The New Challenge for New Construction:

The Intersection of Energy Codes and Building Performance Standards

Amy Boyce, Institute for Market Transformation
Kim Cheslak, New Buildings Institute
Jim Edelson, New Buildings Institute

ABSTRACT

Leading jurisdictions are seeking to address climate and decarbonization goals on two policy fronts: energy codes and building performance standards (BPS). The combination seems like a perfect match, with one addressing new construction and one addressing the existing building stocks. However, this approach overlooks a key factor: newly constructed buildings become existing buildings the moment the first occupant arrives. New buildings may use less energy than existing buildings on average, but not every new building is a high performer. What happens when a new building is deemed code-compliant but fails to meet the BPS in the same jurisdiction? There is mounting evidence this could happen as early as the first compliance deadline in the U.S. in 2024. More widespread adoption of BPS means that governments, owners, designers, and builders need to understand and plan for the future performance targets. This will require both project teams and regulators to look at new construction as only the starting point of a building's performance lifecycle – and ensure that decarbonization goals in the design of new buildings meet the performance obligations set by BPS.

This paper will explore how new construction codes in several sample jurisdictions compare to existing or proposed BPS thresholds and provide examples of where new construction code-level designs are falling short. Additionally, we will explore methods to bridge the gap between new and existing buildings, the potential and limitations of each method, and the need to shift industry thinking towards a holistic, performance lifecycle approach to buildings.

Introduction

As governments and industry look to combat the rapid advance of climate change, it has become clear that buildings play a critical role in reducing energy and greenhouse gas emissions, and this has spurred the adoption of new policy approaches. A Building Performance Standard (BPS) is an emerging policy tool that requires minimum levels of performance, usually energy-related, from existing buildings by a future date. In January 2021, President Biden announced the formation of the National BPS Coalition, with more than 30 participating local governments committed to adopting a BPS by 2024.

While it is commonly assumed that newly constructed buildings will outperform existing buildings, there is no guarantee this will be true. A myriad of factors, including construction techniques, adherence to code requirements, and operational variances can impact a building's energy use. Depending on the specific BPS ordinance, a new building that complies with current energy code minimums might or might not comply with the relevant BPS. As BPS gain traction, the transition from new construction to existing buildings, and from code requirements to performance requirements, will become increasingly important. Current energy codes are not developed to predict performance, and their authority ends at occupancy, while BPS look solely at the performance of existing buildings, including those that have been recently constructed. Conflicts will arise if these two policies are siloed, because new construction becomes an existing building the moment it is occupied. If a building meets code at the time of construction but fails to meet BPS in just a few years, the consequences could be significant. How do we prevent this? By aligning performance targets with energy codes and pursing a building performance lifecycle framework.

Background

Energy Codes

Energy codes, most commonly the International Energy Conservation Code (IECC) or ASHRAE 90.1[1], set the energy-related requirements for building elements and systems at the time of design and construction. Though the codes do govern renovations, including events ranging from additions to equipment replacement, the energy codes' greatest impact is during design and initial construction. Once the certificate of occupancy is issued the authority of the code ceases, meaning the codes provide no regulatory basis for gauging performance. A building that meets code, gains its certificate of occupancy, and performs poorly is still legal unless there is an additional law, such as a BPS, that regulates actual performance.

Compliance with the energy code generally occurs through either the prescriptive path or the performance path. In the prescriptive path, specific requirements are laid out for each building element with few opportunities for tradeoffs. While more restrictive, the prescriptive path is more straight-forward to follow and does not require the creation of an energy model. Measures in the prescriptive path are always energy focused, with new measures being added that can explicitly show increased energy savings. The performance path, on the other hand, allows for a large number of tradeoffs, and relies on energy modeling to demonstrate compliance by comparing a proposed building to a baseline building of the same size and function with prescriptively compliant elements. The most common performance path (ASHRAE's Appendix G) is actually cost focused, driving modeling and design decisions based on data surrounding the current cost of fuels and not just the least consumption of energy.

Despite its name, the performance path does not require actual performance data to verify code compliance. In fact, the energy use estimates produced by energy models created for code compliance are often significantly different from actual energy use post-occupancy. Models created for code compliance are not intended to predict actual building operations, as they are required to standardize certain assumptions for the comparative model even if those assumptions do not match the intended use or operations of the building. If the proposed design model performs better than the baseline model, it is considered code-compliant, even if the building uses more energy than the modeled value after it is constructed and occupied. That being said,

[1] By federal statute, DOE recognizes the IECC as the residential model code, and ASHRAE 90.1 as the commercial model code. While some jurisdictions adopt 90.1 directly on the commercial side, it is more common to adopt the commercial version of the IECC, which references 90.1 as an alternative compliance path.

this path has the potential to provide a ballpark of future energy use expectations, whereas the prescriptive path does not. Those following the prescriptive path can reference the DOE energy savings analyses for that code version[2] to narrow down energy use intensity estimates by local code, climatic region, and prototype building types, but very large variations are possible.

The code that a specific building must meet depends on the jurisdiction in which it is built. In the US, code adoption at the state level is most common, though codes are adopted at the city or county level in some places. Hybrids of the two models occur as well. The most recent model codes are ASHRAE 90.1-2019 for commercial, and IECC-2021 for residential; however, those versions (or equivalent) have been adopted in very few locations to date. Figure 1 shows the status of commercial energy codes throughout the US by state.

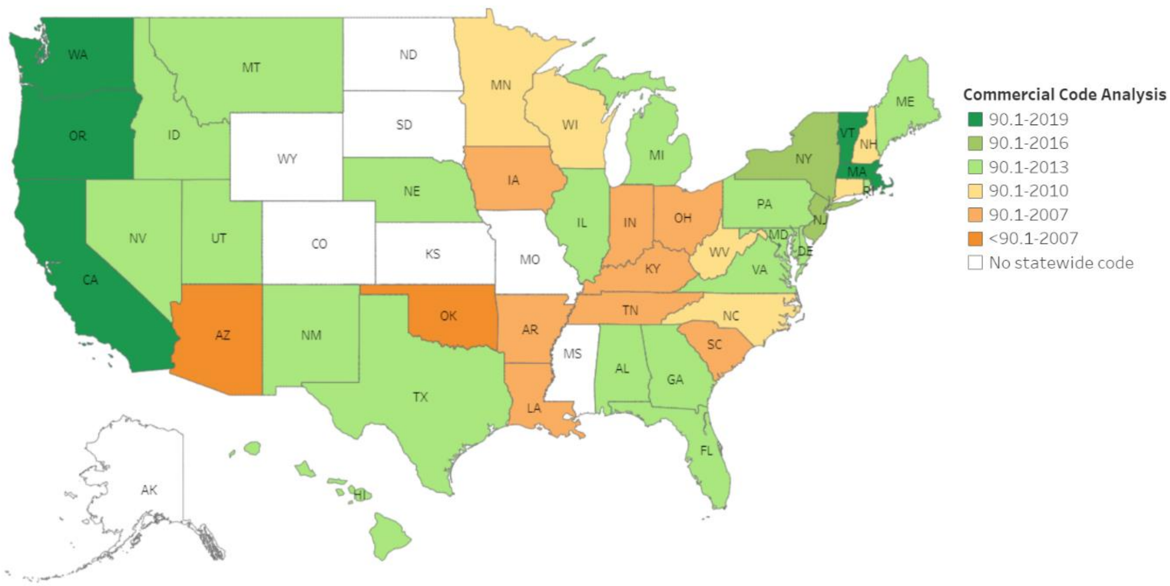

Figure 1: US state code status[3] *Source*: US DOE

Building Performance Standards

Building Performance Standards are directed towards existing buildings, and meant to track actual, measured performance metrics, usually centered on energy or carbon. Targets are set for buildings by size and type, with the stringency ratcheting up at predetermined intervals, typically every four to six years. Unlike energy codes, BPS are part of a long-term relationship between buildings and local governments, with periodic "check-ins" required to determine compliance. While energy and carbon reduction are the primary goals of most BPS, the metrics used to track them vary, and include site Energy Use Intensity (EUI), source EUI, ENERGY STAR Score, or Greenhouse Gas Intensity (GHGI).

[2] The Department of Energy determinations and supporting technical analyses can be accessed through the Building Energy Codes Program website at https://www.energycodes.gov/determinations

[3] Because states may amend their code, the named version may not match the stringency. The map here is intended to represent relative stringency.

Compliance with BPS requires actual performance measured against the metric selected, and the standard, or target, set for compliance. Buildings that meet the target are considered compliant, often referred to as direct compliance. Buildings that miss the mark may be offered additional compliance paths, including performance or prescriptive upgrades that must be completed within the compliance cycle, or exemptions, extensions or possibly even payments or fines for a given compliance cycle (Edelson 2021).

Like codes, the development of BPS is local, either at the state or jurisdiction level. To date only two state and local BPS overlaps exist: Colorado and Denver, and Montgomery County and Maryland. While others are being considered, it is most likely that a single BPS will be in place in most jurisdictions. Table 1 lists current BPS and their metrics, along with the applicable code, in jurisdictions in the U.S. Figure 2 shows the jurisdictions that have signed on to participate in the National BPS Coalition, indicating a commitment to design and implement equitable building performance standards and complementary programs and policies through legislation and/or regulation, by Earth Day, 2024. Of those committed, Boston, MA; New York, NY; Washington, DC; St. Louis, MO; Montgomery Co., MD, Denver, CO; Chula Vista, CA; and the states of Colorado and Washington have already enacted policies.

Table 1. Jurisdiction Energy Code and BPS metric

Location	**Energy Code**	**BPS metric**
New York, NY	NYStretch	GHG
Washington, DC	ASHRAE 90.1-2013	ENERGY STAR Score
St Louis, MO	IECC 2018	Site EUI
Boston, MA	MassStretch	GHG
Montgomery County, MD	IECC 2018	Site EUI
Denver, CO	IECC 2018	Site EUI
Colorado	Varies	TBD
Washington	IECC 2018	Site EUI
Chula Vista, CA	California Title 24, Part 6	ENERGY STAR Score

Figure 2: National BPS Coalition participants *Source*: IMT

Points of Disconnect

The fundamental disconnects between codes that govern only design and construction and BPS that govern only performance can cause confusion for multiple stakeholders, including designers, building owners and developers, and local jurisdiction code officials. This disconnect is exacerbated by the lack of coordination within individual jurisdictions that have adopted BPS to date. Codes are mostly adopted at the state level and do not allow modifications at the local level, with code stringency being set through national processes. In contrast, BPS have, to date, been mainly adopted at the local level and the stringency of BPS has been based on local climate or energy goals without consideration of code requirements. Even when the local government has authority over both codes and BPS, the disconnect will exist if the processes to develop BPS and codes do not explicitly consider the relationship of the two policies.

Metrics and Targets

Energy codes primarily rely on estimated energy use intensity (for prescriptive paths) and energy cost (for performance paths) as metrics. The BPS enacted to date use a variety of metrics including site or source EUI, ENERGY STAR score, or GHGI. A building designed to minimize energy cost might not be optimized to meet a future BPS target. This misalignment of metrics is problematic, and becomes even more difficult to correct if the code and the BPS are adopted at different governmental levels, i.e. state versus city or county.

Where the BPS is enacted in a jurisdiction that has been more proactively addressing climate change than the state in which it resides, the stringency of the code versus the BPS targets may be significantly misaligned. If the existing code is weak, even a modest BPS may cause compliance problems for new buildings. If policy makers are not fully aware of the code impacts or choose to proceed with policy design and target setting despite them, newly constructed building may require major upgrades in the near term. Such upgrades are generally more costly than making changes during construction. At a minimum, owners are likely to seek exemptions on the grounds that the buildings complied with recent code.

Example: Washington DC. In Washington, DC, the current energy code is the 2017 District of Columbia Energy Conservation Code (DCECC), which references ASHRAE 90.1-2013, and went into effect in May of 2020. Local amendments to the energy code in the District result in a code that is stronger than the referenced code and closer to the efficiency of the 2019 version of ASHRAE 90.1 (US DOE 2022). The previous code, the 2013 DCECC, first went into effect in March of 2014, referencing the 2012 IECC. For the purposes of this discussion, we consider all buildings constructed under the both the 2013 and 2017 versions of the DCECC as new construction.

The District's BEPS[4] Period 1 became effective January 1, 2021 and is applicable to all buildings who were required to benchmark in calendar year 2019, which covered all privately-owned buildings over 50,000 square feet, and all District-owned buildings over 10,000 square feet (DC 2018). Given those parameters, we know that no buildings subject to BEPS were constructed under the 2017 DCECC, as it was not effective until 2020. But a number of buildings

[4] Washington, DC's regulatory language uses the term "Building Energy Performance Standard (BEPS)". Elsewhere in the document the more general "Building Performance Standard (BPS)" is used.

built to the 2013 DCECC are required to comply, depending on their completion date.[5] Per DC's requirements, an office building must meet an ENERGY STAR score of 71 and multifamily buildings must meet a score of 66 (DC DOEE 2021).

Broadly speaking, for new construction reporting in the 2019 benchmarking compliance cycle there is an inverse relationship between energy use (site and source EUI) and ENERGY STAR score; the lower the energy use, the higher the ENERGY STAR score. In Figures 3 and 4 there are several buildings for which this is not the case: multifamily buildings F and I, and office buildings D and I, all have higher site and source EUI than expected for their ENERGY STAR score, likely due to the variables used for the score calculations (ENERGY STAR 2021).

In this analysis, nine in ten office buildings under the 2013 DCECC are compliant, and 21 out of 29 multifamily are complaint, as indicated in the figures where the ENERGY STAR Score is above the dashed target line. While not a statistically valid sample, a potential noncompliance rate for new construction of 10% and 28% (meaning 10-28% of all new buildings will likely need to undergo an energy related renovation or retrofit within five years of existence), respectively, should be concerning for an implementing jurisdiction.

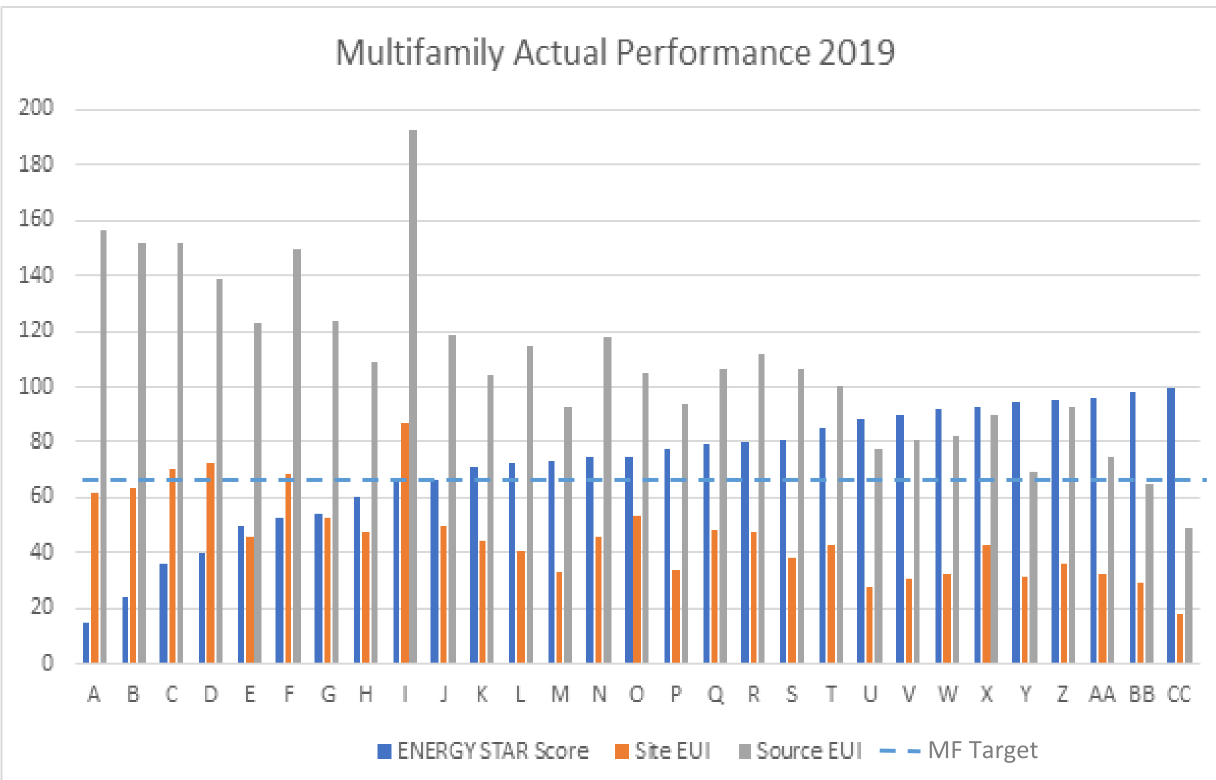

Figure 3: Multifamily Actual Performance 2019, Washington, DC

[5] DC does not track in a searchable database the code used for construction. All assumptions here are based on reported data for the 2019 benchmarking year with dates of construction between 2015-2017 as a proxy for compliance under the 2013 DC Energy Code.

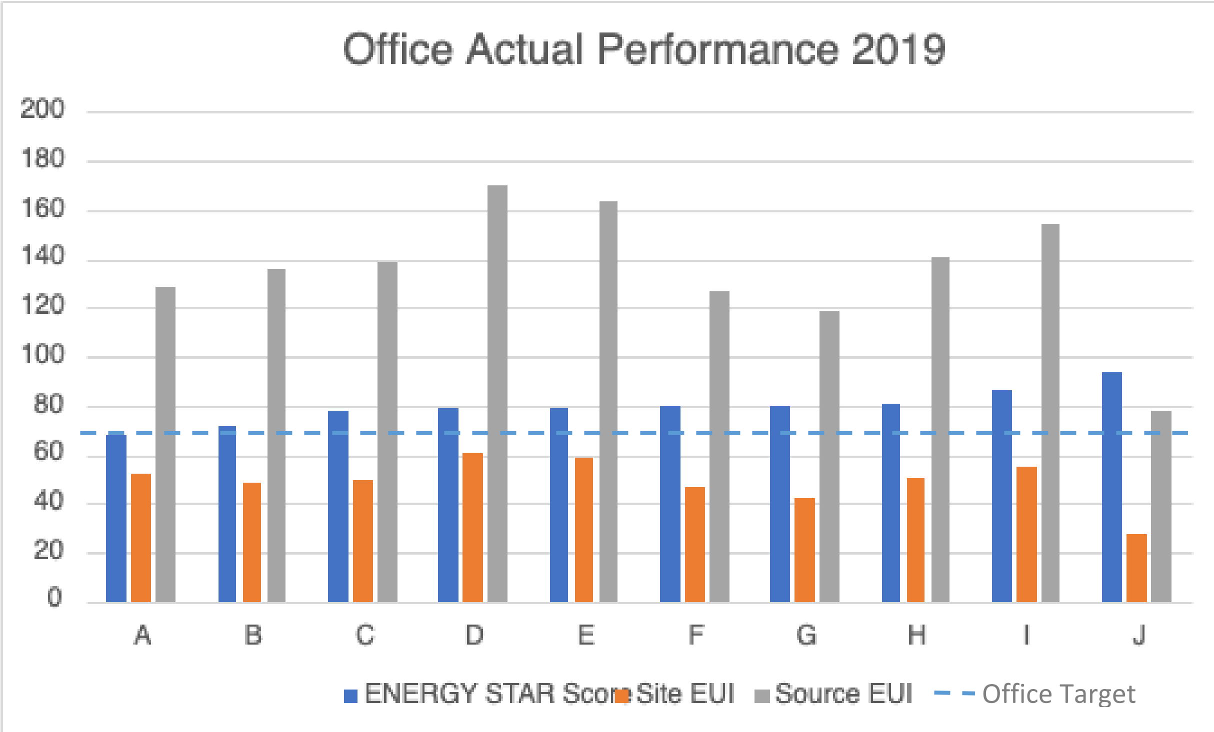

Figure 4: Office Actual Performance 2019, Washington, DC

Based on this analysis, it is not fully possible to state whether the reason behind the disparity between the energy performance of newly constructed code-compliant buildings and BPS requirements for occupied buildings in DC is due to different metrics between the code and BEPS, or targets that were not well set in relationship to expected code outcomes; it is clear, however, that the resulting gap in performance is potentially problematic for recent and future new construction.

Example: St. Louis, MO. The City of St. Louis, Missouri passed its own BEPS,[6] focusing its metric on site EUI, but setting its intended threshold at the 65th percentile, instead of a median score. Using primarily local data to set targets, St. Louis released its first compliance targets in May of 2021 (City of St. Louis 2021). St. Louis currently uses the 2018 IECC as its new construction energy code (City of St. Louis 2018).

While some of the set BEPS targets appear to be within range of expected performance for new construction, there are others that are very close, and some that appear to be set at a level where new code-compliant construction will likely miss the mark. Table 2 highlights key building activities and types where the comparison to national site EUIs for the 2018 IECC (Zhang 2018) will lead to the construction of new buildings that do not meet the first BEPS cycle, (highlighted in orange) and buildings that are within five points of the BEPS target (highlighted in yellow).

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[6] Like Washington, DC, St. Louis uses the term "BEPS" for its Building Energy Performance Standard.

Table 2. Comparison of St Louis Code to BEPS Targets (Site EUI)

Building Type	Subtype	2018 IECC	BEPS Target
Education	Primary	48.8	63.5
	Secondary	40.2	63.5
Food Service	Quick Service	572.2	181.9
	Full Service	368	181.9
Healthcare	Outpatient	115.7	105.9
	Hospital	124.3	259.9
Lodging	Large Hotel	85.4	89.4
Multifamily	Mid-Rise	43	42.5
	High-Rise	46.6	42.5
Office	Large	67.9	71.7
Retail	Stand-Alone	40.9	79.3
	Strip Mall	51.5	101.1
Warehouse	Non-refrigerated	14.4	17.6

XX code w/in 5 pts of target XX code below BEPS target

Most concerning of these targets are office and multifamily, which in many US cities represent the highest new construction starts. An Office for example, is estimated, as based on prototype modeling, at 67.9 kBtu/ft2-yr, below the BEPS target of 71.7. The difference in site EUI here is 5.6%, within a range of error that small changes in design or operations that do not align with the prototype modeling may cause a new building to be out of compliance with BEPS. Multifamily is in a more precarious position, with potentially all new multifamily buildings being non-compliant at construction.

Other building types like retail and schools seem to be able to be compliant without much concern at this level of analysis. All building owners should consider the impacts of maintaining pace with a 65th percentile target. Assuming all buildings below the target for the first compliance cycle move up to meet or exceed the target, the next round of 65th percentile targets will almost certainly impact new construction from the 2018 code that was near the edge of compliance. Additional analysis should be done using local analysis of 2018 IECC for full understanding of the potential scale of the problem.

Timelines and Cycles

To date, most BPS have presented a 4-6 year cycle for increasing stringency and reporting compliance. Most energy codes are updated on a three-year cycle. Even when jurisdictions adopt newer codes, many buildings are “grandfathered” in under the old code if they have initiated the design process. The BPS and code compliance cycles are, therefore, out of sync. When we further consider that some jurisdictions establish the next BPS target at the end of the previous cycle, and the length of time required for design and construction of a typical building that is large enough to require compliance with a BPS, understanding how to plan for performance compliance becomes increasingly fraught.

A combination of factors including lags in code adoption, grandfathered buildings, and the long timelines for the construction process, may mean that many buildings are constructed in a way that limits their potential for high performance, with implications for both the jurisdiction implementing the BPS and those required to comply with it. For jurisdictions, it adds to the challenges already present in setting targets to meet climate goals.

Conflicting Governance

States generally fall into one of two categories, operating under Dillon's Rule, or Home Rule. Dillon's Rule generally limits the authority of local jurisdictions, while Home Rule provides additional freedom to city and county governments, with specific powers varying by state (NLC 2020). States following Dillon's Rule determine the energy code at the state level and may provide for some allowances at local levels. States following Home Rule allow individual jurisdictions to establish their own building codes, but still may have some restrictions imposed by the state government.

As with codes, location in a Home Rule or Dillon's Rule state will impact how a BPS can be developed and adopted by a jurisdiction. In a Home Rule state, jurisdictions can establish their own BPS. In Dillon's Rule states, the same preemption that restricts the local adoption of a different code will also likely present a barrier to adoption of a BPS – especially one that is tied to energy use, or energy efficiency, creating a statutorily necessary lack of alignment in metrics. Where jurisdictions are looking to expand BPS beyond energy to carbon, or to specifically promote electrification, local authority may also be limited. Preemptive bans on gas bans have been passed in nineteen states (DiChristopher, 2021), extremely limiting actions that local jurisdictions in those states can take to limit fossil fuel use. Even in more progressive areas, local policies seeking to phase out or limit fossil fuels have faced opposition as well, suggesting that there are significant political hurdles to regulating fossil fuel use in new and existing buildings, regardless of location.

Example: Boston, MA. The Commonwealth of Massachusetts is under Dillon's Rule, with state limitations on building energy codes and building energy regulations. Currently the state allows jurisdictions to use either a base energy code or the Massachusetts Stretch Energy Code. No other option for building energy regulation (less, more, or in between) can be adopted by a local jurisdiction. Boston adopts the Massachusetts Stretch Code.

Boston city leadership has strong interest in pursuing its climate goals and saw BPS as a clear option to address the impact of existing buildings. Because the city was restricted from passing an energy regulation, its BPS, BERDO 2.0, requires that buildings in Boston put themselves on the path to zero carbon performance by 2050 (Boston 2021). The use of a carbon metric was necessary due to the statutory restrictions of the state. Table 3 considers the difference between ASHRAE 90.1-2019 (Zhang 2021) and BERDO targets using the adopted carbon metric.[7]

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[7] DOE state level analysis considers Massachusetts code to be equivalent to 90.1-2019, even though in name this more recent standard has not been adopted.

Table 3. Comparison of ASHRAE 90.1-2019 to BERDO 2.0 Targets

Building Type	Subtype	ASHRAE 90.1-2019	Target years 2025-2029
		kgCO$_2$e/SF/yr	
Education	Primary	6.9	3.9
	Secondary	6.2	3.9
Food Service	Quick Service	53.5	17.4
	Full Service	41.5	17.4
Healthcare	Outpatient	18.5	15.4
	Hospital	17.9	15.4
Lodging	Large Hotel	10.7	5.8
Multifamily	Mid-Rise	7.1	4.1
	High-Rise	6	4.1
Office	Large	10.7	5.3
Retail	Stand-Alone	7.2	7.1
	Strip Mall	8.8	7.1
Warehouse	Non-refrigerated	2.1	5.4

XX code w/in 5 pts of target XX code below BEPS target

Table 3 quickly makes apparent that no building type except non-refrigerated warehouses, if built to current code, is likely to meet the BERDO targets. While the ASHRAE figures presented here are national, this level of diversion from a recent model code begs for additional analysis. For jurisdictions considering GHG metrics, it will be an important to look at local grid emission factors and building fuel use mixes to understand the potential areas of concern for new construction.

Currently Massachusetts is in the process of updating its stretch code, but through its BERDO ordinance, Boston has already set the targets for each building type across all six compliance cycles, targeting the goal of zero carbon by 2050. Analysis can still be used to inform either the development of further stretch codes in Massachusetts or, at a minimum, design decisions for new construction that both meet code and the required GHG targets.

In addition to the hurdles associated with the adoption of codes and BPS at different governmental levels, coordination within jurisdictional departments can also pose challenges. Building permit review and inspections are typically handled by a local buildings department. This department will look at all building codes, not just energy codes, including mechanical, plumbing, fire, etc. Where they have been established so far, BPS are developed, implemented, and enforced by a separate energy or sustainability department, which might also be looking at other city elements, such as transportation or waste. As the same buildings that are subject to energy codes will also be subject to BPS, coordinating on both code and BPS requirements and enforcement is critical to avoid overly burdening owners and operators. As it stands, energy codes are already at the periphery of code department work, often receiving less attention than other codes, making further coordination with energy/sustainability departments an additional burden to frequently understaffed code and energy teams. Furthermore, BPS compliance requires performance tracking over time; if clear lines of communication and coordination are not established at the onset, data may overlap significantly between departments, raising the risk that data could be duplicated or contradictory.

If rulemaking, compliance review, and enforcement are not aligned between codes and BPS (and with each other), and a code-complaint building does not meet initial BPS requirements, the question of responsibility may arise. While the building owner will ultimately bear responsibility for meeting BPS requirements, they rely on the expertise of designers, builders, and regulatory agencies to ensure that the expected building is delivered. If the owner is subject to a fine or needs to invest in major upgrades just years after initial construction, it is inevitable that blame and conflict will result. The better way forward is to align rulemaking, compliance review, and enforcement processes for energy codes and BPS regulations.

Aligning Codes and BPS

Prior attempts to integrate real performance measurement into code – often referred to as “outcome-based codes” – have run up against a host of issues, including lack of regulatory authority, lack of departmental resources, and lack of expertise or experience in dealing with building performance data. In order to measure real world performance, a building must be occupied, but in order for a building to be occupied, it must obtain its Certificate of Occupancy, which is granted after the building passes its final inspections. Attempts at workarounds to this chicken-or-the-egg scenario create additional burden for code officials and introduce additional uncertainty into the process. While it has historically been difficult to include performance in code, there are options to align these current policy tools, both from a technical perspective and within the regulatory process.

Metrics and Targets

First and foremost, whenever possible the code and BPS should be using the same metric. This may involve adopting a new approach to code that shifts energy modeling metrics from those based on cost to metrics based on site energy or carbon. Such a solution is now possible based on proposed language to ASHRAE 90.1-2019, giving alternative building performance factors for Appendix G (ASHRAE 2022). Where metrics cannot be aligned due to state preemption or other factors, jurisdictions should seek to understand the relationship and potential impacts on either code or BPS compliance with their long term goals.

Targets can and should be aligned as well. Jurisdictions should compare their new construction data from recently constructed buildings to code expectations and draft BPS targets during target setting, for both the first targets, and any known future targets. The best thing a jurisdiction can do is put its new construction code on a faster path to meet or exceed its final BPS target. For example, if the final BPS target is set for 2050, ensuring that new construction is looking at the same target for 2030, will help to ensure alignment and success.

Additionally, in line with the Washington state model, jurisdictions should recognize the margins of performance between building vintages, and market segmentation analysis based on year of building construction to ensure that the existing building BPS threshold is both forgiving, while aggressive where necessary, in setting targets for BPS.

Example: Washington State. Washington State’s BPS rulemaking has included proposals for different targets for more recently constructed buildings. In both state climate zones (4C and 5B), new construction targets, based on current best available technologies, result in standards that average 39% better than potential BPS targets and 63% better than the mean Washington State building today (Washington Department of Commerce, 2020). Achieving this additional savings potential from the BPS is critical to meeting the intent of the state's statutory codes requirement to be near zero by 2031 (Frankel and Edelson 2015).

The state follows a two-tier target setting approach for BPS which is aligned with recent analysis by NBI (Carbonnier 2019) and Steven Winter Associates (Steven Winter Associates 2020). When setting site EUI targets at net-zero ready levels across three ASHRAE climate zones, significant differences emerge between new construction (NC) and existing buildings (EB) in all building types except apartments (shown in Figure 5).

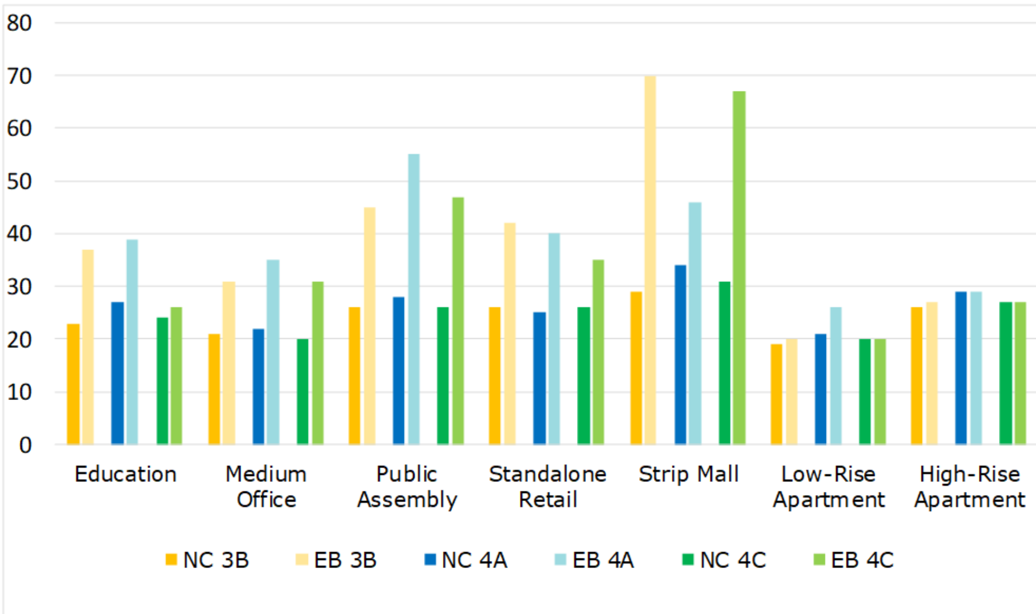

Figure 5. Comparison of New Construction and Existing Building EUIs.

Jurisdictions should consider their overall jurisdictional goal when setting targets for different types and ages of buildings. While older buildings have the most room to improve, it's not sufficient to hold new construction to the same standard as a 100-year old building; the potential for new construction contribution to the energy and carbon reduction goals is significantly greater. Where new construction will need to meet a net zero ready or near net zero standard as part of a BPS (and an overall city carbon goal), the building energy codes that govern how those buildings are built must, as a first step, require at least that same level of stringency.

Code Language

One path to alignment involves including language and provisions in the energy code that help pave the path to actual performance. Specific requirements already exist in the code that will aid owners and building managers in operations that can reduce energy use and carbon impact:

Solar generation. The addition of onsite solar generation will, in most current generation mixes, reduce both fossil fuels used to generate electricity on the grid and losses due to transmission, creating a benefit to the BPS target score of a building where metrics use source energy or carbon. Jurisdictions may also consider allowing offsite renewable electricity purchase as a compliance pathway in code (and BPS) to provide more flexibility, while ensuring the renewable energy meets power purchasing agreement requirements.

HVAC Controls. Heating, cooling, and ventilation remain the largest energy uses in most buildings (DOE, 2015). By including controls by which these systems can be easily managed, the building operator can tune the building to run more efficiently, and use less energy. Ramp up and ramp down schedules can be included and executed. As technology and programs to better utilize demand-responsive controls continue to grow, buildings will also be able to deal with carbon intensity by tailoring their energy use to specific utility signals when the grid is the cleanest.

Plug and Process Load Controls. Traditionally, energy codes do not regulate user-driven (plug and process) loads. Recent changes to the code have begun to include receptacle sensors, which automatically turn power off based on occupancy or schedule. User-driven loads could have large impact on actual building energy use, affecting BPS compliance under any metric. The increased acceptance and use of these controls will only aid in increased energy reductions and BPS compliance.

Energy Submetering. Energy submetering can provide more insight into a building's energy use than master metering and utility bills alone. Submetering by system, and by occupancy and tenant (where allowed), will provide increased detail into building owners' and operators' understanding of areas for improvement to meet BPS targets. Additionally, with the increased attention on EV charging in buildings, it will be necessary to accurately account for those loads to have them accounted for in the BPS compliance data. Boston's BERDO requires EV loads be submetered to be able to be removed from the total; other regulations are expected to follow this lead.

Commissioning. Undergoing full building system commissioning will ensure that systems are running as designed at initial operation and point out areas that need additional attention for building turnover. The resulting report will aid in efforts to minimize excess energy use down the road and help operators to understand where potential improvements could be made.

Drawing attention to all of these code measures in compliance reviews and adding, strengthening, or requiring them in future code updates, especially during certain types of renovations and retrofits, should aid in BPS compliance.

Coordinated Goals

In order to achieve decarbonization of the built environment, codes and BPS will have to move beyond addressing just efficiency to include requirements surrounding electrification and building-grid interconnections. If these goals are to be successful, they must be addressed in both codes and performance policy.

The easiest time to eliminate fossil fuels from a building is during initial design and construction. Jurisdictions are considering a variety of additional requirements related to electric readiness and electrification of new construction, which may prove useful in the implementation of a carbon-based BPS. By ensuring that all new construction is ready to accept renewable and low-carbon energy from the grid, the energy code can remove the barriers associated with replacing fossil fuel-based systems in the future. Even limiting requirements to only electric-ready provisions can save property owners from making significant changes down the road and can be included at very low costs (Denniston, 2022).

Regulatory Alignment

In the case of governmental departments, one way to minimize this risk is for the departments that create, implement, and enforce both codes and BPS to be closely aligned, or even combined. While not always feasible, enforcing departments have the ability to ensure that a building is treated consistently in design and construction, and through occupancy and performance, and not subject to unanticipated requirements along the way, such as changes in electrification requirements between construction and BPS implementation.

Education

A key tool for energy code and BPS coordination is education. Increasing the knowledge of designers and owners so that safeguards are put in place early in the process to monitor and verify performance expectations and results will go a long way to bridging this gap. Some cities that are adopting BPS have also created building performance hubs, or resource centers, as a way to disseminate information to various stakeholders and to encourage cross-discipline interactions and coordination. Examples include the New York City-based Building Energy Exchange and the Washington, DC-based Building Innovation Hub.

Conclusions

In reviewing the connection between building energy codes and BPS, it is helpful to look at these two policy tools as part of a continuous building regulatory policy in the form of a building performance lifecycle framework. By starting with the premise that new construction and existing buildings are not separate entities, but the same entity at different times, it makes sense to treat design, construction, and ongoing performance and renovation as different points along a continuous path. This view allows and encourages a long-term thought process for both policy makers and building owners, which acknowledges that buildings grow and change over time, and need to adopt to changing circumstances such as evolving environmental concerns and new technologies.

Given the speed at which many local governments are adopting BPS, it is critical that jurisdictions begin to align their codes with their BPS. By ensuring, at a minimum, that new construction will meet a BPS, jurisdictions can address one area of concern and opposition from stakeholders, helping the policy to succeed long-term, and, thus, to achieve climate objectives. Recommended steps are for policy decision-makers to:

- Align code and BPS metrics where possible.
- Use benchmarking data to evaluate new construction in target setting.
- Consider the range of potential impact achievable through new construction and existing buildings in overall target setting, and set higher targets for new construction where potential is more attainable.

- Enhance code at state or local level to produce the newly constructed buildings needed to meet the long-term goals of BPS.

Finally, as jurisdictions begin to explore the addition of other elements such as water or indoor air quality to their BPS, the need for alignment and relationship to new construction only increases. While energy codes, the primary discussion here, do not regulate all areas that may be regulated by a BPS, other building codes certainly do (e.g. water use in the plumbing code, air quality in the mechanical code). Every policy change creates a ripple effect, and successful policies will anticipate and plan for these consequences.

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