Adding Resilience to Building Performance Standards

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ABSTRACT

This paper outlines a first-in-the-nation model ordinance for existing buildings that uses a carrot and stick approach to improve community resilience and mitigate carbon pollution. The model, called the Building Energy and Resilience Performance Standard (BERPS) combines the stick features of Building Performance Standards and Building Codes with carrot features of insurance risk transfer.

Jurisdictions with high climate risk are motivated to balance resilience objectives with climate mitigation goals. According to Climate Central's (2026) database of billion-dollar climate disasters, the United States experienced 23 such events in 2023 incurring a direct cost of $115bn. Damages to the built environment represent the majority of direct costs in most natural catastrophes and extreme weather events. To be successful, a resilience policy will need to target existing buildings, both large and small and work best across building scale and typology, from commercial to residential buildings

BERPS is a points-based system balancing the energy and greenhouse gas reduction focus of a traditional BPS with added resilience requirements for locally relevant environmental hazards. The hazards that can be covered by BERPS include sea-level and riverine flooding, wildfire, high wind and extreme heat risks. Each jurisdiction selects the resilience metrics that make the most sense for their community as not every jurisdiction faces the same threats. The intent of the model ordinance is to be customizable for local climate risk exposure. A diverse group of jurisdictions, each with their own set of environmental hazards, were analyzed to ensure the model language is widely applicable. These jurisdictions included: Annapolis MD, Montpelier, VT, Portland, ME, Colorado mountain towns, and Santa Barbara, CA. The City of Annapolis is considering implementation of the model BERPS ordinance.

Introduction

This paper emerges at the intersection of two building policies driven by climate change: Building Performance Standards (BPS) and Building Codes. Building Performance Standards seek to mitigate the emissions and energy consumption from large, existing buildings while resilient building codes seek to increase the resilience of new buildings in response to increased risk. Approximately 80% of the buildings that will exist in 2050 are already in place today (Parish, 2022); any policy tackling resilience must therefore address the existing building stock and not just new construction via code requirements.

Building performance standards (BPS) are policies focusing on existing, typically larger, buildings. This allows the policy to target a substantial fraction of emissions and consumption from the built environment with a manageable number of compliance entities. BPS policies require buildings to turn in detailed energy consumption information on an annual basis in a data intensive process that would make the approach challenging to implement across millions of smaller homes and buildings. Larger buildings with superior structural engineering are often also more resilient to wind and fire perils, while existing, smaller buildings in areas of high climate risk bear the brunt of climate exposure. This leaves a policy gap for jurisdictions with high levels of climate risk that are motivated to balance climate mitigation goals with resilience objectives.

According to Climate Central's (2026) database of billion-dollar climate disasters, the United States experienced 23 such events in 2023 incurring a direct cost of $115bn. Damages to the built environment represent most direct costs in most natural catastrophe and extreme weather events. According to analysis by UCLA (Li, 2025), the Palisades and Eaton fires in Los Angeles in January 2025 destroyed 16,251 homes and commercial structures including 12,585 single-family homes, duplexes, apartments, and condominiums. The estimated loss from the housing stock alone is approximately $60bn or half of the total direct cost nationwide. The exponential growth in losses from wildfires, extreme storms, tropical storms and hurricanes is driving insurers to abandon the areas with the highest climate risk. The only way to reverse this trend is to increase the resilience of the building stock and make it less prone to risk.

The paper summarizes progress towards developing a first in the nation building energy and resilience performance standard (BERPS) for existing buildings. The project was initially supported by a federal grant and involves small to mid-size jurisdictions with acute climate risks. The federal funding allowed Northeast Energy Efficiency Partnerships (NEEP) and ClearlyEnergy to draft the model ordinance described in this paper. The paper's focus is the city of Annapolis, Maryland, which suffers from chronic tidal flooding directly attributable to sea level rise and climate change. The ordinance was designed with flexibility to address any combination of climate risks found in project partner cities. For example, Santa Barbara, California is critically exposed to wildfires, having experienced one of the first wildfires at the interface between undeveloped vegetation and the built environment, the "wildland urban interface", in the United States in 1990. The Thomas Fire in 1990 destroyed 1,063 structures and was followed by mudslides on slopes left barren by the fire (Santa Barbara Fire Safe Council, 2026). Basalt, Colorado, similarly experiences wildfire risk and rapidly increasing property insurance rates whilst Montpelier Vermont has suffered major riverine flooding in its downtown area in 2023 and 2024 (Scott, 2025).

Policy Design

Background

The proposed policy is designed to apply to existing buildings and thus falls broadly in the BPS category. The approach retains key elements from BPS designs, including increased ambition in each "compliance period, " typically defined as five-year intervals. However, it attempts to simplify compliance for use with smaller buildings by using a points-based system and adds resilience requirements; it is therefore substantially different from current large-building BPS programs.

The inspiration for the policy is the Norfolk, Virginia, revised zoning ordinance of 2018, which applies only to new construction and complete building retrofits (Pew Charitable Trusts, 2019). Norfolk suffers from land subsidence which aggravates sea-level rise and leads to recurrent tidal flooding. The zoning ordinance approved in 2018 has several novelties including new zoning requirements to encourage investment in less risk-prone areas. New development and redevelopment projects must meet a threshold of points, the resilience quotient, in each of three categories: risk reduction, stormwater management and energy resilience. Development in flood prone areas is subject to requirements that go beyond the base standard, specifically the point requirements within the *coastal resilience overlay* is higher than in other parts of the city. Properties in the flood plain are required to be elevated by at least three feet above ground or 1.5 feet above the 500-year flood plain, whichever is higher, not have a basement, and have electrical systems raised by at least a foot above the finished floor. Development in the higher elevations of town is promoted through the *upland resilience overlay*, which grants reduced resilience requirements when developers choose to relinquish rights to develop in flood-prone areas.

Design Principles

The draft model ordinance follows several principles and designs:

- In keeping with the Norfolk model, the model ordinance has points-based targets across three categories: a) reducing climate risk, b) addressing building emissions and increasing building grid resilience with a suite of efficiency and renewable energy measures, and c) improving stormwater management. However, the team recognizes that jurisdictions may not be motivated to address all three components and may prioritize one or two of the categories.
- Buildings with existing resilience certifications such as Insurance Institute for Business & Home Safety (IBHS) Fortified Roofs, IBHS Wildfire Prepared Homes or ASHRAE 189.1 Resilience Appendix should be grandfathered and exempt from compliance in the relevant category. IBHS Fortified Roofs are installed by certified contractors, with upgraded fasteners and are sealed to the elements. The Wildfire Prepared designation has two tiers of certification each with a list of requirements such as a five-foot noncombustible zone around the perimeter of the home. The draft ASHRAE 189.1 Appendix on Climate Resiliency provides a comprehensive set of building resilience requirements for climate hazards such as grid disruption, extreme heat, extreme cold, wildfire, water management, and air quality with applicability trigger determined at the jurisdiction level.
- Larger buildings already subject to an energy or greenhouse gas-based Building Performance Standard are exempt from the energy efficiency category.
- The target number of points increases in each compliance period. Jurisdictions should test for compliance every few years, typically five, but that number can be determined adjusted depending on the local sense of urgency to improve building resilience. The policy's aim should be to give building owners enough flexibility to align the timing of building upgrades and cycle of equipment replacement with the gradual strengthening of the policy goals. An alternative design proposed by Achieving Zero (2026) recommends leveraging *intervention points* such as the sale of the building, major renovation or system upgrades, or a lease turnover as a checkpoint to require upgrades. Contrary to the

five-year compliance interval, the intervention point does not guarantee gradual upgrades of every building.

- Climate risks are very local in nature, and the model ordinance should be customizable to focus on one or more risk factors. Basalt, Colorado, has acute wildfire exposure and no sea-level rise risk whilst Annapolis' situation is the opposite. Both jurisdictions share urban flooding risks tied to stormwater management systems that were not designed for increased storm intensities. Extreme heat is another systemic risk with jurisdiction-wide impacts.
- Not only does the nature of the risk vary regionally, but the level of risk can vary greatly within a jurisdiction. Coastal, near coastal and inland neighborhoods have completely different sea-level rise exposure. Likewise, a neighborhood at the wildland urban interface has greater wildfire exposure than urban centers. The policy uses *resilience overlays* to map the high-risk neighborhoods and requires buildings in those zones to accrue more risk reduction points. Alternatively, buildings outside of the *resilience overlays* can be fully exempt from the risk reduction category if they are not affected by significant climate risk.
- Resilience is often best achieved at the neighborhood level. This means the policy should allow individual buildings to receive compliance points from neighborhood level measures.
- The policy must also be simple enough to implement in small and mid-size jurisdictions with acute climate exposure. This meant the detailed point accounting from the Norfolk zoning ordinance which worked for new construction had to be greatly pared back to a set of measures that could be easily understood by the owners and operators of existing buildings.

Design Challenges

Building Performance Standards (BPS) have emerged in the last decade as a policy tool to improve the performance of the existing building stock, complementing the role building energy codes play for new construction. The BPS policy experience to date is limited to energy use or greenhouse gas emissions in large office, multi-family, government, industrial, health care, school and other categories of commercial buildings. The smallest building size thresholds are 10,000 square feet in the District of Columbia (2018) and 5,000 square feet in the City of Aspen, (2022). However, efficiency and resilience of the building stock will not increase without including smaller buildings. The large number of residential and small commercial buildings poses new questions on the appropriate scope of the program and creates operational complexities.

Scope. The key scope question is whether to only apply the policy to the buildings in the most at-risk zones such as the flood plain for storm surge or sea-level rise risk and homes at the urban wilderness boundary for wildfires. The tentative answer is to start small and reduce the number of compliance entities by focusing only on the most at risk buildings in the initial compliance period with options to expand the zone and the list of perils as risks evolve in later periods. Climate Central's Coastal Risk Finder estimates the number of buildings at risk of flooding for different sea-level rise and storm surge scenarios. Results for Annapolis are summarized in Table

1: 210 homes and businesses in Annapolis at risk of tidal and storm flooding would initially be subject to resilience requirements. This approach would, however, ignore risks such as extreme heat and grid vulnerabilities that apply to the entire building stock.

Table 1. Number of buildings at risk by risk and time period. Source: Climate Central, 2026.

Year	Sea-Level Rise (Tidal Flooding)	Sea-Level Rise + 100-year Storm
2030	30	210
2050	50	280
2070	70	350
2100	150	470

Overlays Over Time. Resilience overlays can be designed leveraging existing maps of infrastructure risk, notably flood plain maps. However, the proposed policy is designed to span decades, and the overlays need to adjust dynamically to reflect growing risks. Using Annapolis as an example, the overlay for the first compliance period spanning the late 2020s and early 2030s (left panel in Figure 1) will have to be redrawn every decade as the projected rise in sea-level affects more streets and properties, as illustrated in the 2100 projection (right panel in Figure 2). For more systemic issues like extreme heat in urban areas, jurisdictions will have to decide when the issue is expected to warrant city-wide coverage.

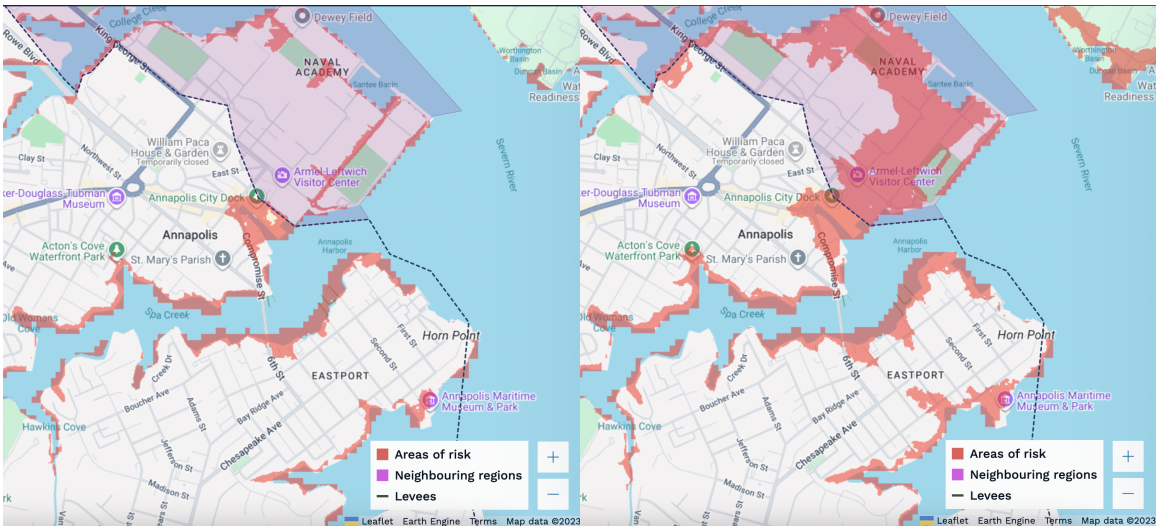

Figure 1. Map of Annapolis with storm surge projections for a 100-year storm in 2030 (left) and 2100 (right). *Source*: Climate Central 2026.

Crediting Community Projects. The implementation of community crediting is one of the more complex elements of the policy. Rain gardens or water retention structures help with stormwater management; levees, dikes, nature based coastal solutions or hard infrastructure provide community-wide protection against floods. The question is not whether these projects should be

credited down to the individual building level, but how to organize communication between the project developers and the building owners to ensure that crediting happens. Should crediting be automatic and managed by the jurisdiction or does the resilience measure have to be claimed by each building owner? For example, the City of Annapolis is implementing a flood barrier project to protect the downtown area known as City Dock (Figure 2). This project replaces waterfront parking with a community park that is elevated by six feet above the current street level: "Dock Street Park" in Figure 2.. The park and other barriers are designed to protect the critical downtown infrastructure and buildings from recurrent nuisance flooding. The project would allow the properties located on Dock St, Craig St, Prince Geoge St, Randall St and Compromise St to claim the resilience credits, or be removed from the resilience overlay if they are formally zoned out of the floodplain.

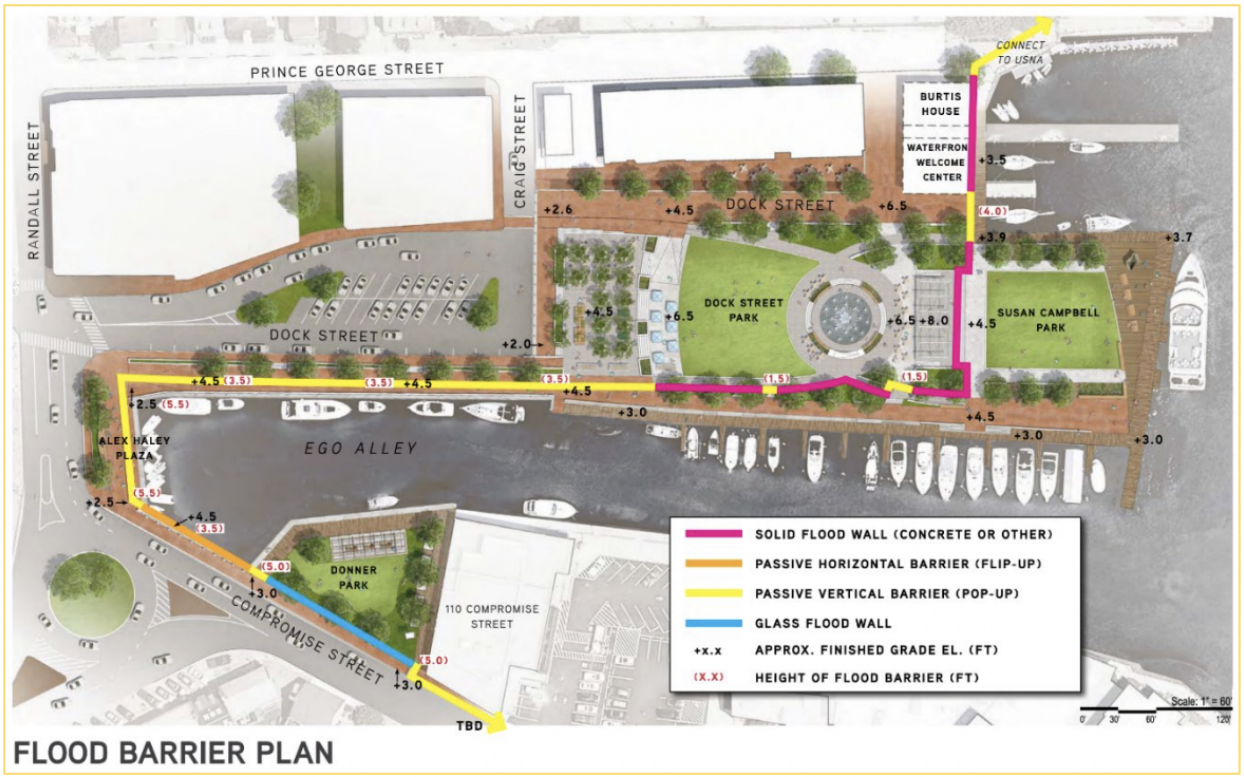

Figure 2. Schematic of proposed City Dock flood protection project. *Source*: City of Annapolis Office of Emergency Management, 2025.

If Policy is the Stick, Insurance is the Carrot

Communities with acute climate risks are experiencing dramatic increases in insurance rates and an exodus of companies that will provide coverage. Insurers have already largely abandoned flood insurance, which is provided by the Federal Flood Insurance Program (NFIP). NFIP is gradually pricing in buildings' real flood risk by factoring in proximity to water, flood history, the type of exposure and the building elevation and characteristics, a program known as Risk Rating 2.0 (NFIP, 2024). Rates have been increasing across the country for most home and

building owners in the flood plain, but Risk Rating 2.0 also offers opportunities for rate reductions by elevating electrical and HVAC systems or by having communities participate in the FEMA Community Rating System (FEMA, 2026).

Other catastrophe risks are covered by property and casualty insurance policies. Traditionally offered by private firms, that business is also being ceded to state run or state backed *policies of last resort* in areas of high risk. The greater the perceived wildfire or tropical storm risk, the faster rates have been going up (Insurance for Good, 2026), and the more likely insurers are to abandon coverage altogether. California's insurer of last resort is known as the FAIR plan. The lack of affordable property insurance has forced homeowners in the zip codes most exposed to wildfires to migrate to the FAIR plan, which has seen exposure grow by 230% in the three-year period between September 2022 and December 2025 (California FAIR Property Insurance, 2026). Similar insurance structures exist in the states most exposed to hurricane risk, including Florida, Louisiana, Alabama, Mississippi, Texas, South and North Carolina, and Georgia.

Involving the insurance industry in the design of a Building Energy and Resilience Performance Standard is critical to improve the insurability of the building stock, to create long-term incentives for insurers to remain active, and to capture the insurance savings unlocked by increasing resilience.

To date, the insurance linked policy approaches to building resilience have included:

- Mandating transparency on rate design and available rebates for risk reduction measures. Colorado passed a law, HB25-1182 (Colorado, 2025) and the California Department of Insurance passed a regulation (California Dept. Insurance, 2022) that require insurers to reward wildfire mitigation efforts by homes and businesses.
- Building codes such as the International Wildland-Urban Interface Code - IWUIC® (ICC, 2021) adopted by Boulder County, Colorado, have requirements for fire suppression equipment, ignition-resistant construction requirements and protects the property from wildland fire intrusion by prescribing defensible areas. Like Norfolk's zoning ordinance, IWUIC applies only to new construction, extensions or complete renovations.
- Voluntary standards that can be adopted by jurisdictions. For example, the IBHS Wildfire Prepared Home™ Standard has a range of requirements for the building and its surrounding environment.

Contrary to voluntary resilience standards and building codes, the BERPS approach can guarantee gradual resilience improvements across the stock of covered buildings, giving insurers a reason to remain active in the community despite increasing climate risks. Policies such as those passed in Colorado and California would facilitate the implementation of the BERPS policy by mandating rebates for resilience measures but are not a pre-requisite. Several recent studies highlight policy shortcomings and loopholes (Sproul, 2025) or low savings to date from

the implementation of the California risk disclosure rule (RFF, 2025). A key argument is that hardening and resilience measures are a victim of their success. The losses avoided by improving building resilience are not measured and the pricing of insurance policies reflects risk and costs as they are experienced (Conway, 2026). This market dynamic will dominate the price signal experienced by consumers unless a significant fraction of an insurer's portfolio becomes markedly safer, a prospect offered by a citywide resilience standard policy.

A challenge to achieving insurance rate reductions is documenting building adaptation and resilience improvements in a way that can be trusted and used for crediting and financial risk transfer by the insurance industry. Experience with quality assurance requirements for building efficiency measures, for example the Pacific Northwest National Lab's Quality Install Tool (PNNL, 2026), shows that this can be accomplished by taking a set of guided, geocoded pictures.

For example, the properties protected by the City Dock project in Annapolis, illustrated in Figure 2 currently in the FEMA flood plain (Figure 3), will be much more flood safe once the project is completed. The homes and business owners in the zone will have several options:

- Ask FEMA to re-zone the home or business out of the flood plain by producing a Letter of Map Change;
- Leverage Annapolis' participation in FEMA's Community Rating System for points towards the Community Rating Certification;
- Use a resilience certificate issued by the city to home and building owners and recognized by insurers.

A goal of the policy is to select and streamline implementation of the options most likely to provide rapid insurance crediting to the relevant home and business owners.

Figure 3. FEMA Flood map for downtown Annapolis. Source: Capital News Service (2014)

Operational Considerations

Several Building Performance Standard policies have components that involve the completion of building maintenance or retrofit measures. Notably, the District of Columbia's BEPS policy (District of Columbia, 2018) has a prescriptive pathway that allows buildings to customize a set of efficiency improvements deemed equivalent to the data driven pathways. New York City's Local Law 97 (NYC, 20198) has a mandatory set of building efficiency measures that rent-controlled buildings and houses of worship can complete in lieu of the target-based approach applied to other buildings. In both cases, the jurisdictions are relying on accredited third-party verification firms to validate that the measures have been completed. This approach could be cost prohibitive for a program targeted at smaller buildings.

The proposed solution leverages technology to facilitate certification of resilience projects by contractors or self-certification by building owners. The city would perform remote quality assurance on the evidence submitted to ensure compliance with the ordinance and award points and, as needed, require additional information or an on-site inspection. Third-party ratings such as IBHS Fortified Roofs would be automatically accepted and projects requiring significant investments and community-level projects would require third-party on-site verification.

Conclusion

Climate change requires both mitigation and adaptation. For buildings, this means mitigating building energy consumption and emissions and increasing resilience and building adaptability. The building stock most at risk from physical climate impacts is often smaller buildings. Some impacts such as flood and wildfire risks are limited to individual neighborhoods and communities; others such as extreme heat and grid resilience can affect broad swaths of a jurisdiction.

Escalating insurance rates and the exodus of key insurers from the highest-risk areas make policy innovations even more urgent. The policy described in this paper is a modified building performance standard, simplified to accommodate smaller buildings but adding resilience improvement requirements. A draft model ordinance was developed that is being considered by the City of Annapolis. The drafting process raised several questions, most notably whether to include residential buildings, how to set additional standards for the neighborhoods most at risk, how to credit community level resilience projects and how to operationalize the ordinance with minimum imposition on the public. These questions will best be answered as the project progresses in Annapolis.

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