Can We Walk and Chew Bubblegum at the Same Time? Climate resilience-building in Building Performance Standards: opportunities to align mitigation and adaptation

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ABSTRACT

The urgency of reducing greenhouse emissions puts a spotlight on addressing and transitioning our existing building stock to become energy efficient, all-electric, and grid supportive. By recent estimates, meeting California statewide climate goals demands electrifying 95% of water and space heating in buildings by 2045 (Edison International, 2023). Retrofitting on this scale will require unprecedented investment. Given the climate is rapidly changing, alongside rising sea levels, more extreme high and low temperatures, and increasingly severe storms, energy efficiency retrofits are also an opportunity to enhance the climate resilience of existing buildings. Existing buildings face varying levels of exposure to an array of hazards, requiring climate resilience to be viewed from a holistic lens. Building Performance Standards (BPS) should seek to increase climate resilience through measures that enhance the resilience of a building (e.g. weatherization) as well as measures that enhance the stability of the grid (e.g. energy efficiency and demand response). This study investigates the extent to which current Building Performance Standards across the nation incorporate provisions for enhancing resilience and climate adaptation, and explores untapped synergies between reducing emissions and preparing for escalating weather events. This paper introduces a rubric to assess BPS from a resilience perspective, across dimensions of building energy resilience, grid support, and building performance against hazards like extreme heat. The findings of this research offer insights and recommendations to jurisdictions in the early stages of policy planning, helping them align their emissions goals and climate action plans with the imperative of enhancing climate resilience and equity.

Introduction

BPS As Catalyst

In the realm of building regulations, Building Performance Standards (BPS) offer a unique opportunity to address the performance and conditions of existing buildings. While traditional building energy codes and reach codes primarily focus on what's new or changing—such as new construction, additions, and renovations—additional requirements like accessibility, fire life safety, and energy upgrades often remain dormant unless triggered by renovation work. BPS, however, take a different approach. They are not triggered by specific actions; instead, they are applied based on building characteristics such as use, year built, and square footage. These standards typically compel covered buildings to enhance their performance if they fall below

specified levels by certain deadlines. In doing so, BPS bridge the gap between regulatory compliance and proactive improvement, ensuring that our existing building stock evolves. Thus, there is a policy opportunity to guide existing buildings not *just* towards better energy performance, but also towards enhanced climate resilience, safety, and occupant health. By lowering greenhouse gas emissions (and criteria pollutants), BPS can also reduce the effects of climate change which goes to reducing the need for greater climate resilience.

Concurrent Crises Demand Holistic, Systems-Thinking Policy

During the 1980's, the United States faced a one-billion-dollar disaster every four months[1]. Now, that rate has escalated to a one-billion-dollar disaster every three weeks (Jay, et al., 2023). As highlighted in the Fifth National Climate Change Assessment, the effects of climate change are already evident. Our built environment is increasingly pushed beyond its intended limits, leaving people, especially in under-invested communities, exposed to life-threatening consequences such as unrelenting heat, frigid cold, and other extreme weather conditions (e.g., hurricanes, tornadoes, heavy snowfall). There is a fundamental need to address both mitigation and adaptation together.

Existing buildings have additional interconnected needs, such as tackling deferred maintenance and needed repairs. Alongside the climate crisis, there is also a housing crisis, and ensuring the continuing availability of affordable housing is crucial for community resilience. It's essential that Building Performance Standards be designed in consideration of these overlapping needs and adopt a systems-thinking approach. Policymakers need to be conscious of and take proactive steps to mitigate potential harm caused by imposing requirements on already overburdened building types, such as affordable housing and small businesses.

[1] On average, inflation-adjusted

How Equity And Resilience Are Inextricably Linked

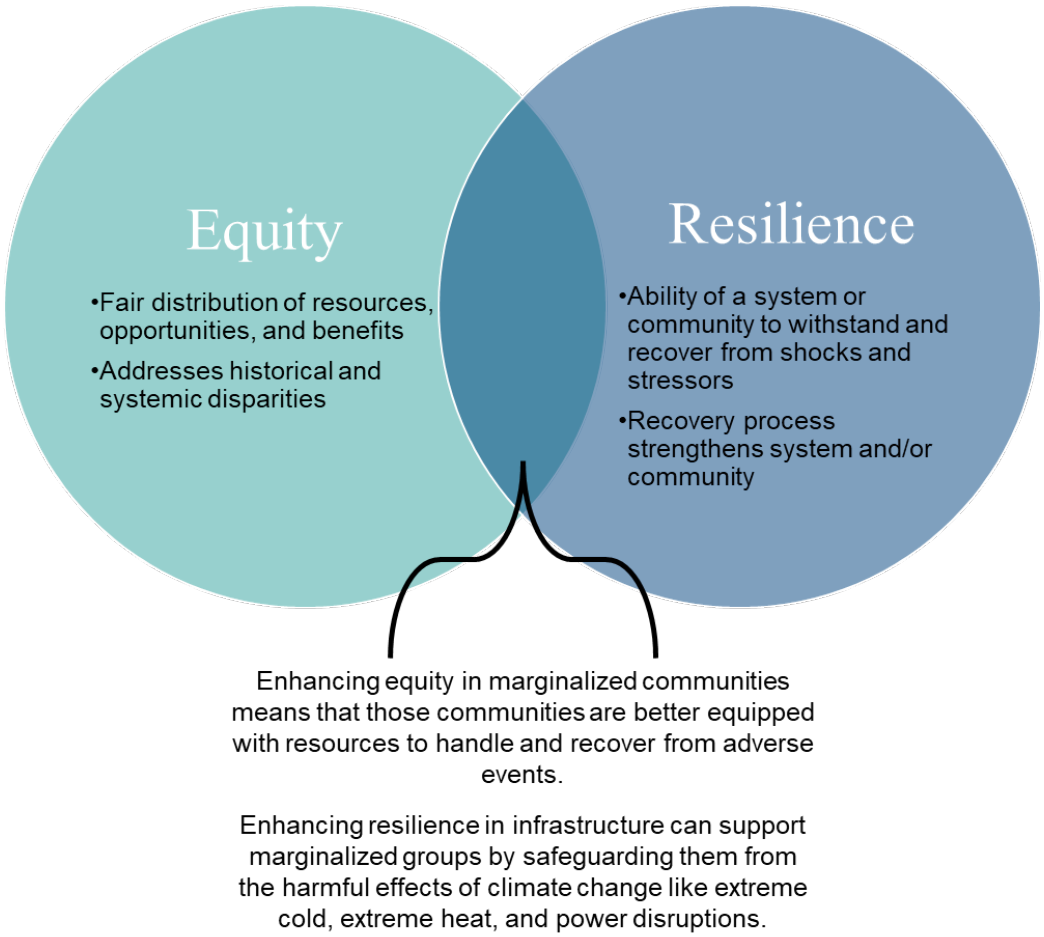

Figure 1. Illustrating the tie between equity and resilience in this context

While equity and resilience are separate considerations in the development and implementation of BPS, it's crucial to recognize how they can complement each other and amplify the other's impact. Both equity and resilience stem from meeting people's fundamental needs. As the frequency and intensity of climate change effects rise, it becomes increasingly important for communities to be able to withstand and recover from adverse events. In particular, residents' safety and housing must be assured. This can be achieved by safeguarding the affordability[2] of housing and energy, enabling the functionality of buildings during extreme events, and providing reliable and clean energy. Furthermore, meeting these key needs strengthens the communities' ability to optimize their use of emergency resources by reducing the demand of those emergency support systems that are historically stretched thin.

Moreover, climate impacts are not evenly distributed. Communities that have historically been underserved and overburdened often bear the brunt of climate impacts, exacerbated by inadequate resources and infrastructure. Prioritizing these communities in the planning and implementation of BPS is essential to ensuring that the needs of the most vulnerable are met. This includes safeguarding affordable housing, which not only enhances the resilience of

[2] Affordable housing here refers to residential units or houses priced at a level that enables low to moderate income households to obtain safe and suitable housing without facing overwhelming financial burden.

burdened communities but also strengthens the resilience of the broader community by fostering economic stability, workforce resilience, and enhanced community capacity. Therefore, integrating equity considerations into resilience planning and vice versa is critical for developing effective and inclusive BPS that address the diverse needs of all communities.

Overview Of This Policy Analysis

This study took a resilience lens in reviewing the trailblazing cities, counties, and states that have enacted the nation's first Building Performance Standards. The review encompasses twelve cities (Aspen, Boulder, Boston, Cambridge, Chula Vista, Denver, New York City, Reno, Seattle, St. Louis, Vancouver, BC, and Washington D.C.), four states (Colorado, Maryland, Oregon, and Washington), and one county (Montgomery County, MD). This study assessed whether the BPS for each of these locations included language that directly contributed to enhancing resilience of existing buildings, enhancing grid resilience, or both. This study also defines and outlines how the BPS integrated equity, based on the types of existing buildings these policies apply to, who is ultimately affected by the policy, and the effect on community level resilience.

Methodology

Definitions And Targeted Outcomes

To assess existing and emerging Building Performance Standards in terms of equity and resilience, this research first established a clear definition of what "equity" and "resilience" mean in this context.[3] This was achieved by examining the desired outcomes of related policy inclusions.

[3] In establishing the guiding framework, the authors have defined the pillars of equity and resilience separately. However, as described in the introduction, these are inherently interrelated concepts and there are natural overlaps between equity and resilience outcomes. Considering the beneficiaries of BPS-related benefits in designing policy serves to strengthen the interconnections.

In terms of equity inclusions, objectives should encompass one or more of the following:

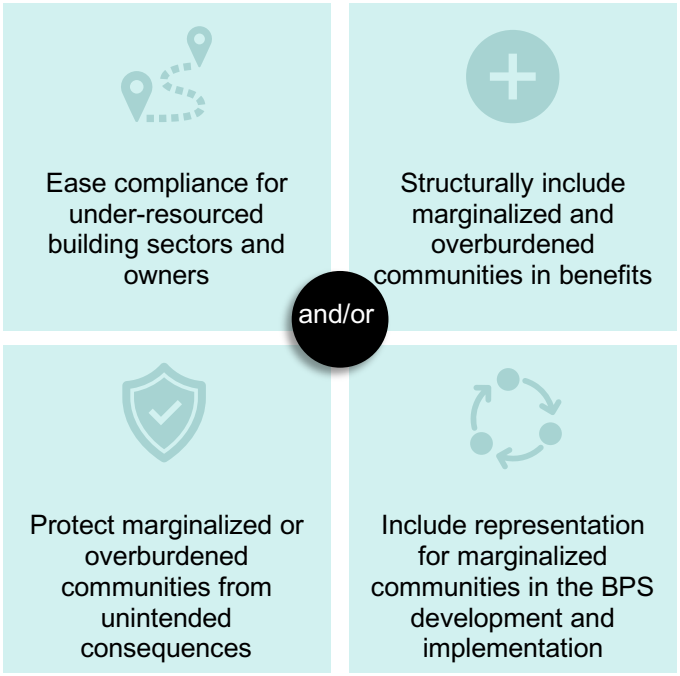

Figure 2. The equity guiding principles used in this study

Resilience inclusions should strive to achieve the following outcomes:

Figure 3. The resilience guiding principles used in this study

Rubric Development

From the established guiding principles, the authors created a rubric to identify policy elements that align with the equity and resilience objectives. The equity categories used in the review were drawn from ASHRAE's Building Performance Standards: A Technical Resource Guide (ASHRAE, 2023)[4]. The review specifically examined specific targets, plans, and actions, rather than broad goals like promoting equity, preventing job losses, and building climate

[4] Note that ASHRAE Standard 100 Energy and Emissions Building Performance Standard for Existing Building is used as the basis for BPS in several jurisdictions.

resilience. To be included here, actions must be clearly defined and committed to. For instance, there should be specific directives to develop methodologies, as opposed to general statements about equity. Resilience categories were based on research conducted by Arup for the Southern California Edison Codes & Standards team, on the resilience implications of building decarbonization.

Table 1. Rubric developed for evaluating equity-related inclusions

Equity Rubric	
Categories	**Examples**[5]
Companion policies or programs that provide financial and/or technical support for under-resourced sectors	• Direct financial assistance • Technical assistance • Direct installation • Subsidies outlined for disadvantaged communities (DACs), marginalized racial and ethnic groups, and/or low-income owners
Equity-related metrics, calculated or structured benefits required or optional as part of a compliance pathway	• Direction to calculate benefits accrued to tenants • Fines that flow into incentive pool for under-resourced building owners or workforce development • Program requirements to protect tenants in all-electric buildings from incurring higher electric bills than if they were living in a mixed-fuel version of the same building[6]
Accommodation - different compliance timeline or requirements under-resourced building types (outside of square footage alone)	• Long compliance timelines outlined for overburdened building types like affordable housing • Not included: extensions based on missing information
Exemptions for burdened building types	• Exemptions for economic hardships • Exemptions for emergency replacement of equipment
Protections in place for vulnerable groups like affordable housing renters	• Protections for affordable housing and/or marginalized groups • Representation in decision-making bodies (e.g., review boards) by members of disadvantaged communities

[5] Examples are expansive, including elements not found in the document review.
[6] The need for tenant protections in this context stems from the concern that costs associated with compliance could be passed on through allowable rent increases, leading to displacement, or used as grounds for eviction.

Table 2. Rubric developed for evaluating resilience-related inclusions

Resilience Rubric	
Categories	**Examples**
Supports **building energy resilience**	• Energy supply redundancy • Building features to support passive survivability (e.g., insulation, natural ventilation, cool roofs)
Makes buildings more **grid supportive**	• Demand flexibility responding to real-time or day-ahead grid congestion, rate changes, and GHG emissions as a metric • Demand response protocols required • Demand response programs mentioned • On-site renewables and energy storage • Energy efficiency requirements
Both supports building energy resilience and grid resilience	• On-site renewables paired with energy storage • Weatherization that supports passive survivability, reduces peak energy demand, and increases occupant comfort
Includes **other hazard considerations,** unrelated to power outages alone	• Intersections with other retrofit needs • Boosts building resilience to hazards like heat, extreme cold, and wildfire smoke, earthquakes, and floods

Research Limitations

The review focused solely on the language within a jurisdiction's Building Performance Standards (BPS) and/or benchmarking language, without considering aspects of policy implementation such as programs not explicitly outlined in legislative text, or in subsequent rulemaking. Supportive programs and funding are crucial for achieving resilience and equity benefits, so solely examining policy language may underestimate a jurisdiction's efforts. However, evaluating policy language ensures that targets and commitments are integrated into the policy, leading to a higher level of commitment and accountability. This makes it less likely to be ignored or softened as policies transition from design to implementation and compliance.

Findings From The BPS Landscape

While many of these emerging plans emphasize the importance of equity, and, to a lesser extent, climate resilience, in their introductory and framing language they typically lack specific guardrails, measurable commitments, or mention of allocated funds or resources. Across all BPS evaluated, very few included any resilience-enhancing dimensions, as defined by the framework

described above. Even when included, "resilience" was not named explicitly as a direct outcome or accompanying benefit. To be successful, jurisdictions must be explicit around synergies.

While policies could lean further into resilience-enhancing considerations to increase the direct co-benefits of decarbonization measures, there are significant benefits of upgrading existing buildings that haven't otherwise garnered attention or investment. The baseline existing conditions of buildings vary dramatically and can hinder compliance with BPS and then limit an owner's ability to participate in supportive programs (deferred maintenance can preclude the installation of certain energy efficiency measures). The development and implementation of BPS provides a unique opportunity to weave together existing programs and structures of support to optimize positive impact on building tenants. This multi-pronged approach helps ensure that a building's tenants benefit from building decarbonization measures, with limited risk that the upfront costs of implementing the measures will be passed down to them. Where access to capital has led to deferred maintenance, as in some affordable housing and chronically under-funded institutional buildings, there can be partially functional equipment and systems being used well beyond their useful life. There is a need for a multi-pronged approach that ties existing resources to repair and maintenance needs, priming these existing buildings to maximize the benefits of larger upgrades down the line. Aligning resources with repairs, maintenance, and upgrades taps into the potential of existing buildings to not just be energy efficient, but to be safe, healthy, and comfortable as well.

To effectively assess the potential impacts of programs that support BPS at the community level, it is crucial to recognize the uniqueness of each community and prioritize a comprehensive understanding of the needs of historically marginalized, under-resourced, and disadvantaged populations who have often been excluded from public investment and decision-making processes. While most of these standards express aspirations such as improving equity, preserving employment, and enhancing climate resilience, explicit plans and allocated funding for execution are lacking. The research found that relief to overburdened buildings often came in the form of exemptions, which may lead to further disinvestment in the buildings that most need investment. Equity requires more than set-asides and exemptions, it not only requires adequate representation during BPS development and implementation, but also targeted technically and financially supportive programs that alleviate burdens and deliver benefits to marginalized communities.

The following describes the proposed tactics of a comprehensive BPS, and examples of inclusions that are more robust or developed in either mitigating harm or maximizing benefits to under-resourced communities.

Encourage energy efficiency measures that also safeguard thermal health.

In addition to reducing energy usage, energy efficiency reduces the demand on the grid, increases the effectiveness of back-up power (if available), and improves a building's ability to maintain a comfortable internal temperature.

Both performance and prescriptive compliance pathways can integrate measures that improve energy performance, passive survivability, and thermal health during increasing temperature extremes. For example, ordinances could require a minimum number of weatherization measures and that heat pumps be installed (improving overall energy efficiency and bringing cooling capacity to buildings) to achieve compliance through any BPS metric. Similarly, supportive programs could require a minimum number of weatherization measures as well as heat pump installation as a condition of project funding.

- While all BPS reviewed implicitly encourage energy efficiency, some explicitly call out energy conservation measures (ECMs). Chula Vista's multifamily prescriptive measure requirements are more stringent for the more severe climate zone and older buildings, increasing the likelihood that weatherization measures are addressed and can enhance passive survivability during a power outage.

- Similar provisions are in the New York City and Reno ordinances. Compliance with these jurisdictions' ordinances would provide resilience co-benefits during extreme heat, extreme cold, and wildfire smoke events.

- Denver's ordinance requires that air conditioners be replaced with heat pumps to better prepare households to manage escalating extreme heat days. It is also critical to provide technical assistance programs or financial assistance programs to assist building owners in accessing and navigating heat pump replacement.

Ensure representation to help distribute benefits and reduce potential harm.

Identifying and engaging key stakeholders in the process of BPS development and implementation is crucial to success for all covered buildings and affected residents. Ordinances should require board membership from community members and industry experts knowledgeable on resilience considerations and other elements of technical implementation, as well as members representing the owners and residents of under-resourced sectors.

- Maryland's Senate Bill 528, the Climate Solutions Now Act of 2022, details the creation and membership of several working groups, including the Energy Industry Revitalization Working Group, the Energy Resilience and Efficiency Working Group, and the Solar Photovoltaic Systems Recovery, Reuse, and Recycling Working Group, among others.

- Washington, D.C.'s BPS Task Force and St. Louis's Building Energy Improvement Board must include affordable housing representation.

- NYC's advisory board must include one environmental justice organization representative, one environmental advocacy representative, and one not for profit organization representative.

- Montgomery County's legislation provides specific groups be represented on the Building Performance Improvement Board. The list includes:
    a) Providers of energy efficiency, building resilience and/or renewable energy services or consulting.
    b) Owners or managers of affordable housing.
    c) Nonprofit building owners or managers.
    d) Representatives of nonprofit organizations dedicated to climate action, resiliency, public health, green building, economic development, or building decarbonization.
    e) Representatives of nonprofit organizations dedicated to racial equity or environmental justice.

Encourage demand response (DR), conceiving grid support as community support.

Designing BPS requirements that prioritize and incentivize grid-friendly buildings with load flexibility is essential in the transition towards increased electrification. With greater electrification comes the need for expanded grid infrastructure, which typically requires rate increases. However, buildings with load flexibility can shift usage to hours of low-carbon electricity, reducing emissions, reducing the need for extensive grid expansion, and putting downward pressure on rates. Equipping buildings with load flexibility not only minimizes the need for larger grid infrastructure upgrades, but also reduces the likelihood of power outages related to grid stress by lowering demand on the grid. Creating a more reliable power source helps preserve typically strained emergency support programs by reducing the need for them during power interruptions. Additionally, having more certainty about power procurement needs and grid expansion requirements can put downward pressure on rising rates and enhance grid reliability. Nonetheless, uncertainty remains a challenge in this evolving landscape, particularly regarding grid outages and disruptions, underscoring the importance of continued research and planning to understand the available capacity and capabilities of the grid to support climate resilience measures.

Key suggestions and examples below:

- Maryland's Senate Bill 528 requires that utilities implement demand response programming to achieve a given reduction ("*require each electric company to implement a cost–effective demand response program in the electric company's service territory…").*

- Washington, D.C.'s policy (the Clean Energy DC Omnibus Amendment Act of 2018) notes that utilities "*may apply to the Commission to offer energy efficiency and demand reduction programs in the District that the company…"*. Supporting demand response functionality allows for better utilization of the grid by expanding the building's ability to manage loads and decrease grid stress, ultimately reducing the likelihood of power outages.

- Require communication protocols that facilitate demand response performance (e.g., Denver's requirement for storage electric water heaters, which facilitates demand response).

- Require utilities to implement cost-effective DR programs (e.g. Montgomery County's requirement that electric utilities implement DR programs and Washington, D.C.'s legislation establishing a working group to consider energy savings metrics, performance indicators, and cost-effective standards for energy efficiency and demand response programs).

- Jurisdictions could further consider how enrollment in DR programs can be incentivized and engage with utilities on options to implement an "opt-out" DR program which automatically enrolls customers into the program unless otherwise specified.

Distributed Energy Resources (DER)- back-up power as a grid benefit, community benefit, and medical necessity.

Encouraging self-utilization of onsite renewable energy generation can both minimize energy export when the grid is congested with excess renewable energy and minimize demand when grid demand is high. This requires onsite energy generation and storage to have appropriate controls to optimize charging and discharging of the storage system, and in some jurisdictions might require changes to electrical code or utility regulations. The ability to island from the grid in times of high grid stress, extreme weather, and/or natural disasters ensures the welfare of a building's tenants/residents and continuous access to the electricity needed to power lifesaving medical devices.

- Ordinances could allow for battery back-up demand to be partially deducted from total energy use to encourage use in BPS compliance or otherwise value the contribution by on-site renewables and storage. As above, supportive funding programs could require that a comprehensive energy management package include onsite generation and storage on top of traditional energy efficiency measure packages.

- Maryland's Climate Solutions Now Act of 2022 created the Climate Catalytic Capital (C3) Fund, and one of many acceptable uses it to expand on-site clean energy generation and storage.

Provide funding and supportive programs to reduce burden on building owners (prioritizing disadvantaged communities).

Compliance with current BPS alone will require monumental investment. But certain building types, occupants, or locations will be more prone to experiencing unintended consequences resulting from Building Performance Standards or may require extra support to foster equity or resilience. While many existing or emerging BPS do not include these distinctions, incorporating them into policy frameworks can ensure a more comprehensive approach that meets the needs of the communities affected by these policies. However, special considerations should not automatically lead to the exclusion of vulnerable building types from policies aimed at enhancing building performance. Instead, efforts should focus on identifying project or customer types that are particularly burdened or vulnerable, with the goal of addressing existing inequities through supportive program design and implementation, thereby improving policy design.

The following is a non-exhaustive list of building types and their related risks that would benefit from special consideration and support in policy and supportive program design. Policy development must be grounded in and responsive to the specific characteristics of the buildings and communities within the jurisdiction.

- **Regulated Affordable Housing -** Risk of Resource Diversion: There's a risk that focusing on meeting BPS requirements may divert resources away from addressing other retrofit and repair needs crucial to enhanced livability and resilience in affordable housing units.

- **Unregulated Affordable Housing -** Rent Burden and Displacement: BPS could result in retrofit costs being passed on to renters, increasing rent burdens and potentially leading to displacement. Small-scale building owners may exit the market, reducing the availability of affordable units, particularly impacting low-income communities.

- **Low-Margin Businesses Supporting Low-Income Communities -** Business Viability: Businesses operating on thin profit margins, like grocery stores, may struggle with increased operating expenses due to BPS requirements. This could lead to businesses leaving communities and reducing access to essential services.

- **Affordable Commercial Spaces Owned/Operated by Disadvantaged Communities -** Limited Capital Access: Immigrant and first-time business owners provide local services and employment but may have limited access to capital. BPS compliance could pose financial challenges, impacting their ability to sustain operations.

- **Rural or Remote Areas -** Limited Resources and Infrastructure: Rural areas may face challenges accessing skilled labor and energy-efficient products, increasing the price for upgrades and retrofits. The local distribution grid may lack capacity to support increased electrical loads required for BPS compliance, posing additional barriers.

- **Healthcare Facilities -** Energy Intensive Operations: If BPS requirements include electrification, there may be challenges in reducing energy-intensive healthcare loads or thermal loads that utilize waste heat generated from fossil fuel-fired equipment (e.g. cogeneration).

- **Grocery Stores -** Energy Intensive Operations: Grocery stores have energy-intensive refrigeration needs, in total usage but especially when considering square foot-based metrics like EUI. The energy efficiency retrofits can be quite costly, with little opportunity to pivot to off-peak usage without more modern controls systems. This is particularly poignant if the grocery store is in a food desert.

- **Restaurants -** Operational Changes: BPS may necessitate changes to cooking styles and equipment in restaurants, impacting operations and affordability. Restaurants, vital to community cultural fabric, may face challenges in achieving BPS compliance.

- **Single Family Homes -** Financial Constraints: While single-family homes are not yet addressed by current BPS, there is the potential to do so in the future, especially via building point-of-sale requirements. It should be noted that owners, especially in marginalized communities, may lack reserves to invest in meeting these requirements, and may not be aware of programs that exist to support them. Navigating evolving policy landscapes is cumbersome and requires dedicated time and effort that may be limited for overburdened communities. Affordability barriers could hinder necessary retrofits or upgrades. Home cooking practices that are vital to cultural identity may also face challenges when BPS or other requirements demand that practice be updated to utilize unfamiliar equipment.

- **Non-profit or Public Service Providers -** Operating Margins: Non-profits providing public benefits operate on tight margins with limited access to capital. While crucial for community resilience, developing these providers into resilience hubs requires substantial resources and an array of technical support to deliver multi-system level resilience.

It is also important to recognize how dimensions like building size and geographic location impact the categories above. For example, a square footage threshold might exclude a small restaurant if in a standalone structure, but it could be impacted by requirements if tucked in the ground floor of a large commercial building. Similarly, square footage thresholds might functionally eliminate some categories like single family homes.

Additionally, the location of a building—whether it's in a recognized disadvantaged community or flagged based on census-tract income or revenue—also influences policy considerations as that recognition may mean an existing building is exempt, has alternative compliance pathways, or specialized access to funding and/or technical services.

Certain buildings may need to address deferred maintenance before efficiency improvements, and have limited access to capital, making it challenging to overcome initial costs. However, both scenarios carry a downstream risk of unintended consequences, such as diverting resources from necessary maintenance, business closures, or even triggering displacement.

Some examples of BPS that specify commitments to low-income communities:

- Washington, D.C.'s BPS includes a fund fed by compliance fees that provide financial incentives for projects, with a prioritization on small businesses.
- Maryland's C3 fund is required to use 40% of the fund balance in each fiscal year in low-to-moderate income communities.
- Washington State's BPS directs penalty funds to low-income weatherization and structural rehabilitation assistance.
- New York City's BPS allows an adjustment to emissions limits if compliance would be overly financially burdensome.
- Reno allows delayed compliance requirements for low-income multifamily housing certified under Enterprise Green Communities.
- St. Louis permits a two-year extension for affordable housing to meet BPS compliance requirements.
- New York City exempts income-restricted housing from annual building emission limits and reporting requirements.

Conclusion

In conclusion, the design and implementation of Building Performance Standards present unique opportunities to address both the energy performance and general condition of existing buildings, aiming for a more resilient grid and safer, healthier living environments. Bridging the gap between regulatory compliance and proactive improvement is crucial, given the expected scale of investment required to achieve compliance.

As our communities face increasingly frequent and severe climate-related crises, it is imperative that policy frameworks adopt a holistic, systems-thinking approach. This approach

should address the interconnected needs of existing buildings, including deferred maintenance and repairs, alongside broader challenges such as access to affordable housing and community resilience. Equity and resilience are deeply intertwined, and integrating equity considerations into resilience planning is essential to the development of effective and inclusive BPS that meet the diverse needs of all communities.

Our study examined various BPS across cities, counties, and states, assessing their inclusion of provisions that enhance the resilience of existing buildings and the grid, and also promote equity. While many policies aspire to equity and resilience, explicit plans and allocated funding for execution are often lacking. Additionally, certain building types and communities may require extra support to foster equity and resilience. Policy frameworks must be designed to address these specific needs while avoiding unintended consequences.

By recognizing the unique characteristics and challenges of different building types and communities, policymakers can develop more comprehensive and effective BPS that prioritize equity, resilience, and community well-being.

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