# LOCAL CLIMATE ACTION: CITIES TACKLE EMISSIONS OF COMMERCIAL BUILDINGS


CENTER FOR CLIMATE AND ENERGY SOLUTIONS

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As a significant source of emissions, cities have an important role to play in addressing the carbon footprint of activities occurring within their boundaries. Among many actions targeting different sectors, cities are actively pursuing improvements in the energy performance of commercial buildings. This brief explores several policies that leading cities are adopting: energy use benchmarking and disclosure mandates, retro-commissioning and retrofitting policies, and requirements for building upgrades to meet current codes. Our review finds these policies stand to deliver and facilitate emissions reductions in cities that adopt them. However, it should be noted that achieving deep reductions and a true market transformation will require collaboration between cities, state and federal agencies, and a range of non-government entities. The need for such a collaborative approach is applicable not just to addressing emissions from buildings, but indeed is relevant broadly to city efforts to reduce emissions.

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Cities have been leading the way in responding to the causes and impacts of climate change, and have established city networks, both in the United States and globally, to accelerate greenhouse gas emissions reductions. Through the Global Covenant of Mayors, for example, thousands of cities around the world have agreed to set mitigation commitments, report activities, and share best practices on a common platform.[1] City leadership also gained international attention during the 21st Conference of the Parties (COP21) negotiations in Paris when the Non-State Actor Zone for Climate Action (NAZCA) documented thousands of city actions; contributions that collectively opened the door for ambitious emission reduction commitments put forward by countries in the Paris Agreement.[2] This is for good reason; with 40–70 percent of total global emissions[3] estimated to originate within their boundaries, actions within cities will need to be a significant source of emissions reductions. Indeed, one estimation finds that enhancing mitigation action in urban areas could reduce global emissions by 8.0 gigatons of carbon dioxide equivalent ($GtCO_2e$) in 2050, approximately 25 percent of the emissions gap between pledged national reductions to the Paris Agreement and a 2-degree pathway.[4]

The building sector—including residential, commercial, and industrial properties—is one of the largest sources of emissions for cities. The sector accounts for 70 percent of community-wide emissions in New York City, 73 percent of emissions in Boston; and a significant portion of emissions even in smaller U.S. cities. While cities are putting measures in place to improve the energy performance of new buildings, the projected rate of retirement of existing floor space will not see older, less efficient buildings replaced quickly enough to deliver the sizeable emissions reductions that cities are seeking.[5]

## LOCAL GOVERNMENT POLICY OPTIONS TO REDUCE EMISSIONS FROM EXISTING COMMERCIAL BUILDINGS

Many U.S. cities are implementing policies to address building energy use, including improving building codes, establishing developer incentives and property assessed clean energy (PACE) programs, and promoting sub-metering, among others. A number of cities are now turning their focus to existing commercial buildings, a concentrated group of high-energy users, and are pursuing a variety of policies to drive emissions reductions including: benchmarking and disclosure mandates, retro-commissioning and retrofitting requirements, and mandating that renovations are upgraded to current building codes.

### BENCHMARKING AND DISCLOSURE MANDATES

Benchmarking and disclosure mandates require the measurement and reporting of building energy use to the city on an annual basis. This information, if enabled by disclosure provisions in the policy, is then made available to the public at either the aggregate-city or building-specific level, with many cities also requiring disclosure of performance upon building sale or lease. Further, individual buildings are benchmarked against others in the same category and size, providing building owners with an indication of the energy performance level being achieved by similar buildings. To date, 15 U.S. cities and one county[6] have some form of mandatory benchmarking and/or disclosure requirement of commercial buildings.

Benchmarking and disclosure mandates do not directly result in emissions reductions as they are informational tools without requirements to act on the information. However, the policies resolve a critical information gap that is needed to underpin action within the sector. The collection and analysis of detailed data can help cities identify hotspot areas to target their efforts, help building owners understand their building's energy use as a first step to induce individual action,[7] and provide valuable information to potential buyers and lessees. The analysis of data reported in 2015 for Chicago's reporting buildings suggests the large opportunity available for improving energy efficiency, identifying the potential for savings of 13 to 24 percent if the energy use intensity of all buildings was brought up to median and above-average levels for each respective building category.[8] As such, U.S. cities are viewing benchmarking and energy disclosure measures as a no regrets action and sound first step towards further measures to address building emissions, such as minimum performance standards.[9]

#### *Benchmarking in Chicago*

The City of Chicago enacted the *Building Energy Use and Benchmarking Ordinance* in 2013 as part of its strategy to improve the energy performance of the city's building stock. The ordinance requires affected buildings to: (1) track monthly whole-building energy use, (2) report this use to the city annually, and (3) verify the accuracy of the reported data every three years. The ordinance also authorizes the city to share building-specific data on energy use with the public.

All commercial, institutional, and multifamily properties 50,000 square feet or greater are covered by the ordinance. Compliance was phased-in over three years from 2014–2016 by building size and type. By the third reporting period of 2016, all commercial, institutional, and residential buildings greater than 50,000 square feet were required to comply with the ordinance. Once the phase-in period is completed and all affected buildings are covered, it will result in less than 1 percent of Chicago's buildings being

benchmarked. However, these buildings account for approximately 20 percent of total energy used by buildings in the city.[10]

## RETRO-COMMISSIONING POLICIES

Several cities are establishing requirements for commercial buildings to identify and implement low- to zero-cost improvements in the form of retro-commissioning policies. Retro-commissioning is a two-part process that involves a comprehensive audit of the building's equipment and systems to identify opportunities for improved performance, and implementation of low- to zero- cost operational and maintenance improvements.[11] Retro-commissioning typically resolves energy performance problems that occur during the design and construction of a building and those that develop throughout a building's life. The process is distinct from preventative maintenance or tune-ups of individual building systems, which address issues on a component-by-component basis. In contrast, retro-commissioning considers the operation of the entire building system and focuses on both how *and* why equipment is operating.[12] Steps taken during the implementation phase might include optimizing chillers and boilers, adjusting heating, ventilation, and air-conditioning (HVAC) control settings, recalibrating building sensors, and fixing broken parts. It is estimated that fewer than 5 percent of existing buildings (of all types) in the United States have been retro-commissioned, suggesting that there is significant opportunity to apply this action to commercial buildings to achieve emissions reductions.[13]

The energy performance improvements achieved through the retro-commissioning process are highly building dependent, influenced by building age, location, activity, contained systems and equipment, and operational capacity. The largest meta-analysis of U.S. retro-commissioning projects, incorporating 332 projects in 561 existing buildings across 21 states, determined an average annual energy savings of 16 percent, with lower and upper bounds of 9 percent and 31 percent respectively.[14] Given the breadth of building type, size, age, and location covered by this meta-analysis, it offers the best macro-level indication of the potential energy savings from retro-commissioning currently available.

To date, there has been limited adoption of retro-commissioning requirements by U.S. cities, resulting in few examples of policy implementation and management. Atlanta's Commercial Energy Efficiency Ordinance contains provisions for buildings to undertake retro-commissioning processes, however these provisions are currently optional.[15] Similarly, San Francisco encourages but does not require commercial buildings to undertake retro-commissioning as an alternative compliance pathway with its benchmarking and auditing ordinance.[16] New York City goes a step further in requiring building owners to confirm that specified retro-commissioning items have been completed before filing an energy efficiency report with the city, which is required every 10 years.[17] Seattle is currently implementing a retro-commissioning policy for buildings, having passed the requirement in early 2016.

### *Retro-Commissioning in Seattle*

The City of Seattle enacted legislation in March 2016 that enables the city to begin working toward its goal of reducing emissions from the building sector's largest and least efficient commercial and multi-family buildings.[18] The Buildings Tune-Up Ordinance requires periodic retro-commissioning of non-residential buildings, and is expected to deliver a 5 percent reduction in citywide commercial energy consumption. Analysis is currently underway to determine more robust estimates of anticipated energy and emissions savings.[19]

The ordinance requires building owners to conduct a tune-up of building systems once every five years and to submit a report to the city of the findings, outcomes, and actions taken based on the tune-up.[20] This requirement is placed on all non-residential buildings larger than 50,000 square feet, with exemptions for buildings that have achieved high ENERGY STAR scores, a green building certification, or that have conducted retro-commissioning processes in the immediate past. The requirements are being phased-in by building size; those buildings 200,000 square feet or greater are required to comply from 2018 onward, with the final phase-in for buildings of 50,000–70,000 square feet occurring in 2021.

The Office of Sustainability & Environment is developing a rule that will define the substantive details of the tune-up requirement, including the definition of low-cost adjustments and repairs.[21]

## RETROFITTING REQUIREMENTS

Cities seeking to ensure significant energy-saving actions

in the commercial sector can consider adopting a retrofit requirement. Retrofitting has the potential to deliver greater improvements in building energy performance, incorporating the activities of retro-commissioning and then extending beyond these tune-up activities to include changes to the energy systems infrastructure of buildings. Retrofit approaches are commonly distinguished by the magnitude of savings sought. Buildings can undergo either standard or deep retrofits, although no consensus exists on what specifically defines a retrofit project as one or the other.[22] Standard retrofits are typically conceived as incremental, system-by-system improvements, where upgrades to infrastructure such as lighting and HVAC systems are made in a piecemeal fashion. In contrast, deep retrofits adopt a holistic consideration of the building, undertaking a whole-building analysis and examining the interactions of all systems to seek energy savings upwards of 50 percent.[23] In either case, retrofits, as distinct from retro-commissioning, involve changes to physical building infrastructure and thus require financial resources to deliver the identified energy savings.

As with retro-commissioning, the energy performance improvements achieved through retrofitting are highly building specific, and depend on whether standard or deep retrofit activities are pursued. A study of buildings that have undergone deep retrofits in the Northwest region of the United States, considered to be leading nationally in such activities, identified energy savings ranging from 38–79 percent, with average savings of 51 percent.[24] Another study of deep retrofits to existing buildings in the United States identified 49 projects, with energy savings over the baseline ranging from 27–83 percent.[25] As an alternative to assessing the energy savings delivered by actual retrofit activities, simulations by the U.S. Department of Energy and detailed in its *Advanced Energy Retrofit Guides*[26] indicate improvements in energy performance arising from retrofits to different building types in different geographic regions. As an example, a simulated standard retrofit for the same office building in five different climatic zones delivers estimated energy savings of 33–43 percent while a deep retrofit delivers savings of 45–53 percent.[27]

### *Building Retrofitting in New York City*

As part of New York City's target to achieve an 80 percent reduction in emissions below 2005 levels by 2050, and acknowledging that 75 percent of emissions in the city arise from buildings, the mayor released a plan in 2014 detailing how energy efficiency in buildings throughout the city will contribute to the target. Lighting is identified as a target area, with Local Law 88: Lighting Upgrades and Sub-metering establishing a mandatory retrofit requirement for buildings. The current law requires buildings greater than 50,000 square feet to install or modify lighting systems to current Energy Code standards in common areas and non-residential tenant spaces greater than 10,000 square feet in area. The law also requires those non-residential tenant spaces to be equipped with a sub-meter and that the energy consumption is disclosed to the tenant. There are plans to expand the reach to all buildings greater than 25,000 square feet.[28] Expanding this mandatory requirement affects more than 5,000 buildings and is expected to reduce annual emissions by approximately 60,000 metric tons of carbon dioxide equivalent ($MtCO_2e$), and save $35 million annually due to reduced energy costs.[29]

More generally, the strategic plan seeks to promote deep retrofit projects in public buildings, acknowledging that this type of retrofit will be necessary for the building stock to make a meaningful contribution to overall emissions reductions.[30] The deep-retrofit strategy provides a guiding vision for the city's building sector, and with no mandatory policy mechanism, it serves primarily as a model for the private sector. However, the city has established a Retrofit Accelerator, which provides direct assistance to building owners to identify efficiency opportunities, and supports them through the projects as they realize these opportunities.[31]

## BUILDING UPGRADES TO CODE

Building codes are an important policy lever that cities can use to ensure that new buildings minimize their emissions by specifying minimum levels of energy efficiency that new construction must meet. Building codes also provide a mechanism through which energy savings can be achieved in existing buildings, by specifying that upgrades trigger the requirement for the building to be brought up to the latest code. Such mechanisms can be triggered at different upgrade thresholds (e.g., if more than 50 percent of floor space is being renovated), and require different levels of achievement with respect to code compliance. The application of building codes in this manner seeks to bring the energy performance of older buildings more in line with newer buildings, which have likely been constructed under higher efficiency standards.

The U.S. Department of Energy, through the Building Energy Codes Program, provides assessments of the energy performance improvements offered by adopting the latest versions of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and International Energy Conservation Code (IECC) standards. These assessments are informed by energy use simulations using representative buildings that vary by type and geographic location, with the building systems specifications (for systems such as lighting and HVAC) altered to align with the code changes.[32] Table 1 details the energy performance improvements estimated between successive revisions of both the ASHRAE Standard 90.1 and the IECC, highlighting the potential for substantial reductions in energy use from bringing older buildings up to current standards. However, these improvements represent modeled conditions where all changes necessary to bring a building up to code are implemented; real-world energy performance improvements will vary.

### *Upgrading Buildings to Code in Washington, D.C.*

The Green Building Act in Washington, D.C., provides an example of how current building laws can be applied to existing buildings. The law specifies that any substantial improvement to a privately owned, non-residential property triggers the requirement that the property be designed and constructed to meet or exceed the U.S. Green Buildings Council's Leadership in Energy and Environmental Design (LEED) standard applicable for the building type, with these LEED standards subject to change to reflect current practices. A substantial improvement is defined as any repair, alteration, or addition of a building/structure where the cost equals or exceeds 50 percent of the market value of the building/structure prior to the improvements.[33] As such, improvements of reasonable magnitude trigger this requirement to bring the property up to the latest LEED standard applicable to the building type.

## TABLE 1: Energy Savings from Upgrading Buildings to Code

| ASHRAE | |
|---|---|
| **VERSION CHANGE** | **ENERGY SAVINGS VERSUS PREVIOUS VERSION** |
| 1975 to 1980 | 0% |
| 1980 to 1989 | 14% |
| 1989 to 1999 | 4.5% |
| 1999 to 2004 | 12.3% |
| 2004 to 2007 | 4.5% |
| 2007 to 2010 | 18.5% |
| 2010 to 2013 | 7.6% |

| IECC | |
|---|---|
| **VERSION CHANGE** | **ENERGY SAVINGS VERSUS PREVIOUS VERSION** |
| 2006 to 2009 | 7.7% |
| 2009 to 2012 | 9.7% |
| 2012 to 2015 | 11.1% |

Upgrading buildings to meet a newer version of code than the one under which it was constructed can result in energy savings, as updated versions of the building codes specify more stringent minimum performance standards.

*Source: For Ashrae, see: Halverson, M. et al., ANSI/ASHRAE/IES Standard 90.1-2013 Determination of Energy Savings: Qualitative Analysis, No. PNNL-23481 (Richland, WA: Pacific Northwest National Laboratory (PNNL), 2014), http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23481.pdf, and Livingston, O., D. Elliot, P. Cole, and R. Bartlett, Building Energy Codes Program: National Benefits Assessment, 1992-2040, No. PNNL-22610 (Richland, WA: Pacific Northwest National Laboratory (PNNL), 2013), https://www.energycodes.gov/sites/default/files/documents/BenefitsReport_Final_March20142.pdf. For IECC, see: Zhang, J. et al., Energy and Energy Cost Savings Analysis of the IECC for Commercial Buildings, No. PNNL-22760 (Richland, WA:, Pacific Northwest National Laboratory (PNNL), 2013), http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22760.pdf.*

## CITIES AS A KEY PLAYER IN A COLLABORATIVE EFFORT

While a number of cities across the United States are beginning to address the energy use of existing commercial buildings through the policies discussed here, such action is not yet pervasive. Moreover, the limits to local government authority and resources mean that cities alone cannot transform the sector. Indeed, a report by the C40 Climate Leadership Group determined that more than 75 percent of all climate challenges faced by cities cannot be managed unilaterally by cities, and instead should be the combined responsibility of government, business, and civil society.[34] To achieve the transformation necessary, collaborations need to be scaled up and replicated.

From a governing perspective, efficient collaboration across different levels of government—federal, state, and municipal—requires recognition that each provides unique strengths as governing bodies, as outlined in Table 2. While cities will continue to be primary architects and leaders of certain policies, they can also be the critical implementers or strategic partners of policies designed at higher levels of government. For instance, states are required through the Clean Power Plan to meaningfully reduce emissions from the power sector. Properly designed, state implementation plans for the Clean Power Plan could incentivize utilities and commercial building operators to improve the performance of the building stock. City governments could be valuable allies in creating a supportive policy environment. For example, states may establish energy efficiency grant or credit programs or pass legislation that allows commercial property assessed clean energy (PACE) loans, and city governments can engage local project developers to facilitate greater adoption of those state policies and grant opportunities.

Similarly, as more businesses publicly commit to pursue climate-sensitive operations, they are placing new pressure on utilities and commercial building operators to improve the performance of the building stock. This increasing alignment of city and private sector goals presents new opportunities for coordination. While cities have always been uniquely positioned to work closely with the private sector entities in their jurisdictions, this relationship becomes particularly important as the focus turns to existing commercial buildings. Private sector stakeholders manage a large portion of the activities where emission reduction opportunities exist, and they

### TABLE 2: Collaborating Across Different Levels of Government

| CITY INVOLVEMENT IN CLIMATE POLICY IS APPROPRIATE WHEN SUCCESS DEPENDS ON: | STATE/FEDERAL INVOLVEMENT IN CLIMATE POLICY IS APPROPRIATE WHEN SUCCESS DEPENDS ON: |
|---|---|
| • Existing local government capacities | • Achieving economies of scale |
| • Access to local data and information | • Minimizing transaction costs |
| • Mobilization of local resources | • Economy-wide market transformations |
| • Tailoring responses to local circumstances | • Coordination across multiple jurisdictions |
| • Engagement with local stakeholders | • Avoiding in-country leakage of emissions |
| • Adaptability to changing local conditions | • Avoiding free-riding or "race to the bottom" behavior among subnational jurisdictions |
| • Integration with other local policy objectives | |
| • Targeted mitigation measures with low leakage risks | |

Efficiently collaborating across different levels of government on climate policy requires recognition that each have relative strengths as governing bodies, and these strengths should be considered when determining relevant roles in policy design and implementation (Table reproduced from Broekhoff, Ericsson, & Tempest, 2015).

*Source: Broekhoff, Derik, Peter Erickson, and Carrie M. Lee, What cities do best: Piecing together an efficient global climate governance (Stockholm: Stockholm Environment Institute, 2015), http://ledsgp.org/wp-content/uploads/2015/12/SEI-WP-2015-15-Cities-vertical-climate-governance.pdf.*

will provide the technologies, business models, behavior changes, and ultimately the emissions reductions that cities will need to deliver on their commitments.[35] Taking a more collaborative and integrated approach can lead to policies that are technically, politically, and financially actionable. For example, the business community—including utilities—can provide valuable input to local governments about how to craft new energy and building policies (such as those described in this brief) that will support the development of financial and technical innovations and allow for wide-scale adoption by the community. In turn, the private sector can align its activities to complement the new policy direction.

Such collaborations between government, business, and civil society are already underway. The United States Department of Energy's Better Buildings Challenge brings together building owners, financial institutions, utilities, and solutions providers to create implementation models that can be shared with the marketplace. Many cities participate in the challenge, which aims to improve the energy efficiency of buildings, including commercial properties, by 20 percent or more over 10 years.[36] Chicago is one such city, committing more than 24 million square feet of building space, both city and privately owned, to the challenge.[37]

Other collaborative efforts are emerging. The Pacific Coast Collaborative recently announced a new accord to support efforts to create a vertically complementary policy environment.[38] And the newly formed Global Covenant of Mayors for Climate and Energy has announced its plans to engage financial institutions to provide the city-to-city network with guidance around accelerating investments in urban infrastructure.[39]

Most recently, the Alliance for a Sustainable Future was established by the Center for Climate and Energy Solutions and the U.S. Conference of Mayors. The alliance will create a framework for U.S. mayors and business leaders to cooperatively develop concrete approaches to reduce carbon emissions and speed deployment of new technology. By building crucial links between cities and companies, the alliance aims to spur innovative partnerships and increase participation in national and state climate efforts, such as the U.S. Environmental Protection Agency's Clean Power Plan.[40] Coordination on the Clean Power Plan could be particularly beneficial as it will eventually lead to a cleaner energy mix that will help cities achieve their climate goals.

As leaders around the world work to reduce emissions and mitigate climate change, they are increasingly confronted with the impacts of energy-intensive existing buildings. While technical solutions and opportunities for efficiency investments abound, the path to transform the sector is still developing. The collaborations and policies such as those described here can offer practical strategies to public and private sector leaders in the pursuit of a high-performing, low-carbon building stock.

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