Public Health Impacts of Woody Biomass Combustion to Comply with Building Performance Standards

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ABSTRACT

Building performance standards (BPS) have emerged as a key policy tool for cities and states to reduce energy use and greenhouse gas (GHG) emissions associated with the existing building stock through energy efficiency and increased use of renewable or low-carbon fuels. New York City's (NYC) Local Law 97 (LL97), for example, requires all mid-size and large buildings to reduce GHG emissions from energy use, targeting a 40% reduction by 2030 and 80% by 2050. Whether a BPS leads to increased combustion of wood and wood pellets depends on the specific metric used to assess compliance and the energy or emission factors assigned to biomass fuels. A recent study projected that LL97's original biomass compliance path would significantly increase mortality, citing between 707 and 1,870 premature deaths in 2017 due to solid fuel combustion. In response, NYC modified its biomass emission factors to discourage reliance on biomass, thereby mitigating these potential health impacts. Beyond NYC, other jurisdictions are beginning to prioritize both energy use intensity and GHG emissions intensity in their BPS frameworks. ASHRAE Standard 100-2024 has established targets for these metrics across several building types. This paper evaluates how U.S. jurisdictions treat wood fuels by categorizing their BPS metrics and associated emission factors. Based on these categorizations, selected policies will be analyzed to assess the impact of BPS design on biomass-related morbidity and mortality. Health impact projections for the 2025-2050 implementation period, derived from the selected metrics and biomass factors, will inform policy recommendations aimed at minimizing adverse outcomes.

ROLE OF BPS IN CARBON/CLIMATE

BPS are an essential policy tool for reducing energy use and carbon emissions from buildings. In the U.S., the National Building Performance Standards Coalition was launched in 2021, with state and local governments committing to equitably decarbonize buildings and increase community ownership in climate action. The Coalition has grown to over 40 jurisdictions.

If all participants follow through on their commitments, the estimated impact includes improved building performance for nearly 74 million people, \$124 billion in cumulative building investments through 2040, and the elimination of 624 million metric tons of CO_2e—calculated using Equation A-1 in 40 CFR Part 98—over the same period (National BPS Coalition, n.d.).

Maryland's rulemakings on Building Energy Performance Standards, led by the Maryland Clean Buildings Hub, exemplify recent state-level efforts to reduce air pollution from buildings and surrounding ambient air (Maryland Energy Administration, n.d.). Additionally, several jurisdictions have enacted direct regulations targeting criteria pollutants emitted by combustion equipment in buildings (South Coast Air Quality Management District, 2020, p. 4; Multnomah County, n.d.).

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BPS are mandatory policy mechanisms that require existing buildings—including newly constructed buildings once occupied—to reduce energy use or GHG emissions over a defined timeframe. The first BPS was enacted in the District of Columbia in January 2019, followed by New York City and Washington State later that year (Stoppelmoor et al. 2024, p. 32). As of June 2025, Colorado, Maryland, Oregon, and Washington, along with 11 local jurisdictions, have adopted a BPS, while one additional state and 28 local jurisdictions are actively considering adopting BPS (Building Performance Standards by Building Energy Codes Program, n.d.). ASHRAE and its Task Force for Building Decarbonization view ANSI/ASHRAE/IES Standard 100-2024 (Standard 100) as a model for BPS implementation worldwide (Stoppelmoor et al., 2024, p. 30).

Health impacts from combustion in buildings have been well documented across multiple studies (Edelson et al., 2023, p. 6). ASHRAE Standard 100 includes provisions for an energy and emissions management plan that prescribes the phase-out of all onsite fossil fuel combustion equipment and systems, except where such equipment is designed solely for standby or emergency use. An opportunity exists to expand this provision to include combustion equipment that utilizes biomass fuels.

Any building required to comply with ASHRAE Standard 100 and relying on onsite woody biomass would need to account for the emissions released from biomass when satisfying jurisdictional BPS requirements. Standard 100 incorporates biomass into calculated building GHG emissions through conversion factors that reflect the emissions associated with the extraction, processing, and transportation of source energy forms.

Although Table 5-2 of Standard 100 includes an "Other" category that could serve as a basis for a source energy conversion factor for woody biomass, "imported biofuels" offer a more analogous comparison. Table K-2 of ANSI/ASHRAE 105-2021 specifies a source energy factor of 1.20 for imported biofuels. The committee responsible for Although Table 5-2 of Standard 100 includes an "Other" category that could serve as a basis for a source energy conversion factor for woody biomass, "imported biofuels" provide a more analogous comparison. Table K-2 of ANSI/ASHRAE 105-2021 specifies a source energy factor of 1.20 for imported biofuels. Standard 100's should consider incorporating this value into Table 5-2 for use with woody biomass.

In Europe, steps taken by the European Parliament in recent years aim to ensure that emissions from biomass are appropriately addressed in regulations and that tax credits or rebates do not unduly incentivize its use. (Lois Parshley 2022, n.d.) This paper recommends examining European policy approaches and explicitly addressing the emissions and related health impacts of biomass in BPS frameworks.

RANGE OF METRICS AND RANGE OF BIOMASS SOURCES

The selection of a metric for a BPS affects whether biomass used for on-site combustion or electricity generation is incentivized or disincentivized by the BPS policy. While many metrics could define "building performance," BPS frameworks generally focus on reducing energy consumption or building energy-related GHG emissions. Metrics currently used in BPS emphasize direct energy and carbon reductions. These metrics alone can advance jurisdictions toward their building sector goals. (ASHRAE 2023, p. 14).

Metrics currently used to meet the energy or GHG objectives in enacted BPS policies, are shown in Table 1 (ASHRAE 2023, p. 11). Colorado has prioritized both energy and emissions metrics. Jurisdictions have also introduced alternate compliance pathways to support building performance improvements in scenarios where Energy Use Intensity (EUI) or Greenhouse Gas Intensity (GHGI) targets may be challenging to achieve.

Table 1. Key Attributes of Metrics for BPS (Derived from Table 2.1 on Key Attributes of Metrics for BPS of in ASHRAE's Building Performance Standards: A Technical Resource Guide)

Category	Metric	Metrics Currently in Use with Units (Numerator and Denominator)	Where Used
Energy	Site EUI‡	kBtu/ft^2/year	St Louis, MO, Washington State, (adapted Standard 100-2018), Denver, CO, ANSI/ASHRAE/IES Standard 100 (2018 and 2024 editions, Colorado, Montogomery County, MD, Oregon (adapted Standard 100-2024)†
	ENERGY STAR® Score	Normalized 1 to 100 score, based on statistical regression analysis of source energy use per ft^2/year	Washington, D.C. and Chula Vista, CA
Carbon	GHGI	CO_2e/ft^2/year	New York, NY, Boston, MA, ANSI/ASHRAE/IES Standard 90.1-2022, Seattle, WA, Vancouver, BC, and ANSI/ASHRAE/IES Standard 100-2024

‡ Some jurisdictions rely on a weather normalized EUI.
† Oregon's BPS also mandates that an optimized bundle of energy efficiency measures must not increase the site EUI and GHGI of an existing commercial building.

With the enactment of NYC's LL97 in 2019, GHG performance metrics were elevated alongside energy metrics to define

BPS compliance limits. By adopting a GHG metric, NYC clarified key distinctions within its building performance framework, highlighting the relative impacts of onsite combustion, primarily of methane gas, compared to the electricity used for building operations.

NYC's transition toward clean grid electricity (assumed to be increasingly generated by renewables under New York State's Renewable Portfolio Standard (New York Department of Public Service, n.d.)), demonstrates how building decarbonization policies, including new construction codes and BPS, can yield co-benefits for public health and reduce health care costs. (New Buildings Institute, n.d.) The policy-driven reductions in criteria pollutants such as PM2.5 and NOx from liquid and gaseous fossil fuels represent a positive unintended outcome of compliance metric that favor low-carbon energy sources.

However, this same set of GHG and energy metrics may inadvertently incentivize the combustion of solid biomass fuels, which are often classified as "renewable energy" or "carbon neutral." Table 2 outlines the range of values associated with BPS policy applications and includes corresponding PM2.5 pollutant levels that could inform more health-conscious BPS design.

Table 2. Summary of Biomass Fuels Metrics in Policy Applications

BioMass Fuel Types	Common Fuels	Units	Energy MMBtu/Unit// MJ/Unit	GHG lbsCO_2e/MMBtu// kgCO_2e/MJ	PM2.5 lbs/MMBtu//kg/MJ
Gas	Lower C pipeline Methane, Propane	scf, Therm	0.000655 MMBtu/scf //24.4 MJ/m^3	114.79//0.0494	0.00741//3.19 x 10^{-6}
Liquid	Biodiesel, Biofuel Oil (Ethanol, Rendered Animal Fat, Vegetable oil)	Gallon	0.084-0.128 MMBtu/Gallon //23.4 - 35.7 MJ/L	150.88-179.79//0.065-0.077	0.00060//2.58 x 10^{-7}
Solid	Cord, Wood Pellets	Btu, Tonnes, Tons, cord	4,500 - 8,000 Btu/lbs//10.47 – 18.62 MJ/kg	0 – 209.35//0 – 0.09	No Controls 0.25 – 0.43//(1.07-1.85) x 10^{-4} With Controls 0.12 – 0.29//(0.52-1.24) x 10^{-4}

Particulate matter (PM), especially particles no larger than 2.5 micrometers (PM2.5), is a criteria pollutant of major concern associated with wood combustion. Emission level depends primarily on the type of biomass fuel and the particle control device. Nitrogen oxides (NOx) may also be released in significant quantities, particularly when certain woody biomass types are burned or when combustion conditions are suboptimal.

Table 2 shows the wide range of PM2.5 emissions produced during the combustion of solid biomass. This variability is primarily influenced by the type of wood being burned and the presence or absence of emission control technologies on the combustion device.

Uncontrolled PM2.5 emissions from woody biomass significantly exceed those of liquid and gaseous biomass fuels. This disparity underscores the importance of emission control technologies in mitigating particular matter output.

Common control devices and their associated PM2.5 reduction efficiencies include:

- Mechanical Collectors: 25%-64%
- Wet Scrubbers: 85%
- Electrostatic precipitators: 80-99%
- Fabric filters: 80% or higher

(Source: U.S. Environmental Protection Agency 2022, p. 1.6-3).

This wide variety of wood types and controls technologies complicates efforts to establish a standardized PM2.5 emission factor for policy calculations. To address this, the U.S. Environmental Protection Agency's *National Emissions Inventory Wagon Wheel Emission Factor Compendium* adopts a worst-case scenario approach. It prescribes a no-controls particulate matter emission rate of 0.43 lbs/MMBtu for wood combustion (EPA, n.d.).

In many greenhouse gas accounting frameworks, woody biomass is treated as having zero carbon emissions. This assumption is based on the idea that new trees will grow and reabsorb the carbon released during combustion. While this approach may reflect the role of sustainably managed forests in the long-term carbon cycle, it does not mean that biomass is a zero-CO_2-emission.

Burning wood fuels still produces carbon dioxide, methane, and nitrous oxide. In fact, nearly all of the carbon stored in the wood is released as CO_2 when burned (EPA 2022, page 1.6-2). Even if new forests are planted and eventually reabsorb these emissions—which is not guaranteed—there remains a temporal mismatch between the immediate release of carbon and the delayed process of regrowth.

This lag results in a negative impact on climate-forcing emissions. For any credible net-zero pathway, both the magnitude and timing of biomass-related emissions must be fully recognized, rather than overlooked through simplified carbon accounting.

TREATMENT OF WOOD AND WOOD PELLETS ACROSS EXISTING BPS METRICS

ASHRAE's position document on building decarbonization references Standard 100 as a framework for addressing energy efficiency and GHG emissions in existing buildings (ASHRAE 2024, p. 6).

The 2024 edition of Standard 100 incorporates a greenhouse gas intensity (GHGI) metric and establishes GHGI targets across 55 residential and commercial building types within 20 ASHRAE climate zones.

In cases where wood is used as a fuel, Standard 100 includes an informative appendix with heating values for 13 wood species at varying moisture levels. These values may be used as conversion factors for site energy calculations, but they are not part of the normative standard.

Biomass as an energy source is included in Standard 100's annual bulk energy use calculation, which forms the gross energy values used to derive energy use intensity metric (EUI) values.

Prior to the 2024 publication, Standard 100 was primarily used by consultants pursuing voluntary improvements to existing building stock, with EUI serving as the central performance metric.

Accounting in Codes and Standards

The emphasis on both energy efficiency and emissions metrics within BPS frameworks underscores the need to examine the limitations of the metrics used across Codes and Standards. While these frameworks aim to support decarbonization, certain assumptions and exclusions—particularly around biomass—may hinder comprehensive emissions accounting.

Long-run marginal emission rates (LRMER) estimate the rate at which emissions are expected to be induced or avoided by changes in electricity demand, incorporating projected changes to the electric grid. These rates have previously been evaluated for California and are now published in ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1-2023 (Standard 189.1). LRMER calculations are based on the Cambium database, which assumes zero emissions factor for biomass during the combustion phase and accounts for some emissions in the pre-combustion phase (National Renewable Energy Laboratory 2021, p. 38).

The fossil fuel emission factors set forth in ANSI/RESNET/ICC 301-2022, *Standard for the Calculation and Labeling of the Energy Performance of Dwelling and Sleeping Units*, do not account for biomass fuels as a household combustion fuel. The emission factors in this standard were developed using *EPA's AP 42, Fifth Edition Compilation of Air Pollutant Emissions Factors*, Volume 1, Chapter 1: "External Combustion Sources."

Unlike conventional fossil fuel types, such as natural gas, fuel oil #2, and liquid petroleum gas, biomass fuels are excluded from the calculations used to determine the CO_2e Rating Index (CRI) and LRMER metrics.

Additionally, the Energy Rating Index (ERI)—a metric referenced in the residential provisions of the *International Energy Conservation Code and ANSI/ASHRAE/IES Standard 90.2-2024* (Standard 90.2)—is calculated based on on-site power production (OPP). OPP is defined as the electric energy produced on-site, minus the equivalent electric energy consumed by any purchased fossil fuels used to generate that total output.

Because BPS across states and jurisdictions are expected to evolve in their treatment of energy use and emissions, the metrics in these codes and standards remain limited in their ability to account for on-site woody biomass combustion in dwelling and sleeping units. Since wood and biomass are not classified as fossil fuels, the ERI is not capable of addressing their use in on-site combustion scenarios.

Beginning with the 2012 edition of the *International Energy Conservation Code* (IECC), "biomass" was treated as a fully "renewable" energy resource for building energy use. It should be noted that the generic "biomass" category of renewables was limited to only "biomass waste" in the 2021 IECC cycle. Standard 189.1 does not include "biomass" or wood in its definition of "on-site renewable energy system." Procurement of renewable electricity through Power Purchase Agreements (PPA) also excludes "biomass" or wood as a qualified resource, unless derived from "captured methane from feedlots or landfills" (Standard 189.1 2023, 37).

In contrast, both ANSI/RESNET/ICC 301-2022 and Standard 90.2 treat "biomass" as a "renewable" energy source. Because Standard 90.2's ERI and CRI compliance targets for buildings with "renewable" energy (including "biomass") are more stringent than those for buildings without, a residential unit may rely on on-site wood and wood-derived fuels just as readily as on-site solar to meet the maximum limits specified by Standard 90.2. This is not the case in ASHRAE 189.1, where "biomass" is not defined as "renewable."

CASE STUDIES: BIOMASS TREATMENT IN BPS POLICIES

Six jurisdictional BPS policies that use a GHG metric were identified from the *Institute for Market Transformation's (IMT) Comparison of U.S. BPS* (Institute for Market Transformation, 2025). These jurisdictions include Colorado; Boston and Cambridge, MA; Seattle, WA; Evanston, IL; and New York City. Of the six identified policies three—Boston, MA, Colorado, and Evanston, IL—were selected for analysis to evaluate the potential public health impacts of biomass emissions, including associated mortality and morbidity, based on how each policy classifies and regulates biomass within its framework.

Cast Study Methodology

Building stock data were analyzed to evaluate the impact of criteria pollutant emissions on public health looking at two fuel conversion scenarios; the conversion of on-site natural gas combustion to on-site woody biomass combustion, and the conversion of the standard grid generation mix to woody biomass-based generation. Local building stock data from the *Boston Environment Department* (n.d.) were used where available, while ComStock data from the *National Renewable Energy Laboratory* (n.d.) were used for other locations. The analysis assessed gross energy usage and emissions across all covered buildings and identified the total emissions reductions required for compliance with the applicable BPS policy. It was assumed that 100% of the required emissions reductions were achieved either by replacing on-site natural gas usage with biomass fuel or by substituting standard grid electricity generation with biomass-based generation.

Criteria pollutant impacts associated with reduced on-site natural gas usage and increased on-site biomass fuel usage were calculated using the *2020 National Emissions Inventory Wagon Wheel Emission Factor Compendium* (EPA, n.d.).

Criteria pollutant reductions associated with electricity usage transitioned to biomass-based generation were calculated using PM2.5 data from solid wood biomass generation sources, as presented in the *eGrid* particulate matter emissions analysis (eGrid2020, n.d.).

The EPA COBRA tool (EPA, 2024, n.d.) was used to estimate the net public health cost impacts associated with changes in criteria pollutants from on-site and electricity generation fuel use shifts. Health costs in COBRA were evaluated at the state or county level, reflecting only those incurred by residents of Colorado, Suffolk County, and Cook County for the Colorado, Boston, and Evanston case studies, respectively.

While the case study scenarios assume market-wide emissions reductions achieved by converting 100% of on-site combustion and grid electricity generation to biomass—a highly unlikely outcome—they serve to illustrate the potential magnitude of health cost impacts under the proposed policies, including cases in which only a portion of buildings comply through biomass use.

For on-site emissions, the analysis converted 100% of energy use associated with natural gas reductions to biomass, assuming equal equipment efficiencies between natural gas and biomass systems. For electricity generation, the typical eGrid mix was replaced with 100% biomass-based generation for compliance modeling purposes.

Building Performance Colorado (BPC)

The Colorado BPS standard allows compliance through either EUI or GHG compliance pathways. Under the GHG pathway, the regulation states: "A biomass electric generation facility that was in existence on or before January 1, 2021, or that has a nameplate rating of ten megawatts or less, is a renewable energy facility." (*Colorado Department of Public Health and Environment*, 2023, p. 6).

This provision effectively designates qualifying biomass facilities as a zero-carbon electricity source. As a result, buildings can comply with the GHG pathway without additional efficiency or emissions reductions—provided they electrify and procure electricity from eligible biomass combustion generation.

Additionally, the greenhouse gas intensity reductions pathway references the ENERGY STAR® Portfolio Manager Building Emissions Calculator to demonstrate compliance with the GHG intensity targets. While the ENERGY STAR® Portfolio Manager Building Emissions Calculator allows for reporting of biomass (wood), it does not assign an emissions factor or attribute any direct emissions to wood energy use.

Boston's Building Emissions Reduction and Disclosure (BERDO)

The current language in Part VIII.a of the BERDO regulations states the following: "Emissions Factors for natural gas, propane, fuel oil, diesel oil, and kerosene, and any other fuels not otherwise specified in the Regulations or policies and procedures issued by the commission or Environment Department, shall be the most recent Emissions Factors reported by ENERGY STAR® Portfolio Manager." (Boston Air Pollution Control Commission, 2024, p. 13).

According to ENERGY STAR® Portfolio Manager, the emissions factor for biomass (listed as wood) is 94.96 kg CO_2e / MMBtu (ENERGY STAR® Portfolio Manager, 2024, p. 13). However, the TouchstoneIQ City of Boston BERDO Emissions Calculator (TouchstoneIQ, 2025, n.d.)—referenced on the BERDO website as a resource for building owners—does not allow selection of biomass/wood as a fuel type for emissions calculations. This discrepancy may lead to confusion about whether biomass emissions are calculated, and if so, how they are treated (Boston Environment Department, 2025, n.d.).

The BERDO regulations permit building owners to petition the commission for approval of custom emissions factors, with biogenic fuels specifically identified for inclusion. This provision creates a pathway for the commission to recognize biomass combustion as a lower- or zero-emission fuel source for compliance with the standard.

BERDO allows compliance using RPS Class 1 RECs from "non-CO_2e emitting renewable sources." While Class 1 RECs may be generated from eligible biomass and biofuel electric generation, the term "non-emitting" is not defined in the RPS, the BERDO Ordinance, or the BERDO Regulations. As a result, the treatment of RPS-eligible biomass generation under the BERDO REC compliance pathway remains subject to interpretation by city enforcement.

Evanston, IL

The Evanston, IL BPS policy is still in rulemaking. A sample analysis was completed to evaluate the impact if the policy language allows for treatment of biomass as a zero-emission fuel.

Case Study Results

The results of the analysis on the three case study BPS policies can be found in Tables 3 and 4. The Net Health Cost Impact shows the net health cost impact of reduced natural gas associated criteria pollutant emissions reductions and increased biomass fuel associated criteria pollutant emissions increases. The Health Cost Impact Compared to Zero-Emissions BPS Compliance Framework is the health cost impact compared to a policy that doesn't allow for any fuel combustion and requires absolute emissions reductions.

Table 3. Case Study Results

Description	Colorado	Boston, MA	Evanston, IL
On-Site Natural Gas Health Cost Savings	$7,900,000 - $10,000,000	$1,500,000 – $2,600,000	$3,100,000 – $6,100,000
On-Site Biomass Health Cost Increases	$98,000,000 - $2,000,000,000	$83,000,000 - $180,000,000	$50,000,000 - $110,000,000
On-Site Net Health Cost Impact	$90,100,000 - $1,990,000,000	$81,500,000 - $177,400,000	$49,900,000 - $103,900,000

Table 4. Electric Generation Impacts from Case Study Results

Description	Colorado	Boston, MA	Evanston, IL
Typical Grid Mix Generation Displacement Health Cost Savings	$32,000,000 – $43,000,000	$2,700,000 – $4,900,000	$510,000 - $1,000,000
Biomass Generation Health Cost Increases	$83,000,000 - $110,000,000	$5,100,000 - $8,400,000	$1,800,000 - $3,200,000
Net Electric Generation Health Cost Impacts	$51,000,000 - $67,000,000	$2,400,000 - $3,500,000	$1,290,000 - $2,200,000

While policy goals may be perceived to be met by substituting natural gas with "Carbon Neutral" wood combustion, the health costs associated with this change are two hundred times more expensive than the health cost savings from the reduction in natural gas usage in a typical BPS jurisdictional case study. National level analyses of increased BPS adoption should be conducted to assess the significant health and health cost impacts where woody biomass combustion is incentivized.

RECOMMENDATIONS FOR BPS LANGUAGE

Informative Appendix J of Standard 100 provides jurisdictions with guidance on how to generate BPS targets based on local energy benchmarking data, jurisdictions can either rely on EUI and GHGI targets specified in Normative Appendix B of Standard 100, or use local data to set targets. For instance, ASHRAE provides jurisdictions with support on calculations applying to subnational geographic regions – the calculations are based on region-specific datasets that provide evidence of building activity energy use by the specific region. The British Columbia example on ASHRAE's website provides an overview of a jurisdictional framework for a region with multiple climate zones and unique definitions of building archetypes (ANSI/ASHRAE/IES Standard 100-2024, Energy and Emissions Building Performance Standard for Existing Buildings, Supporting Files, n.d.).

Table 5-2 of Standard 100 provides source energy and GHG values for "On-site renewable thermal energy". It further describes the compliance path in Footnote b as follows: "To be approved by the AHJ. Default values for qualified renewables are 1.00 for source energy conversion factor and 0.000 lb CO_2e/kBtu (I-P) or 0.000 kg CO_2e/MJ (SI) for GHG emissions factor."

Standard 100, however, does not delineate any further what should be considered a "qualified renewable," thus leaving the source and GHG factors for onsite wood combustion at the discretion of the AHJ, who is directed to default to a zero emission factor if not elsewise indicated. As can be seen in the wide range of wood values in use throughout other codes and standards, this footnote may lead some jurisdictions adopting Standard 100 to incentivizing wood combustion in their BPS policy while at the same time they may have quite serious air quality constraints (citation, Multnomah County). The authors recommend that the default emissions factor for woody biomass should be set conservatively at EPA's emission factor of 94.96 kg CO_2e / MMBtu (ENERGY STAR® Portfolio Manager, 2024, page 13).

"b. To be approved by the AHJ. Default values for qualified renewables are 1.00 for source energy conversion factor and 0.000 lb CO2e/kBtu (I-P) or 0.000 kg CO_2e/MJ (SI) for GHG emissions factor. Default emission values for cord wood, pellets and woody waste are 94.96 kg CO_2e / MMBtu."

For buildings that may find it difficult or impossible to meet BPS targets set by local jurisdictions, standardization of alternate pathways is an essential next step for the success of BPS, particularly for under-resourced and very complex buildings (Cherylyn et al. 2025, n.d.) Alternative pathways can serve newly constructed buildings in the transition period from code to BPS compliance, and educate building owners, designers, and operators on the requirements of BPS (Karpman et al. 2024, pages 1 and 5). Alternative pathways in implemented BPS across some jurisdictions include timeline adjustment, percent reduction of baseline consumption, custom performance, prescriptive measures, portfolios and campuses, and alternative payment.

CONCLUSION

BPS are critical policy tools for decarbonizing buildings, but their effectiveness is contingent on selected compliance metrics, how emissions factors are established, and how lower-carbon fuels are incorporated. Treating biomass combustion as a zero-emission or carbon-neutral fuel source can create compliance pathways that result in significant negative health cost impacts in the enacting jurisdictions due to associated criteria pollutant emissions.

The analysis of BPS frameworks in Colorado, Boston, and Evanston shows that when woody biomass combustion can be used to demonstrate GHG reductions for the purpose of compliance with a BPS policy, the significant health costs from particulate matter and other pollutants can outweigh the climate benefits by orders of magnitude. In some cases, woody biomass combustion produces health damages many times greater than the avoided costs of reduced fossil gas use. While the focus of this paper was on woody biomass, these same pollutant dynamics may exist for other renewable biogenic fuel sources and lower carbon emitting fuels. To align decarbonization policies with public health objectives, jurisdictions should explicitly account for biomass pollutants in their BPS implementation. This involves all of the following steps:

- Apply non-zero energy factors to solid biomass such as the 1.20 source energy factor suggested in this paper;
- Exclude biomass from "renewable" or "non-emitting" categories and fully prioritizing non-emitting resources; and clearly define biomass combustion as an emitting resource
- Exclude REC's generated from emitting sources to be treated as zero-carbon; and
- Exclude electric generation from emitting sources to be treated as zero-carbon

By closing this loophole, policymakers can avoid undermining the dual goals of reducing carbon emissions and protecting communities from harmful air pollution. Building decarbonization policies should deliver healthier and more sustainable outcomes, and not trade one form of combustion for another.

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