POLICIES FOR BETTER BUILDINGS

COST-EFFECTIVE WAYS CITIES CAN CUT CARBON, SLASH COSTS, AND CREATE JOBS

INSIGHT BRIEF

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HIGHLIGHTS

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- Cities are setting goals on a pathway to zero or near-zero carbon, but they must address their biggest source of carbon emissions—existing buildings—using thoughtful policies to swiftly and cost-effectively deploy energy efficiency and distributed renewable energy systems.
- Packaging multiple policy elements together can unlock substantial carbon emissions reductions while driving job creation, increasing tax revenue, and developing new markets for renewable energy and energy efficiency.
- Understanding baseline energy consumption and evaluating policies using a citywide model are critical to understanding the efficacy and potential impact of a policy targeting existing buildings.
- Rocky Mountain Institute's work with a tier 1 city led to a cost-optimized point-of-sale policy that can yield over $4 billion in lifetime energy cost savings at full policy implementation and—in conjunction with existing policies—reduce CO_2e emissions in the buildings sector by 67 percent, in support of the City's 2050 goal to reduce greenhouse gas emissions by 80 percent.
- The actions outlined in this paper can enable cities to start driving carbon emissions reductions in their existing buildings.

INTRODUCTION

Cities consume over two-thirds of the world's energy and account for more than 70 percent of global CO_2 emissions, while occupying only 2 percent of its land area. Many cities are well aware of their substantial carbon footprints and have made commitments to emissions reductions and conducted emissions audits to target certain sectors. Overwhelmingly, cities have seen that the energy consumption of existing buildings accounts for the greatest source of carbon emissions—constituting 64 to 73 percent of citywide carbon emissions in the three most populous cities in the United States.[1] Most existing buildings are decades old, suffer from substantial deferred maintenance issues, and have significant potential for cost-effective energy retrofits.

It is clear that reducing energy use in existing buildings is critical to driving down citywide carbon emissions. Many cities have already implemented policies and programs that target energy reductions in existing buildings, and these cities are making real progress toward achieving their carbon goals. However, many of these policies address only technology-specific measures, as opposed to more holistic deep retrofit packages that bundle measures to enable greater energy savings and cost savings over time. A holistic approach to building and citywide energy reductions is necessary for cities to swiftly and cost-effectively reach their carbon reduction goals.

[1] https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/NYC_GHG_Inventory_2014.pdf;
http://plan.lamayor.org/wp-content/uploads/2017/03/the-plan.pdf;
https://www.cityofchicago.org/content/dam/city/progs/env/CCAP/Chicago_2010_Regional_GHG_Inventory.pdf.

For many cities, buildings are the largest source of carbon emissions. While cities across the world have established aggressive carbon reduction goals, with some having developed policies targeting the energy consumption of buildings, there is a significant gap between the energy use reductions seen to date and what is required to reach these goals. As building owners respond to prescriptive city policies and begin to exhaust savings from low-hanging opportunities in existing buildings, they struggle to identify and implement deep, holistic emissions reductions in those buildings cost-effectively. What is the best way to leverage carbon reduction goals to catalyze existing buildings to drive deep, citywide emissions reductions? What policies are both impactful and cost-effective? What first actions can cities take to drive deep emissions reductions in their existing buildings? How deep can you go until life-cycle economics say stop? And what impacts can policy packages have on emissions, the local economy, and renewable energy markets?

To cost-effectively support economic development, deep decarbonization policies for existing buildings require:

- A policy approach that is coordinated with key intervention points in the life cycle of a building
- An outcome-based and holistic energy (or emissions) reduction approach, rather than a prescriptive one
- A detailed assessment of policy enablers
- A cost-optimization analysis of the policy that acknowledges economic constraints

In this insight brief, we explore how to make built-environment city policy both more effective and more cost-effective. We include a case study that illustrates how a well-designed policy—in this case, a point-of-sale energy upgrade strategy—can unlock substantial emissions reductions in a tier 1 city while creating tens of thousands of new, sustained jobs; billions of dollars in additional tax revenues and energy cost savings; and a positive net present value for building owners. The work with the case study city was completed in partnership with Architecture 2030 and the Rockefeller Brothers Fund.

GETTING ON THE PATHWAY TO ZERO EMISSIONS

Many cities are well on their way to achieving carbon emissions goals, but many others need guidance to get started. Cities that are beginning the journey to zero carbon can take some immediate actions to prepare and introduce fast-acting policies before tackling the more holistic policies suggested later in this document.

First actions that cities can take include:

- Introduce benchmarking and disclosure ordinances to identify baseline energy consumption, carbon emissions, and physical characteristics of the building stock. The US Department of Energy's website provides tools and actions that cities can take to establish a successful building energy benchmarking and disclosure ordinance.
- Engage with utilities, the real estate market, and other key parties to encourage their political support and incorporate ideas that could support the development and implementation of such policies.
- Provide financing mechanisms like property assessed clean energy (PACE) to provide building owners access to capital for energy upgrade projects.

- Lead by example by setting net-zero energy goals for the city's building portfolio.
- Update codes for new buildings to phase in requirements to achieve net-zero energy (or be net-zero energy ready).

These recommendations and more are included in Rocky Mountain Institute's (RMI) *The Carbon-Free City Handbook*. The handbook features first actions that city sustainability staff can take immediately to begin reducing carbon, and includes links to example policies and other resources. The full handbook and an interactive set of resources are available at rmi.org/carbonfreecities.

DESIGNING HOLISTIC BUILDING POLICIES TO DRIVE DEEPER SAVINGS

First actions and quick wins are important for generating momentum toward reducing a city's carbon emissions, but cities would struggle to meet aggressive goals like 80 percent carbon reduction or carbon neutrality without more holistic solutions. Somewhat surprisingly, more aggressive long-term approaches—if done in the right way—can be more cost-effective than fast-acting policies. Policies for the built environment that are both impactful and cost-effective often have several characteristics in common:

- A policy approach that is rooted in the life cycle of buildings and takes advantage of key triggers
- An outcome-based, holistic approach, rather than a prescriptive one
- A detailed assessment of policy enablers
- Cost optimization of the policy based on constraints

Bold and thoughtful policies can drive substantial emissions reductions in existing buildings while respecting the market forces at work in a given city. Effective policies have the following outcomes, all of which are beneficial for a city:

- Drive deep carbon emissions reductions by looking at building energy consumption holistically
- Respect the market forces at play, which include minimizing disruption to the local real estate, construction, and finance communities
- Maintain cost-effectiveness for building owners and tenants
- Enable alternative compliance pathways to provide building owners flexibility when they make energy upgrades (e.g., aligning energy upgrades with major building investments such as planned renovations or refinancing). Alternative compliance can include allowing the temporary purchase of off-site green power, the purchase and sale of building efficiency credits, or another structure that provides flexibility.
- Add value to the local economy

In this paper, we lay out a framework for developing a successful energy upgrade policy, and document lessons learned from developing a point-of-sale policy for a tier 1 city. This policy approach can dramatically accelerate code compliance within a city, is rooted in an appropriate trigger for each building, follows an outcome-based approach (code compliance), and can be designed for each city to support market viability with a rigorous and objective approach.

Well-designed policy can unlock substantial carbon emissions reductions while supporting job creation, increasing tax revenues, and developing new renewable energy and energy efficiency markets. By developing holistic policy approaches, cities can take significant steps toward achieving their carbon emissions reduction goals.

A FRAMEWORK FOR DRIVING POLICY SUCCESS

1. IDENTIFY TRIGGERS

Triggers are events that prompt energy upgrades and that align with key market intervention points, such as point-of-sale or point-of-lease negotiations. Triggers are critical because aligning market events and building-life-cycle events can make projects more cost-effective, ease implementation, and provide a logical point in the building's life cycle for a policy to come into effect. Alignment with construction-related projects, including required life-safety upgrades, reduces the incremental costs of an energy upgrade project (compared with the cost of a stand-alone energy project). Additionally, alignment with major events that require financing (e.g., point of sale or point of refinancing) can make capital available for energy efficiency measures at a lower cost than for a stand-alone energy project. A list of key energy upgrade triggers for the built environment is explored in Exhibit 1.

Exhibit 1: Example Policies Corresponding to Key Intervention Points in Buildings

TRIGGER EVENT	DEVELOPMENT APPROACH
Point of Sale	Building buyer (or seller) performs a holistic building energy upgrade at the time of building purchase and ownership transfer.
Point of Lease	Landlord performs a holistic building energy upgrade in the tenant space at the time of tenant lease turnover.
Building Refinancing	Building owner performs holistic building energy upgrade at the time of refinancing.
Permit Issuance/Major Renovation	Building owner performs a holistic building energy upgrade with issuance of construction permit.
End of Major Equipment Lifetime	Building owner performs a holistic building energy upgrade when replacing major pieces of equipment, such as HVAC or envelope.
Life-Safety Improvement Required	Building owner performs a holistic building energy upgrade when major life-safety upgrades must occur (e.g., earthquake preparedness, fire, or other safety upgrades). Conversely, building efficiency projects and all major renovations could also trigger the implementation of life-safety upgrades.

2. APPROACH INTERVENTIONS HOLISTICALLY

The core "event" that is prompted by the trigger can be most broadly defined as an energy upgrade requirement. An energy upgrade requirement could include a progressive energy code for existing buildings that becomes more stringent over time, or a percent decrease in energy use from the previous year's utility billing data.

At its core, this requirement would either elicit a building energy retrofit project or a temporary procurement of green energy until a building owner can perform a more cost-effective retrofit. It is important that this requirement point toward a more holistic solution and reward projects that address energy reductions across multiple building systems. A successful policy ties multiple policy elements together to drive substantial emissions reductions.

3. RECOGNIZE AND RESPOND TO ENABLING FACTORS

In addition to understanding the anatomy of a successful policy package, policy designers should understand the key factors that could enable or prevent success for the policy being considered. It is helpful to segment the existing building market to understand pain points within the market and the building types that would be simplest or most cost-effective to retrofit. Key enabling factors that can be integrated into policy creation for a given city could include:

- Cost of utilities—A high cost of electricity or natural gas enhances the cost savings that results from energy upgrades.
- Greenhouse gas (GHG) reduction targets—A pre-established GHG reduction target encourages political and public support of proposed policies.
- Building stock age—An older building stock has a greater opportunity to reduce energy consumption because energy upgrades are often easier to identify, and upgrades are more cost-effective when combined with planned improvements to deteriorating equipment and building infrastructure. However, deteriorating conditions may require that older buildings make capital-intensive structural or life-safety improvements before any energy upgrades can occur.
- Local construction costs—In cities with low construction labor costs, implementation costs for energy upgrades are lower, making deeper energy retrofit projects more cost-effective.
- Renewable energy potential—Low-density cities with good access to renewable energy resources (e.g., high solar insolation) and an existing renewable energy market have a greater likelihood of benefiting more substantially from renewable energy.
- Incentives—Greater access to incentives, either from the utility or the state/city government, eases the up-front cost burden for building owners and could increase public support for these policies.
- Enabling policies—Cities with active and successful energy efficiency and renewable energy programs are likely to succeed by building on these programs and existing policy efforts. Further, cities with existing benchmarking and disclosure ordinances are well positioned to analyze and propose policy packages.
- Enabling financing mechanisms—Financing mechanisms such as property assessed clean energy or on-bill financing can enable building owners to invest in efficiency with little impact on or even a benefit to annual cash flow. Programs through utilities, green banks, and other entities can similarly reduce up-front costs.

4. APPLY ITERATIVE AND RIGOROUS COST OPTIMIZATION

An iterative evaluation process that includes financial analysis is critical when analyzing a policy package. Although a policy's effectiveness is partially measured by emissions reduction outcomes, a policy can only be effective if it's politically viable, adopted, and accepted by the market. This requires evidence of affordability and market stability.

It is important to understand how a policy could affect job growth and tax revenues, and the scale of any financing or incentive programs that would be necessary to support the policy.

It is important to set boundary conditions for the analysis by considering the sensitive variables that could affect policy outcomes, the requirements of the local real estate market, and the effects that this analysis could have on other key stakeholders within the city.

Critical Element: Financial Analysis

Financial analysis should not be overlooked when analyzing a policy package. Although a policy's effectiveness is partially measured by emissions reduction outcomes, a policy can only be effective if it's politically viable, adopted, and accepted by the market. Each of these stage gates requires evidence of affordability and market stability, and would benefit from a demonstration of job growth and other citywide economic benefits. An effective policy is driven in symphony with market forces and does not test political will.

Exhibit 2: Iterative Process to Evaluate Policy Packages

CASE STUDY: A COST-EFFECTIVE POINT-OF-SALE CODE COMPLIANCE POLICY FOR A TIER 1 CITY

In 2017, RMI worked with a tier 1 city (referred to as the "City") to assess the potential GHG and market impacts of a point-of-sale energy upgrade requirement. RMI's partners included city government and other NGOs. The City's goal was to reduce greenhouse gas emissions citywide by 80 percent by the year 2050, and it already had an extensive set of data from benchmarking and disclosure ordinances.

IDENTIFYING THE TRIGGER

The partners wanted to focus on a point-of-sale energy upgrade requirement because of the high number of real estate transactions in the City. The policy would require building buyers or sellers to perform energy efficiency upgrades when a building changes ownership, and would include a set of energy reduction requirements that become increasingly stringent over several decades.

APPROACHING INTERVENTIONS HOLISTICALLY WHILE ACCOUNTING FOR ENABLING FACTORS

RMI designed a suite of options for the point-of-sale requirement that could be easily adjusted in the model by the policymakers. These options, which we recognized as key and sensitive variables directly impacting the policy's GHG emissions reduction potential and market impact, included the following:

- **Code stringency:** RMI and its partners designed a code with increasing energy use reduction stringency requirements based on energy use intensity (EUI), a whole-building energy performance metric that measures energy consumption per square foot per year. This metric avoids prescriptive measures and allows building owners flexibility in how they improve building energy usage.
  - **RMI recommendation:** Achieve a 60 percent EUI reduction from a citywide average EUI by building typology at full stringency, starting from an initial 10 percent reduction requirement.
- **Implementation phasing by building size:** RMI provided different timelines for different building sizes to allow small building owners more time to prepare for the requirement as appropriate, and to provide more time for the construction market to adapt. With this approach, large commercial buildings would be the first to meet the requirement, and single-family homes would be the last.
  - **RMI recommendation:** Immediate implementation for buildings larger than 50,000 square feet; three-year delay for buildings between 25,000 and 50,000 square feet; six-year delay for buildings smaller than 25,000 square feet, including single-family homes.
- **Code cycle:** Expanding or contracting the code cycle (the time between energy code revisions) results in varying degrees of GHG emissions reductions.
  - **RMI recommendation:** Three-year code cycle.
- **Grace period:** The grace period (the time until an upgraded building needs to be upgraded again) allows a building that is transacted frequently to avoid constant energy upgrade requirements, which would ultimately be uneconomical.
  - **RMI recommendation:** Five-year grace period.

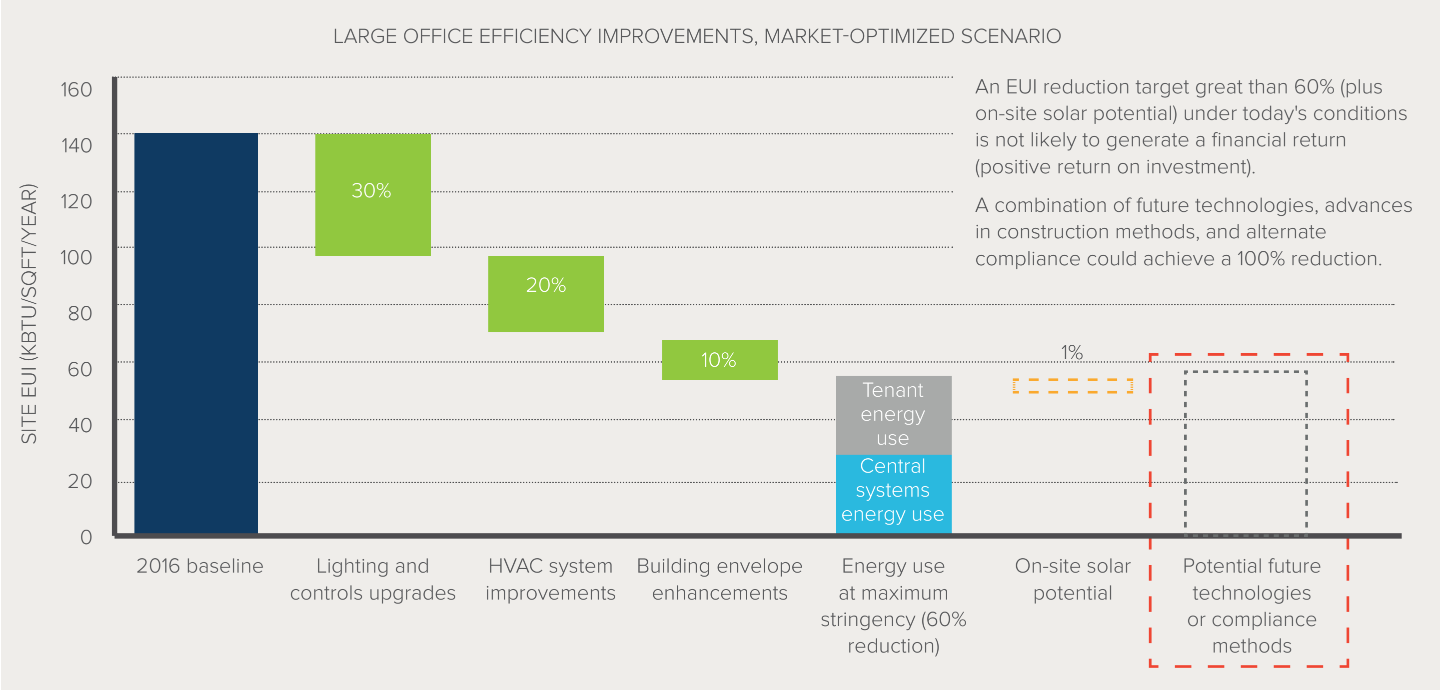
- **Alternative compliance:** RMI incorporated alternative compliance pathways to enable flexibility and alignment with building renovation cycles, which drives more cost-effective retrofits as code stringency increases over time. Alternative compliance may also allow building owners to defer projects if they hold the property for only a short time.
    - **RMI recommendation:** Allow short-term green energy procurement so that buildings can align energy upgrade projects with the building's planned renovation cycle. Without alternative compliance, buildings could typically achieve only a 30 to 50 percent EUI reduction, depending on typology, while maintaining a positive net present value for the energy efficiency measures. Alternative compliance allows these buildings to achieve up to a 60 percent EUI reduction while also allowing the planned renovations to take place cost-effectively over time.

APPLYING ITERATIVE AND RIGOROUS COST OPTIMIZATION

The team solicited the input of a construction company and cost estimator familiar with performing retrofits in the City to produce cost estimates for deep energy retrofits for several prototypical buildings that represent the City's building stock. The cost estimates and energy conservation measures identified for each building type led to a greater understanding of building-level economics. After conducting several iterations on cost analyses and incorporating them into the model, the team uncovered several key takeaways:

- Buildings could realistically achieve up to ~60 percent energy savings on average through deep energy retrofits.
- Energy efficiency upgrades are cost-effective as stand-alone projects until energy savings reach 30 to 50 percent (this range varies by building typology), according to an assessment of return on investment and net present value. The team decided to limit energy upgrades to net-present-value-positive bundles of energy conservation measures, which limits energy savings but maintains real estate market fundamentals.
- Due to the City's density, rooftop solar photovoltaics can only supply 5–15 percent of the total building load for most small commercial and multifamily buildings, and about 1 percent for large commercial and multifamily buildings (on average). This increases the need for off-site renewable energy or procured energy efficiency credits.
- Alternative compliance is a critical part of the recommendation for this city, as building efficiency upgrades and on-site renewable energy are limited by space and financial constraints. The team recommended using local renewable energy offsets as a viable form of alternative compliance for periods between capital improvement cycles, because deeper energy retrofits become more financially viable when aligned with capital improvement cycles.
- The City could achieve emissions reductions in the buildings sector of 67 percent (including existing policies, grid emissions reductions, reductions from solar goals, and fuel mix changes), in support of its 80 percent overall emissions-reduction goal by 2050. This level of penetration was possible only because energy upgrades for buildings were tied to the point of sale in a very active real estate market.
- A significant portion of building energy consumption after a 60 percent EUI reduction is attributed to plug loads (i.e., appliances), which are typically controlled by tenants rather than building owners or property managers in leased buildings.
- The policy was updated to reflect these conclusions, including a limit of 60 percent energy reduction from baseline. These findings are summarized in Exhibit 3.

Exhibit 3: Feasible Reductions in Energy Use Intensity Based on Cost Estimates and Technical Potential



KEY CONSIDERATIONS FOR THE CITY

RMI's discussions with city officials and key market representatives uncovered five key considerations that would define a successful policy for the City:

1. The policy maximizes GHG emissions reductions.
2. Individual project economics are sufficiently affordable for homeowners and building owners to support the policy. Building owners would need to see a positive net present value of investments over the life of the building upgrades.
3. The policy outlines a clear path to implementation that eases burdens on homeowners and owners of small buildings where possible.
4. The policy provides significant job creation and tax revenues to help gather support from the construction industry, city officials, and others.
5. The policy is tailored to the City's needs to ensure minimal or no market disruption. Financing mechanisms (e.g., PACE) could be enabled within the city to reduce financial disruption to building owners.

RECOMMENDED POLICY AND KEY FINDINGS

The team revised its technical and economic calculations several times based on feedback from city officials and core market stakeholders, and on the cost estimates developed to represent the City's building stock. After several rounds of stakeholder feedback and a comprehensive review of the model, the team concluded that a cost-optimized point-of-sale policy that aligns with the economic fundamentals of the real estate market can yield:

- 67 percent GHG emissions reductions in the City's buildings sector in support of its 80 percent overall emissions-reduction goal by 2050[2]

[2] By 2050, measured from a 2005 baseline. Includes existing policies, changes in grid emissions, and other expected variations. Range of savings depends on scenarios modeled.

- $103 million in net tax revenue in the year 2021, and a cumulative ~$3 billion in net tax revenue by 2038 (net of proposed incentives paid by the City)
- Approximately 10,000 new sustained jobs in 2021, increasing to 73,000 in 2038 (the year of full policy implementation)[3]
- $1 billion in lifetime energy cost savings generated by projects deployed in 2021, increasing to ~$4 billion in lifetime energy cost savings from projects deployed in 2038 (the year of full policy implementation)

OUR LAST THOUGHTS ARE YOUR FIRST ACTIONS

Cities—and states—are taking center stage in the effort against climate change, and they need bold policies to reduce emissions from existing buildings to drive carbon reduction levels at the city scale. In order to maximize carbon reductions in existing buildings, cities must tailor energy reduction policies to the unique characteristics and market forces at play in their own cities. A robust, citywide impact model is necessary to characterize the full impact of a particular policy, understand feasibility and market dynamics, and uncover potential roadblocks.

RMI hopes that the approach to developing a holistic citywide policy for decarbonizing buildings outlined in this document will help a number of cities take the first steps toward achieving and exceeding their GHG emissions reduction goals. We would like to collaborate with cities pursuing such a policy. The first step has already been taken in committing to emissions reductions; now it is time for cities to take action by implementing such a policy.

FURTHER READING

- Rocky Mountain Institute, *The Carbon-Free Cities Handbook*
- 2030 Districts Toolkits
- C40 Cities, *BE2020 Building Energy Data Manual*
- C40 Cities, How US Cities Will Get the Job Done
- US Council of Mayors: Mayors Leading the Way on Climate: How Cities Large and Small Are Taking Action
- US Council of Mayors: American Mayors and Businesses: Building Partnerships for a Low-Carbon Future
- Global Covenant of Mayors: Raising Global Climate Ambition Report
- America's Pledge

ABOUT ROCKY MOUNTAIN INSTITUTE

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

[3] Does not include jobs that could be absorbed by the existing labor market.