

# MANDATORY BUILDING PERFORMANCE STANDARDS: A KEY POLICY FOR ACHIEVING CLIMATE GOALS

Steven Nadel and  
Adam Hinge

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## About ACEEE

The American Council for an Energy-Efficient Economy (ACEEE), a nonprofit research organization, develops policies to reduce energy waste and combat climate change. Its independent analysis advances investments, programs, and behaviors that use energy more effectively and help build an equitable clean energy future.

## About the Authors

**Steven Nadel** has been ACEEE's executive director since 2001. He has worked in the energy efficiency field for more than 30 years and has over 200 publications. His current research interests include utility-sector energy efficiency programs and policies; state, federal, and local energy and climate change policy; and appliance and equipment efficiency standards. Steve earned a master of science in energy management from the New York Institute of Technology and a master of arts in environmental studies and a bachelor of arts in government from Wesleyan University.

**Adam Hinge** manages Sustainable Energy Partnerships, a small New York–based consultancy specializing in energy efficiency program and policy issues. He is involved with a variety of efforts working toward improving building energy performance around the United States and globally, including international efforts to share best practices globally on building energy efficiency policies and programs. Prior to founding Sustainable Energy Partnerships in 1995, Adam held management positions at Niagara Mohawk Power Corporation (now part of National Grid) and the New York State Energy Office.

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## Executive Summary

### KEY TAKEAWAYS

- To meet long-term climate goals, substantial energy savings and greenhouse gas emissions reductions must be obtained from existing buildings. In 2050, an estimated 62% of the building stock will be in buildings built prior to 2023. Although programs to encourage energy efficiency upgrades to existing buildings have operated for decades, at current rates, it will take over 300 years to complete whole-building retrofits on all residences (homes and apartments) and over 50 years to complete such retrofits on all commercial buildings. New and more-aggressive approaches are needed.
- Mandatory building performance standards (BPS) can play an important role in achieving these gains. In some ways, building energy performance standards can be thought of as the existing-building analog to building energy codes for new construction.
- BPS are now being successfully implemented in Boulder, Colorado; Tokyo; the United Kingdom; and the Netherlands.
- In the United States, BPS legislation has been enacted in three states (Colorado, Maryland, and Washington) and nine localities ranging in size from Reno, Nevada, to New York City. The number of jurisdictions adopting BPS in the United States has nearly doubled since 2020. In addition, there are BPS in Vancouver, British Columbia, and France. Several additional jurisdictions expect to adopt BPS in 2023.
- These jurisdictions are now developing regulations and working with building owners to prepare for when the mandatory standards take effect. Compliance dates of the U.S. standards range from 2024 to the early 2030s, varying by jurisdiction and building size (in many jurisdictions, standards initially apply to the larger commercial buildings, with smaller buildings applying later).
- To date, most standards cover commercial and multifamily residential buildings above a size threshold, which ranges from about 10,000 to 100,000 square feet (sq. ft.) of floor area, varying by jurisdiction.

- We find that many different approaches are being tested, in part because each jurisdiction is different. One of the key issues is whether to base standards on energy use or greenhouse gas emissions; we discuss pros and cons of each approach.
- Initial experience indicates that there are many important issues that must be addressed including building benchmarking, stakeholder engagement, adequate staffing, service provider capacity, and technical (and sometimes financial) assistance to building owners.
- Special attention must be paid to how performance standards apply in critical markets such as affordable housing.
- As these policies are implemented, jurisdictions must plan for adequate staffing for implementation, and evaluation will be important to improve them and inform future decisions on the best approaches.

To meet long-term climate goals, substantial energy savings and greenhouse gas emissions reductions must be obtained from existing buildings. At current rates, it will take over 50 years to undertake whole-building retrofits of all commercial buildings, and over 300 years for all residences (homes and apartments). New and more-aggressive approaches are needed, such as building performance standards (BPS).<sup>1</sup> BPS are now being successfully implemented in four jurisdictions. In the United States, BPS legislation has been enacted in three states and nine localities as well as for U.S. federal buildings. Several additional jurisdictions either have or expect to adopt BPS soon. Jurisdictions covered in this report are listed in table ES-1.

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<sup>1</sup> Depending on the jurisdiction, the names building performance standards (BPS), building energy performance standard (BEPS) and building emission performance standard (also BEPS) may be used.

**Table ES-1. Jurisdictions with BPS standards covered in this report**

Countries	States	Localities	
		Enacted	Expect enactment in 2023
France	Colorado	Boston, MA	Cambridge, MA
Netherlands	Maryland	Boulder, CO	Portland, OR
United Kingdom	Washington	Chula Vista, CA	Seattle, WA
U.S. federal buildings		Denver, CO	
(EU pending)		Montgomery County, MD	
		New York City	
		Reno, NV	
		St. Louis, MO	
		Tokyo	
		Vancouver, BC	
		Washington, DC	

In this report, for each of these jurisdictions we discuss how their BPS are constructed, implementation progress to date, programs that complement their BPS, and resources for more information. We also discuss a BPS for federal buildings in the United States and a pending European Union directive for member states to develop BPS.

Based on progress to date, we then address a series of topics on BPS policy and design decisions as follows:

- Developing BPS, including what input should be sought prior to adopting BPS
- BPS coverage, metrics, and targets
  - Is energy-use benchmarking a key foundation for performance standards?
  - Which building types and sizes should be covered?
  - What exemptions and accommodations should be considered?
  - Which metrics should be used for performance standards?
  - Should specific provisions be made for electrification?
  - How and when should the standards apply?
  - How stringent should the standards be? Should only initial standards be set, or should long-term standards be set with interim targets?
  - Should initial standards be set in the legislation or in subsequent regulations?

- Equity issues
  - What special provisions are needed for affordable housing?
- Implementation specifics
  - How much lead time should be provided?
  - What level of staffing and other support is needed for BPS implementation?
  - What marketing, educational, and technical assistance efforts should be undertaken?
  - How do we build capacity in the market?
  - What penalties should be set?
- Compliance options
  - What other compliance paths should be included?
  - Should trading be included?
  - Should renewable energy certificates (RECs) or offsets be incorporated?
- Financing required upgrades
  - Should jurisdictions allocate funding for building upgrades?
  - What role can, and should, utility incentives play?

Since implementation is just beginning, it is too early to draw many conclusions. However, we do find that stakeholder consultation is important both before standards are proposed and as implementation is proceeding. We find that building benchmarking is generally an important precursor for performance standards although a few jurisdictions have used detailed building modeling and other data in lieu of benchmarking data. Most standards to date apply to commercial and multifamily buildings above a size threshold (which varies between jurisdictions). Multiple approaches to performance standards are available, and each jurisdiction must pursue approaches that work for its communities. However, it takes time to build support and work out details. Experience to date also shows that for standards to be successful, attention must be paid to implementation, adequate staffing, and complementing standards with other policies and programs. Complementary activities can include easily accessible information for building owners on building performance and BPS requirements, education and technical assistance on ways to reach required performance levels, and financial incentives and financing to help cover costs to building owners. Special attention also must be paid to how performance standards apply in critical markets such as affordable housing. As these policies are implemented, evaluation will be important to improve them and inform future discussions on the best approaches.

In concert with complementary approaches, building performance standards can be an important contributor to efforts to meet energy and climate targets. We are entering an exciting period of experimentation that will likely teach us many lessons on how best to

structure and implement such policies to best create quality housing and workplaces while obtaining large energy savings and emissions reductions.

## Introduction

To meet long-term climate goals, substantial energy savings and greenhouse gas emissions reductions must be obtained from existing buildings. Programs to encourage energy efficiency whole-building retrofits to existing buildings have operated for decades, and even the best programs rarely result in the upgrade of more than 1–2% of eligible buildings annually (York et al., 2015). New and more-aggressive approaches are needed.

One such approach is mandatory building performance standards (BPS)—requiring existing buildings to meet some performance target (energy or carbon intensity, performance rating, and so on), with owners having multiple years to bring buildings into compliance. Such policies are in place for high-energy-use commercial and industrial buildings in Tokyo; rental buildings in Boulder, Colorado, and the United Kingdom; and offices in the Netherlands. Commercial and/or multifamily building policies have been adopted in 14 jurisdictions in the United States and Canada. France has a law for residential performance standards, with implementing details still being finalized. Similar policies are being considered in several other jurisdictions.

This paper reviews the rationale for mandatory building performance standards and summarizes work to date in the specified jurisdictions, including the key decisions they have made and results where available. We also briefly discuss emerging proposals. This paper updates a 2020 ACEEE paper by the same name, incorporating many developments and lessons learned over the past three years. Throughout the paper, we focus on whole-building performance standards. We do not focus on energy assessment/audit, retrocommissioning, or lighting upgrade requirements. Many jurisdictions have adopted these other requirements as a step beyond building benchmarking but short of whole-building energy performance standards. In some cases (e.g., New York City), jurisdictions with these other requirements have gone on to adopt whole-building standards. We also note that the line between whole-building performance standards and partial standards can be hazy at times. For example, Reno has a whole-building performance standard, but energy audits or limited upgrades are an alternative compliance path, allowing owners to avoid the whole-building performance targets. As long as a jurisdiction nominally requires whole-building performance, we include it in this paper.<sup>2</sup> The various standards differ in their stringency and impacts, as we discuss toward the end of this paper.

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<sup>2</sup> The Institute for Market Transformation does not include Reno as a BPS because of the easy alternative compliance path. Reno is discussed in more detail later in this report.

# The Case for Mandatory Building Performance Standards

## NEED FOR LARGE SAVINGS FROM EXISTING BUILDINGS

Buildings account for about 39% of U.S. energy use (EIA 2023) and 31% of U.S. greenhouse gas (GHG) emissions (the GHG proportion is lower because nonenergy GHG emissions come disproportionately from other sectors, including agriculture, industry, and transportation) (EPA 2019). To reach long-term goals to slow climate change, we will need large reductions in residential and commercial building energy use. Some of these reductions can come from building more efficient new homes and buildings, actions that are encouraged by advanced building energy codes that have or are being adopted in many states.

However, since about 66% of the commercial building stock and 60% of the housing inventory in 2050 will be in buildings that were built prior to 2023 (ACEEE analysis using data in EIA 2023), retrofitting the majority of existing buildings must be a key strategy (figure 1). In ACEEE's 2019 report on how energy efficiency can cut U.S. energy use and GHG emissions in half, improvements to existing homes and buildings accounted for about 23% of the energy savings and 18% of the energy-related GHG emissions reductions (Nadel and Ungar 2019).<sup>3</sup>

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<sup>3</sup> These numbers include savings from building retrofits, smart building controls, and half of the savings estimated in the study from appliance and equipment efficiency standards (the remainder of the appliance and equipment standard savings apply to new buildings).

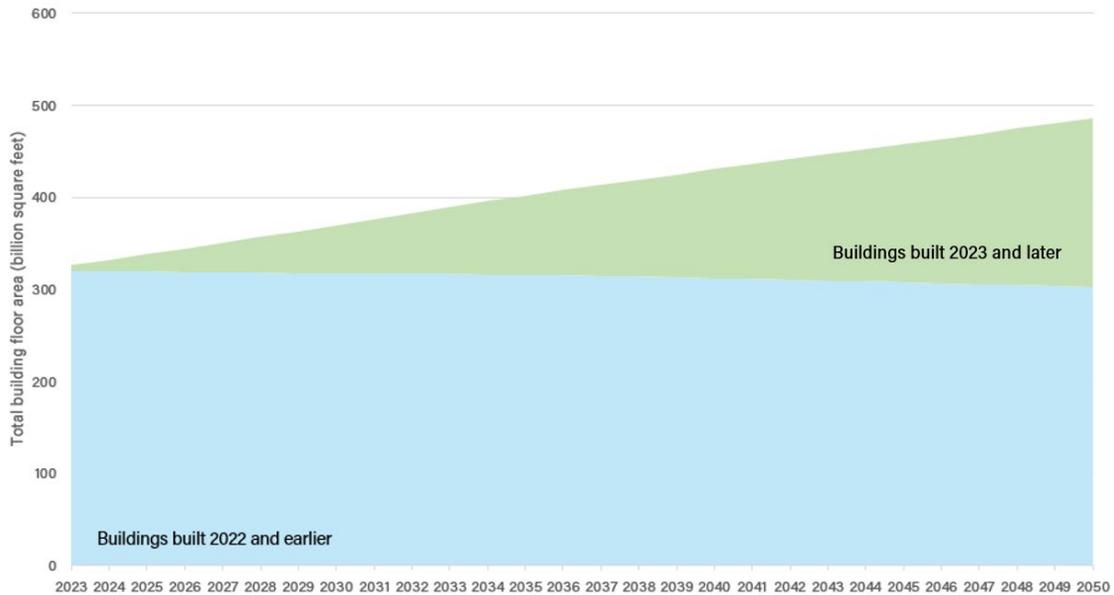


Figure 1. New and existing buildings share of building floor area (residential + commercial) (ACEEE calculations based on data in EIA AEO 2023–EIA 2023)

## LIMITATIONS OF CURRENT APPROACHES

While some home and building retrofits now occur each year, it would take centuries to retrofit all existing U.S. buildings (homes, apartments, and commercial buildings) at current rates.

In the case of homes, the leading retrofit programs are Home Performance with ENERGY STAR®, a U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency (EPA) collaborative program that works with state and local program operators, and the low-income Weatherization Assistance Program (WAP), a grant program under DOE serving households with low and moderate incomes. In 2021, Home Performance Program served 124,489 homes (K. Powell, Redhorse Corp., pers. comm., February 3, 2023), and WAP served at least 64,024 homes (NASCS 2022). Together, these two programs served 0.13% of the 142.2 million housing units (single family and multifamily) in the United States (Census Bureau 2023). In addition, a variety of other retrofit programs are offered by states, localities, utilities, and other agencies of the federal government, and some owners make retrofits on their own. As a crude estimate, if Home Performance and WAP represent half of U.S. annual retrofits, then it would take about 377 years to retrofit the current stock of U.S. homes.<sup>4</sup> This estimate includes only whole-home retrofits. Quite a few homes have received much more

<sup>4</sup> The calculation is 142,153,010 units per the Census divided by 188,513 units through Home Performance and WAP times two (to allow for retrofits beyond Home Performance and WAP) = 377 years.

limited retrofits such as replacing some lightbulbs or upgrading an individual piece of equipment.<sup>5</sup>

For the commercial sector, data from the Energy Information Administration's (EIA's) Commercial Building Energy Consumption Survey (CBECS) can help approximate the building renovation rate. In the 2018 survey (the most recent one published), of the buildings that were at least four years old, 14–39% have had an efficiency-related renovation over the preceding 18 years, a simple average of 0.9–2.6% per year.<sup>6</sup> If we take the midpoint of this range, as a rough estimate, it would take about 56 years to retrofit the current commercial building stock.<sup>7</sup> This estimate is for buildings to receive upgrades to a few building systems. It will likely be longer for most systems in these buildings to be upgraded.

According to these figures, to retrofit 80% of the existing U.S. building stock by 2050, we must increase this annual retrofit rate about 11-fold for residential and nearly twofold for commercial buildings.<sup>8</sup> And, these retrofits will often need to be more comprehensive than many current retrofits are. To address these needs, we must dramatically augment current programs and policies to achieve these large increases. Building performance standards can play an important role in achieving these gains. In some ways, building energy performance standards can be thought of as the existing-building analog to building energy codes for new construction.<sup>9</sup>

Furthermore, in both the residential and commercial sectors there is a “split incentive” problem with rental properties. In these cases the tenant often pays the energy bill but since

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<sup>5</sup> For example, the 2015 Residential Energy Consumption Survey reports that about 5% of housing units have received free or subsidized energy-efficient lightbulbs and about 6% have received a tax credit for a new appliance or equipment (EIA 2018). No time period is provided for when these actions took place.

<sup>6</sup> According to table B1 in the 2018 CBECS (EIA 2022), over the past 18 years, 1.006 million buildings have had a heating, ventilation, and air-conditioning (HVAC) equipment upgrade, which is 17% of the total number of buildings constructed before 2014. If we also include window replacements and lighting and insulation upgrades, and assume no overlap between measures, then 47% of buildings received an energy efficiency upgrade. In all likelihood, some buildings received more than one upgrade, and thus the percentage renovated will be between 17% and 47%. A whole-building retrofit should include multiple systems in a building, and thus the 47% figure is clearly not whole-building retrofits.

<sup>7</sup> The midpoint is 1.7% per year;  $1/1.7\% = 56$  years.

<sup>8</sup> For residences:  $80\% \text{ retrofit} / 27 \text{ years} / 0.26\% \text{ retrofit rate} = 11.4\text{-fold increase}$ . For commercial buildings:  $80\% \text{ retrofit} / 27 \text{ years} / 1.7\% \text{ retrofit rate} = 1.74\text{-fold increase}$ .

<sup>9</sup> While there are similarities, there are also some structural differences. Building energy codes are triggered at time of renovation/major work, whereas BPS typically follow specified compliance cycles. Also, BPS are mostly performance based, whereas most codes are still primarily prescriptive requirements.

they do not own the building, are unable or reluctant to pay for substantial energy efficiency upgrades. And when the building owner does not pay the energy bills, they do not have a financial incentive to make investments that reduce energy costs. BPS force owners to make these upgrades, with the costs incorporated into rents.

## POTENTIAL ENERGY SAVINGS AND GHG EMISSIONS REDUCTIONS IN THE UNITED STATES FROM MANDATORY BUILDING PERFORMANCE STANDARDS

The savings from mandatory building performance standards for existing commercial and multifamily buildings and homes will depend on the stringency of the standards and the proportion of the building stock they apply to. As a rough estimate, using data from the Annual Energy Outlook, if mandatory standards apply to 80% of the pre-2023 commercial building stock and 60% of the pre-2023 residential building stock and reduce energy use by an average of 30% (the average retrofit savings estimated by Nadel and Ungar 2019) and energy-related carbon dioxide (CO<sub>2</sub>) emissions by an average of 60% (higher carbon dioxide savings due to electrification and use of decarbonized fuels), then savings in 2050 will be about 5.4 quads of energy and 271 MMT of CO<sub>2</sub>. These results are summarized in table 1. These reductions are 13% of projected 2050 buildings energy use and 26% of projected 2050 buildings CO<sub>2</sub> in the EIA Reference Case for 2050.

**Table 1. 2050 potential savings from mandatory building performance standards**

Variable	Commercial	Residential	Total
Buildings energy use in 2050 (quads)	18.2	23.4	41.6
Buildings energy-related CO <sub>2</sub> in 2050 (MMT)	468	567	1,035
Proportion in 2050 that are pre-2023	66%	60%	
Proportion of pre-2023 stock covered	80%	60%	70%
Avg. reduction from performance standards			
Energy	30%	30%	30%
Carbon dioxide	60%	60%	60%
2050 energy savings (quads)	2.87	2.54	5.41
2050 CO <sub>2</sub> savings (MMT)	147.8	122.9	270.8

Figures are for source energy, including upstream power-sector losses. Sources: Baseline energy use and CO<sub>2</sub> and existing building share from commercial sector from EIA 2023. Existing building share calculated by ACEEE from data in EIA 2023. Proportion of stock covered and average reduction are rough estimates by the authors.

## Current Mandatory Building Performance Standards

We begin this discussion with five standards that are now in effect: in Tokyo (for very large buildings); Boulder, Colorado (for rental units<sup>10</sup>); the United Kingdom (also for rental units); France (residences); and the Netherlands (for offices). We next proceed to five standards where legislation was enacted before our 2020 report was published and where implementation details have since been largely developed: Reno, Nevada (commercial and multifamily buildings); Washington, DC (commercial and multifamily buildings); New York City (mostly commercial buildings); Washington State (commercial buildings to start); and St. Louis, Missouri (commercial and multifamily buildings). For these jurisdictions we discuss initial lessons learned. Finally, we discuss an additional eight locations that have adopted BPS in 2021–2022: Chula Vista, California; Colorado; Boston, Massachusetts; Denver, Colorado; Maryland; Montgomery County, Maryland; Vancouver, British Columbia; and U.S. federal buildings. All of this last group cover commercial buildings, and all but Vancouver cover multifamily buildings.<sup>11</sup> Within the first group, we order our discussion according to the date requirements begin; for the other standards we order by date of adoption.

### TOKYO

#### Building Performance Standards

In April 2010, the Tokyo Metropolitan Government (TMG) introduced the Tokyo Cap-and-Trade Program (TCTP), which sets mandatory CO<sub>2</sub> emissions reduction targets for the largest energy consumers in the city. The program targets facilities consuming over 1,500 kiloliters of annual crude oil equivalent (equivalent to approximately 55 billion Btu per year). This includes approximately 1,400 facilities, comprising 1,100 office and mixed-use commercial buildings and about 300 industrial facilities. While there is not a direct correlation between the total annual energy consumption and building size, the buildings covered by the TCTP are generally from 20,000 to 30,000 square meters or more (approximately 200,000 to 300,000 square feet (sq. ft.) and up) (Satoshi Chida, director, Emission Cap and Trade Section, TMG, pers. comm., March 9, 2020). Although these facilities represent only about 0.2% of all commercial and industrial facilities in Tokyo, they account for about 40% of the total CO<sub>2</sub> emissions from those sectors.

A covered facility is required to report its emissions to the TMG every year and must meet an emissions reduction target by implementing emissions reduction measures and/or participating in emissions trading. The facility's baseline emissions from which it must reduce are an average of any three consecutive years between 2002 and 2007. When the TCTP was

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<sup>10</sup> Including single-family and multifamily units.

<sup>11</sup> Vancouver's ordinance includes benchmarking of multifamily buildings but does not include performance standards for these buildings.

launched in 2010, the target for emissions reductions from the commercial and industrial sectors was 17% by the year 2020. This 17% reduction by 2020 was also the established target for individual facilities covered by the TCTP.

Reduction targets were specified for the program's first two five-year compliance periods (2010–2014 and 2015–2019). Depending on the baseline starting point and some other factors, buildings were required to reduce emissions 6% or 8% in the first compliance period and then 15% or 17% in the second compliance period. In early 2019, the TMG finalized the caps and compliance factors for the third compliance period (2020–2024), which requires an additional 10% of emissions reductions beyond the second compliance period, resulting in 25–27% reductions from the baseline (TMG 2022).

The TMG decided to use five-year compliance periods as a way to balance its long-term investment in energy reduction planning while also retaining the ability to adjust regularly if adequate progress was not being achieved.

The third compliance period introduced a new mechanism allowing covered facilities to procure electricity or heating from TMG-certified suppliers who document that their energy supply is significantly less carbon intensive than the normal grid electricity or heat. As of the end of the first year of the third compliance period (FY 2020), there were 12 certified low-carbon electricity suppliers and 42 different certified low-carbon heat suppliers.

A significant element of the TCTP is a tenant mechanism that imposes some obligations on the tenants. Through their "tenants' obligation and participation scheme," tenants in covered buildings must work together with the building owner to implement the energy efficiency plan. Tenants occupying more than 5,000 square meters (approximately 50,000 sq. ft.) or using at least 6 million kilowatt-hours (kWh) per year must submit their own carbon reduction plan.

### **Companion Programs**

The TCTP was preceded by the Tokyo Carbon Reporting Program, which had been introduced in 2002. This earlier mandatory reporting scheme, now replaced by the TCTP, provided detailed (and verified) emissions history so that the baselines for mandatory reductions could easily be set.

The TMG has an array of targeted subsidies and tax credits for various building and business types, funded from a variety of sources. For example, there are specific subsidy packages to diffuse green lease practices, including covering a portion of retrofit costs for owners once a green lease has been agreed upon with a tenant (TMG and C40 2017).

In addition, owners of buildings larger than 5,000 square meters constructed since 2002 are required to submit a building environmental plan that addresses a wide range of environmental and energy performance issues.

Beyond companion programs aimed at the biggest emitters covered by the TCTP, many programs are directed toward smaller buildings, including expansion of the Carbon Reduction Reporting Program to small and medium facilities. A benchmarking tool has been developed from the reported data and can enable building owners to understand their energy use and find potential energy management opportunities.

## Results

By 2017, the facilities covered by the TCTP had reduced their emissions 27% relative to the baseline year, meeting the second compliance target two years early (TMG 2022). The majority of the reductions were achieved during the first compliance period, with early reductions driven by electricity supply shortages caused by the Fukushima nuclear disaster and shutdown of much of Japan's nuclear generating capacity that drove major conservation efforts and significant behavior change. These significant reductions offset the impact of higher carbon intensity of the Tokyo electric grid with fossil generation replacing much of the nuclear generation. No backsliding from the early deep reductions has been observed, and additional regular reductions are seen most years.

With the ratcheting down of the cap for the beginning of the third compliance period, and relatively flat emissions over the five years of the second compliance period, significant additional reductions will be required by buildings in the third compliance period. For FY 2020, the first year of the third compliance period, total CO<sub>2</sub> emissions from the covered facilities dropped to 11.04 million tons, a 33% reduction from the base-year (TMG 2022). The TMG requests information from covered facilities about projections of their obligation fulfillment for coming years, and it is currently estimated that 75% of facilities will meet the full third compliance period obligations through their own improvement measures, while 25% of facilities are unlikely to meet the obligations on their own and will likely look to trade with other facilities.

## Sources and Additional Information

- Tokyo Metropolitan Government Cap-and-Trade Program information page: [www.kankyo.metro.tokyo.lg.jp/en/climate/cap\\_and\\_trade/index.html](http://www.kankyo.metro.tokyo.lg.jp/en/climate/cap_and_trade/index.html)
- *Urban Efficiency: A Global Survey of Building Energy Efficiency Policies in Cities* (TMG and C40 2017)

## BOULDER, COLORADO

### Building Performance Standards

In 2010, the Boulder, Colorado City Council adopted the SmartRegs program. The program requires all licensed rental housing in the city (multifamily and single family) to demonstrate that they are about as efficient as buildings built to the 1999 Energy Code. In the City of Boulder, about 52% of housing units are rental and most of the rest are owner occupied

(TownCharts 2023). SmartRegs builds on an existing City of Boulder rental license program that requires a rental property to obtain and renew their license every four years. Renewal entails an inspection for health and safety measures plus additional energy efficiency requirements. Compliance can be demonstrated in one of two ways: (1) achieve a score of 120 or better through the Home Energy Rating System (HERS), a nationwide scoring system, or (2) achieve at least 100 points on a prescriptive scoring checklist the City of Boulder developed based on energy and carbon savings for specific measures. Boulder also requires two water efficiency points. For large multifamily buildings, a sample of representative apartment units can be inspected.

In Boulder, property owners were given until December 31, 2018, to bring their units into compliance. This afforded owners up to two rental license cycles (each license is good for four years) to implement any necessary upgrades. Inspections are performed by private inspectors certified by the city. The cost of an inspection is around \$120 per rental unit inspected; however, inspectors are third-party private business owners, so the cost can vary.

### **Companion Programs**

Boulder also offers a companion Energy Smart program that provides technical assistance, help with selecting contractors for energy efficiency improvements, and financial incentives beyond those offered by the local utility. Energy Smart is financed mostly by Boulder County, which provides services to all municipalities in the county. In 2010, Boulder County was a recipient of a grant from the DOE under the American Recovery and Reinvestment Act (ARRA). Additionally, the city contracted with Energy Smart for specific SmartRegs services, using its Climate Action Plan tax, which is a small city tax on electric service. Energy Smart also leverages available incentives from their local utility.

### **Results**

For the approximately 23,000 licensed rental units, at the end of 2019 (the most recent data available), about 22,500 units in Boulder gained SmartRegs compliance. Over the course of the eight-year compliance timeline, about half of the rental units were found to be compliant at first inspection, 17% qualified for various exemptions specified in the law, and most of the rest required upgrades to reach compliance. Nearly all licensed rental units were inspected using the prescriptive checklist. For those needing upgrades, on average they had to choose two measures to gain an additional 14 points to reach the required 100 points. The most common upgrades were attic, crawlspace, and wall insulation. The average upgrade cost has been \$3,022 per unit, of which an average of \$579 was paid by rebates. As of the end of 2018, the city estimated the program had saved about 1.9 million kWh of electricity, 460,000 therms of natural gas, \$520,000 in energy costs, and 3,900 metric tons of CO<sub>2</sub>. The city estimated total investment at just over \$8 million, including nearly \$1 million in rebates (Boulder 2019). RMI (Peterson and Lalit 2018) estimated, on the basis of initial results, that once fully implemented, the program will save 4.2 million kWh and 940,000

therms of natural gas annually. If correct, this is an annual savings of about 566 kWh and 123 therms per unit requiring an upgrade.<sup>12</sup>

In our discussions, Boulder officials said they are happy with the program. It has achieved energy savings and GHG emissions reductions and helped to improve the rental housing stock. When asked about the impact on the Boulder rental market, they said they have seen no evidence that the SmartRegs requirements led to either increased rents or a reduction in rentals. Available evidence says that the market—supply and demand—is what sets the rental price. They also noted that they will be considering future changes to the SmartRegs requirements as part of a 2023 update to their overall building stock strategy (C. Elam, senior sustainability manager, City of Boulder, pers. comm., January 10, 2023, and March 22, 2023).

### Sources and Additional Information

- SmartRegs website: [boulder.colorado.gov/plan-develop/smartregs-guide](https://boulder.colorado.gov/plan-develop/smartregs-guide)
- A report by the RMI on *Better Rentals, Better City* (Petersen and Lalit 2018) A report by Lawrence Berkeley National Laboratory (Zimring et al. 2012)
- A paper written by Boulder officials and consultants (Antczak et al. 2016)
- An evaluation of the Boulder DOE grant (Arena and Vijayakumar 2012)

### *OTHER RENTAL EFFICIENCY REQUIREMENTS IN THE UNITED STATES*

In addition to the Boulder program, there are two other U.S. cities with more limited prescriptive energy efficiency requirements for rental housing—Burlington, Vermont, and Gainesville, Florida.

#### **BURLINGTON**

The Burlington standard applies to rental properties that use more than 90,000 Btu for space heating per heated square foot of floor area. The standard requires insulation of attics, floors over unheated spaces, water heaters, accessible heating, cooling and hot-water pipes, and heating and cooling ducts. In addition, sealing of heating and cooling ducts is required as is air leakage testing and reduction where it exceeds designated

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<sup>12</sup> Based on 22,500 total rental units and 33% requiring upgrades as discussed earlier in this paragraph.

thresholds and installation of storm windows or double-glazed windows. The cost of improvements is capped at \$2,500 per apartment (Burlington 2021).

### **GAINESVILLE**

Gainesville requires that rental units (single and multifamily) have attic insulation, sealed duct joints, low-flow showerheads and faucet aerators, insulated hot-water pipes, a programmable thermostat, and heating/cooling system maintenance at least every 24 months (Gainesville 2020).

## **UNITED KINGDOM**

### **Building Performance Standards**

Minimum building energy performance standards were adopted in 2015 and have been in effect in the United Kingdom since April 2018, such that it is unlawful to let (lease) properties in England and Wales that do not meet a prescribed minimum level of energy performance as measured by the building's Energy Performance Certificate. Scotland has a similar policy that is about to begin for just the residential sector (see box below at the end of the UK section). Northern Ireland does not have a program. In the remainder of this section, we discuss the program in England and Wales.

In England and Wales, all rental properties, both residential ("domestic," including multifamily) and commercial ("non-domestic"), that require an Energy Performance Certificate (EPC) in accordance with the European Commission's Energy Performance of Buildings Directive of 2012 are within the scope of this regulation (IPEEC 2017).

The metric for the standard is the building's EPC, which in the United Kingdom is an A through G rating based on the calculated (or asset) energy performance rating for that building (A is the best rating, G the worst).<sup>13</sup> The EPC rating is calculated based on the building envelope characteristics and permanent energy using equipment (heating and domestic water heating systems) relying on a standard assessment procedure developed as part of the regulations. The calculated rating can be improved through installation of capital measures intended to improve the building's efficiency, though all based on modeled performance, not including any impacts of changes to the operation of the building. The Energy Efficiency (Domestic Private Rented Property) (England and Wales) Regulations 2015 (revised in 2017; UK BEIS 2020a) require that from April 2018 all rented premises within the

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<sup>13</sup> Most European countries use the EPC label but label details and breakpoints vary between countries. While A–G is the most common, some countries are A–H and some countries also include A+ and A++ ratings to indicate superior buildings. In general an A rating means substantially above average but far from net-zero energy.

specified scope are expected to meet a minimum energy standard of an EPC rating of E. This means that any properties with a rating of F or G are not allowed to be re-leased from April 2018 without upgrading to a higher level of performance or registering an exemption.

While the regulations initially targeted buildings at the time of a new, renewed, or extended lease, beginning in 2018, ultimately all rented buildings must achieve a minimum E rating by the established deadlines of April 2020 for domestic and April 2023 for non-domestic buildings.

For domestic buildings, the regulations include a cost cap such that an owner is not required to spend more than £3,500 (about \$4,500) per dwelling unit. This is self-certified by the building owner or submitting agent. For non-domestic buildings, the cost threshold is defined to include those investments that pay back within a seven-year period. If the property cannot improve to an EPC E rating within the cost thresholds, the owner must make all the improvements that can be made up to that amount and then register an “all improvements made” exemption with the government, which is valid for five years.<sup>14</sup> Other exemptions are described in the references that follow.

It has been proposed through an open UK government consultation, and confirmed in the UK Government Energy White Paper, that the standards will be tightened with the aim of having as many homes as possible upgraded to EPC C or above by 2035, where “practical, cost-effective and affordable” (UK BEIS 2020b). While the consultation closed in December 2020, there has been no update on finalizing the tightening of the standards.

In 2019, the UK government began a consultation process to understand potential changes to the non-domestic standards to move more aggressively toward their economy-wide carbon targets. The main proposal from the government (favored option in the consultation) was to set a trajectory for a new standard of EPC B in 2030 for the non-domestic sector (UK BEIS 2019b). The consultation closed January 2020, and the government has not yet responded with their decision.

While there has not yet been a formal proposal from the UK government, in late 2020 the government confirmed in its Energy White Paper the intention to raise the minimum energy efficiency standard to an EPC B or above by 2030 (UK BEIS 2020b). This would be implemented through two compliance windows, the first requiring all privately rented non-domestic buildings to achieve an EPC rating of C or better by 2027, and the second requiring an EPC of B or better by 2028. It is not yet clear how soon this proposal will be finalized.

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<sup>14</sup> Nothing is set out explicitly about what happens after five years, but one UK expert said that logic suggests that if the exemption expires then the regulation would apply, so a landlord would need to comply with the standard or seek another exemption.

In addition to the potential change to require an EPC of C or better by 2027 in non-domestic buildings, there is also a policy change being considered to shift non-domestic buildings from the current calculated EPC rating (based on modeled energy performance) to have the ratings more aligned with actual energy use and carbon emissions. Many non-domestic stakeholders throughout the UK have been advocating for a change to an operational energy and carbon rating, and there has been a parallel consultation open on that issue while the final required EPC requirements are being debated.

### **Companion Programs**

At the time that the building performance regulations were established, the government also introduced a pay-as-you-save finance initiative called Green Deal Finance. Together with subsidies available for domestic energy efficiency from the utility-funded energy efficiency obligation, the initiative was intended to ensure that the standard could be reached at no cost to the landlord. The Green Deal Finance initiative was largely unsuccessful (e.g., see UK BEIS 2017) and the government has withdrawn its support, so the funding and finance framework did not materialize as expected.

Funding for energy efficiency measures in domestic properties occupied by low-income households is available through the Energy Efficiency Obligation (EEO). For domestic privately rented properties at EPC F and G, the EEO scheme subsidizes selected, higher-cost insulation and renewable heating measures. Other measures are not permitted for F- and G-rated properties (UK BEIS 2023). In addition, some subsidies may be available on a piecemeal basis through individual local authorities.

With dramatically higher energy prices in 2022 and 2023 resulting from the Russian invasion of Ukraine and resulting energy supply challenges, energy affordability has become the highest energy policy priority for the residential (domestic) sector, with price caps and subsidies to protect consumers. It is likely that some of these energy affordability programs will be expanded to include additional energy efficiency features in the coming years.

### **Results**

In 2021, the UK government issued an evaluation report on the domestic private rented sector efficiency standard. The evaluation found that it was not possible to definitively quantify the level of compliance with the regulations. The EPC data for England and Wales have gaps and data quality issues, and as of April 2020 the evaluation found there were approximately 130,000 noncompliant properties (out of around 3 million total). The main energy efficiency improvements made by landlords have been new insulation in combination with more energy-efficient lighting, and the common mindset was for landlords to have made improvements necessary to achieve an E rating while minimizing costs (UK BEIS 2021).

Other anecdotal information from some UK experts suggests that there has not been a big push to renovate buildings, but some buildings have had their EPC ratings recalculated to obtain better ratings (and therefore be allowed to re-lease the building). The lack of action is

due at least in part to expectations of significant project funding through the UK government's Green Deal finance packages, which did not materialize. In addition, many UK policies have not been implemented as smoothly as might otherwise be expected because of turmoil surrounding Brexit, COVID-19, and multiple changes in government leadership over recent years.

### Sources and Additional Information

- *Guidance—Domestic Private Rented Property* (UK BEIS 2023)
- *Guidance—Non-Domestic Private Rented Property* (UK BEIS 2019a)
- *The Domestic Private Rented Property Minimum Standard* (UK BEIS 2020a)

## SCOTLAND

As noted above, Scotland has approved regulations very similar to the rental housing standards in England and Wales. The Scottish regulations differ from the English and Welsh in that they apply only to domestic privately rented properties and they include a tightening of the minimum standard from E to D at change of tenancy from 2022 and for all privately rented homes from 2025. Due to COVID, Scotland proposed to change this to requiring a C rating for private rental housing as of 2028 "where technically feasible and cost-effective." If achieving a C is not technically feasible, then a home or apartment would need to get as close to C as is possible and cost effective, with details still to be developed. In addition, Scotland is developing a regulation for owner-occupied private housing to reach the C level by 2033. The mandatory standard would apply at time of property sale and potentially also to homes undergoing major renovations (with major renovations still to be defined). For publicly owned social housing, initial energy standards went into effect in 2020 and as of 2021 89% of covered units met these standards. The standards will tighten to the B level or equivalent or as much as possible by the end of 2032. Scotland already has a grant program for households in or at risk of fuel poverty, several energy efficiency loan programs, and a technical assistance and advice program, all of which would help households comply with the proposed standards (Scottish Government 2021).

## FRANCE

### Building Performance Standards

In 2015, France adopted the Energy Transition toward Green Growth Act (Ministry of the Environment, Energy and the Sea 2016). This act calls for:

- A 60% reduction in final energy consumption in 2050 compared with the 2010 level for commercial-sector buildings;
- Renovation of 500,000 homes per year starting in 2017, at least half of which are occupied by low-income households, aiming for a 15% reduction in fuel poverty by 2020;
- Energy renovation by 2025 of all private residential buildings whose primary energy consumption exceeds 330 kWh per square meter per year of primary energy.

This last provision is a building performance standard. In France, as in the United Kingdom and most other European countries, buildings are rated and labeled on an A through G scale, based on building characteristics (i.e., this is an asset rating and not a performance rating). The building performance standard in the 2015 law means that “F-rated and G-rated residential buildings (about 15% of the housing stock) must upgrade to at least the E level. This includes both rental and owner-occupied residences. The plan is to steadily tighten these requirements to bring the entire housing stock to low energy levels (“Bâtiment Basse Consommation” [BBC] or equivalent) by 2050. This is equivalent to 80 kWh per square meter per year in primary energy for the regulated loads (heating, cooling, lighting, ventilation, and hot water). This long-term goal, which corresponds to a B rating, is also part of the 2015 law.

A more recent energy and climate law, adopted in November 2019, sets the goal to achieve carbon neutrality by 2050 by reducing fossil fuel consumption by 40% by 2030—instead of the previous 30% target adopted by France—and by closing coal-based electricity generation by 2022. In addition, the law contains various measures to support the development of renewable energy and to improve the energy efficiency of housing to reduce energy consumption by reducing heat loss. Concerning energy efficiency in the housing sector, the new law calls for retrofitting all “passoires énergétiques” (homes and apartments not in compliance with the standard) within 10 years according to the following chronological targets:

- From 2022, freeze rents of “passoire” units. An owner of a passoire will no longer be able to increase rents.<sup>15</sup>

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<sup>15</sup> Similarly, while not full BPS, in the Netherlands and Brussels, rented homes with the lowest energy performance ratings are allowed a lower maximum rent (S. Oxenaar, associate, Regulatory Assistance Project EU, pers. comm., March 23, 2023).

- Starting in 2022, each real estate transaction involving a *passoire* will have to provide an audit on what work is needed to bring it into compliance. Mention of *passoire* status will be compulsory in the real estate advertisements of the dwellings concerned starting in 2022.
- From 2023, for new rental contracts, the “decency” criteria for dwellings that specifies minimum requirements (e.g., minimum floor area and free of vermin) is amended to include a maximum threshold of 450 kWh final energy consumption per square meter per year (this is the dividing line between an F and G rating). When a rental falls short of these decency criteria, a tenant can request that the landlord correct the deficiency.

In 2021, France adopted the Climate and Resilience Law, which modified the building standards and their effective date, and enabled tenant action against noncompliant buildings. Under the new law, G-rated buildings must upgrade by 2025, F-rated buildings by 2028, and E-rated buildings by 2034. After 2034, all buildings must be D or better. The new law prohibits renting out or selling properties with performance below the required levels and allows the tenant or purchaser to take legal action against the owner and demand financial compensation.

### **Companion Programs**

To help support these upgrades, France has a variety of complementary programs. Until the end of 2019, the main form of financial assistance for home energy conservation was an Energy Transition grant tax credit. Since 2019, this tax credit is being phased out, to be replaced by a grants system called MaPrimeRénov. This program has two variations—MaPrimeRénov and MaPrimeRénov Sérénité. The first is for one or a few specific energy-saving measures while the latter is for comprehensive retrofits that reduce energy use at least 35% and that are targeted to address energy poverty. These grants are available to homeowners, landlords, and condominium properties. The level of the grant and work eligible for a grant are a function of household income and the improvements in energy efficiency that are obtained. Priority is being given to those on a low-income living in properties with low energy efficiency performance, and not all households are eligible for all types of work. This new program is administered by a government department called “France Renov.”

In addition, the following other programs are available:

- An interest-free Eco-Loan up to €50,000 is available to property owners carrying out energy renovation work. It can be combined with the grant above.
- The Habiter Mieux Program (Better Housing) targeting fuel poverty and managed by France's National Housing Agency (ANAH) has increased targets for renovating homes. In 2021 the target was 75,000 homes per year (total five-year budget of 1.2 billion Euros).
- France Renov Platforms (a kind of national retrofit one-stop shop) provide technical and financial support to homeowners carrying out energy renovations in

complement to 450 regional “information service units” that cover the whole of France.

- The energy-saving certificate scheme (certificats d'économies d'énergie, CEE) has energy-saving requirements for energy providers (fuel, electricity, gas, heating oil, and so on) to support energy-saving initiatives. This program targets all households and businesses, with a specific minimum share for low-income households.
- An Energy Renovation Guarantee Fund provides loans to low-income households, with a government repayment guarantee.
- Digital maintenance and repair records are being established to compile and store information on individual homes so present and future owners have ready access to information that will aid in planning home renovations (Ministry of the Environment, Energy and the Sea 2016).

### **Sources and Additional Information**

- An English-language summary of the Energy Transition through Green Growth Act (Ministry of the Environment, Energy and the Sea 2016)
- France section in a report on energy efficiency passports (Fabbri, De Groote, and Rapf 2016).
- The 2019 law (in French): [www.ecologique-solidaire.gouv.fr/loi-energie-climat](http://www.ecologique-solidaire.gouv.fr/loi-energie-climat)
- The 2021 law (in French) : [www.ecologie.gouv.fr/projet-loi-climat-resilience-deputes-ont-vote-mesures-sur-renovation-des-logements-ca-change-quoi](http://www.ecologie.gouv.fr/projet-loi-climat-resilience-deputes-ont-vote-mesures-sur-renovation-des-logements-ca-change-quoi)

## **THE NETHERLANDS**

### **Building Performance Standards**

In November 2018, the Dutch government amended their Building Decree to require that office buildings have an Energy Efficiency Index of at least 1.3 (equivalent to a C EPC rating) as of January 1, 2023. After that date, noncomplying buildings will no longer be permitted to be used as office buildings. Dutch EPC ratings are based on calculated energy use, and tied to an Energy Efficiency Index that does not directly translate to energy consumption with ratings that range from A+++++ as the most efficient down to G as the least efficient. Enforcement of the standard is generally by the municipality in which the building is located, but it can also be delegated to another nominated “competent authority.” As the minimum standard applies to the use of the office building, the duty to comply can be with either the tenant or the building owner. Failure to comply will be addressed through administrative enforcement measures, such as periodic penalty payments, a fine, or the closure of the office building. The regulations require that measures needed to meet the standard are calculated to pay back within 10 years. An owner or tenant is required to install measures up to this payback threshold but not over, even if a C certification is not reached. A 2016 study estimated that average payback time to meet this requirement will be between 3 and 6.5 years, with a cumulative total cost of €860 million by 2023.

The Netherlands has around 96,000 offices, 62,000 of which will need to comply with the standard (the rest are exempt as discussed below). Of these, 39% do not yet have an EPC as of late 2022 (Dutch News 2022). Of those that do have an EPC, around 50% have an A–C label and 11% have a label of D–G and therefore will have to undertake work to comply with the standard, a significant improvement from the situation in 2019 when one-quarter of buildings needed to make improvements. Regarding exemptions, the standard does not apply to buildings in which less than 50% of floor area is used for offices (excluding ancillary functions) or buildings in which only a small floor area (less than 100 square meters) is used for offices. Exemptions also apply for listed historic buildings, buildings that are only temporarily used as offices, buildings that do not use energy to regulate indoor climate, and buildings that are due to be demolished in less than two years.

A tighter target of an A label by 2030 was considered but not introduced. However, the C requirement by 2023 is expected to be tightened to a higher level in some future year. As of 2022, it is widely expected that the requirement for all office buildings to have an A energy label by 2030 will be implemented, though there has been no official confirmation from the government (RWV Advocaten 2022).

A more general requirement for operators of commercial establishments to take up energy efficiency measures has already laid the foundation for the introduction of the minimum standard in this sector. The Dutch Environmental Management Activities Law, Decree on Activities, introduced the “energy savings obligation,” which requires the “operator” of 20 different types of commercial establishments (public and private) that use over 50,000 kWh of electricity or over 25,000 cubic meters of natural gas to implement all energy savings measures with a payback less than five years. A list of recognized energy savings measures with payback in the specified period for each sector is published on InfoMil, a government knowledge center for resources on environmental legislation and policy (Netherlands Ministry of Infrastructure and Water Management 2023). A provision allows operators to ask for phased implementation. As of July 1, 2019, all users/tenants had to submit an environmental report (Wet Milieubeheer) to the municipality covering all processes in the part of the building they occupy.

Offices are required to comply with both the Class C regulation and this energy savings obligation.

### **Companion Programs**

The Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO), offers technical support to building owners to enable them to comply with the standard. It provides an online tool that enables building owners to explore investment costs, annual savings, payback times, and CO<sub>2</sub> savings for routes to meeting the standard. A government-approved register lists energy advisors who can assess and recommend improvements to meet the standard. Building owners can receive a grant for the cost of this advice if they go on to install measures.

The Dutch government also provides tax incentives to partially offset the cost of energy efficiency measures. For example, the Energy Investment Allowance allows companies to deduct 45% of specified energy-saving investment costs from taxable profit (Netherlands Enterprise Agency 2022). The Environmental Investment Allowance is available for entrepreneurs to make tax deductible investments in a broader range of environmental measures. In addition, installation of solar thermal and heat pumps is incentivized through the Renewable Energy Investment Allowance, which provides a partial subsidy of the costs of the installation. Finally, “green” loans are also available for commercial buildings. These provide preferential interest rates, often coupled with supporting services such as free energy consultations.

## Results

While implementation is just coming into force in 2023, the program is already having some impact. For example, the number of investors, mortgage banks, owners, and tenants asking for more-detailed information about buildings’ energy performance is rising (IGBC 2019b). A significant increase in investment in the renovation and transformation of commercial properties has been observed. A growing number of financial institutions are also adapting their real estate financing measures accordingly. For example, ING, Rabobank, and ABN AMRO, three leading financial institutions in the Netherlands, have indicated they will stop financing office buildings with a D label or worse. In addition, ING Real Estate Finance is no longer refinancing clients lacking a plan to get at least a C label for their office (IGBC 2019). More recently, it appears that many building owners and consultants are ramping up efforts to be in compliance with the 2023 requirements and that banks continue to pay attention to the law. As one bank noted at a recent finance forum, “compliant assets will have high valuations and good liquidity, while the others will find no financing. We as a bank take this very seriously” (Dynes 2022).

## Sources and Additional Information

- A paper that looks at the potential for minimum performance standards for Europe, including a case study on the Dutch program (Sunderland and Santini 2020) (this section draws heavily from this case study)
- An international compilation that provides information on both the office building and Environmental Management Activities Decree (IGBC 2019)
- The program website (in Dutch): [www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels/bestaande-bouw/energielabel-c-kantoren/veelgestelde-vragen](http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/gebouwen/wetten-en-regels/bestaande-bouw/energielabel-c-kantoren/veelgestelde-vragen)

## RENO, NEVADA

### Building Performance Standards

In January 2019, the City of Reno enacted the Energy and Water Efficiency Program, which includes both commercial and multifamily building benchmarking and a nominal building

performance standard for commercial and multifamily buildings 30,000 sq. ft. and larger. We use the term “nominal,” since as discussed below, the policy includes an easy-to-meet prescriptive compliance option that could be used in lieu of meeting the performance target. Reno was the first U.S. city to adopt a commercial building performance standard; this prescriptive option helped enable passage. Since many cities have since enacted performance standards without an easy-to-meet prescriptive option, Reno is now starting to think about whether this prescriptive path can be tightened, for either the first or second cycle of the standard. Due to the easy alternative compliance pathway, we debated whether to include Reno in this report but ultimately decided to include it due to its nation-leading history and the fact that it might become a true performance standard in the future. The Reno policy was developed by city staff with assistance from the City Energy Project (City Energy 2023) and input from a series of five community workshops. This policy covers 71% of commercial buildings and 90% of multifamily buildings in the city. These buildings must meet both energy and water targets. For energy targets, a building owner may choose from four options:

- The property received an ENERGY STAR score of 50 or higher.
- The property's energy-use intensity (EUI) was equivalent to or better (lower) than the performance of 50% of all covered properties of its type.
- The property achieved an ENERGY STAR score at least 15 points higher than the score it received during its baseline year.
- The property's weather-normalized source EUI was reduced by at least 10% relative to its performance in the baseline year.

For water targets, a building owner may choose from three options:

- The property received an ENERGY STAR water score of 50 or higher.
- The property's water use intensity (WUI) was equivalent to or better (lower) than the performance of 50% of all covered properties of its type.
- The property achieved an ENERGY STAR water score at least 15 points higher than the score it received during its baseline year.

Buildings unable to meet the performance criteria have prescriptive options. For example, in lieu of the energy criteria, buildings may comply via one of the following prescriptive routes:

- Completing retuning or an energy and water audit
- Receiving certification under LEED for Existing Buildings (at “Certified” level or higher)
- Participating in and successfully completing a utility-sponsored retuning incentive program within the past seven years
- Performing ongoing commissioning of electrical and mechanical systems
- Receiving a net-zero energy certification from the International Living Future Institute or other qualified certification program

- For properties without a central cooling system, options include completing three prescriptive measures involving common-area exterior lighting, pipe insulation, a cool roof, a solar water heating system, or a new water heater; participating in a demand response program; or attending at least three locally offered trainings or professional certification programs in energy conservation or energy code compliance

Prescriptive water efficiency measures may be chosen as well. The multiple performance standards and the prescriptive options were added to help address property-owner concerns that a single prescriptive standard (e.g., ENERGY STAR) could be challenging to meet.

Compliance with appropriate performance or prescriptive measures must be demonstrated by 2026 for city-owned properties of 10,000 sq. ft. or more, 2028 for private-sector properties of 100,000 sq. ft. or more, 2029 for private properties of 50,000–99,999 sq. ft., and 2032 for private properties of 30,000–49,999 sq. ft.. Compliance must again be demonstrated every seven years after these dates. The program does not include any special provisions for affordable housing.

### **Companion Programs**

The city also created the voluntary ReEnergize Reno program to improve building energy and water efficiency by 20% by 2025. Participating buildings must track energy and water data through ENERGY STAR Portfolio Manager and disclose results to the City of Reno. The city offers technical support to participating properties. This program was active in prior years but due to limited staffing, ReEnergize Reno activities are very limited at present. Nevada has a Commercial Property Assessed Clean Energy (C-PACE) loan program for commercial buildings and multifamily buildings with five or more units. Thus far, there are several projects in Las Vegas but none yet in Reno. In addition, the local utility offers energy efficiency programs that include incentives and technical assistance.

### **Results**

Since implementation is just beginning, no results are available yet. However, program staff report that they are getting questions from building owners and, in response to some of these questions, must figure out some specific additional details (S. Groneman, sustainability manager, City of Reno, pers. comm., February 28, 2020 and January 6, 2023).

In terms of compliance, buildings at or above the median energy and water scores will pass the performance criteria. For buildings below the median, given the number of prescriptive options and their low cost, we would surmise that use of prescriptive options will be common. Thus, as one observer commented, one could consider Reno's law an audit/retuning law with alternative compliance options including building performance rather than a building performance standard.

### **Sources and Additional Information**

- Energy and Water Efficiency Program website:  
[www.reno.gov/community/sustainability/energy-and-water-efficiency](http://www.reno.gov/community/sustainability/energy-and-water-efficiency)
- Energy and Water Efficiency Ordinance (Reno 2019)

## WASHINGTON, DC

### Building Performance Standards

In December 2018, the city council of the District of Columbia (District) adopted the Clean Energy DC Omnibus Amendment Act of 2018, which increased the District's renewable portfolio standard, expanded energy efficiency funding and programs, sought to expand use of electric vehicles, and adopted mandatory building energy performance standards for large buildings, including multifamily buildings. The legislation was signed by the mayor and became law in early 2019. Since initial passage, some dates were modified due to COVID and to accelerate decarbonization. As modified, the legislation requires performance standards to be set by regulation by January 1, 2022. Buildings failing to meet those standards must make energy efficiency improvements over a five-year compliance cycle. Buildings with a floor area of 50,000 sq. ft. or more must meet the energy performance standards by January 1, 2026, with the standards extending to buildings of 25,000 sq. ft. or more on January 1, 2028, and to buildings of 10,000 sq. ft. or more on January 1, 2031. The District is required to revise the standards every six years.

The performance standards are part of the District's efforts, as specified in the amended legislation, to reduce GHG emissions by 50% by 2030 and to achieve carbon neutrality by 2045. The standards build on an annual energy benchmarking requirement for commercial and multifamily buildings in the District, which was adopted by the council in the Clean and Affordable Energy Act of 2008. It gradually phases in benchmarking, with DC-owned buildings over 10,000 sq. ft. of floor area starting in 2009, private buildings of 50,000 sq. ft. floor area starting in 2013, buildings 25,000–49,999 sq. ft. starting in 2022 using 2021 data, and buildings 10,000–24,999 sq. ft. starting in 2025 using 2024 data.<sup>16</sup>

The performance standards were set in 2021 by the District of Columbia Department of Energy and Environment (DOEE) on the basis of criteria in the legislation and input from an advisory Building Energy Performance Standards (BEPS) task force of about a dozen stakeholders whose makeup was specified in the Clean Energy DC Omnibus Amendment Act of 2018. The Act specifies that "the building energy performance standard shall be no lower than the District median ENERGY STAR score for buildings of each property type." It also specifies that multiple compliance pathways be established. Ultimately, four pathways were established through regulation:

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<sup>16</sup> Buildings with a floor area under 50,000 sq. ft. were added in the Clean DC Energy Act of 2018.

1. Performance Pathway: reduce site energy usage intensity by 20%.
2. Prescriptive Pathway: conduct audit, create action plan, implement energy efficiency measures projected to save at least 25% of site energy-use intensity, complete monitoring, evaluation, and verification.
3. Standard Target Pathway: For high-performing property types with a standard above the national median, reach the standard.
4. Alternative Compliance Pathway options: allows an owner to apply to follow an optional pathway if they meet specific criteria.

In the case of campuses owned by postsecondary educational institutions and hospitals, campus-wide goals can be established.

The Standard Target Pathway is expressed in terms of ENERGY STAR score for building types for which a score is available, and in source EUI (Btu/sq. ft. including generation losses) for other building types (DOEE 2021a).

Another provision in the legislation allows DOEE to establish criteria for delaying, by up to three years, compliance with requirements for buildings that demonstrate financial distress, have a change of ownership, are vacant, are receiving a major renovation, are pending demolition, or meet other criteria established by DOEE. In addition, the compliance requirements for affordable housing meeting the above criteria may be delayed by DOEE for up to three years. In 2021, compliance regulations were published addressing these options and other issues along with a Compliance and Enforcement Guidebook; it was revised in 2023 (District of Columbia DOEE 2023). The District also developed an online owner portal that each building owner can use to aid and record compliance with benchmarking and the BEPS.<sup>17</sup>

Along with these regulatory steps, DOEE also hired a consultant to estimate the costs and benefits of the program. They looked at 13 case study properties finding compliance costs ranging from \$0.46–30.35 per sq. ft. and annual benefits of \$0.13–0.90 per sq. ft. These ranges include more than one compliance option for some of the buildings. The study concluded that the average cost of compliance was approximately \$10 per square foot, and DOEE used this information to inform the penalties for noncompliance with the BEPS requirements. Many details are included in the study (District of Columbia DOEE 2022b).

The legislation requires that performance targets be revised every six years, and thus the standards for large buildings that were published in 2021 will need to be replaced by a new standard published by January 1, 2027.

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<sup>17</sup> [https://dc.beam-portal.org/helpdesk/kb/building\\_owner\\_portal/](https://dc.beam-portal.org/helpdesk/kb/building_owner_portal/).

The law also required DOEE to prepare a report to assess whether the standards should be converted from an energy to a GHG-based metric in the future. This report was published in late-2022 and recommends moving toward two complementary metrics—site energy-use intensity and on-site GHG—beginning in the third compliance period and ultimately following a trajectory toward a long-range goal (District of Columbia DOEE 2022a). A decision on these issues will be made by the city council, as any changes to the current BEPS framework will need to be established through a legislative amendment.

When asked about lessons learned to date, DC’s lead on implementation said it is important to engage stakeholders early and often, be humble, transparent and honest, and recognize that it will take substantial resources to implement a BPS (DC now has 11 people working on benchmarking and BPS). She said in retrospect they moved quickly and could have done more to engage community-based organizations and tenants and suggests paying attention to how BPS can be used to develop the local community workforce (K. Bergfield, chief, Building Performance & Enforcement Branch, DOEE, pers. comm., January 11, 2023).

### **Companion Programs**

To help support implementation of the building performance standards, in the same legislation establishing the standards the DC Council also increased funding support for energy efficiency, including additional funding for the DC Sustainable Energy Utility (the main program administrator in the District; their budget is now over \$20 million per year), allocating \$70 million over six years to the DC Green Bank, allocating \$3 million per year for affordable housing compliance with the standards starting in 2022, and allowing gas and electric utilities to again offer energy efficiency and demand-reduction programs. The District funded a “High-Performance Building Hub” to provide technical assistance. And in 2021, it launched a three-year program called the BEPS Affordable Housing Retrofit Accelerator to provide technical and financial support to 100 affordable multifamily buildings to assist them with meeting the BEPS requirements (DOEE undated). In the first year of the Accelerator program, 35 buildings have received free energy audits and have begun discussing funding and financing options for the building upgrades with DOEE and its implementing partners, the DCSEU and the DC Green Bank. Funding comes from the District’s share of funds from the federal ARRA program with approximately \$30 million invested annually in both 2022 and 2023; budgets for 2024 have yet to be decided.

### **Sources and Additional Information**

- Building Energy Performance Standards (BEPS) website: <https://dc.beam-portal.org/helpdesk/>
- Legislation (District of Columbia 2018)
- An overview presentation on the standards (District of Columbia DOEE 2019)
- Frequently asked questions (District of Columbia DOEE 2020)
- A blog on the 2018 Act with links to other information (Majersik 2018)

- DC Green Bank website: [www.dcgreenbank.org/](http://www.dcgreenbank.org/)

## NEW YORK CITY

### Building Performance Standards

In April 2019, the New York City (NYC) City Council passed a package of bills known as the Climate Mobilization Act (CMA). The centerpiece of the CMA is Local Law 97 (LL97) of 2019, which requires buildings larger than 25,000 sq. ft. to meet strict GHG emissions limits starting in 2024.

The law established GHG intensity limits, expressed in CO<sub>2</sub> equivalent per square foot for 10 building categories (based on Building Code occupancy groups), with the limits taking effect in 2024 (covering each year in the 2024–2029 period) affecting the most carbon-intensive 20% of buildings. Some of the buildings affected in this first compliance period will need to reduce their emissions by only 10% or less, but other high-emission buildings in many of the occupancy groups will have to achieve significantly higher reductions.

Significantly more-stringent limits take effect for the second compliance period, 2030–2034, and will affect about 75% of covered buildings. Many buildings will need to make substantial reductions to meet the limits, in some cases cutting emissions by as much as 50% or more from their 2018 levels. Yet more-stringent limits are expected to take effect in 2035, and the law establishes the process for setting those out-year limits.

While the law mandates maximum GHG intensity limits, concerns had been raised during development of the law that building owners should not be held responsible for changes in the emissions intensity for electricity. This is forecast to change very significantly during the coming decade or two, both increasing in the near term with the closing of two large nuclear plants and then decreasing with increased renewable sources planned by 2030. As such, emissions intensity conversion factors were specified in the law for both electricity and the district steam system for the 2024–2029 period, and a deadline was included in the law for factors to be set for 2030 and beyond. This was considered a critical issue to give building owners more certainty about the reduction needed to give more capital-planning certainty to justify major investments.

In October 2022 the New York City Department of Buildings issued a proposed rule clarifying some of the law's requirements, the most significant of which was transitioning from the 10 building categories based on Building Code occupancy groups to over 40 different ENERGY STAR Portfolio Manager property types. The rationale for this was that the ENERGY STAR Portfolio Manager property types are a much better segmentation to represent comparable energy and environmental performance than the Building Code occupancy groups that are segmented mainly for life safety and zoning purposes.

The proposed rule also establishes the electricity and district steam emissions intensity conversion factors for 2030–2034, with the carbon intensity of electricity dropping by about half from the value specified in the law for the first compliance period (2024–2029). This

major change reflects policies established by New York State's Climate Protection and Community Protection Act of 2019, which sets legally binding targets for a dramatic reduction of electric grid emissions by 2030, leading to a zero-carbon electric grid by 2040.

The rule includes additional clarifications to specific provisions for the first and second compliance periods, including guidance around calculations for annual GHG emissions, gross floor area, and annual emissions limits. The rule also specifies GHG limits for the remaining compliance periods out to 2050, ramping down to require carbon neutral buildings by 2050 (Bocra 2022).

The final rule was published in December 2022, effective in January 2023, and is essentially identical to the rule proposed in October 2022, though it is expected that additional rulemaking with other details will follow later in 2023.

In addition, in December 2022, per the legislated requirement, the Local Law 97 Advisory Board Report was published by the Department of Buildings (NYC 2022). The Advisory Board makeup was specified in the legislation, and their work was supported by seven appointed Working Groups that met regularly from 2020 through 2022. The report was required by the 2019 legislation and provides recommendations to help the city achieve at least a 40% reduction in aggregate GHG emissions from covered buildings by 2030, relative to a 2005 baseline (NYC DOB 2022). The law allows flexibility through alternative compliance paths, including up to 100% deduction from annual emissions limits for purchase of credits for renewable energy generated in New York City or feeding directly into New York City. Also included is a deduction for up to 10% of the limits through purchase of GHG offsets for the 2024–2029 period, with rules to be established that will further define what types of offsets are allowed.

In addition, the law allows the possibility for a new trading system (similar to the Tokyo Cap-and-Trade Program), where individual buildings could trade emissions reductions with other buildings, presumably leading to lower costs to achieve the law's emissions reduction goals. The legislation directed the city to conduct a study on the feasibility of a citywide trading scheme for buildings, which was completed in 2021 (Guarini 2021). The study found that compared with implementing LL97 without trading, either of the trading schemes outlined in the study would reduce more GHG emissions from buildings, reduce more local air pollution in environmental justice communities and the city as a whole, and reduce costs for building owners seeking to bring their properties into compliance with LL97. In total, though, the benefits to building owners, in the form of lower costs, would be modest. However, because of ongoing concerns about a trading system increasing air pollution in environmental justice communities, at this time it is unlikely that trading will be a compliance option.

The law established a new Office of Building Energy and Emissions Performance within the New York City Department of Buildings that will continue to develop additional rules to provide more guidance on the alternative compliance paths, as well as a number of other issues delegated to them through the legislation.

Some building types are excluded from the law's GHG limits. The largest sector excluded is multifamily housing buildings with at least one rent-regulated unit or other low-income or subsidized housing. The original passage of LL97 had the threshold of "at least one rent-regulated unit . . .," though a subsequent 2020 amendment of the law changed that threshold to "more than 35% of the units in the building," following changes to New York State legislation regarding rent-regulated housing and cost recovery from tenants for required capital investments. These buildings can either meet the emissions limits or follow a prescriptive path that requires a list of relatively low-cost energy savings measures. Concerns were expressed about the impacts of more-stringent requirements on rents. Some special conditions allow flexibility for houses of worship and nonprofit hospitals and health-care facilities.

### **Companion Programs**

The new law builds on the earlier Greener, Greater Buildings package of laws passed in 2009 (NYC 2009),<sup>18</sup> which requires energy audits with retrocommissioning every 10 years, and mandatory lighting system and submetering upgrades by 2025.

A variety of other supporting programs and initiatives have been established:

- The New York City Energy Efficiency Corporation, which is a nonprofit finance company with financing solutions to enable projects that save energy or reduce GHG emissions;
- The Building Energy Exchange, which is a resource and trusted expert to the building industry;
- The NYC Accelerator, which offers targeted outreach and free advisory services to help building owners streamline the process of improving energy and water efficiency.

In addition, substantial market support activities are funded by the New York State Energy Research and Development Authority (NYSERDA) (e.g., a flexible technical assistance program for facility owners and work on demonstrating deep low-rise multifamily retrofits), along with significant incentives from the local utilities Con Edison and National Grid.

### **Sources and Additional Information**

- New York City Mayor's Office of Sustainability Buildings Page: [www1.nyc.gov/site/sustainability/our-programs/buildings.page](http://www1.nyc.gov/site/sustainability/our-programs/buildings.page)

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<sup>18</sup> The benchmarking and disclosure law was expanded in 2016 to include buildings over 25,000 sq. ft.

- New York City Department of Buildings LL97 Page: [www.nyc.gov/site/sustainablebuildings/ll97/local-law-97.page](http://www.nyc.gov/site/sustainablebuildings/ll97/local-law-97.page)
- Urban Green Council resources: [www.urbangreencouncil.org/content/projects/all-about-nycs-historic-building-emissions-law](http://www.urbangreencouncil.org/content/projects/all-about-nycs-historic-building-emissions-law)

## WASHINGTON STATE

### Building Performance Standards

On May 7, 2019, the Clean Buildings Bill was signed into law as part of a package of climate-change bills promoted by the governor and passed by the legislature. While there was some opposition to the commercial building standards in the bill, it was muted because those with concerns saw that the bill would pass and directed their energies to some modifications rather than outright opposition. The bill requires the Washington State Department of Commerce to develop and implement an energy performance standard for covered commercial buildings (those with a floor area of 50,000 sq. ft. or more) and to provide incentives for early compliance. Under the law, from 2021 until mandatory compliance begins for a building, the standard will be used to administer a voluntary efficiency incentive program. Beginning in 2026, the standard will be implemented as a mandatory requirement for the largest buildings (floor area of 220,000 sq. ft. or more), with mandatory requirements beginning a year later for buildings 90,000–219,999 sq. ft. and an additional year later for buildings 50,000–89,999 sq. ft. The law also calls for revising the initial performance standards by July 1, 2029, and every five years thereafter.

In 2022, the legislature modified the original legislation to include multifamily buildings and to reduce the floor area threshold for the program from 50,000 sq. ft. to 20,000 sq. ft. Initially benchmarking, operations and maintenance programs, and energy management planning will be extended to these buildings starting in 2027, and then site energy use targets will be applied four years later in 2031.

The law instructs that American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/Illuminating Engineering Society (IES) Standard 100-2018, Energy Efficiency in Existing Buildings (ASHRAE 2018), be used as the model standard. A rulemaking completed in late-2020 created a Washington-specific modified version of the standard to meet specific requirements of the law. This rule established a state energy performance standard for covered commercial buildings as well as multifamily buildings seeking an incentive (discussed further below). In compliance with the statute, the standard included site EUI targets by building type, that are no greater than the average EUI for the covered commercial building occupancy type, with adjustments for unique energy-using features. The law allows more-stringent targets for newer buildings and the rule does set stronger targets for buildings covered by the 2015 and subsequent Washington State energy codes. The rule also includes methods of conditional compliance that include an energy management plan, operations and maintenance program, energy efficiency audits, and investment in energy efficiency measures designed to meet the targets.

All buildings covered by the program will require energy management as well as operations and maintenance plans, including creating energy benchmarking reports. The mandatory standard requires building owners to demonstrate that their building consumes less energy than a specified EUI target or be in the process of reducing the building's EUI. The incentive program provides early adopters financial support when they demonstrate they have moved a noncompliant building into compliance with the standard.

In preparing to begin implementation, program staff have had to work through a variety of issues. They have had challenges synchronizing data from various sources in order to determine which buildings are covered by the program. Also, while some utilities have successfully linked their billing data to ENERGY STAR Portfolio Manager (the benchmarking tool), other utilities have had difficulties doing so. While pre-2015 buildings are subject to the same standards, some building owners have suggested that the oldest buildings need separate targets. The state has offered many workshops for building owners to explain the law and regulations and plan further outreach and educational activities. They are still wrestling with the details on exemptions for financial hardship—what specifically to exempt and how requests for exemption need to be documented (E. Salzberg, buildings unit managing director, Washington State Department of Commerce, pers. comm., December 5, 2022).

### **Companion Programs**

As noted, the legislation establishing the law also establishes an incentive program for buildings demonstrating early compliance. The incentive is \$0.85 per square foot of conditioned floor area. At this level, incentives are anticipated to cover only a portion of upgrade costs. Total incentives in the initial legislation are capped at \$75 million but the 2022 amendment to the law added \$150 million for buildings added by the 2022 amendment. The incentives will be paid by utilities who in turn receive an offsetting credit on their state utility tax. Owners could submit applications for incentives starting July 1, 2021, and if an application is accepted after review, incentive funds will be set aside for use by that building. Buildings will be given a period (e.g., two years) to come into early compliance with the standards and receive their incentive. As written in law, incentives will be paid after compliance with the standards is demonstrated; hence, the building owner must front money for compliance. This has proven to be a major barrier to participation and as of the end of 2022, only 35 applications have been initiated and only four have been submitted.

The \$150 million provided in the 2022 amendment can help cover the costs of benchmarking newly covered buildings and allows enhanced incentives for affordable housing in exchange for agreement by the owner to limit future rent increases.

In addition to the state incentives, covered buildings may be eligible for other utility energy efficiency incentives. A provision in the law and to be reflected in the rules provides that utilities may pay incentives for energy savings to meet the standards, even though the

standards are mandatory. This was done to assure utility incentives remained available to help reduce costs to building owners and to contribute to political support for the bill.

In addition, the Department of Commerce has developed a technical support program for participants. Through a joint effort with the Northwest Energy Efficiency Alliance, British Columbia, and others, a Standard 100 user's manual was developed and published in 2021 (RDH Energy 2021).

### Sources and Additional Information

- Program webpage: [www.commerce.wa.gov/buildings](http://www.commerce.wa.gov/buildings)
- The original law (Washington State Legislature 2019)
- The 2022 amendment (Washington State Legislature 2022)
- Clean Buildings Performance Standard—Integrated Document (Washington State Department of Commerce 2021)
- Clean Buildings Early Adopter Incentive Program (Washington State Department of Commerce 2023).
- Presentation on the program (Murray 2019)
- A blog on the act and challenges that need to be addressed (Majersik and Miller 2019)

## ST. LOUIS, MISSOURI

### Building Performance Standards

Legislation to establish performance standards for commercial, institutional, multifamily, and municipal buildings with a floor area of 50,000 sq. ft. or more was enacted by the city council in April 2020 and signed by the mayor in May 2020. The law builds on energy benchmarking for these same buildings that was adopted in 2017. The law directed the mayor to appoint a Building Energy Improvement Board (BEIB) to develop the specific standards and other details of the standards. Under the law, the standards can be no lower than the 65th percentile of current buildings of each type, meaning that at least 65% of buildings must upgrade each cycle (St. Louis 2020a). The initial standards are expressed as an EUI target that varies by building type and were adopted in spring 2021 and must be achieved within four years (six years for affordable housing). Initial standards are shown in table 2.

**Table 2. Initial St. Louis BEPS (site EUI is Btu/sq. ft.)**

Property group type	BEPS	Property group type	BEPS
College/university	113.8	Museum	118.4
Dormitory	64.5	Nonrefrigerated warehouse	17.6
Education	80.1	Office	71.7

Property group type	BEPS	Property group type	BEPS
Food service	181.9	Outpatient healthcare	105.9
Grocery store	256.5	Public assembly	77.3
Hospital	259.9	Public order and safety	112.3
Hotel	89.4	Refrigerated warehouse	84.1
K–12 school	63.5	Religious worship	63.4
Laboratory	219.2	Retail/service	79.3
Library	57.0	Senior care/residential care	111.3
Manufacturing/industrial	38.9	Strip shopping mall	101.1
Multifamily housing	42.5		

**Source: St. Louis 2020a**

Under the law, the standards must be updated every four years (or every six years for affordable housing). The law allows the BEIB to grant extensions for hardship, allows alternative compliance plans, and allows alternative compliance payments. Another provision in the bill allows buildings that slash their site EUI by undergoing a deep retrofit to be deemed compliant for the next 15 years (St. Louis 2020a). Based on this guidance, St. Louis has established four main compliance paths (St. Louis 2020b):

1. Performance—meet the EUI target for the relevant building type.
2. Early adopters—deep retrofits meeting specific criteria will be deemed to be in compliance for several cycles.
3. Narrow the gap alternative compliance path—if a building improves its performance to the midpoint between its 2018 performance and its performance standard, then it can qualify for this path (only applies to cycles 1 and 2).
4. Custom alternative compliance path—for special situations where the above three paths will not work, an owner can submit a proposed custom compliance plan for review, and if accepted then the approved proposal becomes binding between the owner and the city.

In anticipation of the legislation, the city budget for fiscal year 2021 included funding to establish and staff an Office of High Performance Buildings to work on implementation. This office now has four staff, who are currently working to improve the benchmarking compliance rate as part of efforts to reach out to and educate building owners. They are also working to make sure that benchmarking submissions include all data such as monthly energy consumption so that weather-normalized consumption can be accurately determined. For 2024, the city will require third-party verification of benchmarking data and is now planning training for these third-party verifiers. The city is also developing a web portal for building owners to help them navigate the program. In 2023 the city will develop guidance on when a custom alternative compliance plan is needed and criteria for

evaluating those plans. They are also assembling a technical subcommittee to provide input and advice on custom plans.

When asked for lessons learned so far, staff working on the program note the importance of reaching out to people and providing one-on-one consultation and technical assistance. Presently the city is using customized software developed by a contractor, but they are interested in purchasing more sophisticated software if funds can be found to pay annual subscription fees (K. Michalova, program manager, Office of High Performance Buildings, City of St. Louis, pers. comm., January 11, 2023).

### **Companion Programs**

Several current programs will help with implementation. For example, the Missouri Gateway Chapter of the U.S. Green Building Council has worked with the City of St. Louis on education programs connected with the initial building benchmarking program and now operates a Building Energy Exchange St. Louis that provides information and resources. This is funded by local utilities, corporations, a local university, and an environmental group (E. Andrews, executive director at US Green Building Council—Missouri Gateway Chapter, pers. comm., January 6, 2022). Missouri also has property assessed clean energy (PACE) financing available (commercial and residential) that can help finance building upgrades. The local utilities, Ameren and Spire, offer a variety of energy efficiency programs, including incentives. These will be available to building owners. Their incentives are particularly generous for upgrades to affordable housing. The targets in the bill were set as performance standards, not prescriptive standards, to make it easier for the utility to continue to claim credit for energy savings when they provide incentives (with prescriptive standards, it could be argued that the measures are required and, therefore, there are not incremental savings benefits).

### **Sources and Additional Information**

- The ordinance (St. Louis 2020a)
- A blog on the act (Majersik and Miller 2020)
- City of St. Louis compliance pathways fact sheet (St. Louis 2020b)
- Implementation handbook (St. Louis 2022)
- Buildings Energy Exchange website: [www.be-exstl.org/](http://www.be-exstl.org/)

## **CHULA VISTA, CALIFORNIA**

### **Building Performance Standards**

Chula Vista is a city of about 275,000 people located just south of San Diego. In March 2021, Chula Vista adopted an ordinance establishing energy benchmarking and upgrade requirements for multifamily and commercial buildings with a floor area of at least 20,000 sq. ft. This ordinance implements one of 12 measures in the city's Climate Change Action

Plan, specifically, requiring energy-saving retrofits in existing buildings. The ordinance was developed by city staff and adopted by the city council.

Under the ordinance, covered buildings must file benchmarking reports using ENERGY STAR Portfolio Manager, beginning in spring 2022. Required upgrades fall into three categories—conservation requirements, multifamily prescriptive upgrades, and minimum improvement requirements. The conservation requirements are that either an energy audit and retrocommissioning study be conducted, or that the building meets specified performance improvement targets (discussed below).

The conservation requirements must be met every five years, beginning in 2023 for buildings of at least 50,000 sq. ft. and in 2026 for buildings of 20,000–49,999 sq. ft. The multifamily prescriptive measures are a list of nine measures, of which 2–5 must be implemented, varying by climate zone (five measures in the inland zone) and building age (2–4 measures in the coastal zone, with the most measures for pre-1978 buildings). Prescriptive measures are attic insulation, air sealing, duct sealing, LED lighting, a water heating package, windows, water heater replacement, and air conditioner replacement. The ordinance authorizes the city manager to add measures to this list. The multifamily requirements apply the same year as the conservation requirements.

The minimum improvement applies every 10 years (initially 2028 and 2031, depending on building size) and calls for a 15% improvement in site EUI (expressed in Btu per sq. ft.) for buildings with an ENERGY STAR benchmark score of 45 or less, and a 10% improvement for buildings with a benchmark score of 46–65. For buildings that are not covered by ENERGY STAR benchmarking, the ordinance includes site EUI thresholds for the 15% and 10% improvement requirements.

The ordinance specifies modest penalties for noncompliance—the maximum noncompliance penalty per incident is \$750 for buildings under 50,000 sq. feet. This rises to \$2,250 for buildings of 100,000 sq. ft. or more. These penalties can be levied each year until a building is in compliance.

### **Companion Programs**

Chula Vista has been working with its local utility, San Diego Gas and Electric, to help inform and educate building owners about benchmarking and their BPS. The utility also has extensive energy efficiency services and incentives that building owners can use to help improve their buildings and meet the BPS requirements.

Another interesting aspect of Chula Vista’s BPS is a provision to limit residential rent increases. Under the law the cost of energy audits and energy-saving improvements to residential property must be amortized over five years and not immediately passed on in higher rents (Silverman, Miller, and Biever 2022).

### **Sources and Additional Information**

- Chula Vista Building Energy Savings Ordinance webpage (includes link to actual ordinance): [www.chulavistaca.gov/departments/clean/benchmarking](http://www.chulavistaca.gov/departments/clean/benchmarking)

## COLORADO

### Building Performance Standards

In Colorado, building performance standards have worked to align energy efficiency and climate goals. In 2019, Colorado passed the Climate Action Plan to Reduce Pollution (House Bill 19-1261) specifying science-based targets for reducing GHG pollution 26% by 2025, 50% by 2030, and 90% by 2050 from 2005 levels. To determine near-term actions by sector to achieve 50% reduction by 2030, Colorado released its “Greenhouse Gas Pollution Reduction Roadmap” in January 2021 and identified that more actions are needed (Colorado 2021). For buildings, the roadmap recommended requiring large commercial buildings to track energy use and make progress toward energy and pollution performance standards.

In response to the Roadmap, the Colorado legislature passed the Energy Performance for Buildings statute, House Bill 21-1286, in June 2021 (Colorado General Assembly 2021). The law established building benchmarking and BPS for all commercial, multifamily, and public buildings of 50,000 sq. ft. or more. It also specified GHG emission reduction targets for the BPS of 7% by 2026 and 20% by 2030 from 2021 levels. The timeline for benchmarking and BPS within the law is shown in figure 2.

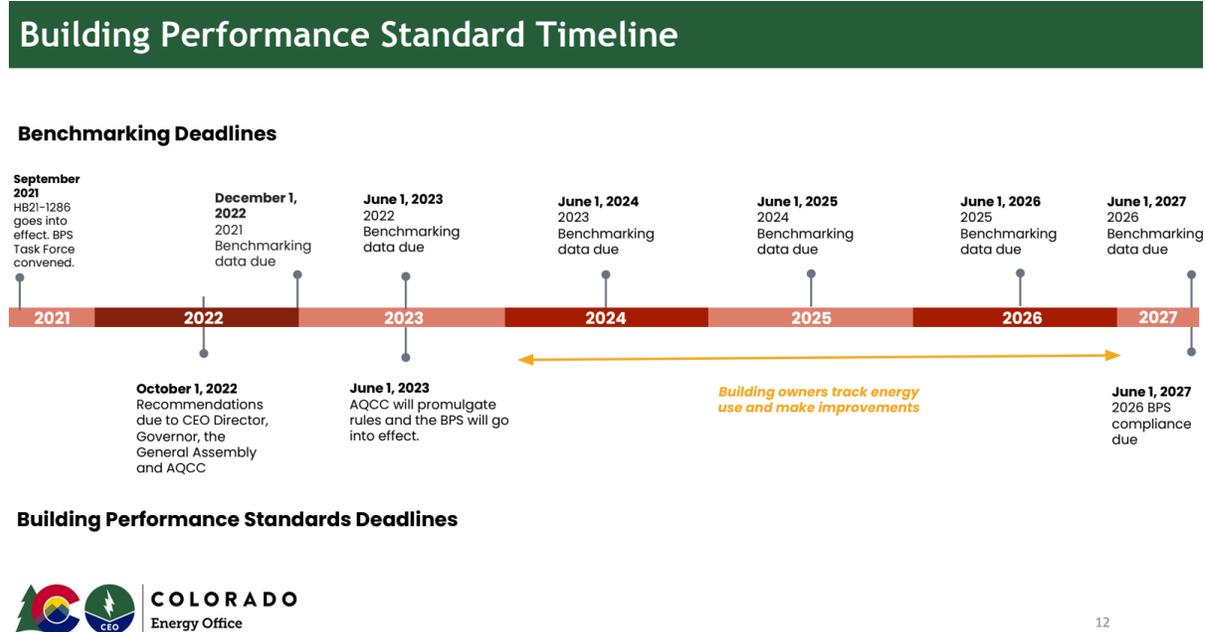


Figure 2. Colorado’s Building Performance Standards: Task Force Recommendations Timeline (CEO 2022a)

Additionally, the law directed the Colorado Energy Office (CEO) to convene a task force to develop recommendations to achieve the BPS emissions targets collectively by all buildings within Colorado. The task force developed broad recommendations including a compliance

structure (shown in figure 3), metrics, as well as programs to support compliance, equity, and workforce. The Colorado BPS will go into effect after June 2023. Between now and then, the Air Quality Control Commission (AQCC) will develop the final rules for the BPS based on the task force recommendations by June 1, 2023 (CDPHE 2023).

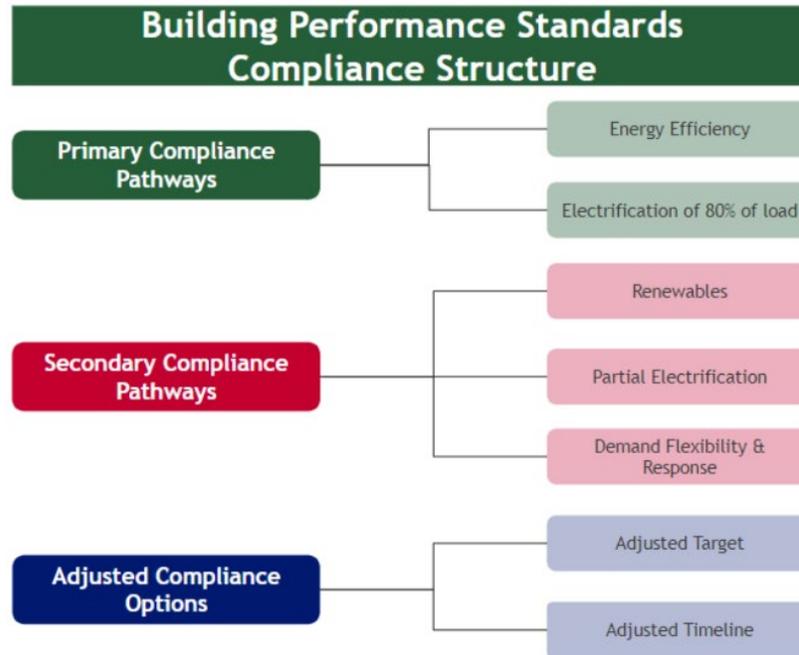


Figure 3. Colorado's BPS Task Force Recommendations Compliance Structure (CEO 2022b). Some changes from this structure are likely in the final rules.

### Companion Programs

The Colorado Benchmarking program in the Energy Performance for Buildings statute House Bill 21-1286 (Colorado General Assembly 2021) went into effect on September 6, 2021 (CEO 2023). The first benchmarking reporting deadline for calendar year 2021 energy use data was December 1, 2022. The online portal for both benchmarking and BPS is Building Performance Colorado (Building Performance Colorado 2023).

In addition, the local utility, Xcel Energy, operates a full suite of energy efficiency programs.

### Sources and Additional Information

- Colorado Energy Office Building Performance Standards website: [energyoffice.colorado.gov/climate-energy/energy-policy/building-performance-standards](https://energyoffice.colorado.gov/climate-energy/energy-policy/building-performance-standards)

## BOSTON

### Building Performance Standards

Boston adopted a building benchmarking law in 2013 called the Building Energy Reporting and Disclosure Ordinance (BERDO) and has been implementing this law since 2014. In fall 2019, Boston revised its Climate Action Plan that included a building emissions performance standard to help the city achieve its ambitious climate goals. The city then conducted technical analysis and a public process (part of which was led by community organizations), leading to a proposed amendment. A final ordinance, renamed the Building Emissions Reduction and Disclosure Ordinance (dubbed BERDO 2.0) was adopted by the city council in September 2021.

The new law lowered the size of buildings subject to BERDO from 35,000 to 20,000 sq. ft. for nonresidential buildings and from 35 units to 15 units for residential buildings. In addition, it instituted mandatory carbon dioxide emissions standards per sq. ft. of floor area beginning in 2025 for buildings over 35,000 sq. ft. or 35 units. For 20,000–34,999 sq. ft. or 15–34-unit buildings, standards do not take effect until 2031. The standards can be met by reducing emissions below the standards levels using energy efficiency, fuel switching, or renewable energy. Buildings may also use power purchase agreements (PPAs) and renewable energy certificates (RECs) to help meet their targets. For PPAs, the RECs must be retired and not sold to others. For RECs, they must be for generation within the New England Power Pool and be “class 1” RECs.

The new BERDO legislation also establishes Alternative Compliance Payments (ACPs) of \$234 per metric ton of CO<sub>2</sub> (which will be reviewed every five years). ACPs can be paid for any amount of carbon over the emissions standard to come into compliance with the standard. Any funds collected will go into an Equitable Emissions Investment Fund to support emissions reduction projects in Boston that prioritize environmental justice communities. A new Emissions Review Board is established to oversee this fund. Two-thirds of the members of this board will be proposed by local community organizations.

Fines may be issued for failure to comply (i.e., falling short of the standards and not making alternative compliance payments) of \$1,000 per day for larger covered buildings (over 35,000 sq. ft) and \$300 per day for smaller covered buildings.

Unlike many cities that first passed legislation and then are developing the specific standards, Boston conducted a detailed analysis before adoption and the specific standards are included in the legislation. These standards, which are shown in table 3, steadily tighten over time and reach zero emissions in 2050. Further implementing details are being developed in regulations and policies by the Boston Air Pollution Control Commission, the organization that oversees BERDO.

Table 3. Building emissions requirements in Boston

Building use	Emissions standard (kgCO <sub>2</sub> e/SF/yr.)					
	2025 - 2029	2030-2034	2035-2039	2040-2044	2045-2049	2050-
<u>Assembly</u>	7.8	4.6	3.3	2.1	1.1	0
<u>College/ University</u>	10.2	5.3	3.8	2.5	1.2	0
<u>Education</u>	3.9	2.4	1.8	1.2	0.6	0
<u>Food Sales &amp; Service</u>	17.4	10.9	8.0	5.4	2.7	0
<u>Healthcare</u>	15.4	10.0	7.4	4.9	2.4	0
<u>Lodging</u>	5.8	3.7	2.7	1.8	0.9	0
<u>Manufacturing/ Industrial</u>	23.9	15.3	10.9	6.7	3.2	0
<u>Multifamily housing</u>	4.1	2.4	1.8	1.1	0.6	0
<u>Office</u>	5.3	3.2	2.4	1.6	0.8	0
<u>Retail</u>	7.1	3.4	2.4	1.5	0.7	0
<u>Services</u>	7.5	4.5	3.3	2.2	1.1	0
<u>Storage</u>	5.4	2.8	1.8	1.0	0.4	0
<u>Technology/Science</u>	19.2	11.1	7.8	5.1	2.5	0

Source: BERDO Ordinance

The 2021 legislation also includes several other changes. In addition to reporting energy and water use annually, buildings must report purchases of RECs and purchases via PPA. Most years owners may self-certify their data, but every five years third-party verification will be required in accordance with regulations that have been developed.

BERDO staff note that putting more details into the legislation has made developing regulations easier. Regulations are being developed in three phases: (1) amending benchmarking and reporting rules to meet the new requirements of BERDO 2.0 and the need for third-party verification every five years; (2) setting rules for the appointment and operation of the review board and adopting emissions factors and renewable energy rules; and (3) addressing flexibility details, such as for hardships and individualized compliance schedules and also developing rules for the expenditure of the equitable investment fund. Staff note that synchronizing benchmarking and city assessment data, which is the primary source of building-level data, has been a challenge as the assessment data were not developed with BERDO in mind (H. Payne, carbon neutrality program manager, City of Boston, pers. comm., December 7, 2022).

## Companion Programs

The Equitable Buildings Emissions Fund discussed above is a major complementary policy. Furthermore, the Boston Environment Department runs a Retrofit Resource Hub for building owners (link below under resources). In addition, the local utilities (Eversource for electricity, National Grid for gas) offer energy efficiency programs and technical assistance that can be used by building owners. Boston engages in a process by which three-year plans are developed for utility-run energy efficiency programs and will look to the next plan to complement BERDO, with items such as additional support for energy upgrades to affordable housing.

Under climate legislation passed in 2022, the Commonwealth of Massachusetts will begin a building benchmarking program for buildings 20,000 sq. ft. and greater. Boston hopes to work closely with the state to understand program details and make it easier for building owners to comply with both the state and city programs.

## Sources and Additional Information

- Building Emissions Reduction and Disclosure website: [boston.gov/departments/environment/building-emissions-reduction-and-disclosure](https://boston.gov/departments/environment/building-emissions-reduction-and-disclosure)
- Article on BERDO (Holland & Knight 2021)
- Ordinance (Boston 2021)
- Technical analysis on emissions standard (Eash-Gates et al. 2021)

## DENVER

### Building Performance Standards

Denver is the largest city in Colorado at a population over 710,000 people. Denver's building performance standard is a decarbonization policy that builds on climate plans and benchmarking requirements (Denver 2023a) by adding energy efficiency and electrification requirements for buildings. As part of Denver's Climate Action Stakeholder process in 2020, the city updated their climate goals to science-based targets committing to reduce GHG emissions by 40% by 2025, 65% by 2030, and 100% by 2040 from 2019 levels (Denver 2023b). This effort was followed by the development of Denver's Office of Climate Action, Sustainability, and Resiliency and the Climate Protection Fund raising local sales and use tax by 0.25% to raise \$40 million each year to act urgently to mitigate the causes of climate change and to center that work on equity (Denver 2023c). One of the keys to success is the fact that Denver has the authority to pass and enforce building energy codes at the local level.

Denver's BPS process began with the Energize Denver Task Force that convened for broad stakeholder input into the development (Denver 2023f). In September 2021, the task force developed recommendations for the City and County of Denver to enhance energy efficiency and reduce emissions from buildings. The approach recommended by the task

force and in the final ordinance and rules and regulations is multifaceted (Denver 2021, 2022b). It applies to varying extents to all commercial and multifamily buildings in Denver and is summarized in table 4. Not only is it tiered by building size, but the implementation is also phased. Similar to Boston, Denver developed specific details for the standard prior to approval of the ordinance and worked to ensure stakeholder involvement throughout development.

**Table 4. Denver’s BPS by building size, compliance date, and energy requirement**

Building size (sq. ft.)	Compliance date	Energy requirement
25,000+	June 1, 2024	Interim EUI Target
	June 1, 2027	Interim EUI Target
	June 1, 2030	EUI Performance Requirement
15,001–24,999	December 31, 2025	Lighting or Renewable Energy Requirement
10,001–15,000	December 31, 2026	Lighting or Renewable Energy Requirement
5,000–10,000	December 31, 2027	Lighting or Renewable Energy Requirement
Under 5,000	n/a	None

Larger buildings at or over 25,000 sq. ft. are currently required to follow all three sections of Denver’s BPS within the Energize Denver Ordinance including annual benchmarking, energy performance requirements, and electrification requirements (Denver 2022a). Benchmarking using ENERGY STAR Portfolio Manager is required each year. For energy performance, Denver’s BPS for larger buildings require a trajectory performance approach (shown below) to get to a 2030 performance requirement specified by building type. Under the legislation, the 2030 performance standard must achieve an average of 30% energy savings across all building types. Each building type has a weather normalized site EUI requirement. A full analysis of building typology and EUI was developed for Denver (Group 14 Engineering 2021). Additionally, interim targets in 2024 and 2027 are specified for each building by drawing a straight line from the 2019 baseline EUI for that building to the 2030 Performance Requirement as shown in figure 4. There are also specifications and allowances for adjusting the targets (Denver 2022b).

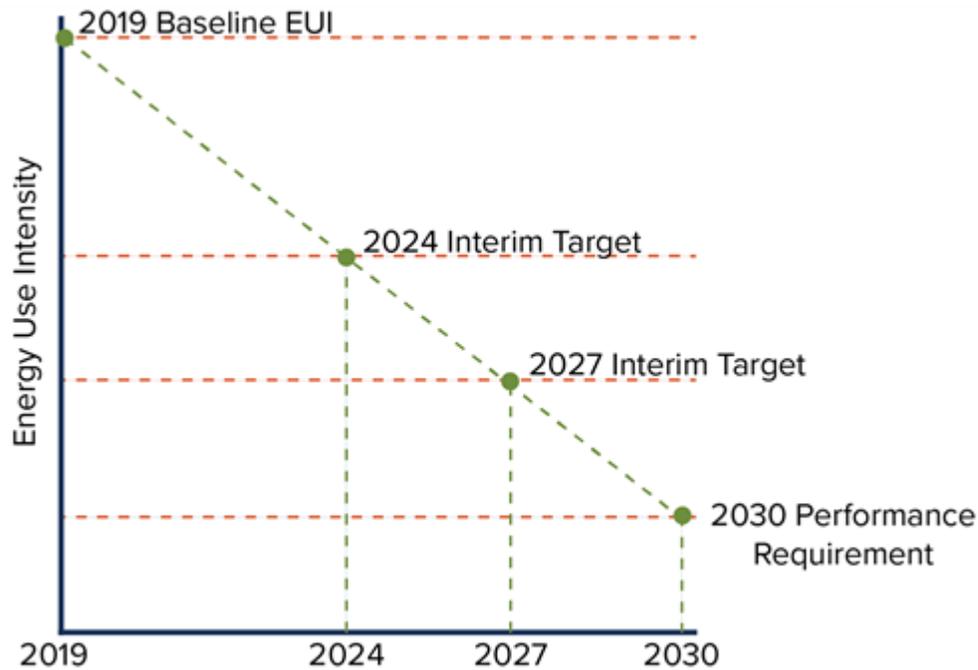


Figure 4. Determining interim energy use intensity targets for each building (Denver 2023i)

All larger buildings at or over 25,000 sq. ft. have electrification requirements when replacing space and water heating equipment covered by building code updates in 2023, 2025, and 2027 (Denver 2023g). On March 1, 2023, like for like replacements will no longer be allowed to pull a quick permit. The quick permit process will become the process for heat pump installations. In 2025 and 2027, additional equipment requirements for decarbonization in the Denver Building Code are phased in over time as shown in table 5.

Table 5. Denver’s Energize Denver ordinance electrification equipment requirements

Building type	Compliance date	Electrification requirement
All	2023	Quick Permit process limited to heat pump installations
commercial and multifamily buildings	2025	Upon failure, gas furnace must be replaced with electric for primary heating system.
	2027	Upon failure, AC/condensing unit must be replaced with electric system that can provide heating

Buildings between 5,000–24,999 sq. ft. are required to meet energy and electrification requirements, but do not have to benchmark. For these buildings, the energy requirements are prescriptive and require improving lighting or improving energy sources through installing renewables. The compliance deadlines vary by building size (as shown above). As with larger buildings, the buildings between 5,000–24,999 sq. ft. have electrification

requirements when replacing space and water heating equipment covered by building code updates in 2023, 2025, and 2027.

Buildings under 5,000 sq. ft. do not have energy requirements but do have electrification requirements when replacing space and water heating equipment covered by building code updates in 2023, 2025, and 2027.

### **Companion Programs**

In 2016, Denver passed a benchmarking ordinance for all buildings 25,000 sq. ft. and larger. The ordinance was updated in 2021 to align with the new BPS requirements. One feature of the program is that Denver maps each building on the interactive Energize Denver Benchmarking Map (Denver 2023d).

Denver is working to both address climate and further equity. Denver developed the Energize Denver Hub to support the community and building owners in complying with the ordinance (Denver 2023e). The hub includes resources online, a newsletter, help desk, and many other efforts. As part of this, they have defined and provided additional support to under-resourced buildings as part of their BPS (Denver 2023h). This began in 2023 to provide further technical services and assistance through the Energize Denver Hub based on feedback from the community. They also have funded several pilot incentive programs for these under-resourced buildings: the Building Electrification Pilot Program; the Steam-to-Electric Conversion Incentive Program; the Renewables and Resilience Incentive Program for Human Service Providers; and the Healthy Homes Program (Denver 2023h).

In addition, the local utility, Xcel Energy, operates a full suite of energy efficiency programs.

### **Sources and Additional Information**

- Performance requirements website: [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Performance-Requirements](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Performance-Requirements)

## **MARYLAND**

### **Building Performance Standards**

The Maryland legislature passed the Climate Solutions Now Act in April 2022, and it became law in May 2022 after the then-governor neither signed nor vetoed it. The law requires the state to reduce emissions by 60% from 2006 levels by 2031, and to reach net-zero emissions by 2045. It requires development of a plan to meet these targets and includes a variety of provisions that will result in direct GHG reductions. One of these provisions is a building energy data reporting and building energy performance standard that applies to most commercial and multifamily buildings over 35,000 sq. ft. of floor area (there are some exceptions). Details on the specific standards will be decided by the Department of the

Environment via rulemaking with input from stakeholders. The regulations must address a variety of considerations specified in the law such as building age, occupancy type, and regional differences and consider the needs of building owners who do not have control over tenant energy use.

The law specifies that the standards shall result in a 20% reduction in net direct GHG emissions by 2030 relative to average 2025 emissions for buildings of similar construction. The law further requires zero net direct GHG emissions by 2040. The term “direct emissions” means only onsite emissions are included and emissions to generate power offsite are not included. Thus, this section of the law is designed to encourage electrification. Another section of the law requires energy use intensity standards be included in the regulations. Under the law, building owners may pay an “alternative compliance fee” in lieu of compliance with the standards, with the fee needing to be at least as much as the social cost of carbon determined by the Maryland Department of the Environment or the U.S. Environmental Protection Agency.

### **Companion Programs**

The law established a (1) Climate Catalytic Capital Fund to leverage private funds with a focus on low- to moderate-income Census tracts, and (2) a Building Energy Transition Implementation Task Force, whose main responsibility is to recommend programs and investments to facilitate the decarbonization of buildings and their compliance with BEPS. In addition, Maryland utilities and the state operate a variety of energy efficiency programs under the name EmPOWER Maryland.

### **Sources and Additional Information**

- Articles summarizing the law (NCEL 2022; Majersik 2022)
- Climate Solutions Now Act (Maryland Legislature 2022)

## **MONTGOMERY COUNTY MARYLAND**

### **Building Performance Standards**

Montgomery County is Maryland’s most populous county and is just north and west of Washington, DC. Montgomery County has had building energy benchmarking for commercial buildings of 50,000 sq. ft. or more since 2016. In May 2022 the law was amended to include multifamily buildings, extend coverage down to 25,000 sq. ft., and establish minimum energy performance standards with details to be developed with input from a Building Performance Improvement Board. Under the law the standards will be specified in terms of site energy use intensity (energy per square foot). Electricity use is included but not upstream energy used for power generation and distribution. Thus, the standards will encourage electrification but also encourage energy efficiency improvements to reduce energy use. In Montgomery County, buildings will likely need to meet both the county and

state standards, and thus the county law will drive energy efficiency savings and both will drive electrification.

Specifically, the Montgomery County standards are structured in a way similar to the Denver standards discussed above, with two rounds of standards over the 2028–2036 period and effective dates and the final standard varying with building type and size. Standards take effect soonest for county-owned buildings and commercial buildings over 50,000 sq. ft. and last for multifamily buildings of 25,000–250,000 sq. ft. Following the trajectory approach that the Institute for Market Transformation (IMT) developed in collaboration with Montgomery County staff and private stakeholders (IMT 2021), the interim standard will depend on both a building’s current energy use and its’ final standard, with the interim standard providing a glide path between the two as illustrated schematically in figure 5.

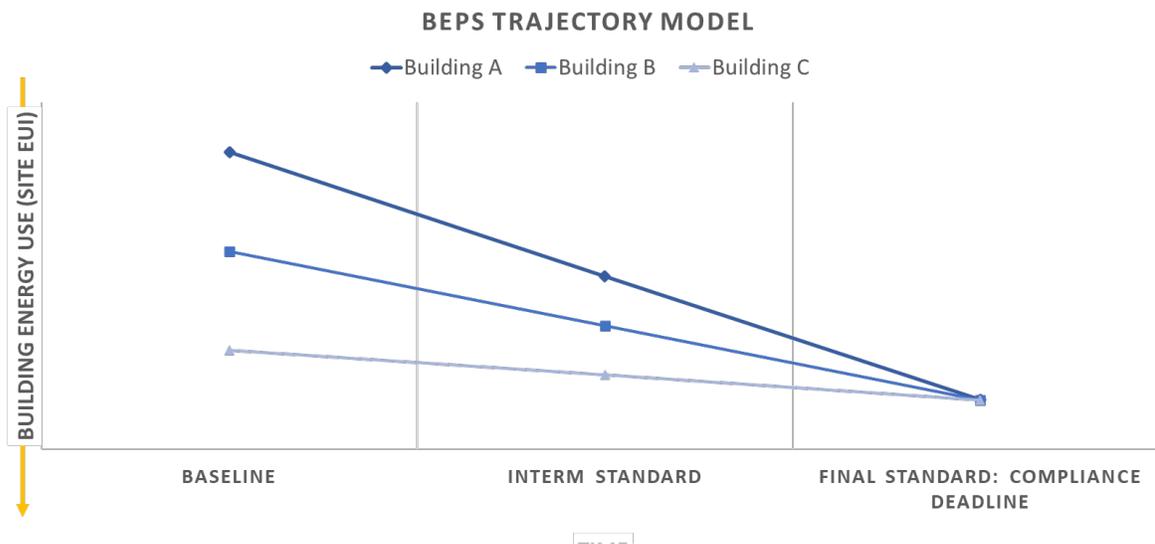


Figure 5. Illustration of how Montgomery County standards are structured

### Companion Programs

Before enacting the BPS, Montgomery County expanded the funding to its Green Bank to provide financing for building energy improvements. Specifically, they dedicated 10% of the county’s fuel-energy tax revenue to the Green Bank and required that at least 20% of the county funds support activities in equity emphasis” areas of the county and that at least 15% of county funds be used to reduce the cost of energy projects undertaken by property owners by a loan subsidy, interest rate buydown, technical assistance, pre-development, blended capital, or other similar tools. Providing financing for affordable housing upgrades was an important part of efforts to build support for the BPS. The county Green Bank presently has three main financing programs open to commercial buildings: (1) Commercial Property Assessed Clean Energy (C-PACE) in which loan repayments are added to property tax bills; (2) Commercial Loan for Energy Efficiency and Renewables (CLEER), which is a more

conventional loan secured by the equipment installed; and (3) Commercial Solar Power Purchase Agreement (CSPPA), under which a developer installs a system and the customer purchases the system output for a defined period of time. In addition, there is a small business program and an option to develop tailored structured finance to achieve positive cashflow and finance up to 100% of project costs. The Green Bank also offers technical assistance for commercial entities to inform and accelerate investment decisions in energy efficiency and renewable energy projects that improve building energy performance.

The county also provides an Energy-Efficient Buildings Property Tax Credit for new and existing buildings. This two-tiered incentive provides credits for existing commercial or multifamily buildings 10,000 sq. ft. or larger that demonstrate improved energy performance in ENERGY STAR Portfolio Manager. Once energy performance improvements are demonstrated, buildings can earn additional credit for achieving recognized green building certifications. Buildings located in Equity Emphasis Areas receive an additional 10% credit, and an up-to-100% deduction in property taxes as a credit granted against the county taxes owed for two years.

Additionally, the District of Columbia High-Performance Buildings Hub is interested in serving the region, which would include expanding services into Montgomery County.

### **Sources and Additional Information**

- Building Energy Performance Standards webpage: [www.montgomerycountymd.gov/green/energy/beps.html](http://www.montgomerycountymd.gov/green/energy/beps.html)
- BPS law (Montgomery County 2022)
- Article on the standard (Majersik 2022)
- Green Bank web page on commercial loans (Montgomery County Green Bank 2023)

## **VANCOUVER, BRITISH COLUMBIA**

### **Building Performance Standards**

Vancouver is the fourth largest city in Canada and the first city in Canada to adopt BPS. The Vancouver Annual Greenhouse Gas and Energy Limits By-Law was adopted in July 2022. The bylaw requires large commercial and multifamily buildings to submit an annual benchmarking report on their consumption and carbon emissions, and for the largest commercial buildings establishes an onsite carbon pollution limit. The benchmarking requirements start in 2024 for commercial buildings over 100,000 sq. ft. of floor area. They extend in 2025 to multifamily buildings over 100,000 sq. ft. and to commercial buildings over 50,000 sq. ft., and extend in 2026 to multifamily buildings over 50,000 sq. ft. The carbon pollution limits apply beginning in 2026 to commercial buildings over 100,000 sq. ft. There presently are no limits for smaller buildings or for large multifamily buildings. The carbon pollution limits for 2026 are 25 kg CO<sub>2</sub> per sq. meter of floor area annually for offices and 14 kg per sq. meter for retail (these are the same as 5.12 and 2.87 lb. per sq. ft., respectively). In 2040, these limits will decline to zero. Due to provincial law, Vancouver cannot apply limits to

electricity, so the limits only apply to fuels used onsite for space and water heating. The intent is to encourage electrification. The British Columbia electric system is mostly hydro, so CO<sub>2</sub> emissions in the electric sector are small. In 2040, covered buildings will also be subject to a heat limit of 0.09 Gigajoules per sq. meter per year (7,925 Btu/sq. ft.). This heat limit will require investment in very high-efficiency space and water heating equipment in order to keep electric loads down. Some use of renewable natural gas will be permitted to meet peak heating demands.

### **Companion Programs**

The Regional Governing Authority for the Vancouver area is thinking about adopting standards similar to Vancouver's that would cover areas near Vancouver.

The Canadian province of British Columbia is developing equipment efficiency standards that will apply point of sale and possibly point of installation (if it does not conflict with the Canadian building code). Tentative plans are to require a coefficient of performance (COP) greater than one, which would require heat pumps (electric or gas).

In addition, the local utilities, BC Hydro and Fortis (gas), offer some additional energy efficiency programs.

### **Sources and Additional Information**

- Article on the bylaw (Silverman 2022)
- Bylaw (Vancouver 2022)

## **SUMMARY AND COMPARISON**

The Boulder and Tokyo standards were adopted in 2010, the France and the UK standards were adopted in 2015, four were adopted between December 2018 and May 2019, and seven were adopted in 2021 and 2022. To allow easy comparisons of these programs, key program criteria for each jurisdiction are summarized in tables 6a, b, and c. We discuss many of the other parameters in the section on key design decisions.

Table 6a. Key criteria for adopted building performance standards—standards in effect

Jurisdiction	Year enacted	Building types included	Minimum building size covered (sq. ft.)	Metric	Initial year of performance requirements	Standard(s)
Tokyo	2010	C, I	1,500 kiloliters of oil equivalent	CO <sub>2</sub> emissions (tonnes CO <sub>2</sub> )	2015	17% reduction from baseline by 2020
Boulder	2010	RR	NA	Points (which are based on energy and carbon)	2019	Earn 100 points using prescriptive table or HERS score of 120
United Kingdom	2015	CR	NA	Energy Performance Certificate Rating*	2018	Meet E performance under A–G label
The Netherlands	2018	Offices	~1,000	Energy Performance Certificate Rating*	2023	Meet C performance under A–G label

\*Energy performance certificate ratings generally based on “delivered” (essentially the same as site) energy use per square meter.

Building types: C = commercial; CR = commercial rental; I = industrial; MF = multifamily; R = residences; RR = rental residences. “Initial year” refers to the first year that requirements apply to at least some buildings. Many cities phase this over time, and thus the date listed often applies to only some covered buildings.

**Table 6b. Key criteria for adopted building performance standards—standards adopted in 2020 and earlier but not yet in effect**

Jurisdiction	Year enacted	Building types included	Minimum building size covered (sq. ft.)	Metric	Initial year of performance requirements	Standard(s)
France	2015	Private R	NA	Energy Performance Certificate Rating*	2025	Meet C performance under A–G label
Reno	2019	C, MF	30,000	ENERGY STAR score (energy and water) or EUI and WUI	2026	Multiple energy and water options—see text
Washington, DC	2019	C, MF	10,000	ENERGY STAR Benchmark Score	2026	Each cycle at least median ENERGY STAR score for that building type or reduce energy use 20%
New York City	2019	C, many MF	25,000	Carbon intensity (tons CO <sub>2</sub> equivalent per sq. ft.)	2024	40% reduction by 2030, 80% by 2050
Washington State	2019	C, MF	20,000	Site EUI (kBtu per sq. ft.)	2026	Must be no more than median for that building type
St. Louis	2020	C, MF	50,000	Site EUI (kBtu per sq. ft.)	2025	Based on the 65th percentile (currently met by 35% of buildings)

Notes for table 6a apply.

**Table 6c. Key criteria for adopted building performance standards—standards adopted 2021–2023 but not yet in effect**

Jurisdiction	Year enacted	Building types included	Minimum building size covered (sq. ft.)	Metric	Initial year of performance requirements	Standard(s)
Chula Vista	2021	C, MF	20,000	Site EUI (kBtu per sq. ft.)	2023 for audit and prescriptive, 2028 for performance	Prescriptive measures for MF, audit, and performance for commercial. Performance requirements must save 10–15% in first round
Colorado	2021	C, MF	50,000	Carbon intensity (tons CO <sub>2</sub> equivalent per sq. ft.)	2028	To be determined but initial standard must reduce emissions at least 7%
Boston	2021	C, MF	20,000	Carbon intensity (tons CO <sub>2</sub> equivalent per sq. ft.)	2024	Zero emission by 2050 with interim targets every five years specified in the law
Denver	2021	C, MF	25,000	Site EUI (kBtu per sq. ft.)	2024	2030 EUI with two interim standards; also restrictions on fossil-fuel equipment at time of replacement
Maryland	2022	C, MF	35,000	Site carbon intensity (tons CO <sub>2</sub> equivalent per sq. ft.)	2030	20% reduction in carbon intensity by 2030, zero direct emissions by 2040
Montgomery County, MD	2022	C, MF	25,000	Site EUI (kBtu per sq. ft.)	2028	TBD (little guidance in bill)
Vancouver	2022	C	100,000	Carbon intensity	2026	25 kg/m <sup>2</sup> for offices, 14 for retail in 2026; zero in 2040. Also a 2040 heat standard.

Jurisdiction	Year enacted	Building types included	Minimum building size covered (sq. ft.)	Metric	Initial year of performance requirements	Standard(s)
Seattle	2023	C, MF	20,000	Carbon intensity (tons CO <sub>2</sub> equivalent per sq. ft.)	2027	Zero emission by 2040 for commercial, 2045 for MF with interim targets

Notes for table 6a apply.

## Geographically Broad Standards

### U.S. FEDERAL BUILDING PERFORMANCE STANDARD

In December 2022, the Council on Environment Quality (CEQ) issued the Federal Building Performance Standard (BPS), which will affect 91% of the total federal government facility energy use (CEQ 2022). This guidance will apply to over 300,000 existing buildings or facilities tracked by the Federal Energy Management Program compliance tracking system.

The federal BPS established a target for each federal agency to achieve zero Scope 1 emissions in 30% of their gross square footage, by 2030. In the context of emissions reporting, the scope of emissions is defined in terms of whether the reporting entity owns and controls the asset producing the emissions. Scope 1 emissions are direct GHG emissions resulting from fuel combustion from sources owned by the reporting entity (typically building owners), including those associated with combustion in boilers, furnaces, and similar equipment.<sup>19</sup>

The intent of the federal BPS is to curtail building fossil fuel use, based on the previously mentioned 30% reduction rule by 2030. Future Scope 1 reduction rates will continue to escalate. The authority for CEQ to issue the BPS comes from Executive Order 14057, which requires agencies to reduce Scope 1 and Scope 2 emissions by 65% (from a 2008 baseline) by 2030 and achieve net-zero emissions across their building portfolio, by 2045.

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<sup>19</sup> Scope 1 emissions, as differentiated from Scope 2 and 3 emissions—Scope 2 emissions are indirect GHG emissions associated with the purchase of useful energy (electricity, steam, heating, cooling) that is used at the reporting entity's site but is not generated by assets controlled by the reporting entity. Scope 3 emissions are the result of activities from assets not owned or controlled by the "reporting authority," but that the organization indirectly affects in its value chain.

As outlined in the federal BPS, Scope 1 conversion to 100% electrification is a performance pathway to meet this standard. BPS guidance outlines both prescriptive and performance GHG pathways to address life cycle-cost analysis requirements, calculations, exclusions, and reporting.

### For Additional Information

- Federal Building Performance Standard: [www.sustainability.gov/pdfs/federal-building-performance-standard.pdf](http://www.sustainability.gov/pdfs/federal-building-performance-standard.pdf)
- Article “How Does the First Federal BPS Measure Up?” (Boyce 2022).

## EUROPE

Beyond the European countries listed above with BPS in place, the European Commission has proposed European Union (EU)-wide performance standards (known as minimum energy performance standards, or MEPS, for buildings) as part of proposed changes to meet the EU “Fit for 55” climate goals to meet EU legislation that mandates a 55% reduction in EU emissions by 2030.

The MEPS are proposed to take effect in all EU member states by 2030 and would be based on the Energy Performance Certificate A through F (or G) grading scale that has been required in the EU since 2010 as part of the EU Energy Performance of Buildings Directive (EPBD). The EPBD has required MEPS for new construction since 2018, and the current Fit for 55 proposal would require new minimum performance from existing buildings.

The proposal would impose the following requirements:

- Residential buildings would need to meet a D energy performance class by 2033, and more-stringent levels for 2040 to be established by each country, with all existing buildings transformed to zero emission buildings by 2050.
- Nonresidential buildings would, by 2030, need to meet a standard set at 15% below the average amount of energy that buildings use per square meter based on the total building stock in place as of January 2020. This requirement would increase to 25% below by 2034,
- There are significant exceptions in the proposal, including historic buildings, places of worship, and buildings used for religious purposes, as well as stand-alone small buildings (less than 50 square meters) (European Council 2023).

As of October 2022, the European Council has reached an agreement on this proposal to revise the EPBD, and it is expected that sometime in 2023 the European Commission will formally adopt revisions requiring member states to adopt these MEPS.

### For Additional Information

- Fit for 55: making buildings in the EU greener:  
<https://www.consilium.europa.eu/en/infographics/fit-for-55-making-buildings-in-the-eu-greener/>

## Pending Proposals

In the United States, many additional jurisdictions have joined the National Building Performance Standards Coalition, which is a nationwide group of state and local governments that have committed to inclusively design and implement building performance policies and programs in their jurisdictions. The Coalition was formed by the Biden Administration Council on Environmental Quality and as of this writing includes 37 jurisdictions. This includes most of the jurisdictions that have already enacted BPS, as discussed above. The jurisdictions that have not yet adopted BPS but have committed to do so, generally via a commitment by their chief elected official, are listed in table 7.

Table 7. Members of the National Building Performance Standards Coalition that have not already adopted BPS

<b>States</b>	<b>Cities</b>	
California	Ann Arbor, MI	Annapolis, MD
	Aspen, CO	Atlanta, GA
	Berkeley, CA	Cambridge, MA
	Chicago, IL	Columbus, OH
	Evanston, IL	Fort Collins, CO
	Grand Rapids, MI	Ithaca, NY
	Kansas City, MO	Los Angeles, CA
	Milwaukee, WI	Minneapolis, MN
	Montpelier, VT	Orlando, FL
	Philadelphia, PA	Pittsburgh, PA
	Portland, OR	Prince Georges County, MD
	Sacramento, CA	San Diego, CA
	San Francisco, CA	Savannah, SC

Most of these jurisdictions are still developing proposals, but three—Cambridge, MA, Portland, OR, and Seattle, WA—are planning to adopt final legislation in 2023. We discuss these proposals below.

#### *CAMBRIDGE, MASSACHUSETTS*

Cambridge enacted a Building Energy Use Disclosure Ordinance (BEUDO) in 2014. It establishes a building energy-use reporting and disclosure requirement for commercial buildings of 25,000 sq. ft. or more and multifamily buildings with 50 units or more. These buildings account for about 70% of the city's GHG emissions.

The ordinance includes a provision directing staff to look into possible building performance standards. A study by the city found that building performance was improving about 1% per year, much too slowly to meet the city's goal of being carbon neutral by 2050. As a result, the city conducted extensive stakeholder engagement to explore possible building performance standard options. On the basis of these consultations, recommended building performance standard amendments to BEUDO will be based on GHG standards where each building must steadily reduce its emissions relative to a 2019–2020 baseline. An ordinance

has been drafted and is now being reviewed and revised by the city council, with a target of adoption in the fall of 2023.

Originally the city was planning to require all buildings to have zero emissions by 2050, but the city council has changed that to 2035 for commercial buildings and added options to purchase offsite renewable energy (details are still being developed) and to allow building owners to purchase alternative compliance credits (ACCs), with the initial price of such credits set at \$234 per ton (the same as Boston). They are considering the possibility of allowing building owners to take credit for GHG reductions beyond the requirements paid for in other Cambridge buildings and are also considering allowing deferral of ACCs up to 10 years to execute capital improvement projects, assuming that cumulative GHG reductions are equivalent (Cambridge 2022). For university campuses, the entire campus could be managed as a unit. GHG standards were chosen because reducing GHG is the ultimate goal and because GHG standards allow each building to determine an appropriate mix of energy efficiency, electrification, and clean energy in order to comply.

The city has also worked with the local utility, Eversource, to set up a “concierge service” to help covered buildings improve their energy efficiency. Eversource staffs the program and provides technical assistance and financial incentives, all covered by its energy efficiency budget (Shemkus 2019; Cambridge 2023).

### *PORTLAND, OREGON*

The City of Portland has been developing a BPS proposal for several years with assistance from IMT. The current proposal is to have a GHG emissions standard that steadily ramps down to zero emissions in 2050. Initial standards will reduce emissions about 15% relative to a base period with the base ranging from 2023 for commercial buildings greater than 50,000 sq. ft., to 2026 for small multifamily buildings of 20,000–50,000 sq. ft. Small commercial buildings will have a 2024 base; large multifamily buildings will have a 2025 base. Initial standards will apply four years after the base period with new standards every four years on the trajectory to the 2050 target. The city will encourage energy efficiency, but Oregon law prevents them from adopting energy standards that differ from the state building code. Emissions from use of electricity will be included until the electric grid is 100% decarbonized, hopefully by 2030 due to a combination of city and state policies.

A complementary effort is the HEART standards for rental apartments, which include health (i.e., stove ventilation) equitable energy (carbon limits to reduce energy cost burdens), anti-displacement (link funding to restrictions on passing through costs to renters), resilience (i.e., to power outages), and temperature (requirements for cooling in apartments). The proposed HEART standards are on a similar schedule to the BPS and include identifying funding for improvements to regulated and unregulated affordable housing such as federal funds from the Inflation Reduction Act and funds from the Portland Energy Fund, which is financed by a tax on large businesses (Portland 2022; V. Mason, senior climate policy advisor, City of Portland, pers. comm., January 13, 2023).

*SEATTLE, WASHINGTON*

Seattle has been developing a BEPS for several years as part of its effort to reach its climate goals. The proposed standard is a GHG emissions standard that would apply to commercial and multifamily buildings over 20,000 sq. ft. With Seattle's already low electric emissions, the majority of emissions reductions from the policy would come from natural gas and district energy sources powered by fossil fuels. Like Boston, targets are in the proposed legislation, varying by building type, with targets steadily tightening every five years until net-zero emissions are required by 2050 or sooner, depending on building size, type, and compliance path.

The policy development process has included extensive consultation with stakeholders and as a result of stakeholder concerns, a variety of alternative compliance paths are built into the proposal:

- Custom targets based on current emissions ramping down over time to net zero;
- Ability to apply targets in aggregate for a portfolio of buildings, or buildings on a campus that share district energy or metering;
- Hardship compliance plans for significant extenuating circumstances, such as unreinforced masonry, city landmark historic building, electric service capacity constraints, district campus central plant upgrade, or for when no practicable low or zero GHG emissions alternatives are available on the market for a necessary function;
- Alternative compliance payments based on the social cost of carbon per metric ton CO<sub>2</sub>e, with funds directed to technical and financial assistance for reducing emissions in under-resourced buildings.

There are also a variety of proposed time-limited end-use deductions (e.g., for process energy use and cooking). If the legislation is enacted, a rulemaking process will further define and clarify alternative compliance options, deductions, and administrative procedures.

The city launched a Seattle Clean Buildings Accelerator support hub in 2022 for building owners and managers, specifically prioritizing those who are under-resourced and especially nonprofits and those serving communities of color. The hub plans to add staff and significantly grow the program in 2023 and beyond.

More detail on Seattle's BEPS proposal, compliance dates, and an updated timeline for the policy development process can be found in Seattle's Buildings Emission Performance Standards document (Seattle 2023).

## **Policies Short of Whole-Building Performance Standards**

While this paper discusses whole-building performance standards, a number of cities have adopted prescriptive building standards covering such items as lighting upgrades and other retrofit requirements, building tune-up and recommissioning/retrocommissioning

requirements (recommissioning HVAC and other major systems in an existing building), and energy audit requirements. As noted in the Introduction, these policies are usually a step beyond building benchmarking but fall short of whole-building standards. Some cities (e.g., New York City) have used these policies as a stepping-stone to whole-building standards.

The 2020 version of this report includes brief descriptions of two dozen of these policies (Nadel and Hinge 2020). A more recent map highlighting many of these policies can be found in figure 7 below.

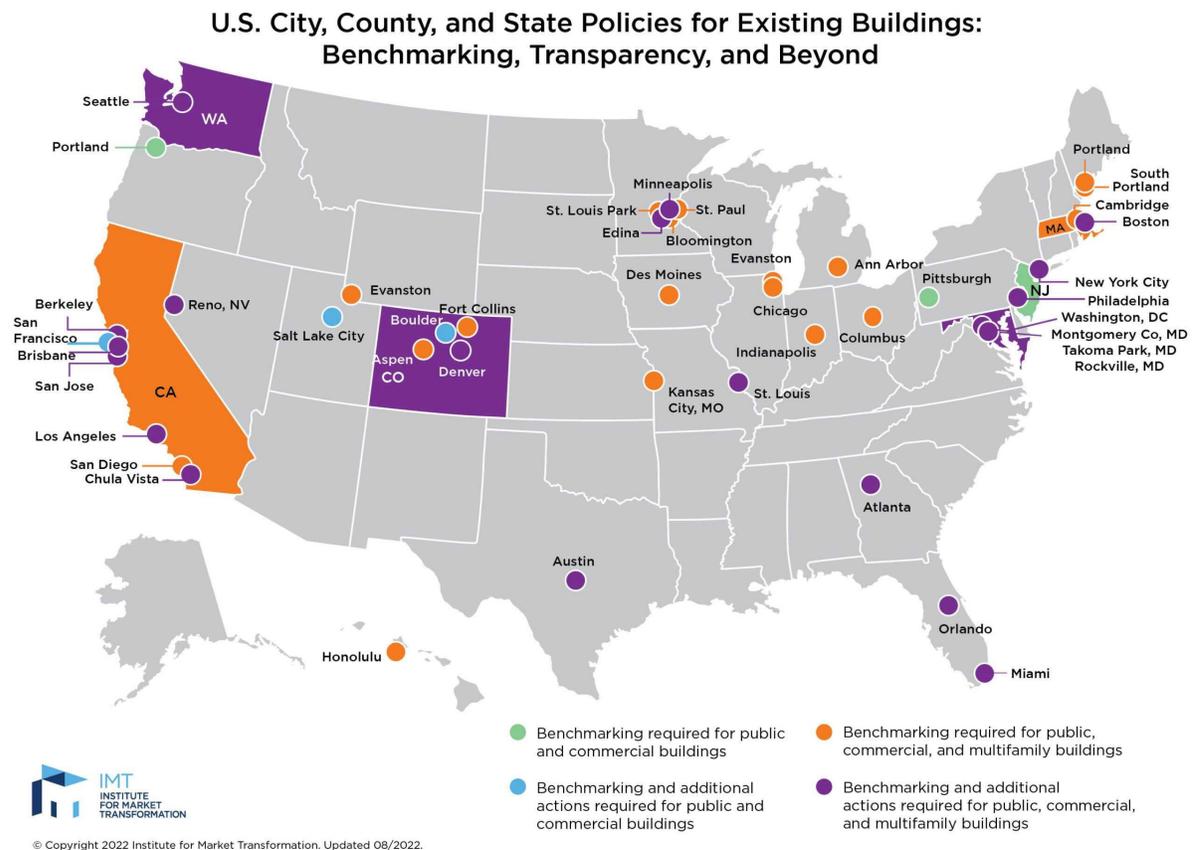


Figure 7. Cities and states with benchmarking and policies beyond benchmarking. Source: IMT 2023.

## Key Policy and Design Decisions

In developing building performance standards, policymakers have a variety of design decisions to make. In this section, we discuss several of these decisions and how jurisdictions have addressed them to date. This section reports on the range of decisions jurisdictions are making. We do provide some recommendations in subsequent sections. In general, however, each jurisdiction is different, and we are still early on the learning curve, so the ability to make reasoned recommendations is limited.

In this section, we address six topics, with specific questions under each:

- Seeking input prior to adopting a BPS;
- BPS coverage, metrics, and targets;
- Equity issues;
- Implementation specifics;
- Compliance options;
- Financing required upgrades.

In addition, we note that some publications by others, such as ASHRAE (2023), EPA (2022a), and IMT (2022) also discuss these and other topics and may be worth reviewing.

## **DEVELOPING A BPS INCLUDING WHAT INPUT SHOULD BE SOUGHT PRIOR TO ADOPTING A BPS**

Development of a BPS can begin at many levels. It may begin with city or state staff who develop the idea and ultimately seek legislative adoption. For example, this was the process used in Chula Vista, St. Louis, Montgomery County, and Vancouver, and that is now being used in Cambridge, Portland, and Seattle. It may begin with a member of a legislature or city council, often with assistance from outside experts, which was the case in DC, Colorado, and Maryland. In some cases, a taskforce or commission is convened, to either make general or highly specific recommendations, as in Denver, Maryland, and Montgomery County. There is no best process but each jurisdiction needs to consider its available time, expertise, interested stakeholders, and political situation.

During the BPS development process, all jurisdictions sought input from interested stakeholders, always including building owners and often including building trades, utilities, energy, and consumer groups and community-based organizations. As the manager of the DC BPS said when asked about lessons learned, it is important to engage stakeholders early and often, be humble, transparent, and honest. Boston went a step further and contracted with a community organization to facilitate input from tenants in affected buildings. Through these consultations, compromises were often negotiated, which gave the legislation broad support. Examples of critical compromises include considering a trading program in New York City, Boston's Equitable Buildings Emissions Fund, and providing substantial funds to green banks in DC and Montgomery County and to the Sustainable Energy Utility in DC.

As part of the development process, a lead implementation agency should be identified. Other state or city agencies play a supportive role but decisions and implementation become clearer if there is a designated lead agency.

## BPS COVERAGE, METRICS AND TARGETS

### *IS ENERGY-USE BENCHMARKING A KEY FOUNDATION FOR PERFORMANCE STANDARDS?*

In 12 of the 18 cases we profile, energy-use benchmarking preceded the building performance standards.<sup>20</sup> In Boston, Denver, Montgomery County, St. Louis, Washington, DC, Washington State, France, the Netherlands, and the United Kingdom, the standards specifically use the results of benchmarking, such as the ENERGY STAR score or the European A–G label (known in Europe as building rating or certification, not benchmarking). In Tokyo and New York City, the benchmarking results provided the baseline for carbon reduction goals. In six jurisdictions (Chula Vista, Colorado, Maryland, Reno, Vancouver, and Washington State), the same legislation established both benchmarking and standards. Thus, benchmarking is generally a foundation for performance standards.

However, Vancouver established their BPS targets using computer models of representative buildings. These models were calibrated using benchmarking data from Seattle, a nearby city. Likewise, Washington State established their targets with a combination of Seattle benchmarking data and computer models of representative buildings.

Of the programs now being implemented, only Boulder is not currently benchmarking buildings covered by their performance standard.<sup>21</sup> In Boulder, the standard is based on the building code instead of benchmarking.

### *WHICH BUILDING TYPES AND SIZES SHOULD BE COVERED?*

One of the initial decisions is which building types to cover—commercial, multifamily, and/or single family. Of the 18 jurisdictions with building performance standards, 16 cover commercial buildings and 15 include multifamily (two cover just rentals; the others also include owner-occupied multifamily). Three cover single family; two of these cover just rentals; and only one (France) includes single-family owner-occupied. These data are shown in table 2. As noted in earlier sections, many cities choose commercial and multifamily because these buildings generally account for a large share of energy use and GHG emissions and hence potential energy and emissions reductions.

The 16 standards that apply to commercial buildings (many also include multifamily) all have a minimum size threshold for coverage. This size threshold ranges from 100 square meters (just over 1,000 sq. ft.) in the Netherlands to 100,000 sq. ft. in Vancouver. In the United

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<sup>20</sup> However, the requirement in Washington State applies only at the time of building sale or lease.

<sup>21</sup> Boulder does benchmark large commercial buildings, but these are not covered by their building performance standard, which only covers rental housing. Rental housing is not covered by benchmarking.

States, size thresholds range from 10,000 sq. ft. (Washington, DC) to 50,000 sq. ft. (St. Louis and Colorado). The Tokyo standard applies to high energy users, defined as at least 1,500 kiloliters of oil equivalent annually. Specific data are shown in table 2. For many of the programs, the standards apply first to the largest buildings, with the size thresholds declining over time. For example, Reno's standards phase in for four different size and ownership classes over a six-year period. Some jurisdictions also have the standards apply first to public (government owned) buildings to lead by example.

### *WHAT EXEMPTIONS AND ACCOMMODATIONS SHOULD BE CONSIDERED?*

The performance standards generally include some exemptions and/or include some accommodations for specific buildings or types of buildings. Exemptions mean that a building is not subject to the BPS. Accommodations mean that the requirements are in some way modified, such as an extended timetable for compliance or a less stringent set of standards.

For example, in Boulder, exemptions include buildings built after 2001 (they were built to the 1999 code upon which the program was based), accessory dwelling units, mobile homes, and units that have already received free weatherization through the low-income weatherization program. In Reno, the legislation lists 13 specific exemptions such as new buildings built under the current building code, unoccupied buildings, buildings undergoing financial distress (specifically defined), buildings with less than 60% occupancy, and buildings with a demolition permit.

As an example of an accommodation, in Washington, DC, the effective date can be delayed for buildings that demonstrate financial distress, have a change of ownership, are vacant, are receiving a major renovation, are pending demolition, or meet other criteria established by the DC Department of Energy and Environment. As another example, the New York City legislation has less stringent, differentiated requirements for houses of worship and for multifamily buildings where 35% or more of the units in the building are rent-regulated.

The United Kingdom has a maximum expenditure per housing unit, and once the cap is reached, the apartment is deemed exempt, even if it is not yet at the E level. The Netherlands and the United Kingdom have a maximum simple payback period for required improvements. Scotland is considering an exemption as well for homes where meeting the target is not feasible or economically viable. Boulder considered a cost cap but ultimately decided against it, electing instead to provide more time (eight years) to bring buildings into compliance.

For many of the jurisdictions, the details—including exemptions and accommodations—are still being decided.

In general, some limited exemptions will probably be needed, but the general advice we received from program implementers is to keep exemptions limited. When a building is exempted, they do not contribute to community goals nor do they achieve building-specific benefits. For example, while a few communities exempt new construction, many do not, but

instead recognize that new buildings meeting recent building codes will often have an easier path to come into compliance with a BPS. In Washington State newer buildings were given more-stringent targets when BPS regulations were developed. Instead of exemptions, accommodations can be used to address challenging situations such as affordable housing (discussed later in these questions) and historic buildings (e.g., New York City allows owners of historic buildings to apply for an adjustment to the emissions limit if they can demonstrate that there are constraints from other laws protecting the site, or there are some other constraints such as lack of access to energy infrastructure space constraints, or lack of access to a space within the building covered by a lease).

### *WHICH METRICS SHOULD BE USED FOR PERFORMANCE STANDARDS?*

The choice of the metric for the performance standard affects many other important items in the development and implementation of the standard. While most jurisdictions are implementing performance standards to reduce building-sector GHG emissions, using energy as the metric instead of GHG may be simpler for owners to understand and make changes to comply.

Most of the performance standards to date use an energy metric, typically some variation on energy-use per unit of floor area. Several programs use some type of energy rating system that normalizes for a variety of occupancy issues and other drivers of energy intensity between different buildings. In the United States, this is usually the ENERGY STAR score. The ENERGY STAR score starts with the energy use per unit floor area for specific building types and geographies but is then adjusted for weather and several occupancy-related and other factors. ENERGY STAR scores are based on “source” energy use, meaning that electricity is valued according to the amount of energy (Btu) needed to generate, transmit, and distribute a kWh of electricity. In Europe, all member states were required through the European Energy Performance of Buildings Directive to provide EPCs for all buildings, most often as an A through G rating, somewhat mirroring the equipment and appliance labeling system in place throughout Europe. These ratings are generally based on building “delivered” (essentially site) energy use per square meter of building floor area.

An underlying issue is whether ratings should be based on actual measured building energy use, often called operational ratings (like EPA’s ENERGY STAR), or calculated on the basis of as-built building characteristics, often called asset ratings (such as the European rating scheme as well as Home Energy Scores<sup>22</sup> in the United States). Operational ratings are based on actual performance and hence are much less dependent on assumptions. However, operational ratings are very much affected by the behavior of current occupants, and the performance for future occupants could well be very different. The advantages and

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<sup>22</sup> Home Energy Score rates homes on a 10-point scale. It was developed by DOE and is used in some city and utility programs.

disadvantages of these two approaches are discussed by the International Partnership for Energy Efficiency Cooperation (IPEEC 2014). In general, the trend in the United States and Canada is to use operational ratings for commercial buildings (including large multifamily buildings) but asset ratings for single-family homes. We discuss this issue further in the lessons learned section.

One city (Boulder) uses a point-based energy metric (a type of asset rating), but with some adjustments for the carbon intensity of specific fuels. Two standards (New York City and Boston) use carbon intensity (based on operational data), and one other city (Washington, DC) plans to investigate carbon intensity for future use. Tokyo uses carbon as the metric but assigns a specific baseline “allocation” for each building based on historic emissions. Specifics by jurisdiction are shown in table 6. One way to simplify calculating GHG emissions is to calculate and publish an average GHG emissions factor for electricity that building owners and managers can use in their calculations. For example, New York City has published such factors for the second compliance period through to 2034 based on analysis of likely electric grid improvements in the coming decade.

Where possible, it is helpful to have the performance standard metric be consistent with other building energy or environmental policies in the jurisdiction. For example, the Boulder standard is based on their building codes, but in other cases this is just not possible. For example, some building codes use energy cost relative to an equivalent baseline building as a compliance path, which requires computer simulations of individual buildings. This would be an onerous approach for a BPS. In other cases, policies may be inconsistent but perhaps could be aligned in the future. In New York City, for example, while the performance standard uses GHG intensity as the metric, the city’s building energy label is based on the building’s ENERGY STAR score, which adds confusion about the relative performance under the different metrics.

Also, in some cases, state or provincial law limits what a city can do. For example, state building code requirements in British Columbia and Oregon restricted the metrics that Vancouver and Portland could use.

Given that many larger building owners have properties in multiple jurisdictions, using established models such as ENERGY STAR score or other outputs from Portfolio Manager makes acceptance of the policies simpler and compliance potentially easier compared with very different approaches that have been established in some jurisdictions.

Since the two main approaches thus far are based on EUI and CO<sub>2</sub> emissions, table 8 provides a summary of the pros and cons of these two approaches.

**Table 8. Pros and cons of the two major performance standard approaches**

Approach	Pros	Cons
EUI	<p>Can use established programs such as ENERGY STAR and the European Energy Performance Certificate to address important normalizations; many users are familiar with these metrics and tools</p> <p>Emphasizes energy efficiency</p>	<p>Largely ignores what happens on the grid, even though the source of power is very important for emissions</p> <p>Since only addresses energy use, harder to develop long-term very deep emissions reduction targets</p>
GHG emissions	<p>Gets at the ultimate goal for most jurisdictions—reducing GHG emissions</p> <p>Provides additional flexibility for building owners if offsets and trading are allowed</p> <p>Easier to set long-term goals, for example, out to 2050</p>	<p>Emissions from the grid included but are beyond the control of building owners; emissions per kWh will change over time depending on what happens on the grid<sup>23</sup></p> <p>Could deemphasize energy efficiency if RECs or offsets widely available; with less efficiency, comfort and other benefits of efficiency reduced and supplying power on peak and calm/cloudy days can be more challenging</p>

It is also possible to include multiple metrics, as discussed in the text box below.

More details on the advantages of these and other metrics are provided in EPA ENERGY STAR (EPA 2022b) and ASHRAE (2023).

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<sup>23</sup> Issue of changing emissions factors can be addressed by specifying conversion factors as part of the standard, as in the NYC law.

## USING MULTIPLE METRICS IN ONE JURISDICTION

Jurisdictions may elect to use multiple metrics. There are two primary ways this has been done:

1. Each building is subject to a single metric, but different metrics are applied by building type or size for a reason identified by the jurisdiction or a limitation of the primary selected metric.

- Example: The Washington, DC, BPS metric is the ENERGY STAR score, except for building types where an ENERGY STAR score is not available, where the equivalent metric is weather-normalized source EUI. Buildings that do not meet the standard have five years to reduce their energy use by 20%, as measured in weather-normalized source EUI.

2. Each building is subject to multiple metrics because the selection of a single metric was identified as unable to achieve the specific goals outlined by the jurisdiction.

- Example: Denver is seeking to reduce energy consumption and drive electrification. Both site EUI and electrification ratio are being considered to simultaneously signal the need for both. Likewise, Maryland is setting both GHG and energy intensity standards.

IMT, in their model legislation, is now recommending that both site energy and overall carbon intensity metrics be adopted. The former helps drive energy efficiency improvements while the latter helps drive electrification and the use of renewable energy (IMT 2021).

### *SHOULD SPECIFIC PROVISIONS BE MADE FOR ELECTRIFICATION?*

One consideration for a growing number of jurisdictions is to encourage not only energy efficiency improvements but also a shift in home and commercial building energy use from fossil fuels (e.g., fuel oil, propane, and natural gas) to electricity. Such a shift can reduce GHG emissions as long as the electric grid is moderately clean, a situation that applies in many, but not all, states now and will become more common in the coming years (Nadel 2018, 2016). Several of the building performance standards deal with electrification in either explicit or implicit ways.

Explicit ways to encourage electrification include:

- Applying BPS to only onsite fuel use as Vancouver does (provincial law prevents them from regulating electricity) and the primary Maryland standard also does (the state is likely to also enforce a secondary energy use intensity metric in order to

encourage energy efficiency and discourage use of electric resistance heat).<sup>24</sup> This is also the approach in the federal buildings BPS.

- Explicit standards on replacement equipment to discourage or prohibit fossil-fuel heating equipment. Denver includes such equipment standards in their program and British Columbia is developing such standards.<sup>25</sup>

Implicit ways to encourage electrification include

- Establishing standards based on GHG emissions, particularly in jurisdictions with clean electric grids. With a clean grid, heat pumps generally have lower emissions than fossil fuel heat and electrifying can be one way to help meet a standard. New York City, Boston, and most of the other jurisdictions with GHG standards recognize that these standards encourage electrification.
- Energy-use intensity standards that look only at site energy use and not upstream energy losses. Such standards include only the 3,412 Btu in a kWh of electricity and not the roughly 10,000 Btu of fuel that might need to be burned to generate that kWh. From a site energy-use perspective, electricity is 100% efficient, and thus generally more efficient than fuels that are burned onsite. Jurisdictions using site energy use include Chula Vista, Denver, Montgomery County, St. Louis, and Washington State.

Finally, it should be noted that even if upstream energy use is included in the calculations, heat pumps generally use less energy than fossil-fuel systems (Nadel 2016, 2018), providing some incentive to switch to heat pumps as a strategy to meet BPS.

### *HOW AND WHEN SHOULD THE STANDARDS APPLY?*

Some of the building performance standards apply to rentals or sales after a specific date. For example, the Boulder standard applies to rental certificates issued starting January 1, 2019. The UK standard applies to any property leased after April 2018. And the French standard applies to rentals and sales after January 1, 2028.

Other standards affect all covered buildings as of a specific date or dates. For example, the Tokyo standard applies to covered buildings in 2020, the New York City standard in 2024. Reno; Washington, DC; and many of the other jurisdictions have several effective dates, starting with the largest buildings and proceeding in stages to smaller buildings. Phasing in standards starting with the largest buildings first can avert a compliance pileup by having a

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<sup>24</sup> The primary and secondary standards used in Maryland are discussed in the Maryland section earlier in this report.

<sup>25</sup> A substantial number of jurisdictions are restricting use of fossil-fuel equipment using strategies besides BPS. See Louis-Préscott and Golden (2023) and Building Decarbonization Coalition (2023).

smaller number of buildings affected in the earliest years. It can also address the buildings with the largest emissions first, providing substantial energy and emissions reductions from a small number of buildings. Sometimes affordable housing or all multifamily housing is given a few extra years, as is the case in St. Louis, Vancouver, and Montgomery County.

Many of the standards are subject to periodic adjustments. The Tokyo standard is revised every five years and is now in its third compliance period. The New York City standard has different standards for 2024 and 2030 and provisions for additional levels to be developed for each five-year period through the legislated 2050 intensity limit. The Washington, DC, and Washington State standards, for example, will be strengthened every five years, and the Reno standard reset every seven years. St. Louis is planning updates every four years for most buildings and every six years for multifamily affordable housing.

Boston, Denver, Maryland, Montgomery County, New York City, Seattle, and Vancouver have all set, or are setting, long-term goals, such as long-term net-zero GHG, with several interim points. In Denver, “long-term” is 2030, in Montgomery County it is 2036, in Maryland and Vancouver 2040, in Seattle 2040 or 2045 depending on building type, and it is 2050 in Boston and New York City. To date, the long-term targets in the 2030s are all energy targets while the targets in the 2040–2050 period are all GHG targets (80% GHG reduction in NYC, net zero in the rest). In addition, many cities have aligned energy savings with their climate plans even if energy is the metric for the standard.

As discussed earlier, the United Kingdom has begun consultations on revisions. France plans to tighten their standards over time with a long-term 2050 target of a B rating. Boulder will be considering next steps in 2023.

### *HOW STRINGENT SHOULD THE STANDARDS BE? SHOULD ONLY INITIAL STANDARDS BE SET OR SHOULD LONG-TERM STANDARDS BE SET WITH INTERIM TARGETS?*

Until about 2020, most U.S. standards were commonly set around the median current performance of covered buildings, typically based on building benchmarking data. The median current performance is mentioned in the legislation enacted in Reno and Washington, DC; the Washington State legislation refers to the average. Reno notes the median in its legislation but also offers a variety of other optional performance and prescriptive standards to provide flexibility to building owners, perhaps meaning an effective standard well below the median. In St. Louis, the standard is based on the 65th percentile, meaning that 65% of covered buildings must upgrade. Vancouver on the other hand did not have benchmarking data and instead prepared computer simulations of typical buildings, calibrated with benchmarking data from a nearby city (Seattle).

Tokyo requires CO<sub>2</sub> reductions, with 17% reduction achieved thus far and 25–27% planned for 2025 (including the current 17%). In Boulder, the standard is based on equivalent performance to a new home meeting the 1999 version of the International Energy Conservation Code. In Denver the legislation says that the 2030 standard should be based

on 30% average energy savings across all building types and also has electrification requirements. In Colorado, the legislation specified GHG reductions of 7% in 2026 and 20% in 2030.

In Europe, the performance standards thus far are based on their A–G label, with the United Kingdom requiring an E and France a D. These standards thus affect homes and apartments with performance below the median, often substantially below the median. The Netherlands requires a C for offices, and Scotland is considering a C requirement but only if such a level is feasible and cost effective.

In New York City and a substantial portion of the more recent standards, long targets are being set, often for GHG emissions. In New York City the standard calls for a 40% reduction in aggregate CO<sub>2</sub> emissions of covered buildings by 2030 (following initial requirements affecting the worst-performing 25% of buildings that take effect in 2024) and an 80% reduction by 2050. Maryland and Vancouver are requiring zero onsite emissions by 2040, and Seattle and Boston are requiring zero net GHG emissions (by 2040 or 2045 in Seattle or 2050 in Boston). There is a tendency for more recent standards to have stronger targets. New York City's standard is the oldest and requires 80% reductions, Boston's net zero by 2050 standard was adopted in 2021, while Seattle's net-zero standard by 2040–2045 was adopted in 2023. And thus far, all of the jurisdictions with long-term standards have established at least one interim standard (e.g., Maryland and Vancouver), and several have set long-term glide paths with periodic interim requirements (e.g., Boston, Denver, and Montgomery County).

In summary, standards to date tend to fall into five categories:

- Upgrade buildings that are significantly below average (United Kingdom and France, although France has long-term plans, not yet codified, to move to the highest levels of energy performance)
- Move buildings to about the median or average level of performance (Washington, DC; Washington State; and Boulder)
- Move buildings to somewhat above the median or average (Netherlands, St. Louis, and Scotland)
- Set long-term targets with deep reductions (New York City, Boston, Maryland, Vancouver, and Seattle)
- Set targets that are feasible politically (Reno and Tokyo)

Another issue is whether the same standard applies to all buildings of a specific type or whether each building has its own standard. For the most part, most of the standards set a long-term target by building type, but many take a building's initial performance into account in establishing interim standards. For example, Washington, DC, sets standards by building type but allows buildings that reduce energy use by 20% to comply for the first compliance period (St. Louis has something similar deeming a building in compliance for early stages if it reduces that gap between its initial performance and the standard for its

building type by at least 50%). Some jurisdictions have established a “trajectory approach” in which each building type has a long-term standard and a straight line is drawn between a building’s initial performance and long-term standard to establish interim standards. This approach is being promoted by IMT, which includes this approach in their model legislation (IMT 2021). This approach is illustrated in figures 4 (Denver) and 5 (Montgomery County).

### *SHOULD INITIAL STANDARDS BE SET IN THE LEGISLATION OR IN SUBSEQUENT REGULATIONS?*

In most cases, the legislation establishing standards has set guidelines and left the determination of the actual standards to a regulatory process. It is common for legislation to establish general policy direction but then leave the details to regulation, primarily because legislators generally do not have the time or technical expertise to get into the details.

However, in recent years a few jurisdictions have established the initial standards in the legislation. For example, Boston and Seattle did detailed analyses of their benchmarking data and wrote the standards into the legislation, with opportunities for adjustment of later stages of the standards. Vancouver also put its standards in legislation. They did not have benchmarking data, so instead used detailed building simulations calibrated in part with benchmarking data from a nearby city (Seattle). Conducting analysis prior to adoption is a lot of work but allows policymakers and stakeholders to better understand impacts before adoption decisions are made. Setting standards in legislation will generally slow down the adoption process but can speed up the implementation process. If the specific standards are left to a regulatory process, adequate time should be provided for the analysis and for necessary public input.

## **EQUITY ISSUES**

### *WHAT SPECIAL PROVISIONS ARE NEEDED FOR AFFORDABLE HOUSING?*

As noted, most of jurisdictions with BPS include at least some housing in their programs. Meeting performance levels in affordable housing can be particularly challenging as these buildings tend to be less energy efficient<sup>26</sup> and may be in poor condition, building owners frequently lack the resources to improve their buildings, and, where upgrades do happen, there is concern that owners will raise rents and these units will no longer be affordable.

To address these issues, many BPS programs make special allowances for affordable multifamily housing. The most notable examples are Boston and Washington, DC, but there are also interesting approaches in other jurisdictions.

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<sup>26</sup> For example, Carliner (2013) finds that as household income of renters declines, energy costs as a percentage of rent increase.

In Boston, tenants and community-based organizations were consulted in developing the BPS. The Boston program includes Alternative Compliance Payments (ACPs)—funds collected will go into an Equitable Emissions Investment Fund to support emissions reduction projects in Boston that prioritize environmental justice communities. A new Emissions Review Board was established to oversee this fund, and two-thirds of the members of this board will be proposed by local community organizations.

In Washington, DC, as part of the legislation establishing the BPS, extra funding was provided for their Sustainable Energy Utility and their Green Bank to help pay for retrofits. More recently they have established a well-funded Affordable Housing Retrofit Accelerator program.

Other notable examples of ways to assist affordable housing include:

- Montgomery County established a Green Bank just before passing their BPS and requires at least 20% of Green Bank funds to go to “equity emphasis” areas of the county.
- France allocated special funding for public housing renovation and for its Energy Renovation Guarantee Fund that helps underwrite loans to low-income households.
- In both France and the United Kingdom, utility energy efficiency certificates have set-asides for households with fuel poverty.
- In St. Louis, utility incentives are especially generous for affordable housing. They also provide more time for affordable housing to comply with the standards.
- In New York City, the standards are significantly weaker for buildings with a substantial number of rent-regulated apartments due to concerns that performance standards would lead to higher rents.
- In Boulder, rental units that have participated in the federal low-income Weatherization Assistance Program are exempt from further upgrades.
- In Reno, compliance is delayed for 3–6 years for low-income multifamily housing buildings with Enterprise Green Communities certification.
- In Denver, their Energize Denver Hub provides additional support to “under-resourced buildings” including further technical services and assistance.

None of the BPS programs to date outright exempt affordable housing, meaning tenants can still benefit from energy efficiency upgrades.

Other approaches for addressing affordable housing were suggested by the National Housing Trust to the DC government as part of the process to develop rules for the DC standards (NHT 2019) and are included in a policy brief authored by IMT (Silverman, Miller, and Biever 2022).

As a general rule, if affordable housing is covered under a BPS, sources of financial assistance for building upgrades will be needed, and protections against large rent increases may be advisable. We also note that electrification of high-rise multifamily buildings can be

challenging and expensive (Nadel and Fadali 2022). If a BPS is designed to encourage electrification, accommodations and/or financial incentives to help cover costs for electrifying affordable housing will be particularly important.

In addition to this question, some of the other sections also have important considerations for affordable housing:

- What input should be sought prior to adopting a BPS?
- How and when should the standards apply?
- Should jurisdictions allocate funding for building upgrades?

### *BPS AND DISADVANTAGED COMMUNITIES*

This section focuses on affordable housing, but there may also be challenges with commercial building compliance in neighborhoods with low rents. These neighborhoods tend to be disinvested with many buildings in poor condition. Meeting BPS requirements may be more challenging in these neighborhoods. Attention needs to be paid to technical and financial assistance in these neighborhoods and perhaps other accommodations will need to be made, such as an extra year or two for compliance, so owners have more time to build resources and make changes and not have to compete for service providers with richer neighborhoods. We are not aware of any jurisdictions that have made accommodations for disadvantaged neighborhoods yet, but several reviewers suggested that it could be an issue requiring attention in the future.

## **IMPLEMENTATION SPECIFICS**

### *HOW MUCH LEAD TIME SHOULD BE PROVIDED?*

Depending on the jurisdiction, 3 to 10 years are provided for building owners to make investments to meet standards. At the short end, Boston, Denver, and the United Kingdom are providing a three-year lead time. Chula Vista provides only two years for an initial prescriptive standard but seven years for their performance standard. At the long end, France is providing 10 years, Boulder and DC 8 years, and Reno and Washington State 7 years. In St. Louis, it is four years for most buildings, but six years for affordable housing. New York City provided 5 years for their initial standard and 10 years for their more demanding targets. The lead time is summarized below in table 9 with a median of five years.

### *WHAT LEVEL OF STAFFING AND OTHER SUPPORT IS NEEDED FOR BPS IMPLEMENTATION?*

BPS implementation requires dedicated staff to do many tasks including outreach and education, developing guidebooks and other written materials, answering building owner questions, working with other city departments, and monitoring compliance. Most

jurisdictions have multiple staff performing these functions. For example, as noted earlier, St. Louis now has four staff working on the program while Washington, DC, has 11 (including benchmarking and BEPS). Of the smaller cities, Reno has only one person presently while Chula Vista just added a second person. Where the jurisdiction already has other building performance-related policies like benchmarking, there may be economies of scale to use existing staff without as much need to expand for the BPS.

In addition to staff, there is a need for other support. Computer systems need to be established to make data readily available to building owners and to track compliance. There are now commercial software packages available to handle these tasks, but these have substantial set-up costs as well as annual service fees. Some jurisdictions are setting up their own systems. Using a compliance tracking system that can build on public tools like ENERGY STAR Portfolio Manager can help in reducing first costs and ongoing costs.

### *WHAT MARKETING, EDUCATIONAL AND TECHNICAL ASSISTANCE EFFORTS SHOULD BE UNDERTAKEN?*

All of the jurisdictions have either set up or plan to set-up programs to provide education and technical assistance. As examples, Boulder has its Energy Smart program; Washington, DC, has its High Performance Building Hub (as does New York City and St. Louis, both called Building Energy Exchange); France has its Regional Energy Renovation Platforms; the Netherlands has its RVO program; and Washington State has its Early Adopter program (which is built out of incentives, but they are also planning some technical assistance). So far, assistance programs are limited in Colorado, Maryland, and Chula Vista.

IMT (IMT 2020) discusses a variety of issues involved with providing local market support with a high-performance building hub.

### *HOW DO WE BUILD CAPACITY IN THE MARKET?*

Most BPS will spur a large amount of building retrofit activity, requiring skilled staff in engineering and construction. These are fields that can be in short supply in some areas and thus jurisdictions will need to think about how they can grow local capacity. For example, in New York City, significant workforce development and training initiatives are supported by NYSERDA and the local utilities. And in Washington, DC, there are extensive efforts to grow opportunities for local residents to be trained for “green jobs” (Sustainable DC 2023) and to create opportunities for local businesses (Building Innovation Hub 2023).

Likewise, obtaining adequate equipment supply could be an issue, particularly as BPS compliance dates approach. Heat pump availability was mentioned by several reviewers of this report as a potential problem, particularly the larger central heat pump/chiller systems used in many large buildings. Many of these systems are now produced in Europe and not yet in the United States. (Nadel and Perry 2021).

### *WHAT PENALTIES SHOULD BE SET?*

While compliance is required, and all the jurisdictions we talked to are emphasizing “carrots” to improve compliance (education, technical assistance, incentives), some building owners will not comply without pressure from penalties and some owners will balance the cost of compliance versus the cost of penalties. In our discussions with BPS implementers, several noted that building owners are waiting to see what penalties are so they can consider whether just paying the penalty is less expensive than coming into compliance. In the United States, jurisdictions are often just starting to develop penalties, although in some jurisdictions, decisions have been made, either in the legislation or via regulatory processes.

Boston has set an alternative compliance fee of \$234 per metric ton of carbon dioxide, based on the federal social cost of carbon. Cambridge is expecting to adopt the same value. New York City’s legislation set a penalty of \$268 per metric ton, which would go into the city’s General Fund. Many stakeholders are interested in some sort of “equitable housing fund” to allow an alternative to the fines or RECs for those buildings that cannot reduce emissions to the limits, but this will often require new legislation. The legislation in Maryland also references the federal social cost of carbon.

In Washington State, depending on the level of noncompliance, the penalty is up to \$1.00 per square foot, per year, for up to 18 months. In Washington, DC, the maximum alternative compliance penalty is \$10 per sq. ft. of floor area, but with reduction factors for partial compliance. The maximum penalty for a building or a campus is \$7,500,000 per compliance cycle (DOEE 2022). In St. Louis, noncomplying owners can be fined of up to \$500 per day and/or barred from obtaining an occupancy permit for the property. In Chula Vista, the legislation sets penalties of \$250–2,250 varying by building size. These can apply each year.

One set of review comments on this report suggested that a two-tier set of penalties be implemented, with modest initial penalties and more substantial penalties ramping in for multiple years of noncompliance. We are not aware of any jurisdictions that have implemented such a system.

## **COMPLIANCE OPTIONS**

### *WHAT OTHER COMPLIANCE PATHS SHOULD BE INCLUDED?*

All of the BPS are built around a performance path where each covered building must meet a specified performance level such as a Btu per square foot target or a specific label performance level (e.g., EPC level D). And some jurisdictions have multiple requirements such as both performance and prescriptive requirements (e.g. in Denver and Chula Vista). In addition, many of the BPS have other alternative compliance levels. Among these are:

- Prescriptive pathway: Washington, DC, has a pathway that includes conducting an energy audit, creating an action plan, implementing energy efficiency measures projected to save at least 25% of site energy use intensity, and completing monitoring, evaluation, and verification.

- Early adopters: St. Louis has a pathway under which deep retrofits meeting specific criteria will be deemed to be in compliance for several cycles.
- Narrow the gap alternative compliance path: St. Louis also notes that if a building improves its performance to the midpoint between its 2018 performance and its performance standard, then it can qualify for this path (only applies to cycles 1 and 2).
- Custom alternative compliance path: For special situations in St. Louis and Washington, DC, an owner can submit a proposed custom compliance plan for review.
- Alternative compliance payments: Boston has an option of paying \$234 per metric ton for excess emissions each year, with the funds going into an Equitable Emissions Investment Fund. Seattle is also planning for a payment option for the first few compliance periods.
- Alternative prescriptive levels: A few cities have made it easier to comply by establishing prescriptive levels for some or all buildings. New York City has such a path for multifamily buildings where more than 35% of the units are rent controlled. Reno has an energy audit on utility rebate path open to all buildings, but as noted earlier, this easy path draws into question whether its standard is truly a BPS.

These are just examples, but they show that many jurisdictions do have several alternative pathways, giving owners multiple compliance options. Since targets are not yet being enforced in most cities and states, it is too soon to say how well these work.

### *SHOULD TRADING BE INCLUDED?*

Trading, or allowing different buildings to “trade” emissions reductions instead of each building meeting a set target, is the key focus of the Tokyo program. New York City’s legislation included the potential for trading, but while it was found that it could result in greater emissions reductions at a lower cost, the environmental justice concerns about any increased local pollution have taken trading out of consideration at this time. Trading can be an alternative compliance path. The other, jurisdictions covered by this report do not have trading.

Trading is popular in Tokyo and New York City because many building owners own multiple buildings and trading gives them the option to exceed the standards on some of their buildings to compensate for other buildings where meeting the standards would be more expensive. Trading programs allows a real-estate portfolio approach and tend to encourage the lowest-cost ways to reach collective targets, as buildings with low-cost savings or emissions reductions can trade excess credits to buildings with higher compliance costs. Trading has worked well in Tokyo, helping them to reduce energy consumption and emissions significantly when compared with other buildings’ performance standards. The Tokyo policy has been emulated elsewhere, with a new national trading system in Korea covering large buildings (or companies) emitting over a certain level taking effect in 2018 (ICAP 2020). Urban Green Council (2018) has additional information on trading.

While trading is not likely to be part of the New York City performance standard in the near term, a broader New York statewide trading system has been proposed as part of the state's climate action planning, tentatively being called "Cap-and-Invest" (New York State Climate Action Council 2022).

### *SHOULD RECs OR OFFSETS BE INCORPORATED?*

Some jurisdictions, particularly New York City in its adopted LL97 and Boston's BERDO, allow buildings to use renewable RECs and/or GHG offsets as an alternative to reducing the energy use to meet the standard. This was a somewhat controversial portion in the New York City law, with many arguing that many other policies are driving renewable energy development, and any building performance standard should focus on just actual building energy (or environmental) performance improvement. The allowable RECs in New York City are tightly defined, and need to be physically delivered in transmission lines directly into New York City, and will be tracked through a statewide REC registry.

When New York City issued the draft rulemaking in October 2022, the lack of any limitation on RECs generated the most concern among all of the public comments on the draft. Many stakeholders, including a majority of the members of the New York City Council, urged that the draft rule be amended to limit RECs to some portion of the building emissions allowance (or amount of the overage) to avoid having a loophole that would allow owners to avoid making investments in energy efficiency or electrification. While this concern is real, the legislation that was passed allows for unlimited RECs, so without some new legislation to limit RECs there is a real concern about RECs providing a path that allows owners to avoid making improvements to their building.

While LL97 allowed for the use of GHG offsets, so far there is no direction about what types of offsets might be allowed, and the advisory board report issued in December 2022 recommended that only offsets generated within New York City, and through energy efficiency or building electrification projects, be considered. It is unclear whether any market for these very limited offsets will develop.

Boston's BERDO allows buildings to use power purchase agreements or RECs to help meet their targets, but has specific rules about this.

Cambridge is also planning to allow use of offsets and RECs and is considering what types of constraints to put on use of these credits. The city is also looking into ways to encourage offsets/credits within its limits.

If energy consumption is the chosen metric for the standard, RECs should not be an issue. But for a standard using CO<sub>2</sub> as the metric, use of RECs is a critical policy decision and can take away much of the potential driver of energy performance improvement. For both energy and CO<sub>2</sub> standards, offsets within the covered jurisdiction should not be an issue. But if offsets extend beyond a jurisdiction's borders, they can dilute actions within the jurisdiction.

Allowing RECs or offsets does provide owners with another compliance option, but the early experience so far in New York City suggests that there are also many potential problems without very carefully considered guardrails on what is allowed.

## FINANCING REQUIRED UPGRADES

### *SHOULD JURISDICTIONS ALLOCATE FUNDING FOR BUILDING UPGRADES?*

In many of the jurisdictions, funding was allocated to help building owners pay for upgrades needed to meet the standards. In Boulder, funds and programs are provided by a small carbon fee on electric service. In Washington, DC, specific funds were allocated to the DC Green Bank and for improvements to affordable housing. They also allocated substantial funds out of their federal ARRA grant for their Affordable Housing Retrofit Accelerator. In Washington State, \$75 million was allocated to the Early Adopter Incentive Program. Boston established their Equitable Buildings Emissions Fund (funded with fines for BPS noncompliance) and Montgomery County dedicated a portion of their existing utility tax to the Montgomery County Green Bank. France uses tax incentives, loans, and allocations from the government budget. New York City has a variety of funding programs, as discussed earlier.

Colorado, Denver, Reno, St. Louis, and Vancouver have some energy efficiency incentives from the local utility and some of them have C-PACE loans, but, unlike the jurisdictions noted in the paragraph above, did not make substantial funding available. In the United Kingdom, some funding is available, but the major funding expected from their Green Deal did not work out.

And in the United States, the Inflation Reduction Act funded many programs that can fund residential and commercial building renovations (Ungar and Nadel 2022, 2023).

### *WHAT ROLE CAN AND SHOULD UTILITY INCENTIVES PLAY?*

As noted earlier, utilities are key stakeholders to engage during BPS design, adoption, and implementation. One important question is whether utility energy efficiency incentives will be available to help fund energy retrofits even though retrofits will now be mandated. Nadel (2020) examines this question in detail. In general, building upgrades will continue to be eligible for incentives at least until the time that BPS standards take effect for a particular building. But most observers that Nadel interviewed expect that there will be a continued need for utility incentives after the standards take effect, particularly for affordable housing, houses of worship, and small buildings. While these buildings technically should meet the standards without utility funding, they often lack the resources and will also have the option of paying penalties (sometimes only small ones) instead of upgrading their buildings. Proponents of building performance standards also sometimes argue that the standards would not have been adopted but for the expectation of future utility incentives, and thus continued utility incentives are important for making sure the standards are successful and not either ignored or repealed.

Utilities and regulators are just starting to discuss these issues and for the most part decisions have not been made. But in a few places, directions have been set. For example, in Washington State, the legislation makes clear that utilities will fund the early adopter incentives (with offsetting reductions in taxes they pay), and state staff are planning to make clear that even after the standards take effect, utilities may still offer incentives and claim energy savings. St. Louis worked with its utilities in drafting its bill to assure that the bill will not hinder utility efficiency programs. And in Boulder, utilities continued to provide incentives, even after the Smart Regs took effect. These discussions are also beginning in Boston, Cambridge, and New York City. So far, no final decisions have been made.

As jurisdictions count energy savings and GHG reductions from their programs, they should be careful not to assume full compliance in all buildings, as the discussion above makes clear. Likewise, care should be taken to avoid double-counting savings between the BPS and utility programs.

## SUMMARY OF BUILDING PERFORMANCE STANDARD IMPLEMENTATION INFORMATION

As a complement to the information in table 6, additional information on many of the supporting aspects of the various building performance standards is summarized in table 9.

**Table 9. Additional summary information on building performance standard implementation**

Jurisdiction	Years of benchmarking	Lead time to first standard	Trading	Funding assistance	Education and technical assistance	Housing affordability provisions
Boulder	0	8	No	Extensive	Extensive	Limited
Tokyo	8	5	Yes	Significant	Significant	NA
United Kingdom	8	3	No	Limited	Extensive	Significant
The Netherlands	10	4	No	Extensive	Extensive	NA
Reno	0	7	No	Limited	Significant	No
Washington, DC	5	8	No	Extensive	Extensive	Extensive
New York City	8	5	Yes	Extensive	Extensive	Significant

Jurisdiction	Years of benchmarking	Lead time to first standard	Trading	Funding assistance	Education and technical assistance	Housing affordability provisions
Washington State	9 <sup>27</sup>	7	No	Extensive	Significant	NA
France	10	10	No	Extensive	Extensive	Extensive
St. Louis	3	5	No	Significant	Substantial	Significant
Chula Vista	0	2,7*	No	Limited	Limited	Some
Colorado	0	7	No	Limited	Limited	Limited
Boston	8	3	No	Extensive	Extensive	Extensive
Denver	5	3	No	Limited	Substantial	Significant
Maryland	0	8	No	Limited	Limited	Significant
Montgomery County	6	6	No	Substantial	Extensive planned	Substantial
Vancouver	0	4	No	Limited	Limited	NA

**“Years of benchmarking” is the number of years of required benchmarking at the time when performance standards were adopted. “Lead time to first standard” is from the date of law enactment. Detailed implementing regulations are often developed in the first year or two.**

**\*Two years for prescriptive requirements, seven years for performance requirements.**

## Lessons Learned Thus Far

With 18 performance standards now in place and more pending, a number of lessons have been learned regarding adoption of building performance standards:

*Building energy benchmarking is generally an important precursor for performance standards.* Most of the performance standards in place rely on prior building benchmarking (or a related building rating/certification system, as in Europe). Such benchmarking provides data that can be used to help set performance standards, and often the performance standards use the metrics established with benchmarking. However, there are a few exceptions such as Boulder, Washington State, and Vancouver, where standards are set on the basis of building code, ASHRAE Standard 100 procedures, or detailed modeling of typical buildings,

<sup>27</sup> However, as noted previously, benchmarking is limited in Washington State, applying only to sales and new leases. Furthermore, there is no state enforcement; compliance is up to current owners and prospective buyers and tenants.

complemented with studies needed to translate these codes and procedures into appropriate standards. Other jurisdictions that have joined the National BPS Coalition are working to develop BPS without benchmarking, including standards derived from modeled performance (ASHRAE 2023).

*Stakeholder consultation is important before standards are proposed.* Consultation helps to understand the diversity of the building stock and ownership in a jurisdiction, to identify concerns, and to allow stakeholders to identify ways to address these concerns. This should include reaching out to community-based organizations, and, through them, getting input from tenants. For example, Reno added a number of alternative compliance mechanisms to address concerns about bringing some buildings to a median ENERGY STAR score. Cambridge moved toward CO<sub>2</sub> metrics and added special paths for university campuses and laboratories to address concerns. And Boston developed its Equitable Emissions Investment Fund. In many jurisdictions, affordable housing is a significant issue that required/requires substantial attention. Each jurisdiction is different, and these are only examples.

*There is no one-size-fits-all approach.* There are multiple approaches to performance standards, and each jurisdiction must pursue approaches that work for its communities and stakeholders. Also, no single compliance path will work for all buildings. Most jurisdictions have multiple compliance paths, including the opportunity to apply for a custom compliance path that ultimately reaches the designated long-term goal.

*It takes time to build support and work out details.* In many of our interviews, staff pointed out how they hoped for adoption within one year, but it ultimately took two years or longer as there are many details to work out and many stakeholders to consult.

*Most standards to date involve commercial buildings and/or rental buildings.* In the United States, most of the interest has been in commercial buildings (all but Boulder) and large multifamily/rental buildings. Targeting commercial and large multifamily buildings allows the policies to impact a relatively small number of buildings and owners yet have significant impact because of their outsized contribution to energy consumption and emissions. Some limited and old programs are for single-family owner-occupied homes (Suozzo, Wang, and Thorne 1997), but nothing recent. Europe has been more willing to tackle single-family owner-occupied homes, such as adopted standards in France and planned standards in Scotland.

*Early experience suggests that an operational rating metric (such as EPA's ENERGY STAR score or EUI) is well suited to commercial buildings, while an asset-based metric is appropriate for small residential ones.* With the wide variety of commercial building uses, and even different occupancies among office buildings, finding a valid asset-based rating that can serve as the metric for larger nonresidential buildings is challenging. If the desire is to reduce actual energy use (or resulting emissions), the better metric is measured performance. In homes and small residential buildings, having replicable asset ratings based on easily observable appliances, equipment, and building envelopes is more reasonable. In addition, operational ratings in homes are very susceptible to resident behavior, and an operational rating could

be misleading to a prospective purchaser. Due to these two considerations, the asset rating is likely a better metric for homes. For multifamily buildings it is not yet clear where to draw the line—large multifamily buildings will tend to be similar to commercial buildings and can use operational ratings while very small buildings should perhaps use asset ratings. A common demarcation for multifamily building classification purposes is that “large” buildings are five or more units. Perhaps this should be explored as the possible place to draw the line between where asset versus operational ratings are employed.

*Only five standards are now being implemented, but initial experience indicates high compliance rates in Tokyo and Boulder and limited compliance so far in the United Kingdom.* In Boulder, the program was added to an existing rental certificate program, and substantial resources were devoted to implementation. Tokyo compliance was aided by extensive stakeholder engagement and earlier voluntary initiatives. The United Kingdom, by contrast, did not add to an existing regulatory program and thus far has not devoted many resources to compliance. Implementation is just beginning in France and the Netherlands (with some initial positive experience in the latter), and it has yet to begin elsewhere.

*There is an ongoing need for significant stakeholder input.* As noted earlier, stakeholder consultation is important before standards are proposed, but also as implementation planning and any necessary rulemaking is underway. In New York City, the makeup of an advisory board was specified in the legislation, but a number of expert working groups were established and provided key input to the advisory board and the city government as regulations have been developed and challenges with the initial legislation have arisen.

*Significant resources are required to effectively implement building performance standards.* As shown by the successful program in Boulder and the less successful (thus far) program in the United Kingdom, significant resources are needed to implement building performance standards. This includes staff and other resources for education and enforcement, as well as resources for technical assistance, incentives, and financing. While small cities may have less staff, many of the larger cities have five to 10 (or more) staff working on BPS.

## Next Steps

For jurisdictions with building performance standards, the key next step is to ensure successful implementation, devoting the resources that are needed for education, technical assistance, financing and incentives (which sometimes can be leveraged from other sources such as utilities), thoughtful and careful development of implementing regulations, and effective enforcement. Evaluation will be important to understand what aspects are working well and what aspects may need rethinking. Several jurisdictions have adopted overarching legislation and are now working out implementation details.

For jurisdictions considering building performance standards, a key next step is to perform proper due diligence, review experience elsewhere, consult with stakeholders, allocate adequate staffing, and figure out an appropriate approach for the community. It is also helpful to discuss potential issues with other jurisdictions that already have performance

standards to learn what they might have done differently. As part of this process, it is important to consider key implementation details, as availability of future technical and financial support will be important for building support for a proposal.<sup>28</sup>

One other issue meriting consideration is whether some improved standardization of BPS might be useful. While each jurisdiction is different, having each BPS be very different means more work for implementing jurisdictions, stakeholders, building owners and managers, and building improvement engineers and contractors, particularly for people who work in more than one jurisdiction. We received several suggestions for a national model BPS that jurisdictions could modify, just as many jurisdictions adopt model building codes developed by ASHRAE and the International Code Council. The IMT Model Law (IMT 2021) may fit this need. Since its publication in early 2021 this model has served as a starting point for many new BPS bills, including those adopted in Montgomery County and Vancouver, as well as several now-pending bills. ASHRAE has its Standard 100 for existing buildings that could also play this role,<sup>29</sup> although thus far only one BPS jurisdiction (Washington State) has worked with this standard.

## Conclusions

To meet long-term climate goals, substantial energy savings and GHG emissions reductions must be obtained from existing buildings. Programs to encourage energy efficiency upgrades to existing buildings have operated for decades, and at current retrofit rates, it will take over 300 years to retrofit all residences and over 50 years to retrofit all commercial buildings. New and more-aggressive approaches are clearly needed.

Mandatory building performance standards are one such approach. Such standards are now being successfully implemented in Boulder, Colorado; the Netherlands; and Tokyo with the UK BPS achieving some success while also identifying some challenges. We have documented 13 other jurisdictions that have adopted, and are preparing to implement, such standards, and other additional jurisdictions that are considering adoption. We find that jurisdictions are trying many approaches, in part because each jurisdiction is different.

As these policies are implemented, evaluation will be important to improve these policies and inform future discussions on the best approaches. However, at this point, we do know

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<sup>28</sup> DOE has suggested that some funding for BPS may be available under their IRA Funded Technical Assistance for Building Energy Codes program (USDOE 2023).

<sup>29</sup> ASHRAE Standard 100 has recently changed its title to Energy and Emissions Building Performance Standard for Existing Buildings along with revising the standard's purpose and scope to possibly serve as a model BPS.

that, to be successful, building performance standards must be complemented with other policies and programs, such as building benchmarking, education, and technical assistance on ways to reach required performance; both financial incentives and financing to help cover costs to building owners; and special attention to how the performance standards apply in critical markets such as affordable housing. Every jurisdiction needs to plan for adequate resources in order to ensure a successful implementation.

In concert with complementary approaches, building performance standards can be an important contributor to efforts to meet energy and climate targets. We are entering an exciting period of experimentation that will likely teach us many lessons on how best to structure and implement such policies to best meet the objective of quality housing and workplaces while obtaining large energy savings and emissions reductions.

## References

- Antczak, A., M. Culbertson, D. Hatchimonji, and E. Vasatka. 2016. "Boulder's Pathway to Sustainability Lies in Being Bolder." *Proceedings of the 2016 ACEEE Summer Study on Energy Efficiency in Buildings* 11: 1–10. Washington, DC: ACEEE. [aceee.org/files/proceedings/2016/data/papers/11\\_838.pdf](https://www.aceee.org/files/proceedings/2016/data/papers/11_838.pdf).
- Arena, L., and G. Vijayakumar. 2012. *Evaluation of Boulder, CO, SmartRegs Ordinance and Better Buildings Program*. Washington, DC: DOE (Department of Energy). [nrel.gov/docs/fy12osti/54724.pdf](https://www.nrel.gov/docs/fy12osti/54724.pdf).
- ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers). 2023. *Building Performance Standards: A Technical Resource Guide*. Peachtree Corners, GA: ASHRAE. [forms.ashrae.org/forms/PDFdownload\\_BuildingPerformanceStandards](https://www.ashrae.org/forms/PDFdownload_BuildingPerformanceStandards).
- \_\_\_\_\_. 2018. *Energy Efficiency in Existing Buildings. Standard 100-2018*. Atlanta, GA: ASHRAE. [ashrae.org/news/esociety/updated-standard-100-published](https://www.ashrae.org/news/esociety/updated-standard-100-published).
- Bocra, G. 2022. "Proposed Rules for LL97." *Climate Mobilization Act Series: Following the Rules; Unpacking LL97 Rulemaking*. New York: Building Energy Exchange. [be-exchange.org/wp-content/uploads/2022/11/SlideDeck\\_CMA-Series-LL97-Purposd-Rules.pdf](https://www.be-exchange.org/wp-content/uploads/2022/11/SlideDeck_CMA-Series-LL97-Purposd-Rules.pdf).
- Boulder. 2019. *SmartRegs Program-to-Date Progress Report*. Boulder: City of Boulder. [bouldercolorado.gov/sites/default/files/2021-08/smartregsdashboardq42018.pdf](https://www.bouldercolorado.gov/sites/default/files/2021-08/smartregsdashboardq42018.pdf).
- Boston. 2021. *Ordinance Amending City of Boston Code, Ordinances, Chapter VII, Sections 7-2.1 AND 7-2.2, Building Energy Reporting and Disclosure (BERDO)*. Boston: City of Boston. [boston.gov/sites/default/files/file/2021/12/Final%20Amended%20Docket%200775%20BERDO%2020.pdf](https://www.boston.gov/sites/default/files/file/2021/12/Final%20Amended%20Docket%200775%20BERDO%2020.pdf).
- Boyce, A. 2022. "How Does the First Federal BPS Measure Up?" *IMT (Institute for Market Transformation)*, December 16. [imt.org/news/how-does-the-first-federal-bps-measure-up/](https://www.imt.org/news/how-does-the-first-federal-bps-measure-up/).
- Building Decarbonization Coalition. 2023. "Zero Emission Building Ordinances Tracker." [buildingdecarb.org/resource/zero-emission-building-ordinances-tracker](https://www.buildingdecarb.org/resource/zero-emission-building-ordinances-tracker). Visited January 15, 2023.
- Building Innovation Hub. 2023. "DC's Building Energy Law Promotes Small Business and Job Opportunities." [buildinginnovationhub.org/dcs-building-energy-law-promotes-small-business-and-job-opportunities/](https://www.buildinginnovationhub.org/dcs-building-energy-law-promotes-small-business-and-job-opportunities/).
- Building Performance Colorado. 2023. "Building Performance Colorado." [buildingperformanceco.com/](https://www.buildingperformanceco.com/).

- Burlington. 2021. *An Ordinance in Relation to Chapter 18, Housing—Change re Energy Efficiency and Weatherization in Rental Housing*. Burlington, VT: City of Burlington. [go.boarddocs.com/vt/burlingtonvt/Board.nsf/files/C2RKKP51C01A/\\$file/BCO Chapter 18. Housing Change re Energy Efficiency and Weatherization in Rental Housing Revised - City Council 5.10.2021.pdf](https://go.boarddocs.com/vt/burlingtonvt/Board.nsf/files/C2RKKP51C01A/$file/BCO_Chapter_18_Housing_Change_re_Energy_Efficiency_and_Weatherization_in_Rental_Housing_Revised_-_City_Council_5.10.2021.pdf).
- Cambridge. 2022. *Building Energy Use Disclosure Ordinance (BEUDO) Amendment Proposal*. Cambridge, MA: City of Cambridge. [cambridgema.gov/-/media/Files/CDD/Climate/BEUDO/beudooverviewpresentationforcommunityforum91522\\_final.pdf](https://cambridgema.gov/-/media/Files/CDD/Climate/BEUDO/beudooverviewpresentationforcommunityforum91522_final.pdf).
- \_\_\_\_\_. 2023. "Cambridge Building Energy Retrofit Program." [cambridgema.gov/Services/buildingretrofitprogram](https://cambridgema.gov/Services/buildingretrofitprogram).
- Carliner, M. 2013. *Reducing Energy Costs in Rental Housing: The Need and the Potential*. Cambridge, MA: Joint Center for Housing Studies of Harvard University. [jchs.harvard.edu/sites/default/files/harvard\\_jchs\\_carliner\\_research\\_brief.pdf](https://jchs.harvard.edu/sites/default/files/harvard_jchs_carliner_research_brief.pdf).
- CDPHE (Colorado Department of Public Health and Environment). 2023. "Colorado Air Quality Control Commission." [cdphe.colorado.gov/aqcc](https://cdphe.colorado.gov/aqcc).
- CEO (Colorado Energy Office). 2022a. *Colorado's Building Performance Standards: Task Force Recommendations*. Denver: Colorado Energy Office. [drive.google.com/file/d/1hTwtx-yV02mbTv\\_6RsnZGecpYv7CRDd8/view](https://drive.google.com/file/d/1hTwtx-yV02mbTv_6RsnZGecpYv7CRDd8/view).
- . 2022b. *Colorado's Building Performance Standards (BPS) Task Force Recommendations*. Denver: Colorado Energy Office. [drive.google.com/file/d/110pvRfosqdSOQyXrBAzh0vJTQH5Uc\\_nN/view](https://drive.google.com/file/d/110pvRfosqdSOQyXrBAzh0vJTQH5Uc_nN/view).
- . 2023. "Building Benchmarking." [energyoffice.colorado.gov/climate-energy/energy-policy/building-benchmarking](https://energyoffice.colorado.gov/climate-energy/energy-policy/building-benchmarking).
- CEQ (Council on Environmental Quality). 2022. *The Federal Building Performance Standard*. Washington, DC: Executive Office of the President. [www.sustainability.gov/pdfs/federal-building-performance-standard.pdf](https://www.sustainability.gov/pdfs/federal-building-performance-standard.pdf).
- City Energy. 2023. "About the City Energy Project." Accessed February. [cityenergyproject.org/about-the-city-energy-project/](https://cityenergyproject.org/about-the-city-energy-project/).
- Colorado. 2021. *Colorado Greenhouse Gas Pollution Reduction Roadmap*. Denver: State of Colorado. [drive.google.com/file/d/1jzLvFcrDryhhs9ZkT\\_UXkQM\\_0LiYZfq/view](https://drive.google.com/file/d/1jzLvFcrDryhhs9ZkT_UXkQM_0LiYZfq/view).
- Colorado General Assembly. 2021. *House Bill 21-1286, Energy Performance for Buildings*. Denver: Colorado General Assembly. [leg.colorado.gov/sites/default/files/2021a\\_1286\\_signed.pdf](https://leg.colorado.gov/sites/default/files/2021a_1286_signed.pdf).

- Denver. 2021. *Denver Ordinance 21-1310*. Denver: City and County of Denver.  
[denver.legistar.com/LegislationDetail.aspx?ID=5196421&GUID=641EBED8-31C9-4CA0-A8F9-946569B7C293&Options=ID%7CText%7C&Search=greenhouse+gas+emissions](https://denver.legistar.com/LegislationDetail.aspx?ID=5196421&GUID=641EBED8-31C9-4CA0-A8F9-946569B7C293&Options=ID%7CText%7C&Search=greenhouse+gas+emissions).
- \_\_\_\_\_. 2022a. *Article XIV. High-Performance Existing Buildings Program: Energize Denver Ordinance*. Denver: City and County of Denver.  
[library.municode.com/co/denver/codes/code\\_of\\_ordinances?nodeId=TITIIREMUCO\\_CH10BUBURE\\_ARTXIVHIRFEXBUPR](https://library.municode.com/co/denver/codes/code_of_ordinances?nodeId=TITIIREMUCO_CH10BUBURE_ARTXIVHIRFEXBUPR).
- \_\_\_\_\_. 2022b. *City and County of Denver DRAFT Rules & Regulations Governing Energize Denver Benchmarking and Energy Performance Requirements*. Denver: City and County of Denver. [denvergov.org/files/assets/public/climate-action/documents/energize-denver-hub/ed-performance-rules-and-regs-nov-2022-update-clean-final-1.pdf](https://denvergov.org/files/assets/public/climate-action/documents/energize-denver-hub/ed-performance-rules-and-regs-nov-2022-update-clean-final-1.pdf).
- \_\_\_\_\_. 2023a. "Benchmarking Requirements." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Benchmarking-Requirements](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Benchmarking-Requirements).
- \_\_\_\_\_. 2023b. "Climate Action Stakeholder Process." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/Climate-Action/Climate-Action-Stakeholder-Process](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/Climate-Action/Climate-Action-Stakeholder-Process).
- \_\_\_\_\_. 2023c. "Climate Protection Fund." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/Climate-Protection-Fund](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/Climate-Protection-Fund).
- \_\_\_\_\_. 2023d. "Energize Denver Benchmarking Map." [energizedenver.org/](https://energizedenver.org/).
- \_\_\_\_\_. 2023e. "Energize Denver Hub—Existing Buildings." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub).
- \_\_\_\_\_. 2023f. "Energize Denver Task Force." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Energize-Denver-Task-Force](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Energize-Denver-Task-Force).
- \_\_\_\_\_. 2023g. "Equipment Replacement Code Changes in 2023, 2025, and 2027." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Electrification-Program/Code-Changes-in-2023-2025-and-2027](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Electrification-Program/Code-Changes-in-2023-2025-and-2027).

\_\_\_\_\_. 2023h. "Equity Priority Buildings." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directories/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Performance-Requirements/Equity-Priority-Buildings](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directories/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Performance-Requirements/Equity-Priority-Buildings).

\_\_\_\_\_. 2023i. "Targets." [denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directories/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Performance-Requirements/Targets](https://denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directories/Climate-Action-Sustainability-Resiliency/High-Performance-Buildings-and-Homes/Energize-Denver-Hub/Buildings-25000-sq-ft-or-Larger/Performance-Requirements/Targets).

District of Columbia. 2018. *D.C. Law 22-257. CleanEnergy DC Omnibus Amendment Act of 2018*. Washington, DC: Council of the District of Columbia. [code.dccouncil.gov/us/dc/council/laws/22-257](https://code.dccouncil.gov/us/dc/council/laws/22-257).

District of Columbia DOEE (Department of Energy and the Environment). 2019. *DC's New Building Energy Performance Standards*. Washington, DC: District of Columbia DOEE. [doee.dc.gov/sites/default/files/dc/sites/ddoe/service\\_content/attachments/BEPS%20Overview%20Presentation.pdf](https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/BEPS%20Overview%20Presentation.pdf).

\_\_\_\_\_. 2020. "BEPS Frequently Asked Questions." [dc.beam-portal.org/helpdesk/kb/BEPS/](https://dc.beam-portal.org/helpdesk/kb/BEPS/).

\_\_\_\_\_. 2022a. *BEPS Greenhouse Gas Study*. Washington, DC: District of Columbia DOEE. [dc.beam-portal.org/api/v3/media/helpdesk/attachments/kb/BEPS\(1\)/85/DOEE BEPS Greenhouse Gas Metric Study FINAL.pdf](https://dc.beam-portal.org/api/v3/media/helpdesk/attachments/kb/BEPS(1)/85/DOEE%20BEPS%20Greenhouse%20Gas%20Metric%20Study%20FINAL.pdf).

\_\_\_\_\_. 2022b. *Cost and Benefit Impact Study of the Building Energy Performance Standards Program*. Washington, DC: DOEE. [dc.beam-portal.org/api/v3/media/helpdesk/attachments/kb/BEPS/79/BEPS Cost-Benefit Study.pdf](https://dc.beam-portal.org/api/v3/media/helpdesk/attachments/kb/BEPS/79/BEPS_Cost-Benefit_Study.pdf).

\_\_\_\_\_. 2023. "Building Energy Performance Standards (BEPS) Compliance and Enforcement Guidebook for Compliance Cycle 1." [dc.beam-portal.org/helpdesk/kb/BEPS\\_Guidebook/](https://dc.beam-portal.org/helpdesk/kb/BEPS_Guidebook/).

Dutch News. 2022. "Half of Dutch Offices Won't Make Energy Efficient Grade: Minister." *Dutch News*, October 19. [dutchnews.nl/news/2022/10/half-of-dutch-offices-wont-make-energy-efficient-grade-minister/](https://dutchnews.nl/news/2022/10/half-of-dutch-offices-wont-make-energy-efficient-grade-minister/).

Dynes, N. 2022. "Energy Efficiency a Must for Offices in the Netherlands." *Real Asset Insight*, February 14. [realassetinsight.com/2022/02/14/energy-efficiency-a-must-for-offices-in-the-netherlands/](https://realassetinsight.com/2022/02/14/energy-efficiency-a-must-for-offices-in-the-netherlands/).

Eash-Gates, P., K. Takahashi, D. Goldberg, A. Hopkins and S. Kwok. 2021. *Boston Building Emissions Performance Standard: Technical Methods Overview*. Prepared by Synapse Resource Economics. Boston: City of Boston. [synapse-energy.com/sites/default/files/Boston Performance Standard Technical Methods 2021-02-18\\_20-013.pdf](https://synapse-energy.com/sites/default/files/Boston%20Performance%20Standard%20Technical%20Methods%202021-02-18_20-013.pdf).

- EIA (Energy Information Administration). 2018. *Residential Energy Consumption Survey: 2015 RECS Survey Data*. Washington, DC: EIA. [eia.gov/consumption/residential/data/2015/#structural](https://www.eia.gov/consumption/residential/data/2015/#structural).
- \_\_\_\_\_. 2022. *2018 Commercial Buildings Energy Consumption Survey*. Washington, DC: EIA. [eia.gov/consumption/commercial/data/2018/index.php?view=characteristics](https://www.eia.gov/consumption/commercial/data/2018/index.php?view=characteristics).
- \_\_\_\_\_. 2023. *Annual Energy Outlook 2023*. Washington, DC: EIA. [eia.gov/outlooks/aeo/](https://www.eia.gov/outlooks/aeo/).
- EPA (Environmental Protection Agency). 2019. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2017*. Washington, DC: EPA. [epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017](https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2017).
- \_\_\_\_\_. 2022a. "Benchmarking and Building Performance Standards Policy Toolkit." [epa.gov/statelocalenergy/benchmarking-and-building-performance-standards-policy-toolkit](https://www.epa.gov/statelocalenergy/benchmarking-and-building-performance-standards-policy-toolkit).
- \_\_\_\_\_. 2022b. *Understanding and Choosing Metrics for Building Performance Standards*. Washington, DC: EPA. [energystar.gov/sites/default/files/tools/BPS-White\\_paper\\_final.pdf](https://energystar.gov/sites/default/files/tools/BPS-White_paper_final.pdf).
- European Council. 2023. "Fit for 55: Making Buildings in the EU Greener." [consilium.europa.eu/en/infographics/fit-for-55-making-buildings-in-the-eu-greener/](https://consilium.europa.eu/en/infographics/fit-for-55-making-buildings-in-the-eu-greener/).
- Fabbri, M., M. De Groot, and O. Rapf. 2016. *Building Renovation Passports: Customised Roadmaps towards Deep Renovation and Better Homes*. Brussels: BPIE (Buildings Performance Institute Europe). [bpie.eu/publication/renovation-passports/](https://bpie.eu/publication/renovation-passports/).
- Ministry of the Environment, Energy and the Sea (France). 2016. *Energy Transition for Green Growth Act*. Paris: Government of France. [ecologique-solidaire.gouv.fr/sites/default/files/Energy Transition for Green Growth Act in action - Regions, citizens, business %28 32 pages - juillet 2016 - Versions anglaise%29.pdf](https://ecologique-solidaire.gouv.fr/sites/default/files/Energy%20Transition%20for%20Green%20Growth%20Act%20in%20action%20-%20Regions,%20citizens,%20business%28%2032%20pages%20-%20juillet%202016%20-%20Versions%20anglaise%29.pdf).
- Gainesville. 2020. *Code of Ordinances, Article I.—Residential Unit Permits, Sec. 14.5-4. —Living Standards*. Gainesville, FL: City of Gainesville. [library.municode.com/fl/gainesville/codes/code\\_of\\_ordinances?nodeId=PTIICOOR\\_CH14\\_5MIBURE\\_ARTIREREUNPE\\_S14.5-4LIST](https://library.municode.com/fl/gainesville/codes/code_of_ordinances?nodeId=PTIICOOR_CH14_5MIBURE_ARTIREREUNPE_S14.5-4LIST).
- Group 14 Engineering. 2021. *City and County of Denver Building Typology and EUI Targets*. Denver: City and County of Denver. [denvergov.org/files/assets/public/climate-action/documents/energize-denver-hub/building-typology-and-eui-targets.pdf](https://denvergov.org/files/assets/public/climate-action/documents/energize-denver-hub/building-typology-and-eui-targets.pdf).
- Guarini Center (on Environmental, Energy & Land Use Law) 2021. *Carbon Trading for New York City's Building Sector: Report of the Local Law 97 Carbon Trading Study Group to the New York City Mayor's Office of Climate & Sustainability*. June 2021. New York: New York University Law School. [policyintegrity.org/files/publications/2021-11-15\\_Guarini\\_-\\_Carbon\\_Trading\\_For\\_New\\_York\\_City\\_Building\\_Sector.pdf](https://policyintegrity.org/files/publications/2021-11-15_Guarini_-_Carbon_Trading_For_New_York_City_Building_Sector.pdf)

IMT (Institute for Market Transformation). 2020. *Providing Local Market Support for a Building Performance Standard*. Washington, DC: IMT. .

\_\_\_\_\_. 2021. *Model Law for Building Performance Standards*. Washington, DC: IMT. [imt.org/resources/model-ordinance-for-building-performance-standards/](http://imt.org/resources/model-ordinance-for-building-performance-standards/).

\_\_\_\_\_. 2022. *Putting Policy in Action: Building Performance Standard Implementation Guide*. Washington, DC: IMT. [imt.org/resources/building-performance-standard-implementation-guide/](http://imt.org/resources/building-performance-standard-implementation-guide/).

\_\_\_\_\_. 2023. *U.S. City, County and State Policies for Existing Buildings: Benchmarking, Transparency and Beyond*. Washington, DC: IMT. [imt.org/wp-content/uploads/2017/09/IMT-Benchmarking-Map-2-scaled.jpg](http://imt.org/wp-content/uploads/2017/09/IMT-Benchmarking-Map-2-scaled.jpg).

ICAP (International Carbon Action Partnership). 2020. "Korea Emissions Trading Scheme." [icapcarbonaction.com/en/ets/korea-emissions-trading-scheme](http://icapcarbonaction.com/en/ets/korea-emissions-trading-scheme).

IGBC (Irish Green Building Council). 2019b. *Overcoming the Split Incentive Barrier in the Private Rental Market, International Case Studies*. Dublin: IGBC. [igbc.ie/wp-content/uploads/2019/04/WP3\\_D1\\_Final-1.pdf](http://igbc.ie/wp-content/uploads/2019/04/WP3_D1_Final-1.pdf).

IPEEC (International Partnerships for Energy Efficiency Cooperation). 2014. *Building Energy Rating Schemes: Assessing Issues and Impacts*. Paris: IPEEC. [energy.gov.au/sites/default/files/BEET%201%20Building%20Energy%20Rating%20Schemes%202014%20%E2%80%93%20Assessing%20Issues%20and%20Impacts.pdf](http://energy.gov.au/sites/default/files/BEET%201%20Building%20Energy%20Rating%20Schemes%202014%20%E2%80%93%20Assessing%20Issues%20and%20Impacts.pdf).

\_\_\_\_\_. 2017. *Existing Building Energy Efficiency Renovation: International Review of Regulatory Policies*. Paris: IPEEC. [globalabc.org/resources/publications/existing-building-energy-efficiency-renovation-international-review](http://globalabc.org/resources/publications/existing-building-energy-efficiency-renovation-international-review).

Louis-Prescott, L., and R. Golden. 2023. "How Local Governments and Communities Are Taking Action to Get Fossil Fuels out of Buildings." [rmi.org/taking-action-to-get-fossil-fuels-out-of-buildings/](http://rmi.org/taking-action-to-get-fossil-fuels-out-of-buildings/).

Majersik, C. 2018. "DC Adopts Nation's Strongest Climate Law." IMT, December 18. [www.imt.org/dc-adopts-nations-strongest-climate-law/](http://www.imt.org/dc-adopts-nations-strongest-climate-law/).

\_\_\_\_\_. 2022. "Two New Building Performance Standards Adopted in Maryland." *IMT*, April 22. [imt.org/news/two-new-building-performance-standards-adopted-in-maryland/](http://imt.org/news/two-new-building-performance-standards-adopted-in-maryland/).

Majersik, C., and J. Miller. 2019. "Washington Blazes a Trail for State Action on Energy Efficiency" *IMT*, June 20. [imt.org/washington-blazes-a-trail-for-state-action-on-energy-efficiency/](http://imt.org/washington-blazes-a-trail-for-state-action-on-energy-efficiency/).

\_\_\_\_\_. 2020. "St. Louis Passes First Building Performance Standard in the Midwest." *IMT*, April 21. [imt.org/st-louis-passes-first-building-performance-standard-in-the-midwest/](http://imt.org/st-louis-passes-first-building-performance-standard-in-the-midwest/).

- Maryland Legislature. 2022. *Climate Solutions Now Act of 2022*. S.B. 528. Annapolis: Maryland Legislature. [mgaleg.maryland.gov/2022RS/bills/sb/sb0528e.pdf](https://mgaleg.maryland.gov/2022RS/bills/sb/sb0528e.pdf).
- Montgomery County. 2022. *Article 6. Building Energy Use Benchmarking and Performance Standards*. Rockville, MD: Montgomery County. [apps.montgomerycountymd.gov/ccllms/DownloadFilePage?FileName=2707\\_1\\_20205\\_Bill\\_16-21\\_Signed\\_20220502.pdf](https://apps.montgomerycountymd.gov/ccllms/DownloadFilePage?FileName=2707_1_20205_Bill_16-21_Signed_20220502.pdf).
- Montgomery County Green Bank. 2023. "Solutions for Commercial Property Owners and Businesses to Reach Clean Energy Benefits." [mcgreenbank.org/commercial-programs/](https://mcgreenbank.org/commercial-programs/).
- Murray, C. 2019. *Washington Building Energy Performance Standard: Rulemaking Orientation Webinar*. Olympia: Washington State Department of Commerce. [commerce.wa.gov/wp-content/uploads/2019/11/Introduction-Washington-Building-Performance-Standard-10\\_30.pdf](https://commerce.wa.gov/wp-content/uploads/2019/11/Introduction-Washington-Building-Performance-Standard-10_30.pdf).
- Nadel, S. 2016. *Comparative Energy Use of Residential Furnaces and Heat Pumps*. Washington, DC: ACEEE. [aceee.org/research-report/a1602](https://aceee.org/research-report/a1602).
- \_\_\_\_\_. 2018. *Energy Savings, Consumer Economics, and Greenhouse Gas Emissions Reductions from Replacing Oil and Propane Furnaces, Boilers, and Water Heaters with Air-Source Heat Pumps*. Washington, DC: ACEEE. [aceee.org/research-report/a1803](https://aceee.org/research-report/a1803).
- \_\_\_\_\_. 2020. *How Energy Efficiency Programs Can Support Building Performance Standards*. Washington, DC: ACEEE. [www.aceee.org/topic-brief/2020/10/how-energy-efficiency-programs-can-support-building-performance-standards](https://www.aceee.org/topic-brief/2020/10/how-energy-efficiency-programs-can-support-building-performance-standards).
- Nadel, S. and L. Fadali. 2022. *Analysis of Electric and Gas Decarbonization Options for Homes and Apartments*. Washington, DC: ACEEE. [aceee.org/research-report/b2205](https://aceee.org/research-report/b2205).
- Nadel, S., and A. Hinge. 2020. *Mandatory Building Performance Standards: A Key Policy for Achieving Climate Goals*. Washington, DC: ACEEE. [aceee.org/white-paper/2020/06/mandatory-building-performance-standards-key-policy-achieving-climate-goals](https://aceee.org/white-paper/2020/06/mandatory-building-performance-standards-key-policy-achieving-climate-goals).
- Nadel, S., and C. Perry. 2020. *Electrifying Space Heating in Existing Commercial Buildings: Opportunities and Challenges*. Washington, DC: ACEEE. [aceee.org/research-report/b2004](https://aceee.org/research-report/b2004).
- Nadel, S. and L. Ungar. 2019. *Halfway There: Energy Efficiency Can Cut Energy Use and Greenhouse Gas Emissions in Half by 2050*. Washington, DC: ACEEE. [aceee.org/research-report/u1907](https://aceee.org/research-report/u1907).
- NASCSP (National Association for State Community Service Programs). 2022. *Weatherization Assistance Program: Funding Report Program Year 2021*. Washington, DC: NASCSP. [nascsp.org/wp-content/uploads/2022/12/PY21-WAP-Funding-Report\\_Final-1.pdf](https://nascsp.org/wp-content/uploads/2022/12/PY21-WAP-Funding-Report_Final-1.pdf).

- NCEL (National Caucus of Environmental Legislators). 2022. "Policy Update, Maryland Passes the Climate Solutions Now Act." [ncelenviro.org/articles/maryland-passes-the-climate-solutions-now-act/](https://ncelenviro.org/articles/maryland-passes-the-climate-solutions-now-act/).
- Netherlands Enterprise Agency. 2022. "Energy Investment Allowance." [english.rvo.nl/subsidies-programmes/energy-investment-allowance-eia](https://english.rvo.nl/subsidies-programmes/energy-investment-allowance-eia).
- Netherlands Ministry of Infrastructure and Water Management. 2023. "Erkende Maatregelen voor Energiebesparing [Recognized Energy Saving Measures]." [infomil.nl/onderwerpen/duurzaamheid-energie/energiebesparing/erkende-maatregelen/](https://infomil.nl/onderwerpen/duurzaamheid-energie/energiebesparing/erkende-maatregelen/).
- New York State Climate Action Council. 2022. *New York State Climate Action Council Scoping Plan*. Albany: New York State Climate Action Council. [climate.ny.gov/-/media/project/climate/files/NYS-Climate-Action-Council-Final-Scoping-Plan-2022.pdf](https://climate.ny.gov/-/media/project/climate/files/NYS-Climate-Action-Council-Final-Scoping-Plan-2022.pdf).
- NHT (National Housing Trust) 2019. National Housing Trust, "Recommendations for Implementing the District's Building Energy Performance Standard in Affordable Multifamily Housing." Washington, DC: NHT. [nationalhousingtrust.org/sites/default/files/news\\_file\\_attachments/BEPS%20Recommendations%20FINAL.pdf](https://nationalhousingtrust.org/sites/default/files/news_file_attachments/BEPS%20Recommendations%20FINAL.pdf).
- NYC (New York City). 2009. *Greener, Greater Buildings Plan*. New York: NYC. [nyc.gov/html/planyc2030/downloads/pdf/greener\\_greater\\_buildings\\_final.pdf](https://nyc.gov/html/planyc2030/downloads/pdf/greener_greater_buildings_final.pdf).
- \_\_\_\_\_. 2022. *Local Law 97 Advisory Board Report*. New York: NYC Department of Buildings. [nyc.gov/assets/sustainablebuildings/downloads/pdfs/l197\\_ab\\_report.pdf](https://nyc.gov/assets/sustainablebuildings/downloads/pdfs/l197_ab_report.pdf).
- Petersen, A., and R. Lalit. 2018. *Better Rentals, Better City: Smart Policies to Improve Your City's Rental Housing Energy Performance*. Boulder: RMI (Rocky Mountain Institute). [rmi.org/wp-content/uploads/2018/05/Better-Rentals-Better-City\\_Final3.pdf](https://rmi.org/wp-content/uploads/2018/05/Better-Rentals-Better-City_Final3.pdf).
- Portland. 2022. "Developing Standards for Rental Apartments." [portland.gov/bps/climate-action/building-standards/project-overview/rental-apartments](https://portland.gov/bps/climate-action/building-standards/project-overview/rental-apartments).
- RDH Energy. 2021. *ASHRAE 100 Users' Guide: ASHRAE Standard 100-2018, Energy Efficiency in Existing Buildings*. Vancouver: BC Hydro. Victoria: Province of British Columbia. Portland, OR: NEEA (Northwest Energy Efficiency Alliance). [neea.org/resources/ashrae-100-users-guide](https://neea.org/resources/ashrae-100-users-guide).
- Reno. 2019. *Administrative Code Chapter 14.30.—Energy and Water Efficiency Program*. Reno, NV: City of Reno. [library.municode.com/nv/reno/codes/administrative\\_code?nodeId=PT2READCO\\_TIT14BU\\_CO\\_CH14.30ENWAEFPR](https://library.municode.com/nv/reno/codes/administrative_code?nodeId=PT2READCO_TIT14BU_CO_CH14.30ENWAEFPR).

- RWV Advocaten. 2022. "C Energy Label Compulsory for Office Buildings from 2023." *Leiden International Centre*, May 30. [leideninternationalcentre.nl/get-advice/blogs/c-energy-label-compulsory-for-office-buildings-from-2023?ins\\_rd=d3d3LmV4cGF0Y2VudHJlbGVpZGVuLm5s](https://leideninternationalcentre.nl/get-advice/blogs/c-energy-label-compulsory-for-office-buildings-from-2023?ins_rd=d3d3LmV4cGF0Y2VudHJlbGVpZGVuLm5s).
- Scottish Government. 2021. "Heat in Buildings Strategy—Achieving Net Zero Emissions in Scotland's Buildings." [gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings/](https://gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings/).
- \_\_\_\_\_. 2020. "Energy Efficiency in Social Housing: Guidance for Landlords—Revised 2020." [gov.scot/publications/energy-efficiency-standard-social-housing-eessh-scottish-government-guidance-social-landlords-revised-2020/pages/3/](https://gov.scot/publications/energy-efficiency-standard-social-housing-eessh-scottish-government-guidance-social-landlords-revised-2020/pages/3/).
- Seattle. 2023. "Buildings Emission Performance Standards." Seattle: City of Seattle Office of Sustainability and Environment. [seattle.gov/environment/climate-change/buildings-and-energy/building-performance-standards](https://seattle.gov/environment/climate-change/buildings-and-energy/building-performance-standards).
- Shemkus, S. 2019. "In Cambridge, Efficiency 'Concierge' Will Help Large Buildings Cut Energy Use." *Energy News Network*, November 12. [energynews.us/2019/11/12/northeast/in-cambridge-efficiency-concierge-will-help-large-buildings-cut-energy-use/](https://energynews.us/2019/11/12/northeast/in-cambridge-efficiency-concierge-will-help-large-buildings-cut-energy-use/).
- Silverman, B. 2022. "Vancouver Adopts First Building Performance Standard in Canada." *IMT*, August 1. [imt.org/news/vancouver-adopts-first-building-performance-standard-in-canada/](https://imt.org/news/vancouver-adopts-first-building-performance-standard-in-canada/).
- Silverman, B., J. Miller, and Q. Biever. 2022. *Building Performance Standard Module: Housing Affordability*. Washington, DC: IMT. [imt.org/wp-content/uploads/2022/05/IMT-Housing-Affordability-CW5.pdf](https://imt.org/wp-content/uploads/2022/05/IMT-Housing-Affordability-CW5.pdf).
- St. Louis. 2020a. *Board Bill Number 219, Session 2019–2020: Building Energy Performance Standard (BEPS)*. St. Louis, MO: City of St. Louis. [stlouis-mo.gov/government/city-laws/board-bills/boardbill.cfm?bbDetail=true&BBId=13504](https://stlouis-mo.gov/government/city-laws/board-bills/boardbill.cfm?bbDetail=true&BBId=13504).
- \_\_\_\_\_. 2020b. *Implementing the Building Energy Performance Standard in St. Louis: What Building Owners Need to Know*. St. Louis, MO: City of St. Louis. [stlouis-mo.gov/government/departments/public-safety/building/building-energy-improvement-board/documents/upload/BEPS-factsheet.pdf](https://stlouis-mo.gov/government/departments/public-safety/building/building-energy-improvement-board/documents/upload/BEPS-factsheet.pdf).
- \_\_\_\_\_. 2021. *BEPS by Property Type*. St. Louis, MO: City of St. Louis. [www.stlouis-mo.gov/government/departments/public-safety/building/building-energy-improvement-board/documents/upload/ApprovedBEPS\\_05-03-21.pdf](https://www.stlouis-mo.gov/government/departments/public-safety/building/building-energy-improvement-board/documents/upload/ApprovedBEPS_05-03-21.pdf).
- \_\_\_\_\_. 2022. *Building Performance Standards (BEPS) Handbook*. St. Louis, MO: Office of Building Performance, City of St. Louis. [drive.google.com/file/d/1w5NhD1cN6N-ZBO2MkLnMijw4yoYdS5ks/view](https://drive.google.com/file/d/1w5NhD1cN6N-ZBO2MkLnMijw4yoYdS5ks/view).

- Sunderland, L., and M. Santini. 2020. *Filling the Policy Gap: Minimum Energy Performance Standards for European Buildings*. Montpelier, VT: RAP. [raponline.org/knowledge-center/filling-the-policy-gap-minimum-energy-performance-standards-for-european-buildings/](https://raponline.org/knowledge-center/filling-the-policy-gap-minimum-energy-performance-standards-for-european-buildings/).
- Suozzo, M., K. Wang, and J. Thorne. 1997. *Policy Options for Improving Existing Housing Efficiency*. Washington, DC: ACEEE. [aceee.org/research-report/a971](https://aceee.org/research-report/a971).
- Sustainable DC. 2023. "Green Jobs, Careers, and Workforce Development." [sustainable.dc.gov/page/green-jobs-careers-and-workforce-development](https://sustainable.dc.gov/page/green-jobs-careers-and-workforce-development).
- TMG (Tokyo Metropolitan Government). 2022. *Tokyo Cap-and-Trade Program: Significant Emissions Reductions in the First Year of the Third Compliance Period*. Tokyo: Tokyo Metropolitan Government. [kankyo.metro.tokyo.lg.jp/en/climate/cap\\_and\\_trade/index.files/resultfirstyearofthethird.pdf](https://kankyo.metro.tokyo.lg.jp/en/climate/cap_and_trade/index.files/resultfirstyearofthethird.pdf).
- TMG and C40. 2017. *Urban Efficiency: Seven Innovative City Programmes for Existing Building Energy Efficiency*. [issuu.com/c40cities/docs/urbanefficiencyii\\_final\\_hi\\_res\\_1](https://issuu.com/c40cities/docs/urbanefficiencyii_final_hi_res_1)
- TownCharts. 2023. "Boulder, Colorado Housing Data." .
- UK BEIS (Department of Business, Energy & Industrial Strategy). 2017. *Evaluation of the Green Deal Communities PRS Funding*. London: UK Government. [gov.uk/government/publications/evaluation-of-the-green-deal-communities-private-rented-sector-funding](https://gov.uk/government/publications/evaluation-of-the-green-deal-communities-private-rented-sector-funding).
- \_\_\_\_\_. 2019a. *Non-Domestic Private Rented Property: Minimum Energy Efficiency Standard—Landlord Guidance*. London: UK Government. [gov.uk/government/publications/non-domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance](https://gov.uk/government/publications/non-domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance).
- \_\_\_\_\_. 2019b. *The Non-Domestic Private Rented Sector Minimum Energy Efficiency Standards: The Future Trajectory to 2030*. London: UK Government. [assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/839362/future-trajectory-non-dom-prs-regulations-consultation.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/839362/future-trajectory-non-dom-prs-regulations-consultation.pdf).
- \_\_\_\_\_. 2020a. *The Domestic Private Rented Property Minimum Standard*. London: UK Government. [assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/882957/Domestic\\_Private\\_Rented\\_Property\\_Minimum\\_Standard\\_-\\_Landlord\\_Guidance\\_2020.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/882957/Domestic_Private_Rented_Property_Minimum_Standard_-_Landlord_Guidance_2020.pdf).

- \_\_\_\_\_. 2020b. *Powering Our Net Zero Future*. London: UK Government. [assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/945899/201216\\_BEIS\\_EWP\\_Command\\_Paper\\_Accessible.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf).
- \_\_\_\_\_. 2021. *Evaluation of the Domestic Private Rented Property Minimum Energy Efficiency Standard: 2020 Interim Process and Impact Evaluation Report*. London: UK Government. [assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/969540/domestic-private-rented-sector-minimum-energy-efficiency-standards-interim-synthesis-report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/969540/domestic-private-rented-sector-minimum-energy-efficiency-standards-interim-synthesis-report.pdf).
- \_\_\_\_\_. 2023. *The Domestic Private Rented Property Minimum Standard—Landlord Guidance*. London: UK Government. [gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance](https://gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance).
- Ungar, L., and S. Nadel. 2022. *Home Energy Upgrade Incentives: Programs in the Inflation Reduction Act and Other Recent Federal Laws*. Washington, DC: ACEEE. [aceee.org/policy-brief/2022/09/home-energy-upgrade-incentives-programs-inflation-reduction-act-and-other](https://aceee.org/policy-brief/2022/09/home-energy-upgrade-incentives-programs-inflation-reduction-act-and-other).
- \_\_\_\_\_. 2023. *Commercial Building Incentives: Programs for New Construction and Upgrades in the Inflation Reduction Act and Other Recent Federal Laws*. Washington, DC: ACEEE. [aceee.org/policy-brief/2023/02/commercial-building-incentives-programs-new-construction-and-upgrades](https://aceee.org/policy-brief/2023/02/commercial-building-incentives-programs-new-construction-and-upgrades).
- Urban Green Council. 2018. *Blueprint for Efficiency: Detailed Proposals*. New York: Urban Green Council. [urbangreencouncil.org/blueprint-for-efficiency-an-80x50-partnership-report/](https://urbangreencouncil.org/blueprint-for-efficiency-an-80x50-partnership-report/).
- USDOE (U.S. Department of Energy). 2023. "Request for Information & Notice of Intent Released for Technical Assistance for the Adoption of Building Energy Codes." Washington, DC: USDOE. [energy.gov/scep/articles/request-information-notice-intent-released-technical-assistance-adoption-building](https://energy.gov/scep/articles/request-information-notice-intent-released-technical-assistance-adoption-building).
- Vancouver. 2022. *Annual Greenhouse Gas and Energy Limits By-Law No. 13472*. Vancouver, BC: City of Vancouver. [bylaws.vancouver.ca/consolidated/13472.PDF](https://bylaws.vancouver.ca/consolidated/13472.PDF).
- Washington State Department of Commerce. 2021. "Washington State Clean Buildings Performance Standard." [commerce.wa.gov/growing-the-economy/energy/buildings/clean-buildings-performance-standard/](https://commerce.wa.gov/growing-the-economy/energy/buildings/clean-buildings-performance-standard/).
- \_\_\_\_\_. 2023. "Early Adopter Incentive Program." [commerce.wa.gov/growing-the-economy/energy/buildings/early-adopter-incentive-program/](https://commerce.wa.gov/growing-the-economy/energy/buildings/early-adopter-incentive-program/).
- Washington State Legislature. 2019. *Energy Efficiency*. H.B. 1257. Olympia: Washington State Legislature. [lawfilesexternal.wa.gov/v/biennium/2019-20/Pdf/Bills/SessionLaws/House/1257-S3.SL.pdf?q=20221213084657](https://lawfilesexternal.wa.gov/v/biennium/2019-20/Pdf/Bills/SessionLaws/House/1257-S3.SL.pdf?q=20221213084657).

\_\_\_\_\_. 2022. *Buildings—Energy Management and Benchmarking*. S.B. 5722. Olympia: Washington State Legislature. [lawfilesexternal.wa.gov/biennium/2021-22/Pdf/Bills/SessionLaws/Senate/5722-S.SL.pdf?q=20221213085141](http://lawfilesexternal.wa.gov/biennium/2021-22/Pdf/Bills/SessionLaws/Senate/5722-S.SL.pdf?q=20221213085141).

York, D., S. Nowak, M. Neubauer and M. Molina. 2015. Washington, DC: ACEEE.. Washington, DC: ACEEE. [aceee.org/research-report/u1501](http://aceee.org/research-report/u1501) .

Zimring, M., M. Borgeson, I. Hoffman, C. Goldman, E. Stuart, A. Todd, and M. Billingsley. 2012. *Boulder, Colorado's SmartRegs: Minimum Performance Standards for Residential Rental Housing*. Prepared by Berkeley Lab. Washington, DC: DOE. [emp.lbl.gov/publications/boulder-colorados-smartregs-minimum](http://emp.lbl.gov/publications/boulder-colorados-smartregs-minimum).