

Building Performance Standards: A Lifecycle Approach to Building Decarbonization

Harry Bergmann, U.S. Department of Energy

Billierae Engelman, ORISE Fellow hosted by U.S. Department of Energy

Paul Mathew, Travis Walter, Lawrence Berkeley National Laboratory

Jian Zhang, Andrea Mengual, Michael Rosenberg, Bing Liu, Pacific Northwest National Laboratory

ABSTRACT

Building Performance Standards (BPS) are an emerging outcome-based policy movement to decarbonize and improve the efficiency of existing buildings. BPS present a first-of-its-kind opportunity to require buildings to meet energy-based and/or greenhouse gas emissions performance targets throughout their lifetime. Different approaches to BPS policies across the U.S. incorporate different segments of the building stock in different ways and provide varying exemptions to specific building types. While several states and cities that have adopted BPS policies are in the early stages of implementation, issues have been raised around the linkages between energy codes for new construction and BPS since a building very quickly goes from “new” to “existing” upon occupancy. In this paper we will present strategies for aligning new construction codes with BPS to facilitate a “lifecycle” approach to building performance and drive equitable decarbonization. These strategies are based on the authors’ direct experience with the development and impact analysis of new construction codes and existing building BPS across several jurisdictions. We will consider critical resources needed to facilitate the design and adoption of BPS at the jurisdictional level, and what additional supportive structures need to be created to ensure equitable outcomes under this one-of-a-kind opportunity. Conclusions will include recommendations for core program components under an equitable BPS implementation model and how to connect a BPS to new construction codes, enabling both new and existing buildings of all covered types to meet performance targets consistently and predictably.

Introduction

BPS are an emerging outcome-based policy mechanism that improves the performance of and reduces the emissions from buildings using multi-year compliance cycles to incrementally work toward a long-term goal. Building on years of benchmarking, auditing, and retro-commissioning or retuning policies, BPS present a first-of-a-kind opportunity to move the building stock toward a high performance or low emissions goal. The BPS policy movement is largely happening at the state and local government level, resulting in a variety of approaches to addressing the building stock based on the unique nature of the implementing locality. When combined with building codes that regulate performance in specific instances like new construction or major renovations, BPS are powerful policy tools that provide a lifecycle approach to building performance and can empower state and local governments to deliver on their energy and carbon goals for the building sector.

BPS are the natural follow-on to policies like benchmarking and auditing requirements. Benchmarking policies require annual reporting, and sometimes the public disclosure, of building energy consumption. Audit policies require reporting of critical assets within the

building, which enables jurisdictions to gain a better understanding of how the energy reported through benchmarking ordinances is used. BPS can leverage that data and determine a pathway toward decarbonization goals based on the current state of the building stock. While each jurisdiction is unique, the critical questions around the creation of a BPS remain the same:

- What buildings should be covered or exempted?
- How should interim targets that are reasonable for reaching the long-term goal be determined?
- What aspects of BPS policy should be aligned with new construction codes?
- How can equitable outcomes be ensured through support for under-resourced communities and facilities?

These are critical considerations and cannot all be addressed in this paper. However, BPS enable a lifecycle approach to building energy and emissions management, a framework which necessarily considers all of the questions above, and many others. Using a lifecycle approach to buildings may provide solutions for many of the important questions that exist in the gaps between new construction and existing buildings, and between well-resourced and under-resourced facilities. BPS create a framework to support companion policies that enable a more efficient use of financial and physical resources to promote building decarbonization.

In that context, President Biden recently launched a National BPS Coalition, consisting of 33 state and local governments committing to advancing BPS-style legislation or regulation by Earth Day 2024 (Executive Office of the President 2022). This announcement gave even more momentum to an already rapidly growing policy landscape, underscoring the significance of the potential impact from BPS policies implemented at scale. For the first time, there is a consistent approach to the decarbonization of existing buildings and its adoption is only accelerating.

Designing and implementing a program with the intended lifetime of a BPS is not an easy lift. Political, analytical, technical, and social resources are all needed throughout the lifecycle for successful BPS. This paper intends to highlight some of those key considerations and resources, discuss methodologies for approaching questions around the formulation of BPS, and provide recommendations for strategies to ensure efficient implementation and equitable results.

Resources for Design and Adoption of BPS

Unlike other building performance and decarbonization policies such as benchmarking ordinances and energy audit programs, BPS are not merely data collection exercises. Instead, these policies must be carefully designed to advance a jurisdiction's energy and climate objectives while remaining feasible in their implementation. Once the policy objectives have been clearly established, there are three key steps in the design of a BPS: 1) select the performance metrics to be measured by the standard; 2) establish the scope of the policy and the performance targets; and 3) determine compliance timeframe and implementation mechanisms for the standard. Stakeholder engagement and communication throughout the process is essential for designing a policy that can be successfully and equitably implemented.

BPS policies should be designed to reduce greenhouse gas emissions from the building sector by encouraging not only a reduction in overall building energy consumption but also the electrification of building systems and the displacement of fossil fuels. Metrics like operational building energy or greenhouse gas emissions can advance these objectives, however, the final metric selection may be informed by programmatic and legal restrictions. Different states have

different policies about what can and cannot be regulated by local jurisdictions within the state, resulting in some BPS policies focusing on energy, while others may focus on emissions, and still others could focus on metrics yet to be developed.

Jurisdiction	Building Type Scope	Initial Compliance Period	Performance Metric(s)
Boston, MA	City, commercial, and multifamily	2025	CO2e Intensity
Chula Vista, CA	Municipal, commercial, institutional, and multifamily	2023	Site EUI reduction target (%) or ENERGY STAR Score
Denver, CO	Commercial and multifamily	2024	Site EUI
Montgomery County, MD	Non-residential and multifamily	2024	Site EUI
New York City	Commercial, industrial, and multifamily	2024	CO2e Intensity
Reno, NV	City, commercial, and multifamily	2026	ENERGY STAR Score or Site EUI
St. Louis, MO	Municipal, institutional, commercial, and multifamily	2025	Site EUI
State of Washington	Commercial, hotels, dormitories	2026	Site EUI
Washington, D.C.	Commercial and multifamily	2026	ENERGY STAR Score

Figure 1: Examples of BPS policies adopted by state and local jurisdictions and chosen metrics.

Energy and emissions-based metrics vary in their potential to advance electrification and decarbonization when included in a BPS. The U.S. Environmental Protection Agency (EPA) published a Benchmarking and BPS Policy Toolkit resource that considers the trade-offs and policy implications of different BPS metrics, and the differences between energy and emissions-based metrics underpinning a policy (EPA 2021a). While there is no single recommended metric since it depends on the specific policy priorities, jurisdictions can find this resource useful when considering whether to take energy or emissions-oriented approaches to their building stock.

There are two main types of energy-based metrics: annual site energy use intensity (EUI), and source EUI, both normalized by floor area. As a metric, site EUI can help promote energy efficiency and building electrification by encouraging the implementation of conservation measures. This metric also has the advantage of being well-understood by building owners, who may be accustomed to periodically tracking their building's performance and of being easily

measured through utility bills. However, because site energy measures exclusively building-level energy use and not the emissions associated with that energy, the use of this metric may not encourage short-term building decarbonization.

Metrics

EUI Metrics: Source EUI measures the total energy needed to meet a building's demand including the energy lost in the generation, transmission, and distribution of the different energy sources consumed by the building. To use source energy as a metric, jurisdictions must select conversion factors for electricity and other energy sources that translate a building's site energy use into total energy consumption. Selecting the right conversion factor for electricity can be challenging and requires understanding the fuel mix used to produce power for the jurisdiction. When locally specific information is not available, jurisdictions can refer to national factors listed in the ENERGY STAR Portfolio Manager Technical Reference on Source Energy (EPA 2020a), or regional factors listed by Emissions and Generation Resource Integrated Database (eGRID) (EPA 2020b). The extent to which source energy can encourage electrification depends on how emissions-intensive local electricity production is, and places with a cleaner electricity grid will incentivize more electrification than those with a dirtier grid.

GHG metrics: Greenhouse gas emissions-based metrics are an alternative to energy-based metrics and can be used in a BPS to regulate the total emissions from the building sector. Although this metric can be a powerful tool in advancing a jurisdiction's decarbonization objectives, it may not be as effective in reducing overall building energy use if building owners are allowed to rely on locally generated or purchased renewable energy to meet the targets. In addition, as is the case with source energy, this metric's ability to promote electrification depends on the carbon intensity of the power grid. Selecting an appropriate locally based conversion factor to translate electricity use into emissions is key to the success of this metric, but in cases where data is not available, regional factors published by eGRID can be used as a stand-in (EPA 2022).

Once a jurisdiction chooses the metrics for its BPS, a building stock analysis should be conducted to determine the performance targets for buildings included in the scope of the policy. The target-setting process must take into consideration factors like building type and size, energy reduction potential, and technology deployment timelines in order to set targets that will allow the jurisdiction to cost-effectively and efficiently reach its long-term BPS goal. To support policymakers and interested professionals in this process, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) convened a BPS Working Group under its Task Force on Building Decarbonization (TFBD) that is working to produce a Technical Resource Guide that walks jurisdictions through the metric selection and target-setting processes and outlines the available methodology options (ASHRAE 2022).

Goals and Targets

Setting technically and economically achievable BPS performance targets that are aligned with a jurisdiction's policy objectives requires careful analysis. The approach selected for target-setting will vary depending on the access to data and technical expertise available to each jurisdiction. Targets can be derived from both sector-level goals and from empirical data such as building benchmarking data, but these approaches are not mutually exclusive. In fact, the

recommended approach is to consider targets developed from both top-down (e.g., targets from policy) and bottom-up (e.g., targets from benchmarking data and other analyses) methodologies.

All target-setting methodologies require jurisdictions to identify, aggregate, and clean the source datasets before analyzing them to generate a comprehensive set of BPS performance targets. The value of using actual measured performance data for the specific building stock being analyzed in the target-setting process is that it can better inform the types of buildings that can be covered by the BPS and provide more confidence to building owners that the targets are achievable. Jurisdictions with benchmarking policies can effectively use their benchmarking data to conduct stock analysis and target setting, as was done for Washington DC (Bergfeld et al. 2020) and Seattle (Walter and Mathew 2021). Sampling methods can be used to apply the benchmarking data to other buildings not covered by the benchmarking policies, thereby providing a more complete assessment of the stock. Jurisdictions that do not have existing data that can provide a starting point for understanding the performance of the existing building stock could consider enacting benchmarking policies prior to or along with the BPS, and resources like the EPA Benchmarking and BPS toolkit are available to help inform that process (EPA 2021a).

Enacting new policies and collecting data can be time-consuming and delay the implementation of the BPS. As an alternative, jurisdictions can evaluate using published data sources that can be used to determine performance thresholds by either building type and climate zone, such as the Commercial Buildings Energy Consumption Survey (CBECS) (EIA 2018), ASHRAE Standard 100 (ASHRAE 2018); or at the national level like the ENERGY STAR Portfolio Manager Technical Reference on median energy use intensity (EPA 2021b). Each of these published sources uses different performance metrics and normalization parameters, so they should be used carefully to ensure that they align with the goals of the BPS being created.

Further analytical support for target-setting and BPS policy development is available from the U.S. Department of Energy (DOE) and the National Laboratories through direct technical assistance and new building typology and stock segmentation efforts underway. Tools like ComStock inform a more detailed and precise view of the building stock at a local level than CBECS alone would otherwise provide (NREL 2022). Making a baseline building stock typology analysis with national coverage broadly available significantly reduces the analytical burden of designing a BPS with a bespoke approach for each jurisdiction.

Supporting Resources for BPS Implementation

BPS present a unique challenge in terms of data requirements. Jurisdictions implementing BPS are, for the first time, faced with a multi-decadal data management need. From both a data lifespan and data infrastructure (i.e.: IT systems) this is a major challenge. Robust protocols governing data standardization, collection, management, analysis, compliance, and reporting are critical to the long-term success of BPS programs.

Software and Data Standardization

Setting a strong foundation through data standardization is critical. The Building Energy Data Exchange Specification (BEDES) serves as a *Rosetta Stone* for building energy and asset terms and can be implemented through mapping terms and definitions to any preexisting tool or spreadsheet. One step further would consider BuildingSync, a schema that gives structure and relationships to building energy data and leverages standardized BEDES terms. The most robust approach for data standardization is to use standardized data collection tools: ENERGY STAR

Portfolio Manager (performance data) and Audit Template (asset data). These two tools provide standard field names, definitions, provide quality checks, and ensure datapoints submitted are not unreasonable or nonsensical given the particular field.

The use of Portfolio Manager is a widely recognized best practice for reporting building performance data following the building energy benchmarking and disclosure policy movement; there is no reason for that to change under a BPS framework, even though some enhancements to the platform will be necessary. For buildings that can't meet the required performance targets, there are alternative compliance pathways. These compliance pathways, sometimes called prescriptive, require specific interventions to take place in a building for it to be compliant without meeting the performance goal. Prescriptive pathways often start with an audit, or an inventory of the major systems and equipment components in the building. These efforts identify, prioritize, and recommend energy efficiency or decarbonization measures to comply with the BPS goals. Alternate pathways generate a significant amount of asset and equipment data which needs to be collected in a similarly standardized and robust way to performance data through Portfolio Manager. The Audit Template, a freely available web-based template, provides a standardized portal for building asset and equipment data collection (DOE 2021a). Figure 2 illustrates one configuration for how these tools can connect to support data-driven BPS implementation.

Once Portfolio Manager and Audit Template are established as primary channels for data collection under a BPS program, the remaining workflow follows easily, starting with the Standard Energy Efficiency Data (SEED) Platform (DOE 2021b). The SEED Platform is designed to help implementing jurisdictions aggregate critical program-level data in order to assess compliance with policy requirements. Data from both Portfolio Manager and Audit Template can be automatically imported into SEED for analysis and evaluation.

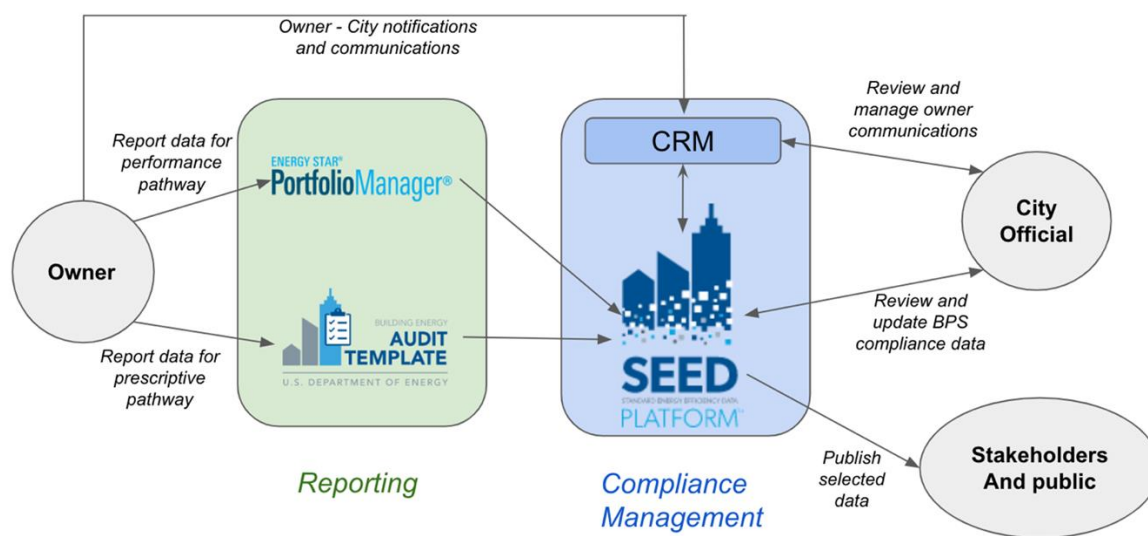


Figure 2: Example of BPS implementation workflow using publicly available, standardized energy data software.

Jurisdictions without the ability to use SEED independently can turn to private sector service providers. The Building Energy Analysis Manager (BEAM) Platform was developed by the Northeast Energy Efficiency Partnerships (NEEP) using a DOE grant to create a turnkey solution for BPS program implementation (NEEP 2021). BEAM is a commercial offering built on top of SEED and leverages the same advantages of data standardization as SEED itself but

provides the support that comes with a Software-as-a-Service business model. The development of customized solutions for data management and standardization on top of or beyond SEED is encouraged and helps the industry move toward decarbonization goals.

Another advantage of these tools is that they enable data persistence. Database software, as opposed to spreadsheets, enable robust collection and preservation of data, meaning that the collected data can be referenced and remain useful for a long time into the future. Spreadsheets run the risk of being “lost” in shared drives or in folders subject to issues as personnel change and turnover – an unavoidable challenge given a program designed to run for 20–30 years. Furthermore, spreadsheets limit the ability to ensure data quality. Considering the challenge of data persistence is critical for successfully delivering a BPS program across a jurisdiction.

Persistent data behind a BPS enables a more robust approach to stakeholder engagement. Implementing agencies will need to have interactions with building owners, service providers, residents, tenants, and others over the course of the program to ensure that performance goals are met and the appropriate interventions are made in order to improve the covered buildings. Robust data systems with integrated quality assurance mechanisms enable more effective use of customer relationship management (CRM) systems, such as Salesforce, by program administrators at the agency so each stakeholder interaction can be backed by actionable data. Centralized, actionable data also enables the program administrator to link owners and owners’ agents with the utility to explore incentive and financing programs, or with qualified contractors or engineering firms to specify particular measures or explore technology packages.

Implementation Strategies

All the performance, asset, and other data coming into an implementing agency under a BPS can be leveraged to determine whether the policy is driving the building stock, and the owners, residents, and tenants within it, toward the appropriate goals and outcomes. There are several program implementation strategies that can enable this type of impact evaluation:

- 1) *Public disclosure of anonymized data* – The public disclosure of annual building energy consumption data included in existing benchmarking policies enabled changes to be tracked over time by not just the implementing jurisdiction, but also owners, tenants, engineering firms, and other interested parties looking to make decisions based on energy performance.
- 2) *Data analysis* – summary statistics can be conveyed in terms of key performance indicators under the BPS based on the specific goals and desired outcomes of the policy. Emissions by building type, size, zip code, or other unit could be conveyed through large-scale analysis platforms like the DOE’s Building Performance Database (BPD) (DOE 2021c).
- 3) *Data visualization* – building performance data, or prescriptive pathway asset or audit data, can be presented in a variety of ways including bar charts, geospatial analyses, and more. Visualizing information about the building stock and its changes under a BPS is critical for communicating the impact and value of the policy to stakeholders.

Over the lifecycle of BPS, success is determined by an efficient and effective ability to implement the program. From setting goals and stakeholder engagement to determining compliance and tracking progress, implementation tools, processes, and structures are the underpinning for ensuring persistent movement toward a policy goal. Leveraging robust software platforms and data tools will enable jurisdictions to create custom approaches to data management and disclosure, and to improve engagement with stakeholders through the development of custom visualization and tracking dashboards.

Strategies for Aligning Energy Codes with BPS - a Lifecycle Approach to Building Decarbonization

While several states and cities that have adopted BPS policies are in the early stages of implementation, issues have been raised around the linkages between energy codes for new construction and the outcome-based BPS since a building very quickly goes from “new” to “existing” upon occupancy. We need to first understand the relationship between the two policies and have strategies for aligning them.

The Role of Energy Codes for Building Decarbonization

Over the past few decades, building energy design and construction codes have been one of the most effective nationwide policies to improve the energy efficiency of new buildings as the codes are periodically upgraded and adopted by many states and jurisdictions. However, the role of energy codes in their traditional prescriptive requirement format towards the decarbonization goals typically ends once a certificate of occupancy is granted. A recent BPS Needs Assessment white paper by ASHRAE (2021) points out that the industry needs design codes to yield performance. Code compliant buildings can have high variation in performance because (1) the compliance is typically judged at component level, (2) codes allow great design flexibilities such as HVAC system types and window area, (3) significant portion of building energy use is not regulated, such as plug and process loads, and (4) building operations are not regulated. In addition, about 30% of all new code requirements since 2004 are related to building controls, and successful configuration of those controls is not assured post-construction (Rosenberg et al. 2017). Although post-construction requirements such as system commissioning and energy metering were recently added to national model codes, they still provide limited impacts on the performance. A report, *Roadmap for the Future of Commercial Energy Codes*, by Rosenberg et al. (2015) provided a high-level review of other codes formats and shared a vision for the next generation of codes format: a modeling-based performance method such as ASHRAE Standard 90.1-2019 Appendix G (ASHRAE 2019) combined with building-specific prescriptive packages. No matter what code format is used, code compliance should be considered as the first of multi-year compliance cycles to assure the buildings are designed towards the decarbonization goals. The most cost-effective means of providing a low-energy building asset are only available at the time of construction and the opportunity is lost if they are not taken advantage of then.

Alignment of Energy Codes and BPS Policies

Once a newly constructed building is occupied, it becomes an existing building and is potentially subject to the BPS policy. BPS provide the most rigorous approach to confirmed energy performance and addresses the limitations of design codes because BPS help maintain the performance throughout the life of a building. The two policies are complementary and provide compliance check opportunities through the building lifecycle events. The following aspects of the two policies should be aligned and coordinated.

- **The goals** - Since the implementing agency’s goals such as climate action and decarbonization are shared by the two policies, there should be coordinated plans and expectations for both

new and existing buildings. When designing the BPS policy, policymakers should work with their peers supporting the local codes policy and align their goals.

- **The performance expectations** – Some local governments considering BPS likely have preexisting new construction codes and some performance data from recent new construction collected through benchmarking ordinances or other programs. As discussed earlier, the prescriptive codes format does not guarantee stable performance, but analyzing performance data from buildings built to recent energy codes informs the performance range of code compliant new buildings under local conditions and use patterns. Understanding code-based performance ranges could both lead to code changes and inform BPS policy design. Setting BPS targets to meet decarbonization goals demonstrates that more stringent codes with expanded scope (such as plugload controls) are needed. Traditionally, codes have been used to define the least energy efficient buildings that can be legally constructed, but BPSs now put pressure on codes development by requiring that all buildings — those that just meet code and those that go beyond — perform at the same threshold once occupied. Ideally, new construction should meet the BPS targets for 10–20 years without energy retrofits and improvements except for retro-commissioning and operational corrections. If the performance data on new construction performance show that BPS targets will not be met over a 10-20 year horizon, high-performance codes, and criteria such as carbon reduction, electrification, and onsite renewables should be considered during code adoption process.
- **Metrics** – BPS target setting and codes adoption criteria are both impacted by the metrics used to judge compliance. When both BPS and codes are in effect, their metrics should be complementary. Different metrics could cause confusion in the market or even promote two different sets of decisions. Codes' metrics are reflected in two forms, the analysis supporting code adoption and some written requirements in the modeling-based performance compliance paths, such as ASHRAE Standard 90.1 Appendix G (ASHRAE 2019). As shown in EPA's white paper on *Understanding and Choosing Metrics for Building Performance Standards and Zero-Carbon Recognition*, the selection of a BPS target metric is directly related to the goals set in the policy (EPA 2021c). Most codes use energy cost as the metric while BPS typically use site energy or direct emissions. The policy makers should harmonize the two policies.
- **Prescriptive packages in BPS and requirements for existing buildings in codes** - BPS policies often include prescriptive retrofit packages as a compliance path when performance targets are not met. Codes, for example ASHRAE Standard 90.1-2019, also have requirements for existing buildings, which are triggered by events such as alteration, repair, addition, change of occupancy (ASHRAE 2019). Careful considerations should be given to coordinate the prescriptive requirements in the two policies and their triggering mechanisms. It would be very confusing to building owners and their design consultants if their alteration or additional project receives a permit from the codes office and are later required to follow a set of more stringent prescriptive packages to comply with the BPS.

Considerations for Equitable Outcomes under BPS

Buildings may require significant upgrades to sufficiently comply with the BPS established for a particular jurisdiction. Some building owners and operators will comply using their own technical resources, staff capacity, and access to capital. Others may desire to comply but may not be well-resourced enough due to their lack of profits or location in a historically underinvested community. Simply excusing these buildings from compliance participation is not

a viable pathway, as exclusion reinforces the cycle of disinvestment, disrepair, and tenant burdens. These buildings and their occupants often stand to gain the most benefits from performance-based upgrades (USDN 2021). Therefore, inclusion and support are vital components to any equitable BPS.

There is little equity in building owners simply passing costs (whether compliance-based or enforcement-based) along to tenants who may already face housing cost and energy cost burdens or hold roots in a historically disadvantaged community. Municipalities considering BPS should pay critical attention to ensuring all relevant buildings and their occupants receive the benefits of healthier, safer, and better performing spaces to live, work, and play. Companion policies strengthening access, inclusion, and support toward compliance for these under-resourced buildings can support equitable BPS outcomes.

BPS administrators should establish supportive technical and resource assistance centers for building owners and operators who may not have in-house expertise or enough funds to hire outside building performance consultants. These actions can help defray the costs, time, and effort (all, but especially under-resourced) building owners spend interpreting and applying performance compliance pathways to their properties. These resources can include direct funding mechanisms for building upgrades; example compliance pathways to suggest the most cost-efficient, least disruptive technology available; facilitated connections to any utility program incentives, rebates, or loan programs that may provide cost-effective or cost-deferred opportunities; “one-stop shop” services that ease the retrofit process, and other building science or financing/funding expertise.

Under-resourced buildings are often operated by over-burdened organizations. Data collection and reporting becomes a challenge for these owners and operators when working to set a baseline or proving they have completed compliant upgrades. Administrators should carefully consider what building and energy data are required to determine baseline consumption profiles and compliance to avoid onerous data collection and reporting burdens on already taxed building owners and their staff. If there is an option to establish utility and/or property assessment data sharing agreements directly with the BPS administrator, this would lessen the work required of all building owners but, in particular, those owners and their staff who may not have dedicated energy or sustainability personnel (Helmes 2022).

BPS administrators should also consider how compliance pathways can support tenants residing in the buildings. Residents of multifamily housing and small businesses in commercial buildings should not fear being displaced as a result of building upgrades. Building owners will go to great lengths to avoid displacing tenants during any planned upgrades or renovations, as this process is time intensive and can add up to 25% of a project’s costs (Helmes, 2022). BPS resource hubs should highlight technologies and upgrades that can be built off-site and installed in one day such as packaged HVAC systems or outside façade-based cladding, exterior continuous insulation, and simple window repair or replacements to minimize tenant disruptions and prevent the need for temporary or permanent relocation entirely. If relocation is absolutely necessary for the success of performance-based upgrades, administrators should consider helping to defray the costs associated or allowing upgrades to happen over time so the building owners can plan accordingly and responsibly for these disruptions (Helmes, 2022). For those upgrades that do require temporary tenant displacement, BPS policies should encourage thorough rehousing plans and offer connections to relocation support services organizations to properly ensure vulnerable populations remain in the communities they have lived in, if they so desire.

Compliance upgrades may result in changes, and possible increases to electricity costs (due to electrification upgrades) for residents of multifamily housing. For income-eligible residents, administrators can ensure building owners are equipped with knowledge of, and enrollment pathways for, the various discount utility rates and the Low-Income Home Energy Assistance Program (Mass Legal Services, LIHEAP) (HHS 2022). These programs can help lower monthly utility costs for residents who may otherwise have trouble paying bills and may be facing disconnection. Similarly, many utilities provide income-eligible grants and incentives that residents qualify for and that building owners can take advantage of to both upgrade their buildings and help residents access the benefits of a more efficient building.

Administrators who offer public funding for under-resourced building compliance can tie that funding to restrictions on allowable rent increases in those buildings. This action may help blunt any potential compliance-based costs from passing through to residents via increased monthly rental rates. Similarly, administrators should establish clear anti-eviction protocols regarding compliance-based building upgrades that access public resources to avoid unfair evictions and tenant displacement because of an owner's upgrade requirements.

Finally, administrators should encourage wherever possible high-road and diversity-focused job creation efforts tied to building upgrades. Administrators should consider coordinating with local and regional economic and workforce development organizations to incorporate diverse and inclusive hiring practices among the building performance industry. Further, administrators should partner with community-based organizations who champion historically disadvantaged communities to ensure equitable involvement in the clean energy demand that BPS will inevitably generate. Any public funding offered toward compliance and resources should be tied to contractor networks promoting family-sustaining wages, comprehensive benefits, and long-term career-minded opportunities.

BPS are an exciting frontier in the quest to upgrade our nation's building stock. To truly reach this vision however, we need to include all buildings and all people residing within. We have the tools and resources necessary to design and implement equitable BPS policies. By using some, or all, of the suggested companion policies included in this section, municipalities can feel confident that they are providing support and resources to all of their building stakeholders and planning for a truly equitable outcome for all.

Conclusion & Considerations for Future Work

BPS enable a new, cross-cutting, inclusive approach to decarbonizing the built environment over the full lifecycle of our buildings and infrastructure. New approaches like strategic decarbonization assessments, supportive software and analytical methods for data collection and evaluation, and companion policies enabling widespread participation and community-scale benefits all underscore the promising potential of this emerging policy movement. Taking a lifecycle view of building decarbonization links new construction codes to existing building performance in a way that ensures improved project delivery, system design and commissioning, and ongoing operation, as well as a greater degree of due diligence in tracking the asset inventory and performance of those assets themselves. Whether tracking energy or carbon, BPS are the most promising policy mechanism on the table to accelerate the current U.S. building stock to a decarbonized future.

Acknowledgements

The authors would like to thank for contributions to and review of this research, analysis, and paper, individuals at Lawrence Berkeley National Laboratory (LBNL), Pacific Northwest National Laboratory (PNNL), the U.S. Department of Energy's Building Technologies Office, and fellows placed in the U.S. Department of Energy's Building Technologies Office via the Oak Ridge Institute for Science and Education (ORISE).

References

- ASHRAE. 2018. *ANSI/ASHRAE/IES Standard 100-2018: Energy Efficiency in Existing Buildings*. ASHRAE, Atlanta, GA.
- ASHRAE. 2019. *ANSI/ASHRAE/IES 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings*. ASHRAE, Atlanta, GA.
- ASHRAE. 2021. *BPS Needs Assessment*. Available at <https://www.ashrae.org/about/ashrae-task-force-for-building-decarbonization>. ASHRAE, Atlanta, GA.
- ASHRAE. 2022. *Building Performance Standards: A Technical Resource Guide*. Forthcoming.
- Bergfeld, K., P. Mathew, M. Duer-Balkind, J. Perakis, P.N. Khah, T. Walter, A. Held. 2020. *Making Data-Driven Policy Decisions for the Nation's First Building Energy Performance Standards*. ACEEE Summer Study on Energy Efficiency in Buildings. August 2020. American Council for an Energy Efficient Economy. <https://doi.org/10.20357/B7831V>.
- DOE - United States Department of Energy. 2021a. *Asset Score/Audit Template Tool*. <https://buildingenergyscore.energy.gov/>. Accessed March 8, 2022.
- DOE – United States Department of Energy. 2021b. *Standard Energy Efficiency Data (SEED) Platform*. <https://buildingdata.energy.gov/#/SEED>. Accessed March 8, 2022.
- DOE – United States Department of Energy. 2021c. *Building Performance Database (BPD)*. <https://buildingdata.energy.gov/#/BPD>. Accessed March 8, 2022.
- EIA – United States Energy Information Administration. 2018. *Commercial Buildings Energy Consumption Survey 2018*. Energy Information Administration of U.S. Department of Energy, Washington, D.C. Available at <http://www.eia.doe.gov/emeu/cbecs/contents.html>
- EPA - United States Environmental Protection Agency. 2020a. *ENERGY STAR Portfolio Manager Technical Reference: Source Energy*. <https://portfoliomanager.energystar.gov/pdf/reference/Source%20Energy.pdf>
- EPA - United States Environmental Protection Agency. 2020b. *Emissions & Generation Resource Integrated Database (eGRID)*, 2020. Washington, DC. Available at <https://www.epa.gov/egrid>.
- EPA - United States Environmental Protection Agency. 2021a. *Benchmarking and Building Performance Standards (BPS) Policy Toolkit Section 2: Building Performance Standards: Overview for State and Local Decision Makers*. Available at https://www.epa.gov/system/files/documents/2021-12/section-2-building-performance-standards_2-12-2021_v2.pdf.
- EPA - United States Environmental Protection Agency. 2021b. *ENERGY STAR Portfolio Manager Technical Reference: U.S. Energy Use Intensity by Property Type*. <https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20able.pdf>.

- EPA - United States Environment Protection Agency. 2021c. *Understanding and Choosing Metrics for Building Performance Standards and Zero-Carbon Recognition*. Available at https://www.energystar.gov/sites/default/files/asset/document/BPS-White_paper_v14May2021.pdf.
- Executive Office of the President. 2022. *FACT SHEET: Biden-Harris Administration Launches Coalition of States and Local Governments to Strengthen Building Performance Standards*. Fact sheet. The White House. Washington, D.C., January 21, 2022. Web.
- Helmes, Dan. Interview. Conducted by Billierae Engelman, March 8, 2022
- HHS - United States Department of Health and Human Services. 2022. Low Income Home Energy Assistance Program (LIHEAP). Available at <https://www.acf.hhs.gov/ocs/low-income-home-energy-assistance-program-liheap>. Accessed March 8, 2022.
- Institute for Market Transformation (IMT) & National Resources Defense Council (NRDC). *Incorporating Equity into Energy Benchmarking Requirements: Guidance for Policy and Program Practitioners*. City Energy Joint Project. March, 2021. https://www.cityenergyproject.org/wp-content/uploads/2021/04/CEP_Incorporating_Equity_Into_Energy_Benchmarking_Requirements.pdf Accessed March 8, 2022.
- Mass Legal Services. 2015. *Utility Discount Rates for Low Income Consumers in Massachusetts*. March, 2015. Available at <https://www.masslegalservices.org/content/utility-discount-rates-low-income-consumers-massachusetts>.
- NREL. ComStock Analysis Tool. 2022. <https://www.nrel.gov/buildings/comstock.html>. Golden, Colorado: National Renewable Energy Laboratory. Accessed March 8, 2022.
- Rosenberg M.I., R. Hart, J. Zhang, and R.A. Athalye. 2015. *Roadmap for the Future of Commercial Energy Codes*. PNNL-24009. Richland, WA: Pacific Northwest National Laboratory. Available at https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-24009.pdf.
- NEEP – Northeast Energy Efficiency Partnerships. 2021. *BEAM – Building Energy Analysis Manager*. <https://neep.org/building-energy-codes-and-benchmarking/beam-building-energy-analysis-manager>. Accessed March 18, 2022.
- Rosenberg M.I., R. Hart, M. Hatten, D. Jones, and M. Cooper. 2017. *Implementation of Energy Code Controls Requirements in New Commercial Buildings*. PNNL-26348. Richland, WA: Pacific Northwest National Laboratory. Available at https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26348.pdf.
- The Greenlining Institute. 2019. *Equitable Building Electrification: A Framework for Powering Resilient Communities*. Available at https://greenlining.org/wp-content/uploads/2019/10/Greenlining_EquitableElectrification_Report_2019_WEB.pdf.
- Urban Sustainability Directors Network (USDN). 2021. *Building Performance Standards: A Framework for Equitable Policies to Address Existing Buildings*. July, 2021. Available at https://www.usdn.org/uploads/cms/documents/bps-framework_july-2021_final.pdf.
- Walter, T. and P. Mathew. 2021. GHG Policy Impacts for Seattle’s Buildings: Targets, Timing, and Scope. *Buildings and Cities*, 2(1), 283–301. DOI: <http://doi.org/10.5334/bc.81>.