to invest in such aggressive strategies, it is important to future-proof the design. "This would include best-in-class thermally broken framing; triple pane, low-e coated, warm-edge glazing package; and perhaps a double skin, with effective exterior solar shading," instructs Sanders. "It would employ strategies to mitigate thermal bridging; include durable long-service life with easily serviceable components; and ideally, orientation specific design balancing energy performance, daylight admission, comfort, and resiliency."

Patterson agrees that new building facades and retrofits must be designed to accommodate future retrofit cycles. Consequently, designs should make it easy for these facade systems to adopt new higher performing glazing products and insulated panels as they become available in the future.

Ultimately, Patterson says, "Building lifecycle carbon performance and resilience will both depend on the capability of our buildings and their facade systems to adapt to these accelerating socio-technological and aesthetic changes, as well as to the uncertainties of climate change into the future."

Working from the other end of the carbon equation, building owners should consider generating their own electricity through solar power, integrated photovoltaics, and thermal and electric power storage.

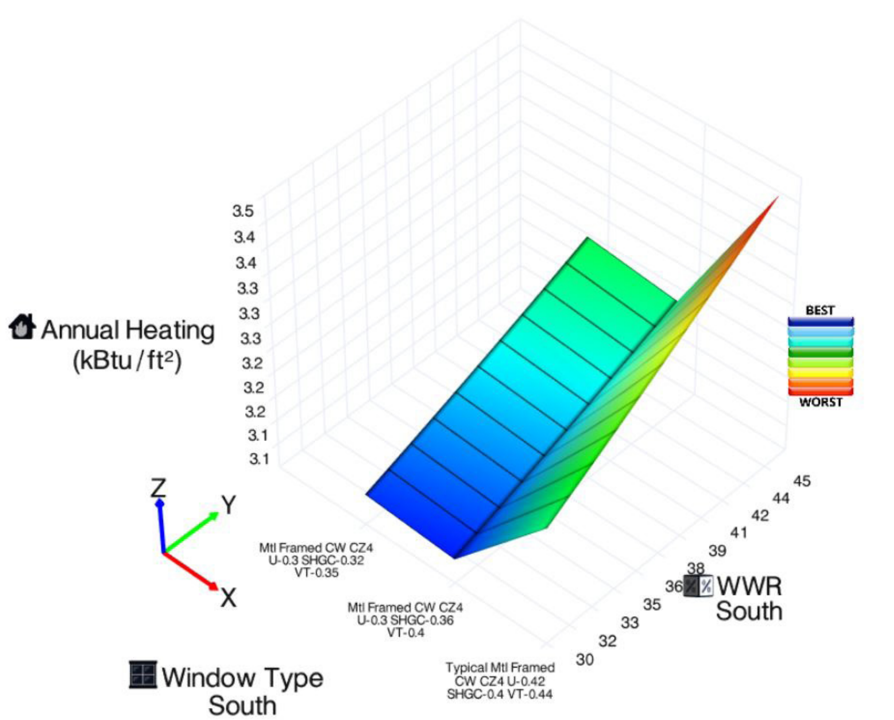


Image courtesy of Perkins and Will

This recladding example shows an existing building with exposed slab edges and spandrel beams with a new unitized curtain wall overcladding.

"In addition, net zero for the nation will require some level of carbon sequestration in our building materials," adds Loftness. "We need to design with biological materials for structure, infill, rainscreens, and even insulation, e.g., wood that is sustainably harvested. We need to seek out alternatives and innovations in concrete, steel, aluminum, and synthetic insulation. Eliminating embodied carbon is the next frontier."

FUNDING

While carbon reduction is clearly beneficial, there is no denying that these retrofits come with a hefty price tag. Further complicating matters is the general state of the economy amidst a pandemic.

To ease the burden, the city is introducing a new finance mechanism called the Commercial Property Assessed Clean Energy program, which offers owners low interest loans for energy improvements.

"The reason why they're low interest is they're collected on the building's property tax bill, so they are a more highly securitized risk," explains Mandyck. "The other benefit is the loan stays with the building, so if the building is sold, the loan goes to the new owner."

In addition, New York State offers incentives through the New York State Energy Research Development Authority, NYSERDA, and some incentives are available from utilities like ConEdison.

Another long-standing option is energy service performance contracts with third-party energy service contract organizations, ESCOs, who finance the upgrade and then share energy savings with the owner.

Selkowitz adds that high-performing, comfortable buildings ultimately make a significant contribution to employee well being and productivity, which is an important variable in an owner's return on investment. "Remember that productivity is worth 100 times the cost of energy, so a design enhancement that improves comfort and productivity can help justify a new investment in better performing solutions," he says.

Even so, Roberts says government funding will be needed to ensure that implementation is successful, both to fund proper regulation and provide additional incentives to owners.

But despite these mechanisms and programs, the fact remains that companies are struggling under today's economic conditions. However, the current situation does seem to have some positive aspects.

For starters, the required Local Law 97 upgrades are anticipated to stimulate economic activity in the construction industry. In fact, Urban Green estimates that if all buildings choose efficiency to meet the carbon caps, this presents a $16.6 billion to $24.3 billion energy retrofit market opportunity in the city by 2030. In comparison, New York building owners invested just $235 million in building improvements to save energy in 2018. Consequently, LL97 could trigger a 13-fold increase in energy upgrades depending on how soon owners begin investing in their properties. In the short term, Urban Green predicts that owners will invest $2.2 billion to meet 2024 targets.

Woods also anticipates that implementing changes at the scale required of LL97 will create positive pressure on all kinds of industries to design and sell the best products and processes to achieve these goals. "This will certainly advance the technology available to architects and building owners to improve building performance," he asserts.

Bringing up a logistical issue, Wolf recommends staggering this construction as much as possible to spread out the unavoidable disruptions, particularly when entire neighborhoods require retrofits. In the absence of strategic planning, he cautions, "Crowding of job sites—possibly one next to the other for blocks—will slow retrofitting rates due to the local decrease in resources: material, spatial and temporal, and competition for workers skilled in constructing high-performance buildings."

For the moment, owners are investing in boosting the indoor air quality in their buildings. This includes better filtration systems, improved sterilization, and antimicrobial materials to battle COVID-19, all of which contribute to sustainability in buildings, explains Leveratto.

In a similar vein, Olsen states, "COVID-19 has greatly heightened the public's awareness of the impact of the indoor built environment on their daily life. This awareness can be leveraged to increase awareness of the need to act to meet the requirements."

Mandyck suggests that the pandemic has introduced a unique learning opportunity to better understand energy use patterns.

Take Rudin Management, for example. The property management company owns 16 commercial buildings totaling 10.2 million square feet in the city. While the company's buildings have been at 10 percent capacity through the shutdown, they only saw a 30 percent drop in energy consumption. With computers, refrigerators, copiers, and the like still plugged in, there is a lot of phantom energy being wasted. Additionally, servers have continued operating to support people working from home.

"This is a learning moment. It is an opportunity for owners to have discussions with their tenants. It is my hope that we can take this opportunity to learn about building energy use patterns to make improvements for the future," says Mandyck.

Andow notes that ventilation rates and energy efficiency have always been at odds, but the COVID-19 pandemic has shifted priorities in favor of increased outside air to dilute potentially contaminated indoor air. "Satisfying new expectations for indoor air quality while reducing carbon emissions will instigate conflicts between near-term safety and long-term climate hazards," he observes.

In the grand scheme of things, Bocra reiterates that the pandemic is a near-term crisis whereas climate change is a long-term crisis that cannot be ignored. The city remains steadfast and warns that the longer society waits to make these changes, the more it is going to cost.

Putting things into perspective, Mandyck points out that the city has 3 trillion dollars of insured coastal properties, which is twice the gross domestic product of the entire country of Canada. "That is what is at risk. Superstorm Sandy hit NYC as a tropical storm, it was not even a hurricane, and it left a $20 billion bill. So I would argue that we are going to pay for climate change one way or another and if we do not make the investments today to lower our carbon emissions, we are in for it tenfold in climate catastrophes and events that we will not be able to overcome from a weather standpoint down the road."

TAKING THE LEAD

Another question is whether New York City's efforts to fight climate change might impact other cities domestically and globally. The consensus seems to be that it will in fact make an impression.

"One of the primary aims of AIA New York and other groups who advocated for the passage of LL97 was to set an example

CARBON TRADING

While New York City's Local Law 97—requiring large buildings to reduce their carbon emissions by 2024, and again in 2030—is a promising climate change policy, it puts dense, high-energy building types at a major disadvantage.

"The way the law was passed presents a major challenge in that it penalizes density, which is counterintuitive to sustainable design because you want to put more people in a single building verses placing that same number of people in multiple buildings," explains John Mandyck, CEO, Urban Green Council, New York.

While these building types have the option of paying the fine, which is $268 for each ton over the cap, this adds up to a few million dollars per building and unfortunately does nothing to help climate change.

"You could have a building that is super energy efficient and highly sustainable, but if it had 10,000 people working there, you can't get around the fact that it uses a lot of energy," says Mandyck.

Carbon trading would give a high-density building—for example, a facility with trading floors or 24/7 operations—the option of paying a lower density building, like an insurance company, to go under their cap so that the net gain is fewer carbon emissions for the city.

"That is the concept of carbon trading that one building goes below their obligation and is able to trade and monetize those extra carbon savings with a building that is not able to meet their requirements," Mandyck clarifies.

Urban Green has invested much in researching the concept and urging the city to incorporate carbon trading into Local Law 97. The council released a report this summer, "Trading: A New Climate Solution for Buildings," which outlines 11 big questions that need to be answered for carbon trading to work in any city and identifies 59 policy options under each of those questions for cities to evaluate.

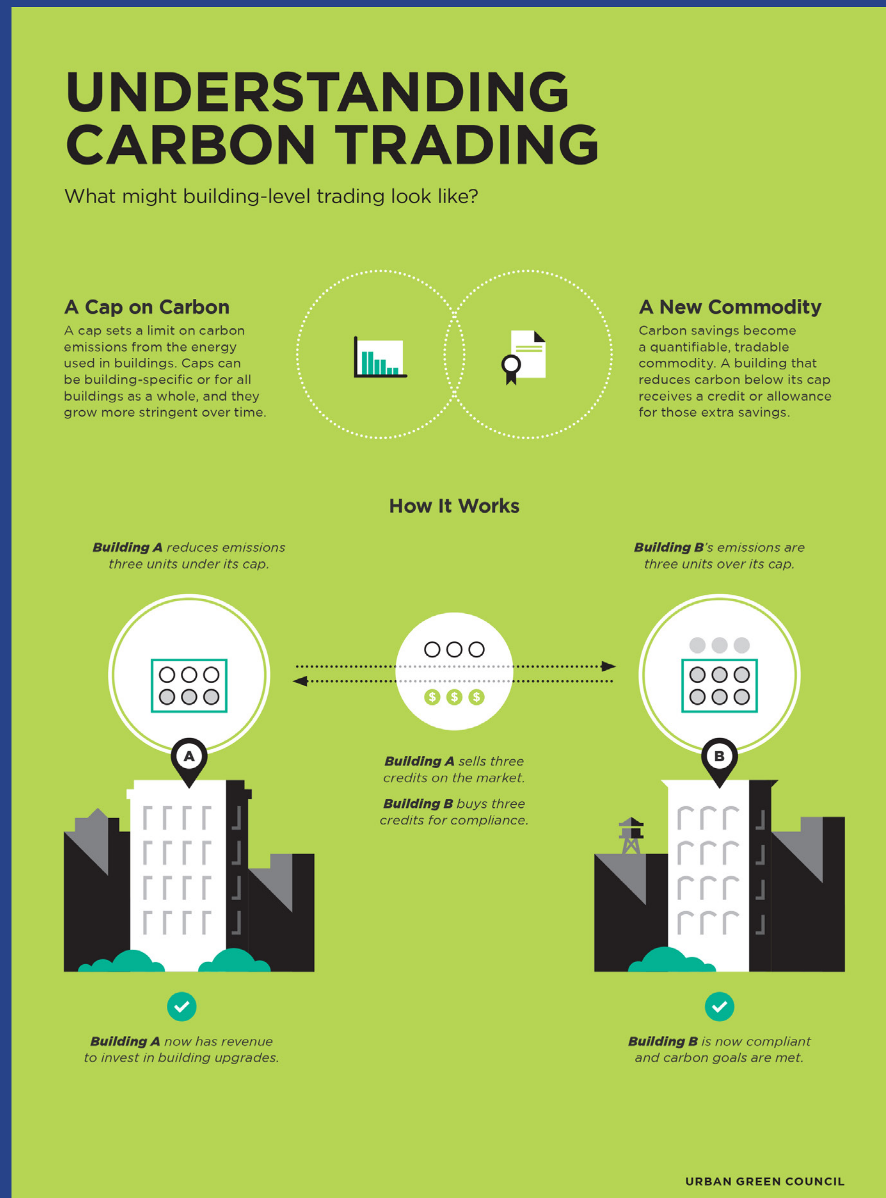
At this time, the city is conducting a study on the details of carbon trading implementation. New York University is leading a team to run carbon modeling scenarios and Urban Green is heading up stakeholder engagement and consultation on the study.

"The study is meant to make a determination in January about whether carbon trading can work in New York City," says Mandyck. "We are hopeful that will lead to a positive determination."

Urban Green views carbon trading as the "secret sauce" that will make Local Law 97 work, and something that can be exported to other cities to help reduce carbon emissions.

"It does not matter what climate you have, what political system you have, the age of your building stock, or whether you have hi-rise or low-rise buildings." explain Mandyck. "This is a breakthrough policy tool for cities that are trying to tackle climate change."

Image courtesy of Urban Green Council



To help dense buildings comply with New York's Local Law 97, it is anticipated that buildings will be able to "trade carbon" by purchasing credits from buildings that have gone below the carbon cap.

for cities throughout the country. NYC is undeniably a leader of architecture and the ambition is that the law will be imitated subsequently by other cities," says Roberts.

"As LL97's carbon emission caps become more rigorous over time, it will serve as an exemplary case study," agrees Yasemin Kologlu, RIBA, LEED AP BD+C, design director, SOM, New York. "It will offer us the opportunity to monitor the actual change in carbon emissions over the years, and learn from this to enhance new ways to improve building performance and related carbon emissions. And it could—and should—set a precedent for all cities to follow in the future."

For example, Mandyck suggests there is a lot to learn from the city's proactive policy solutions like carbon trading and commercial PACE funding, particularly in the absence of a federal solution. (For more, see sidebar, "Carbon Trading.") He also observes that New York is serving as a strong example of cities playing a leading role in battling climate change, particularly in the absence of a federal solution.

"The passing and implementation of the law has and will continue to demonstrate the value of high-performance design," agrees Woods. "It is also critically important to make building performance data accessible to the public and to other cities that stand to learn from and improve what New York City is doing."

At this point, a number of cities have laid the groundwork for implementing a law like LL97. For instance, energy benchmarking is seen as a prerequisite to adopting carbon emission targets as it provides the key data and a reporting infrastructure. To date, 19 U.S. cities—including Chicago, Boston, Washington, D.C., Pittsburgh, Philadelphia, Atlanta, Los Angeles, San Francisco, Seattle, Austin, and Denver—have established building energy benchmarking ordinances.

Further, Washington, D.C.'s +100 percent renewable energy portfolio program is projected to reduce even more carbon emissions, per capita, of LL97.

As for other cities, these energy benchmarking laws, will position them to move into implementing a law like Local Law 97, says Bocra. "We are very excited about paving the way and hopefully we have an implementation program that is as successful as it can be and we can share that with other cities."

At the same time, she points out that efforts like LL97 are all a work in progress. Along these lines, there are a number of factors that still require standardization such as how to calculate on-site distributed energy storage and combined heat and power systems, and accounting for things like on-site solar energy panels. The city is consulting with an advisory board and working on a national level to better standardize how emissions are calculated in buildings.

TACKING THE CHALLENGE

As the Big Apple embarks upon this historic carbon trimming effort, Mandyck points out that if other cities fail to follow suit, the New York Harbor is still going to flood. "So we have an obligation as the largest city in the United States to not only to reduce carbon emissions, but to do it in a way that can help other cities," he says.

Raising the ethical side of the equation, Wolf points out that building teams would never imagine designing a building without safety factors, but when it comes to the ecosystems of our planet, that same sense of responsibility does not always carry through.

"We need to redouble our efforts to see that LL97 not only stays on schedule but attains some quantified margin of safety with detailed contingency plans," he states. "It needs an experienced management team that is subject to open peer review and is answerable to the public at regular hearings."

Further, carbon reduction needs to apply to new building designs. This means making the investment in well-thought-out, integrated sustainable designs at the onset.

"No one buys the cheapest car on the market, so why would you buy only the bare bones, code minimum facade?" asks Selkowitz. "With a bit of speculation, in a more competitive real estate post-COVID world, there may be a premium on workspace that has access to better views, fresh air from the facade, better thermal management and comfort, resilience, etc. A modest incremental investment in the facade may help future-proof your building marketability."

Ultimately, architects are in a position to play a leading role in these crucial environmental efforts. Offering some encouragement, Kologlu states, "As designers, we are trying to spread our optimism to influence positive change. Everything we do today, whether we are setting new policies or designing a new building, can still curb carbon emissions and prevent long-lasting, irreversible disruption to our planet.

When a building owner invests in healthy and low carbon materials, enhancing air quality and natural ventilation, maximizing daylighting and views, and implementing new smart technologies, they are investing in the health of the planet, the wellness and productivity of their tenants, and the longevity of their building," she concludes.

END NOTES

[1]Hens, Hugo. "Heat, Air, and Moisture Transfer in Envelope Parts: The International Energy Agencies Annex 24 Common Exercises." Department of Civil Engineering, Catholic University, Belgium. 1995. Web. 10 September 2020. <https://web.ornl.gov/sci/buildings/conf-archive/1995%20B6%20papers/037_Hens.pdf>.

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__Barbara Horwitz-Bennett__ is a veteran architectural journalist who has written hundreds of CEUs and articles for various AEC publications. ***www.bhbennett.com***