Site Energy Codes at Scale:
Low- and Zero-Fuel-Bias Code Development and Adoption

Erin Sherman, RMI
Adam Berry, Colorado Energy Office
Benjamin Rabe, New Buildings Institute
Jonny Kocher, RMI

ABSTRACT

Authorities having jurisdiction (AHJs) seeking to advance building efficiency and climate alignment beyond the pace of model code development have adopted a wide range of approaches, including all-electric requirements, differentiated standards for all-electric and mixed fuel buildings, electric heat pump performance baselines, and site energy-based codes. Leading AHJs devoted significant resources to code development, which is not possible for most interested AHJs. Following recent litigation and evolving model code processes, many AHJs also face increased legal uncertainty and limited resources to advance codes in alignment with climate and efficiency goals. This study reviews and compares options available to date for AHJs without custom code development resources to adopt site energy-based codes, including the 2024 International Energy Conservation Code's Section CF103, ASHRAE Standard 90.1-2022's site energy-based Appendix G option, and the Zero Fuel Bias Code Overlays published by RMI. This study examines multiple code adoption processes in which those resources were proposed and offers lessons learned and best practices for the provision of technical assistance to small and medium-sized AHJs adopting above-model codes.

Introduction

Building energy codes are a key tool to encourage energy efficiency. Pacific Northwest National Laboratory researchers (Poehlman et al. 2024) estimated that energy codes would avoid over $95 billion in energy costs in the United States between 2010 and 2030. Some authorities having jurisdiction (AHJs) with greenhouse gas emission (GHGe) reduction goals have leveraged this success by accelerating the adoption of energy efficiency and GHGe reduction measures in energy codes. Energy codes offer an attractive intervention point to reduce building sector emissions when it is least costly: when a building is first constructed.

AHJs considering advanced energy codes today must navigate rising energy costs, threats of litigation, and evolving public and policy debates. Early adopters devoted significant resources to customized code development, which is not possible for most AHJs today.

This study considers options available to AHJs to adopt site energy conservation codes, with a focus on options requiring minimal or no customization by AHJs. The term "site energy" refers to the energy used at the site itself. In contrast, "source energy" additionally considers the efficiency of electricity generation, line losses, and other reductions in available energy between the source and the building. Site energy codes evaluate compliance according to the amount of site energy used, as opposed to source energy, energy cost, or other metrics.

AHJs Leading Adoption of Advanced Energy Codes

Leading AHJs have taken a variety of approaches to reach policy goals through energy codes, including all-electric new construction requirements (e.g., New York State), differentiated requirements for all-electric and mixed fuel buildings (Massachusetts stretch code, first adopted in 2021; Montgomery County, MD, 2024; Illinois stretch code, 2023), all-electric requirements through the prescriptive pathway code with performance based options for mixed fuel (California, 2021), and site energy-based codes (Washington State, 2021; and Colorado, in 2025 model code). Many of these AHJs are characterized by their well-resourced and outcome-focused energy code development and adoption processes. Each of these AHJs also adopted energy codes under statutory authority that obligated or encouraged them to improve energy efficiency and/or climate alignment beyond contemporary model energy codes.

Additional AHJs may join this vanguard; for example, Minnesota recently added energy efficiency goals to its energy code law (Minnesota Statutes 2025). Most AHJs, however, would face not only political barriers, but also practical ones. Custom energy codes require the development of tailored training and compliance programs that typical AHJs cannot reasonably fund, particularly with limited federal support. Innovative resourcing mechanisms, such as utility energy code programs, regional GHGe trading proceeds, and noncompliance payment funds, may help overcome these barriers. Insofar as advanced energy code options become more standardized and supported by available training and compliance mechanisms, fewer resources will be needed, improving feasibility for a broader range of AHJs.

Recent Developments

Legal, political, and administrative developments have reduced the availability and feasibility of some advanced energy code options in recent years, especially options that are attractive due to their simplicity, impact, or alignment with typical laws, rules, and compliance norms. Collectively, these limitations suggest a narrowing path for successful energy code advancement.

All-electric code feasibility and risks. The city of Berkeley, California prohibited new gas connections in July 2019 (Berkeley 2019). Compared to other advanced code options, such a prohibition offers little flexibility, but is simple to enforce. Building inspectors need minimal or no training to identify whether there are gas connections in a building.

Berkeley was sued in November 2019 by the California Restaurant Association. Plaintiffs alleged that the prohibition was preempted by state and federal law, and ultimately prevailed. Notably, while the Ninth Circuit rejected Berkeley's petition for *en banc* review in January 2024, it also amended its opinion to narrow its applicability. Legal analyses have suggested that the amended decision increases the risk of preemption by the federal Energy Policy and Conservation Act (EPCA) for new construction codes that prohibit behind-the-meter natural gas infrastructure or covered equipment throughout the Ninth Circuit, while also "[leaving] open several pathways for jurisdictions to pursue electrification policies" (PHLC 2024a).

Similar lawsuits have been filed against other AHJs with building decarbonization policies, whether they prohibit combustion equipment or require building-level energy or GHGe reductions. While none have been decided in favor of the plaintiffs as of Spring 2026, many remain pending.[1] The prospect of litigation—and its financial and political costs—has been cited

---

[1] For the latest updates, see the Public Health Law Center's Litigation Tracker, filtered for climate justice.

by some AHJs as a reason to avoid or delay policies that could be construed as restricting infrastructure or covered equipment, even if they do not prohibit gas infrastructure.

Energy code rule freezes and rollbacks. Many AHJs have reduced energy code advancement recently. For example, North Carolina passed a 2023 law that froze its energy codes until 2031 (North Carolina General Statutes 2023); California passed a similar but less restrictive law in 2025 (California HSC 2025). Also in 2025, Delaware deferred implementation of a statutory mandate to adopt an advanced energy code. The adopting agency sought guidance from elected officials, citing concerns around first-cost affordability despite long-term cost savings (Patterson 2025). Through executive branch action, Vermont (Scott 2025) and New York (NDNY 2025) have similarly opted not to enforce approved code provisions.

Housing affordability is often cited as justification for pausing or delaying energy code updates. While opponents often claim that increasing code stringency also increases construction costs (see, e.g., NAHB 2025), some code changes reduce costs through efficient use of materials, alignment with the market, or improved flexibility. For example, the US Department of Housing and Urban Development (HUD) estimated that ASHRAE Standard 90.1-2019 would reduce upfront costs of mid- and high-rise multifamily construction in many climate zones, and would increase costs by only $18 per dwelling unit on average (Table 26, US HUD 2024). In low-rise residential codes, the 2024 IECC was estimated to result in positive resident cash flow in one year on average by Pacific Northwest National Laboratory (PNNL) (Salcido et al. 2025) and to reduce construction costs for most climate zones and home configurations by Home Innovation Research Labs (HIRL 2025).

Model code scope and process changes. In the past year, both national model energy code-making bodies, ASHRAE and the International Code Council (ICC), have relegated climate-aligned provisions to secondary codes. The ICC Board of Directors announced changes affecting the 2030 IECC; most notably, the its goal will be to equal, not improve, the energy efficiency of the 2027 IECC, and consensus committees may make changes that reduce efficiency (ICC 2026a). The 2030 IECC will be developed under a new cost-effectiveness framework with short-duration, simple-payback thresholds. Additionally, decarbonization-oriented provisions (e.g., renewable energy requirements or credits, solar and storage readiness, etc.) will no longer appear in the base IECC. Instead, they will be relocated to credits or appendices in a new code, the IECC Expanded (IECCX). The ICC Board includes provisions that require more energy efficiency credits for buildings without heat pumps in this category, despite their efficiency benefits. Finally, separate consensus committees will develop the IECCX (ICC 2026b). Similarly, starting with the 2028 edition, ASHRAE Standard 90.1 will place measures that are cost effective when the social cost of carbon is considered into a new Standard 90.1 Extended (90.1-E) (ASHRAE 90.1 MSC 2026).

Over half of US states adopt the IECC and/or ASHRAE Standard 90.1 by reference (US DOE 2025b), and many restrict state amendments by law (e.g., via efficiency, first-cost, or cost-effectiveness criteria). Under these model code scope changes, such laws arguably will not reference extended code editions. While AHJs could adopt extended codes by reference, this approach may not prove resilient. For example, the ICC Board has granted many stringency-reducing appeals and significantly altered IECC development processes in each of the previous two triennial code development cycles, which may instill doubt in the strength and longevity of the IECCX. Overall, there is a risk that the 2028-2030 model code cycle will not yield efficiency or GHGe reduction progress in alignment with ambitious jurisdictions' policy intentions.

Constrained AHJ resources. Multiple factors limit the resources that typical AHJs can devote to energy codes. First, AHJs have been managing fluctuations in federal resources and programs recently Many costs have devolved to these AHJs, causing fiscal strain and necessitating trade-offs. Energy code-related resources from the American Reinvestment and Recovery Act (ARRA), Bipartisan Infrastructure Law (BIL), and Inflation Reduction Act (IRA) have been allocated and spent down (ARRA), reduced from their original scope, or affected by inconsistent funder decision-making (BIL and IRA). Some AHJs are now stymied by these developments. Federally funded AHJs may be sensitive to new guidelines and less likely to consider code provisions focused on GHGe reduction.

Shifting to a site energy conservation metric for new construction codes

In this context, energy code provisions that address legal, political, and institutional risk while continuing energy use and GHGe reductions are of interest. Provisions that adopt a site energy compliance metric address all of these factors. Site energy is the amount of energy used at a site, as opposed to source energy, which includes losses during energy generation and transmission to the site.[2]

While current model energy codes largely measure compliance in terms of energy cost, it has shortcomings as a metric. It varies according to factors that shift over time and cannot be controlled by the building designer, including available and selected energy rates, future fuel price changes, and taxation. As such, it requires assumptions that may introduce error and may unintentionally encourage misplaced certainty about future operating costs. It can also complicate enforcement in AHJs that span multiple utility territories or impose local utility fees.

By comparison, a site energy metric is simple, clear, and within designer control. Site energy outcomes must be estimated to estimate energy costs, so existing modeling software and compliance tools may be easy to adapt or use as-is. Site energy is plainly aligned with energy conservation authority held by AHJs and unlikely to increase EPCA preemption risk, since EPCA recognizes site energy use as a valid metric to set the relative value of credit toward code compliance for above-federal-minimum-efficiency appliances (28 42 U.S.C. § 6297(f)(3)(C)). Given these advantages, site energy is suitable for use in any AHJ. For AHJs with climate goals, site energy has additional benefits: what reduces site energy use almost always reduces GHGe. Depending on relative costs, accessibility, and other local characteristics of fuels and electricity, reductions in energy cost may or may not align with GHGe reductions.

Site energy codes can also address an underlying structural issue in model codes: unequal conservation objectives across equipment types. Model codes often allow buildings with combustion equipment to use more site energy than buildings with electric heat pump equipment. This occurs because almost all model code compliance options require improvement compared to a standard reference design that varies according to the equipment type of the proposed design. For example, a building using natural gas for space and water heating would be compared to a reference design that also uses natural gas for those end uses, and the same pattern would hold for a proposed design using electric heat pumps. This means that differences in

[2] Source energy poses many of the same challenges as energy cost when used as a code metric, and EPCA does not address it. The same is true of GHGe.

efficiency between gas furnaces and electric heat pumps are not accounted for when determining code compliance.

Model codes overlook considerable energy savings due to this accounting gap. Electric heat pumps' coefficient of performance (COP) exceeds 2.0, while combustion furnaces and boilers' annual fuel utilization efficiency (AFUE) cannot exceed 1.0. While space and water heating energy use varies across climate zones and building types, high efficiency in these end uses usually yields a significant reduction in overall site energy. On balance, this gap makes higher efficiency levels costlier to attain, since designers may need to choose costlier measures than high-efficiency equipment types to comply. Site energy codes can instead set a single conservation objective across equipment types by, for example, requiring comparison to the same standard reference design regardless of the proposed design's equipment types. Such a code rewards a broader array of energy-efficient choices than codes with fuel-type-specific conservation objectives, thereby improving flexibility and cost-effectiveness at any stringency level.

Examples of Site Energy Code Templates

Multiple code templates based on site energy are available for AHJs to adopt. Each offers amendments to recent model or state energy codes intended to more closely align building energy use with a site energy conservation objective.

2024 IECC Appendix CF sections CF103 and CF104. The provisions published as Sections CF103 and CF104 of the 2024 IECC were originally proposed by New Buildings Institute (NBI) staff and based on NBI's Building Decarbonization Code (Cheslak et al. 2021). Both sections require that buildings without heat pumps achieve 25% more energy conservation credits than otherwise required by Section C406.1.1 (ICC 2025). This adjustment reduces, though does not eliminate, the site energy outcome discrepancy between buildings with and without heat pumps. This provision is simple to calculate, providing an option for AHJs to value the efficiency of heat pumps without causing large shifts in training or enforcement.

These provisions were incorporated into the final Consensus Committee approved draft of the 2024 IECC (ICC 2023) prior to their relegation to an appendix following appeal (ICC 2024). IECC appendices, while considered part of the published model code, are framed as optional for AHJs to adopt and are rarely considered by AHJs with statutory obligations to adopt new editions of the IECC. The ICC Board construed these provisions as establishing a "penalty" for non-heat-pump equipment, thus failing to comply with the 2024 IECC's Scope & Intent, due to their framing: they require additional efficiency for non-heat-pump buildings, rather than crediting heat pumps for their efficiency. Such a construal, while a matter of framing rather than substance, could contribute to a perception of state preemption in some AHJs (Walker and Malmuth 2024). Regarding federal law, the ICC Board voted unanimously to deem EPCA preemption risks "not applicable" to these provisions (ICC 2024).

ASHRAE Standard 90.1-2022 Appendix G with a site energy metric. The 2024 IECC's Sections CF103 and CF104 reduce discrepancies in site energy outcomes between buildings using different equipment types. Due to their structure, these sections cannot fully reflect site energy differences that may vary based on building design. ASHRAE Standard 90.1-2022 offers a more comprehensive approach to a commercial site energy code (ASHRAE 2022).

The Appendix G Performance Rating Method measures code compliance against a reference design that does not vary across editions of the Standard (US DOE 2026). While the Performance Rating Method uses energy cost as its metric by default, Informative Appendix I—a set of optional provisions, functionally similar to an IECC appendix—offers multiple alternative metric options, including complete example language for site energy.

To date, this language has been adopted as a compliance pathway in the Massachusetts Stretch and Specialized Opt-In Codes for commercial buildings (Massachusetts 2024). It has also been adopted as a sole compliance path for large new buildings by Montgomery County, Maryland (Montgomery County Executive Regulation 2024). Appendix G compliance requires a level of energy modeling capability that may be cost prohibitive for smaller projects and firms, and does not afford typical AHJs visibility into code compliance. Site energy-based codes that retain as multiple code compliance paths may improve viability for a broader range of AHJs.

RMI - PHLC Zero Fuel Bias Overlays to the 2024 IECC. RMI and PHLC (Sherman, Carpenter-Gold, Kocher, and Long 2024) jointly published the Energy Code Safe Harbor Toolkit, including the Zero Fuel Bias Code Overlays (ZFB Overlays). Building on previous approaches, the ZFB Overlays restructure all 2024 IECC compliance pathways to equalize site energy outcomes between fuel types. In each pathway, the ZFB Overlays set the reference design to use minimum-efficiency combustion equipment, and credit efficient equipment toward compliance proportionate to its site energy savings measured in annual kBtu.

The 2024 edition of the ZFB Overlays required additional technical assistance to develop AHJ-appropriate energy efficiency credits in prescriptive path sections R408 and C406, which limited the feasibility of their adoption for typical AHJs. The 2026 edition, renamed the Energy Choice Overlays, includes complete energy credit and performance path values and does not require custom energy modeling.

The commercial 2027 IECC public comment draft currently includes Appendix CK, Commercial Single Conservation Objective (ICC 2026c), which contains provisions similar to those in the Energy Choice Overlays. Appendix CK's High-Efficiency Heating Equipment Credit Alignment provision allocates credit to heating equipment in proportion to the site energy saved by federal minimum efficiency equipment of the same type compared to an 80% AFUE furnace. To avoid reducing energy efficiency overall, Appendix CK increases credit requirements for each building type by the alignment credit's value for a federal minimum efficiency heat pump. In effect, this incorporates a federal minimum efficiency heat pump into the standard reference design. Appendix CK could be enforced via COMcheck with minor software customizations or a job aid that adjusts credit requirements and calculates the alignment credit.

Examples of template site energy code adoption and implementation

Illinois Stretch Energy Code

In 2021, the Illinois Climate and Equitable Jobs Act (CEJA)—which includes multiple significant clean energy and decarbonization commitments—established a provision requiring the state of Illinois to create a stretch energy code (ILGA 2021a). With some exceptions, localities in Illinois were prohibited from adopting residential energy codes that differed from the state code prior to CEJA's passage; while they had authority to adopt more stringent commercial energy codes under law, in practice, they did not. The Illinois Stretch Energy Code ("stretch code") provided a new option for localities to address the efficiency and climate alignment of new buildings in alignment with local policy goals.

Stretch energy codes had been in effect elsewhere in the United States for over a decade when CEJA passed; for example, Massachusetts adopted its first stretch code in 2009 (Massachusetts 2026). Illinois is the first state to establish a statutory requirement for a certain level of energy efficiency advancement with every stretch code update, as shown in Table 1. Implementing a maximum site energy index (SEI) for every triennial update ensures the stretch code will not stagnate, as IECC has at times (US DOE 2025a). CEJA does not allow inclusion of renewable energy in the calculation of SEI (ILGA 2021b), and the final SEI targets are consistent with on-site renewable energy production providing the remaining energy.

Table 1. Illinois Stretch Energy Code deadlines and site energy indices

Statutory deadline*	Residential maximum SEI	Commercial maximum SEI
6/30/24	0.50	0.60
12/31/26	0.40	0.50
12/31/29	0.33	0.44
12/31/32	0.25	0.39

*based on 2026 legislative update. *Source:* ILGA 2021a.

The Illinois Capital Development Board (CDB) and Illinois Energy Codes Advisory Council (IECAC) are charged with developing Illinois energy codes. CEJA's SEI targets function as a percentage of site energy use relative to the 2006 model code. During each update cycle, IECAC evaluates and selects amendments to the latest model code that reduce site energy use to meet the required SEI target. Meeting SEI targets required a novel level of technical rigor from IECAC and CDB. CEJA does not provide guaranteed funding for technical assistance to develop the stretch code, creating a capacity gap. Volunteer technical advisory support from NBI and Rocky Mountain Institute (RMI) filled this gap from late 2022 through 2023.

The first Illinois stretch code largely adopts the commercial 2024 IECC by reference. The residential stretch code uses an energy efficiency credit table to flexibly reach relatively stringent SEI targets, but otherwise largely retains 2021 IECC provisions. IECAC reviewed 2024 IECC provisions as they were developed and approved by the Consensus Committees to align stretch code advancement with future statewide codes. The 2023 Illinois Stretch Energy Code also incorporates measures relegated to appendices by the ICC Board following appeals, including electrification readiness and Appendix CF Sections CF103 and CF104. These provisions were deemed consistent with the letter and intent of CEJA by IECAC and CDB.

Due to the delays in the 2024 IECC development process, the stretch code's publication was likewise delayed. The 2023 stretch code was completed and available for adoption on January 1, 2025 (IL CDB 2025). On February 24, 2025, Evanston became the first municipality to adopt the it (Evanston COO 2025). Other interested localities have opted to wait for the 2026 version to avoid disruptions to the construction market and administrative processes due to a very short effective period for the 2023 version. This concern contributed to CDB's decision to request revision of CEJA's triennial stretch code update cycle, pushing back the delivery date for each edition of the stretch code by one year. The Illinois General Assembly passed a law including this revision in 2025, effective January 1, 2026 (ILGA 2021a).

In 2024, work began on the 2026 version of the Illinois Stretch Energy Code. For this cycle, state funding was secured by CDB, and NBI and Energy Solutions were hired as technical advisors. The commercial 2024 IECC nearly met the 2026 SEI target, while the residential 2024 IECC was estimated to lead to significantly more energy use than allowed under CEJA (Salcido et al. 2024). Technical advisors and the public submitted several proposals to boost energy efficiency. The technical advisors proposed that any remaining energy savings needed would be achieved through flexible mechanisms such as energy efficiency credits and determined the correct number of credits for different building types. Each compliance pathway includes provisions to meet the site energy conservation objective that recognize the relative energy efficiency of the building's space and water heating equipment.[3]

As of Summer 2026, analyses have demonstrated that the draft 2026 stretch code is cost-effective and meets statutory energy efficiency requirements (Energy Solutions 2026a; Energy Solutions 2026b). While the analysis was prompted by a request from the Illinois Joint Committee on Administrative Rulemaking (IL JCAR), interested localities are also interested in this analysis, as it will inform decision-making around stretch code adoption. Further rulemaking is necessary to finalize the rules, which must be final by the end of 2026.

The Illinois stretch code process suggests lessons for AHJs interested in similar approaches. First, adequate energy modeling capability and code development capacity are important when quantitative efficiency targets are set by statute, but an existing code meeting those targets in a similar climate is not readily available. Funding, either for staff or contracted technical assistance, must be identified. When a code advisory body such as IECAC is available, if that body has not historically provided significant technical capacity to code development, it should not be assumed that it can do so when new requirements are set. As more advanced code options are developed with rigorous, publicly available energy efficiency and cost effectiveness assessments, AHJs will require less technical assistance to achieve similar outcomes.

Second, relying on in-progress code development processes to advance AHJ codes is risky and may result in delays or discrepancies between AHJ-approved and referenced model codes. As mentioned above, this may also apply to reliance on model code appendices or IECCX, as the consistent availability of these resources is uncertain. Any effort to develop advanced code resources for AHJs must communicate clearly about the timing of resource availability and earn the trust of interested parties.

Third, considering the locality adoption process is critical. Localities do not want to update their codes twice within three years; re-train code officials, designers, and builders more than necessary; or adopt a code without an analysis of its costs and benefits. Code resource development efforts can be more effective in assisting localities when they prioritize these dimensions of decision-making in the development process.

[3] The language of the amendment differentiates credit requirements based on the presence of fuel-burning space or water heating equipment. This effectively provides credit toward compliance for heat pumps' efficiency because 2024 IECC restricts electric resistance primary heat in the prescriptive pathway in Section R403.7.1.

Colorado Model Low Energy and Carbon Code

Colorado House Bill 19-1261, as amended by Senate Bill 23-016, established a goal of reducing economy-wide net GHGe 100% relative to 2005 levels (COGA 2019; COGA 2023). In response to this target, the Colorado Energy Office and other state agencies developed the state's first Greenhouse Gas Pollution Reduction Roadmap ("Roadmap"), which identified near-term actions across multiple sectors, including buildings (CEO 2024). The Roadmap highly prioritized strengthening building energy codes. Related to this work, the Colorado General Assembly passed House Bill 22-1362, which directed the Colorado Energy Office and Colorado Department of Local Affairs to convene an Energy Code Board ("Board") to evaluate and approve new minimum model energy codes for local governments to adopt (COGA 2022).[4]

The Colorado Model Low Energy and Carbon Code (MLECC) was the second of two codes directed by HB22-1362 for the Board to develop, and it became Colorado's minimum energy code on July 1, 2026. The statute directed the Board to base this code on the more energy efficient of the 2021 IECC and the 2024 IECC. The Board determined that the IECC does not provide equivalent compliance pathways across fuel types. Under the existing structure, mixed-fuel buildings could comply while achieving lower overall energy efficiency than comparable all-electric buildings. In practice, this often made compliance easier and less costly for mixed-fuel projects. Therefore, the Board felt strongly about removing the biases in the code and leveling the playing field for all fuel types to compete fairly, and for the benefits of fuel types to be based on energy efficiency, not multiple fuel-dependent metrics. The Board considered various options as they evaluated this fuel debiasing approach, including code proposals and model code language developed by RMI, the energy code adopted in the State of Washington, and alternative site energy-based compliance options of Normative Appendix G and Informative Appendix I of ASHRAE Standard 90.1. Ultimately, language from each of these resources was incorporated and adapted for use in the MLECC.

The Board modified each of the compliance pathways of the energy code to incorporate a site energy metric. Within prescriptive pathways, the Board considered multiple approaches to balance the playing field for all-electric buildings and ultimately decided on a credit-based approach in the revised sections C406 and R408. The 2024 IECC only included measures for mechanical equipment that exceeded federal minimum efficiency standards. A new measure was added to account for the efficiency differences between the least efficient mechanical options available and more efficient options that also met federal minimum efficiency standards. This allowed credit to be achieved for selection of equipment that had a higher federal minimum efficiency rating than the absolute minimum available. This new credit option enabled heat pumps to achieve credit in the prescriptive pathway proportional to their site energy efficiency.

Similarly, in performance-based pathways, the Board established site energy as the metric by which the standard reference design and the proposed design are modeled. Furthermore, the modeling protocols were changed to ensure that all modeled mechanical systems in a proposed design are compared against a fossil fuel baseline, to ensure that the efficiency benefits of both high-efficiency fossil fuel equipment and heat pump systems are properly accounted for. The Board also modified the residential Energy Rating Index (ERI) pathway. Separate ERI targets were established for all-electric and mixed-fuel homes (see Table

[4] Colorado does not have a statewide energy code. Any time a local AHJ updates any of its building codes, it must also update its energy code to the minimum code identified by state law. Colorado model codes set this minimum standard.

2). Both the ERI and Home Energy Rating System (HERS) index are based on comparisons to reference homes using the same equipment and fuel types, creating a disparity similar to those in other IECC compliance paths. All-electric homes are now permitted under the code to achieve a slightly less stringent ERI target than mixed-fuel homes, helping to even the playing field within that pathway.

Table 2. Colorado MLECC ERI targets for mixed-fuel and all-electric homes based on home size.

Climate zone	<5,000 ft²		5,000-7,499 ft²		≥7,500 ft²	
	Mixed-Fuel	All-Electric	Mixed-Fuel	All-Electric	Mixed-Fuel	All-Electric
4	51	56	48	53	42	47
5	52	57	49	54	42	47
6	51	56	48	53	42	47
7	50	55	47	52	42	47

Source: CEO 2026.

The MLECC officially launched in September 2025 (CEO 2026) and became Colorado's minimum energy code on July 1, 2026. Therefore, it has been adopted only in a select few municipalities and counties across the state[5] (who did so voluntarily ahead of the requirement), and no new construction projects have been officially constructed under the new code. However, energy modeling and design firms have compared compliance outcomes for both commercial and residential projects under the 2021 IECC, 2024 IECC, and MLECC. That analysis suggests that the code should achieve many of its desired outcomes, including:

1. Similar levels of complexity and stringency for mixed fuel buildings as would be expected under modeling protocols based on like-for-like system comparisons and energy cost metrics.
2. Significantly reduced barriers to all-electric design and construction, resulting in lower project costs and easier compliance options for all-electric buildings within the code.
3. Flexibility for all energy sources to comfortably comply with the code to accommodate individual project needs, conditions, and technological solutions.

Howard County, Maryland

In Maryland, localities must enforce the statewide energy code or adopt and enforce strengthening amendments. Howard County is unusual in that it tends to adopt model codes prior to state adoption. Maryland localities adopt building codes by ordinance, usually following the building department's recommendation. Following a grassroots campaign , the County adopted

[5] At the time of this paper's publication, the cities of Arvada, Broomfield, Fort Collins, Golden, Longmont, Loveland, Ridgway, and Wheat Ridge as well as Adams County have adopted the MLECC.

an ordinance in 2023 "requiring the Department of Inspections, Licenses, and Permits to report to the County Council with recommendations about changes to the Howard County Building Code that would be needed to require all-electric buildings" (CCHC 2023). The County had also developed a Climate Action and Resiliency Plan that recommended the adoption of green building standards and all-electric new construction requirements (Howard County, 2023).

While the required report identified several options to require or encourage all-electric buildings, including appendices to the 2024 IECC (Howard County, 2024), the next energy code proposed by the County's building department did not include any of those options (CCHC 2025). By then, neighboring Montgomery County had been sued following its adoption of an ordinance that would require a future all-electric building code requirement, following the same logic that motivated the Ninth Circuit case[6] (PHLC 2024b). In this context, the Howard County Council requested technical assistance from RMI to advance the code. RMI provided information about a broad range of code provisions, including numerous 2024 IECC appendices, the ZFB Overlays, and others, with brief descriptions of their scope and impact.

The Council considered eight code amendments and adopted six (CCHC 2025). Council members expressed concerns about amendments that were not published as 2024 IECC appendices, due to both the benefits of vetting during model code development and the perceived difficulty of enforcing non-model code amendments. The commercial site energy-related amendment, Appendix CF, passed with an exemption for restaurants; the residential site energy-related amendment, which leveraged the ZFB Overlays, did not pass. Appendix CF and Appendix RG, the residential stretch code appendix, were adopted with language to delay enforcement until COMcheck and REScheck were updated to include them. This update was made shortly thereafter, so the amendment caused minimal or no delay in enforcement.

Howard County's story offers lessons for other small AHJs with aligned policy landscapes. First, it suggests that site energy codes may have value to such AHJs. Howard County decision-makers deemed all-electric new construction requirements unacceptably risky, and site energy codes provided a realistic, impactful, low-risk alternative.

Second, risk-averse AHJs seek the certainty associated with model energy codes, including their appendices. As model codes fragment into more divergent options and their development processes become less consistent, this certainty may be threatened. Any effort to develop site energy code provisions for such AHJs should consider the benefits of transparent processes and trust in institutions and expertise. In the near term, provisions' proximity to model code may substitute for these factors; in the longer term, advanced code resource development processes may benefit from reviewing components of historical model energy code processes to determine which might help advanced codes earn similar certainty and trust over time.

Third, ease of enforcement matters. Custom compliance tool development poses a hurdle to adoption for many small AHJs. Site energy code provisions should be designed for ease of enforcement via existing free-to-use compliance tools, such as COMcheck and REScheck, or via very simple tools provided alongside the provisions.

[6] At the time of this paper's publication, the Maryland district court had dismissed the complaint on the grounds that since "the Bill does not regulate 'energy use' at the 'point of use,' its 'all electric' mandate for new construction is not preempted." The plaintiffs appealed in the Fourth Circuit, and the appeal remains open.

Conclusion

AHJs that have adopted site energy codes to date offer lessons for their peers. First, site energy codes can advance a variety of policy goals, from energy efficiency in Illinois, to GHGe reduction in Colorado, to electrification encouragement in Howard County. Each AHJ preserved choice by adopting site energy codes instead of fuel type prohibitions—a decision that may help reduce risk as federal case law regarding energy codes continues to develop.

Some site energy codes have additional benefits. For example, template codes that do not diverge deeply from model codes can ease adoption and enforcement processes, as training and compliance tools can be minimally adapted or used as-is. The same lesson may apply for codes that align with popular certification programs. The Pathway to Zero (PtZ) code overlays developed by an ACEEE-led coalition take advantage of this opportunity by closely aligning requirements to the Efficient New Homes certification (ACEEE 2024). Passive House certifications may be used similarly; builders in several states (e.g., IL, MA) may follow Passive House compliance paths today. AHJs may also wish to select a code resource for which high-quality cost-effectiveness analysis is available. These analyses enable grounded, well informed adoption processes, and in some cases may be necessary for rulemaking procedures.

There are also a number of pitfalls to avoid to minimize delay, cost, and risk. The decision to develop custom code should not be taken lightly: custom development is costly, as is developing training and enforcement tools for the resultant code. AHJs may wish to first consider the suitability of readily available resources to their policy goals and climate zone. Educating interested parties about these resources may help avoid situations where, as with some of the AHJs described above, laws or executive actions preclude their use and require customization. AHJs that choose custom development should ensure appropriate resources are available for the work involved, and should consider outside funding sources with caution, given how their availability may be disrupted. By a similar token, working from already-finished resources will be more efficient, and less prone to administrative and market complications, than following and working from in-progress, pre-publication code development processes.

Code resource developers should bear all of the above in mind when preparing ready-to-adopt codes.

Traditional model code and standard publishers' processes and priorities are evolving. As these resources are increasingly divided into multiple documents with divergent goals and uncertain futures, AHJs have options. By learning from peers and technical assistance providers, AHJs can continue to advance energy efficiency improvements that help manage household and business operating expenses while generating societal benefits.

References

ACEEE (American Council for an Energy-Efficient Economy). 2024. "U.S.-Funded Coalition to Help States Eliminate Carbon Emissions from New Homes." 16 Sep. Washington, DC: ACEEE. www.aceee.org/press-release/2024/09/us-funded-coalition-help-states-eliminate-carbon-emissions-new-homes.

ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.). 2022. *ANSI/ASHRAE/IES Standard 90.1-2022: Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings*. Peachtree Corners, GA: ASHRAE. www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards.

ASHRAE 90.1 MSC (ASHRAE Standard 90.1 Mechanical Subcommittee). 2026. "ASHRAE SSPC 90.1 Mechanical Subcommittee Monthly Meeting Agenda." 8 Jan.

Berkeley regular City Council meeting. 2019. Adopt an Ordinance adding a new Chapter 12.80 to the Berkeley Municipal Code prohibiting natural gas infrastructure in new buildings (reviewed by the Facilities, Infrastructure, Transportation, Environment & Sustainability Committee). July 9, 2019. berkeley.granicus.com/player/clip/4056?meta_id=291409.

California HSC (Health and Safety Code). 2025. Section 18930(g). (Passed 2025.) www.leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202520260AB130.

CCHC (County Council of Howard County). 2023. CB5-2023 (passed 9 May). mgaleg.maryland.gov/pubs/LegisLegal/County-Legislation/2024-Howard-County-CB05-2023.pdf.

———. 2025. CB24-2025 (passed 8 Jul). apps.howardcountymd.gov/olis/LegislationDetail/13746/CB24-2025.

CEO (Colorado Energy Office). 2024. "Greenhouse Gas Pollution Reduction Roadmap." Feb. energyoffice.colorado.gov/ghg-pollution-reduction-roadmap.

———. 2026. "Colorado's Building Energy Codes and Toolkit." Accessed 13 Mar. energyoffice.colorado.gov/building-energy-codes-toolkit.

Cheslak, K., S. Denniston, J. Edelson, M. Lyles, and D. Burk. 2021. *Building Decarbonization Code Version 1.2*. Portland, OR: New Buildings Institute. newbuildings.org/resource/building-decarbonization-code/.

COGA (Colorado General Assembly). 2019. *Climate Action Plan To Reduce Pollution* (passed May 30). leg.colorado.gov/bills/hb19-1261.

———. 2022. *Building Greenhouse Gas Emissions* (passed 2 Jun). leg.colorado.gov/bills/hb22-1362.

———. 2023. *Greenhouse Gas Emission Reduction Measures* (passed 23 May). leg.colorado.gov/bills/sb23-016.

Evanston COO (Code of Ordinances). 2025. "Chapter 19: Energy Code." *Title 4: Building Regulations*. 4.19 (passed 24 Feb). library.municode.com/il/evanston/codes/code_of_ordinances?nodeId=TIT4BURE_CH19ENCO.

Farbman, S., R. Ziazi, J. Wojtak, S. Wang, R. Schloemann, A. Mytelka, J. Shepard, D. Burk, K. Gowri. 2026a. *Cost-Effectiveness Analysis of the Commercial Provisions of the 2026 Illinois Stretch Energy Code*. Chicago, IL: Energy Solutions. https://cdb.illinois.gov/content/dam/soi/en/web/cdb/business/codes/ecacouncil/stretch/docs/2026-commercial-stretch-cost-analysis.pdf.

———. 2026b. *Cost-Effectiveness Analysis of the Residential Provisions of the 2026 Illinois Stretch Energy Code*. Chicago, IL: Energy Solutions. https://cdb.illinois.gov/content/dam/soi/en/web/cdb/business/codes/ecacouncil/stretch/docs/2026-residential-stretch-cost-analysis.pdf.

HIRL (Home Innovation Research Labs). 2025. *2024 IECC Cost Analysis for Single-Family Homes*. Upper Marlboro, MD: HIRL. www.nahb.org/-/media/NAHB/advocacy/ docs/top-priorities/codes/code-adoption/2024-iecc-cost-analysis-hirl.pdf.

Howard County. 2023. *Howard County Climate Forward: Climate Action and Resiliency Plan.* livegreenhoward.com/wp-content/uploads/2023/06/HoCo-Climate-Forward-2023.pdf.

———. 2024. *Building code considerations for comprehensive building decarbonization: report to the Howard County Council pursuant to CB5-2023.* Apr. cc.howardcountymd.gov/sites/default/files/2024-04/CB-5%20Report%20to%20Council_Building%20Code%20Considerations%20for%20Comprehensive%20Building%20Decarbonization.pdf.

ICC (International Code Council). 2023. "CE2D-51-23." *IECC Commercial Committee Action Report on the results on the 2023 public comments/code changes to Public Comment Draft 2 to the International Energy Conservation Code-Commercial*. September 18. Accessed via www.iccsafe.org/committees/energy-iecc/ (see "Energy Documents").

———. 2024. *2024 IECC Appeals: ICC Board of Directors Actions Report*. April 11. www.iccsafe.org/wp-content/uploads/2024_IECC_Report_of_Board_Actions.pdf.

———. 2025. "CF103.1: Buildings without heat pumps." *2024 International Energy Conservation Code*. codes.iccsafe.org/content/IECC2024V1.2/appendix-cf-energy-credits #IECC2024V1.2_CE_AppxCF_SecCF103.

———. 2026a. "2030 Energy Code Final Board of Directors' Decisions." 30 Apr. https://www.iccsafe.org/building-safety-journal/bsj-news/2030-energy-code-final-board-of-directors-decisions/.

———. 2026b. "Public Comment Period - 2030 International Energy Conservation Code®." January 12. www.iccsafe.org/news-and-events-calendar/public-comment-period-2030-international-energy-conservation-code/.

———. 2026c. "Appendix CK, Commercial Single Conservation Objective." Proposal for inclusion in the 2027 IECC. standards.cdpaccess.com/proposal/2918/6645/preview/.

IL CDB (Illinois Capital Development Board). 2025. "Illinois Stretch Energy Code." 1 Jan. cdb.illinois.gov/business/codes/illinois-energy-codes/ illinois-stretch-energy-code.html.

———. 2026. "2026 Stretch Energy Code Proposals." Accessed 13 Mar. cdb.illinois.gov/business/codes/illinois-energy-codes/illinois-stretch-energy-code/2026-stretch-energy-code-proposals.html

ILGA (Illinois General Assembly). 2021a. "Sec. 55 Illinois Stretch Energy Code." 20 ILCS 3125/55. https://my.ilga.gov/legislation/ilcs/fulltext?DocName=002031250K55.

———. 2021b. "Sec. 30 Enforcement." An Act (the Energy Transition Act). 20 ILCS 3125/30. ilga.gov/documents/legislation/102/SB/PDF/10200SB2408enr.pdf.

Massachusetts. 2024. "MA 2025 Commercial Stretch code and Specialized Opt-in code (IECC2021 with MA amendments) DOER Final Draft." 17 Dec. https://www.mass.gov/doc/stretch-specialized-code-commercial/download.

Massachusetts. 2026. "Building Energy Code." Accessed 13 Mar. www.mass.gov/info-details/building-energy-code.

Minnesota Statutes. 2025. Ch. 326B.106.1(g). (Passed 2024). www.revisor.mn.gov/statutes/cite/326B.106.

Montgomery County Executive Regulation. 2024. "Adoption of the 2021 International Building, Energy Conservation, Green Construction, Mechanical, Fuel-Gas, Residential, Swimming Pool and Spa and International Existing Building Codes." No. 13-24 (passed 10 Dec). Rockville, MD: Offices of the County Executive. montgomerycountymd.gov/DPS/Resources/Files/Green/MCER13-24.pdf.

NAHB (National Association of Homebuilders). 2025. "NAHB Commends HUD for Delaying Costly Energy Code Rule." Accessed 19 Jun. https://www.nahb.org/news-and-economics/press-releases/2025/11/nahb-commends-hud-for-delaying-costly-energy-code-rule.

NDNY (United States District Court for the Northern District of New York). 2025. "Stipulation and [Proposed] Order Settling Motion for Injunction Pending Appeal." *Mulhern Gas Co., Inc., et al. v. Walter T. Mosley, in his official capacity as Secretary of State*. Case 1:23-cv-01267-GTS-PJE. Document 74. November 12. earthjustice.org/wp-content/uploads/2025/11/stipulation-1.pdf.

North Carolina General Statutes. 2023. North Carolina State Building Code. § 143-138(d). (Passed 2023.) www.ncleg.net/enactedlegislation/statutes/html/bysection/chapter_143/gs_143-138.html.

Patterson, G. 2025. "To stakeholders, advocates and commenters on Docket No. 2025-R-CCE-0008/7 Del. Admin Code 2101 Regulations for State Energy Conservation Code." October 27. Dover, DE: Delaware Department of Natural Resources and Environmental Control. documents.dnrec.delaware.gov/Admin/Hearings/ 2025-R-CCE-0008/Secretarys-Letter-Declining-to-Approve.pdf.

PHLC (Public Health Law Center). 2024a. "California Restaurant Association v. City of Berkeley (2019)." Saint Paul, MN: PHLC. www.publichealthlawcenter.org/ litigation-tracker/california-restaurant-association-v-city-berkeley-2019.

———. 2024b. "National Association of Home Builders et al. v. Montgomery County (2024)." Saint Paul, MN: PHLC. www.publichealthlawcenter.org/litigation-tracker/national-association-home-builders-et-al-v-montgomery-county-2024.

Poehlman, E., M. Tyler, Y. Xie, M. Niemeyer, D. Wikiarski, and M. Rosenberg. 2024. *Impacts of Model Building Energy Codes*. Richland, WA: PNNL (Pacific Northwest National Laboratory). www.energycodes.gov/sites/default/files/2025-01/Impacts_of_Model_Energy_Codes_2025.pdf.

Salcido, V. R., Y. Chen, Y. Xie, Y. J. Jung, F. Feng, C. Faulkner, M. Niemeyer, and E. Metz. 2024. *Energy Savings Analysis: 2024 IECC for Residential Buildings.* Dec. Washington, DC: US DOE. www.energycodes.gov/sites/default/files/2024-12/2024_IECC_Determination_TSD.pdf.

Salcido, V. R., Y. Chen, Y. Xie, Y. J. Jung, F. Feng, C. Faulkner, and J. Xie. 2025. *National Cost-Effectiveness of the Residential Provisions of the 2024 IECC*. Richland, WA: PNNL. www.energycodes.gov/sites/default/files/2025-01/2024_IECC_CostEffectiveness_Residential_Final.pdf.

Scott, P.B. 2025. *Executive Order No. 06-25 [Promoting Housing Construction and Rehabilitation].* September 17. State of Vermont Executive Department. governor.vermont.gov/sites/scott/files/documents/EO%2006-25%20Promoting%20Housing%20Construction%20and%20Rehabilitation.pdf.

Sherman, E., D. Carpenter-Gold, J. Kocher, and J. Long. 2024. *The Energy Code Safe Harbor Toolkit.* Basalt, CO: RMI. rmi.org/insight/the-energy-code-safe-harbor/.

US HUD (US Department of Housing and Urban Development). 2024. "Final Determination: Adoption of Energy Efficiency Standards for New Construction of HUD- and USDA-Financed Housing." *Federal Register* 89, no. 82 (April 26, 2024): 33112. www.federalregister.gov/documents/2024/04/26/2024-08793/final-determination-adoption-of-energy-efficiency-standards-for-new-construction-of-hud--and.

US DOE (US Department of Energy). 2025a. "Historical Model Energy Code Improvement." Updated 9 Jan. public.tableau.com/app/profile/doebecp/viz/HistoricalModelEnergyCodeImprovement/CombinedHistoricalCodeImprovement_1.

———. 2025b. "Status of State Energy Code Adoption." Updated 30 Dec. public.tableau.com/app/profile/doebecp/viz/BECPStatusofStateEnergyCodeAdoption/ResidentialDashboard.

———. 2026. "ASHRAE Standard 90.1 Performance Based Compliance (Section 12 and Appendix G)." Accessed 13 Mar. www.energycodes.gov/ performance_based_compliance.

Walker, E.T., and A. Malmuth. "The natural gas industry, the Republican Party, and state preemption of local building decarbonization." *npj Clim. Action* B, 98 (2024). doi.org/10.1038/s44168-024-00176-4.