The Future of Building Codes and Emissions

Kevin Berry and Ariel Brenner, New Buildings Institute

ABSTRACT

Buildings sector emissions will likely become more regulated over the next century. As the population urbanizes and energy demand grows globally, jurisdictions in high-GDP nations should expect to face more stringent requirements around inventorying and accounting for carbon emissions. Jurisdictions will likely turn to model international building and energy codes and standards – such as those developed and maintained by the International Code Council (ICC) and the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) – as their key regulatory tools. Even with some cities and states backtracking on climate policy in the short-term, the buildings sector will need codes capable of accurately reporting and regulating its carbon emissions in the longer term.

This paper describes the need for 21st-century international model building energy codes to offer carbon accounting and decarbonization regulations within their scopes. Providing standardized methods for carbon accounting and reporting, as well as options for decarbonization practices, is necessary for existing model codes to continue functioning as adoptable and relevant regulatory tools for jurisdictions who have set and are pursuing climate targets.

This paper surveys historic shifts in building and energy codes across the 20th and 21st centuries and situates codes within the context of public health and risk management across the past, present, and future; it explores the potential for energy codes to offer standardized decarbonization methods to manage the risks associated with a carbon-intensive world. The paper also outlines the importance of establishing uniform methodologies in buildings sector emissions accounting across all levels – subnational, national, and intergovernmental – and presents the case that model building energy codes are appropriate tools to thoroughly address this public policy need. The paper will conclude by illustrating how feasible this can be; the resources already exist for a coherent, simple, adoptable, and enforceable *International Energy and Carbon Code (IECC)*, adequately scoped for the 21st century.

Building Codes Manage Risk

The Historical Role of Codes in Addressing Prevailing Risks

Building and energy codes have, from the outset, been tools for risk management. Laws concerning minimum building standards have existed for centuries, addressing fire safety, sanitation and water safety, material use, and construction practices. Building codes in their modern form – standardized and bureaucratically administered – have existed for nearly a century in the United States. They are interwoven into a broader landscape of governance that, over time, has become increasingly complex and interdependent: financial markets, insurance markets, government-backed home mortgages, construction industries, and supply chains.

What may be considered the first modernized model building code in the US was developed exactly one century ago. The 1927 *Uniform Building Code (UBC)* was published by the International Conference of Building Officials (ICBO), an association founded in 1922

(Jaeschke 2022). The code was dedicated to "better building construction and greater safety to the public," providing "requirements for safe and stable design, methods of construction, and uses of materials," and developing "a sound economic basis for the future growth of cities through unbiased and equitable dealings with structural design and fire hazards" (UBC 1927). This model code was designed to establish a universal set of building requirements for national use, administered by a body of independent experts not tied to any single city.

The *UBC* emerged at a time of intense urbanization in the country, leaving cities in need of building standards that ensured adequate structural and fire safety, health, and sanitation. Additionally, as the Federal Housing Administration (FHA) emerged in the 1930s, the need to ensure that built assets would not present risks to insurers or mortgage lenders became more pronounced. By 1935, a formalized set of Property Standards under the National Housing Act emerged to further emphasize the importance of minimum requirements in ensuring that houses "endure" as "sound investments throughout the life of the mortgage" (NIBS 2003).

Over time, additional economic and public health risks have come to be addressed by building codes. Technologies like air conditioning and elevators enabled buildings to increase in size and complexity, requiring codes to expand their scope and establish legally minimum requirements for complex mechanical systems through the mid-20th century.

In the 1970s, energy became a risk that building codes were called upon to manage. With the rise of globalized supply chains and increasing intergovernmental economic dependency, the 1970s saw energy and fuel scarcity arise as a major national security risk. After geopolitical events led to energy supply shocks, the *Energy Policy and Conservation Act (EPCA)* was passed in 1975, and the US Department of Energy (DOE) was founded in 1977 (Jaeschke 2022). The *Model Energy Code (MEC)* – the predecessor to today's *International Energy Conservation Code (IECC)* – was developed during this decade. *ASHRAE Standard 90-75* was also created during this period as the first national consensus energy standard that responded directly to these risks. Skyscrapers, offices, restaurants, and homes wasting undue amounts of energy with no social benefit became a risk, managed by establishing a regulatory floor that limited and prevented wasteful building designs.

Notably, the 1960s and 1970s were also a time when smog and air pollution reached crisis levels in the US. In this context, the Clean Air Act was passed in 1963 and amended in 1970 and 1977 (Jaeschke 2022). The first energy conservation codes, set in this context, were also formulated to avoid social harm and prevent the nation from increasing atmospheric pollution from building energy use. While the express policy objective of the first generation of building energy codes focused on pure energy conservation and limiting waste at the point of input – as opposed to atmospheric pollution management, which concerns waste at the point of output – these policy objectives have been intertwined from the outset.

Codes evolving through the 1980s and 1990s began to include not just energy conservation, but also environmental performance and green standards. This trajectory clarifies the need emerging in the 21st century to manage an additional layer of risk associated with building energy use: the accounting and constraint of greenhouse gas (GHG) emissions.[1]

[1] Scholars such as Emily Heinz and Benjamin Sovacool have drawn a direct link between the risk-laden character of the 20th and 21st centuries and buildings sector decarbonization regulations: "the risks associated with the ongoing scale of fossil fuel use are now understood as producing incontrovertibly negative outcomes for non-human ecologies and human well-being" (Heinz et al. 2022). Buildings sector decarbonization is an attempt to manage and regulate the "widespread acceptance of inevitable global, human-caused, complex risks, including catastrophic risks" (Heinz et al. 2022).

Greenhouse Gas Risk Management

Excessive atmospheric GHG accumulation is a prevailing risk of the 21st century, in need of policy management (IPCC 2023). This century's sharp increase in global surface temperatures is stark and undeniable. In the decade between 2011 and 2020, temperatures reached 1.1°C above those observed during the late 1800s. The period since 1970 recorded the fastest increase in any 50-year period over the last 2,000 years (IPCC 2023). The scientific evidence is overwhelmingly strong. The changing climate has already impacted weather, ecological, and human systems across the globe (NOAA 2025). If the underlying causes of these conditions are left unaddressed, the consequences are expected to amplify. Observed increases in GHG concentrations in the atmosphere over the past few centuries are clearly linked with human activities and correlate with the temperature increases observed since the Industrial Revolution.

The Intergovernmental Panel on Climate Change (IPCC) publishes the most comprehensive scientific review of the state of climate change; its Sixth Assessment Report (AR6) was published in 2023. The report uses a set of standardized scenarios – Shared Socioeconomic Pathways (SSPs) – to explore a range of possible future impacts of different GHG emission levels combined with a range of assumptions about socioeconomic conditions, levels of climate mitigation, and land use and air pollution controls (IPCC 2023). SSP1-1.9 and SSP 1-2.6 constitute the most optimistic scenarios; SSP2-4.5 represent the intermediate scenario; and SSP3-7.0 and SSP5-8.5 comprise high and very high emissions scenarios, assuming business-as-usual reliance on fossil fuels and high energy demand.

The report relies heavily on the framework of carbon budgets at 1.5°C or 2°C to measure and evaluate the impacts of emissions accumulations and atmospheric warming. Limiting warming to these levels will require constraining the accumulation of carbon emissions until GHGs in the atmosphere can ratchet down and net zero can be reached. The level of GHG emission reductions in the 2020s will largely determine whether warming can be limited to 1.5°C or 2°C. There is a high confidence communicated by the IPCC that delayed action will result in a large range of damaging consequences and cascading impacts, which will be more difficult to manage over time as emissions accumulate. Without any change, the projected carbon emissions from existing fossil fuel infrastructure will likely lead to an exceeding of the remaining carbon budget for 1.5°C (IPCC 2023). The best estimate has global warming reaching a 1.5°C increase before 2050 in nearly all considered scenarios, even under SSP1-1.9. Temperatures are then likely to continue to increase or decline back to below 1.5°C by the end of the 21st century, depending on the modelled scenario. Continued emissions will accumulate impacts on the climate system, resulting in more extreme effects; every region of the world is expected to be impacted (IPCC 2023).

In recognition of the urgency and seriousness of this problem, international, national, and subnational governments have enacted policies aimed at mitigating the deleterious impacts of climate change by managing their GHG emissions.

Existing International Policy Frameworks for GHG Management

Over the past several decades, international agreements and development frameworks have served the purpose of fostering multilateral coordination on issues that are significant enough to call for cooperation across national boundaries. In general, these agreements can be looked to as indicators of the world's priorities, often set by the prevailing challenges and needs of the time. These inform the development priorities that influence financing and impact the built environment around the world today.

In recent years, much of the world has committed to a strong global policy framework that has grown out of an acknowledgement of the undeniable need for consistent carbon accounting to track against the IPCC emissions scenarios. From this need spawned the United Nations Framework Convention on Climate Change (UNFCCC), a global environmental treaty on climate change borne out of the 1992 United Nations Conference on Environment and Development in Brazil, with a central goal of avoiding human-induced GHG emissions from reaching "dangerous" levels and prolonging "interference with the climate system" enough to allow for ecosystems' adaptation without collapse (UNFCCC 2026a). As a result of the UNFCCC, the Conference of Parties (COP) meets annually to review emissions inventories submitted by member states to assess the progress and effectiveness of determined measures to achieve the goals of the UNFCCC (UNFCCC 2026b). These Conferences have led to significant international climate agreements, including the 1997 the Kyoto Protocol – which established commitment periods for signatories to reduce their emissions — and the 2015 Paris Agreement — which superseded the Kyoto Protocol and set targets to keep global warming well below 2°C and preferably below 1.5°C. Under this framework, the UNFCCC monitors the state of global climate change through the IPCC; helps less-wealthy countries finance mitigation and adaptation efforts through climate funds; and catalogs emissions reductions through Nationally Determined Contributions (NDCs), submitted by member states.

At the time of its signing, 195 out of 198 Parties committed to the Paris Agreement, including the US. Across the US, states and jurisdictions have also committed to the goals of the Paris Agreement, setting carbon reduction targets and laying out strategies to most effectively meet them. At the time of the writing of this paper, the US has withdrawn from the Paris Agreement for a second time (Harvard Law School 2026). However, momentum towards increasingly robust emissions reporting and mitigation ambition continues by other Parties as well as non-Party entities. A synthesis report prepared by the UNFCCC in 2022, after the US had first withdrawn then rejoined the Paris Agreement, found that the ambitions of the majority of Parties reporting on their emissions contributions continued to increase, stating, "most of the Parties (74 percent) that submitted new or updated NDCs have strengthened their commitment to reducing or limiting GHG emissions by 2025 and/or 2030, demonstrating increased ambition in addressing climate change" (UNFCCC 2022).

Importance and State of Emissions Reporting

The IPCC framework, as well as the international policy landscape that it informs, relies foundationally on accurate and uniform GHG tracking and accounting practices to further action to control emissions, and these practices are becoming increasingly important.

The IPCC's scenario structure depends on receiving the most up-to-date information regarding the status of the globe's emissions. This informs the projected trajectories and helps to identify the proper and priority solutions to match the level and likelihood of these scenarios. The IPCC's 2018 Special Report entitled *Global Warming of 1.5°C* presented the carbon budgets that remain to keep the increase in temperatures below 1.5°C (Rogelj et al. 2018). Remaining carbon budgets could soon be exhausted: exceeding these remaining carbon budgets will result in higher global warming consequences. Achieving and sustaining net-negative emissions, by contrast, can reverse an exceedance of the cap and ensuing hazards.

The IPCC scenarios are informed in part by NDCs, through which Parties report their plans for curbing emissions per the Paris Agreement. According to the UNFCCC, NDCs account for nearly 95 percent of global GHG emissions. Its 2025 NDC synthesis report highlights the extent to which most of the world's countries are answering the imperative to account for their emissions. 89 percent of the Parties have communicated economy-wide targets and 41 percent of Parties have reported that their NDCs are in line with Paris targets. Collectively, Parties are reducing their emission curve downward, but not quickly enough: recent NDC ambition levels, on the whole, reflected "a stagnation in aggregate NDC ambition level" (US Congress 2025).

Key to the success of Parties' emissions reporting is the establishment of a uniform framework to ensure that accounting is consistent across the globe. Toward this end, the UNFCCC established a robust reporting framework entitled the Enhanced Transparency Framework (ETF) for Parties to report on their progress toward the Paris targets. The reporting system relies on technical guidelines developed by the IPCC, which standardize how different emission sources are measured and reported (IPCC 2006). The ETF mandates the use of the *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 Guidelines)*, which detail a consistent, internationally agreed-upon methodology for inventorying GHG emissions and removals at the national level (IPCC 2006). When it comes to the buildings sector, the *2006 Guidelines* designate emissions from fuel combustion in commercial, institutional, and residential buildings, as well as electricity and heat produced for building use, under the stationary combustion category of the energy sector (IPCC 2006). This category also covers manufacturing and construction, accounting for the fuel combustion and electricity generation resulting from the production of construction materials.

The *2006 Guidelines* provide instruction on accounting at three levels of detail: tier 1 uses default values for a broad estimate, and tier 3 constitutes the most detailed method. Countries are encouraged to prioritize higher-tier methods for their most significant categories. Tiers 2 and 3 allow for the incorporation of activity data from sub-sectors; for buildings, this could include information about building stock, envelope performance, equipment efficiency, energy use, and rates of code compliance. However, the *2006 Guidelines* do not describe the ways that information at this level of granularity should be handled. A standardized accounting methodology is needed for establishing a uniform protocol for systematically collecting, aggregating, and translating buildings sector data into accounting inputs that fit within the *2006 Guidelines'* inventory framework.

Non-Party Role in Carbon Accounting

While the *2006 Guidelines* primarily call for the use of national, international, and sectoral-level data to inform national inventories, they also highlight the useful role that subnational or regional data can play in informing aggregated national statistics: "In some circumstances regional activity statistics and emission datasets are more detailed, up-to-date, accurate and/or complete than national datasets" (IPCC 2006). Regional data may be represented in a national inventory if it is consistent with the practices and parameters detailed in the *2006 Guidelines.*

Recent NDCs also recognize the important role that jurisdictions play in reducing carbon emissions and in making up for the progress that is still needed. These NDCs reflect an increasingly robust engagement of non-Party stakeholders: 95 percent of Parties involved non-Party stakeholders, including the private sector and civil society, in the design and implementation of NDCs, and "[s]ubnational entities are increasingly involved as partners in planning, implementing and monitoring climate action, helping to embed national goals into their local plans for coherent implementation" (UNFCCC 2022). In the US, states and cities often hold the primary responsibility for land use, transportation infrastructure, public utilities, and buildings. As such, subnational governments are stepping up to generate more stringent requirements around inventorying and accounting for carbon emissions.

A parallel ecosystem of emissions tracking run by cities, states, regions, and other non-Party entities has emerged to facilitate stronger non-Party engagement. The UNFCCC established the Global Climate Action Portal, which tracks the progress of non-Party actors by functioning as a collection of pledges (UNFCCC 2026c). Notably, however, there is no equivalent of the UNFCCC's transparency and reporting framework for non-party entities, meaning that coverage is inconsistent and methodologies vary. Additionally, non-Party pledges do not undergo verification of the quality or credibility of the progress that is submitted. This is emblematic of a larger issue, where a variety of frameworks exist to inform GHG accounting methodologies but, at the subnational level, these are not uniformly applied. While many adopt the IPCC's *2006 Guidelines*, subnational governments run up against challenges when applying a framework aimed at national reporting to a more localized context.

The *Greenhouse Gas Protocol,* developed by the World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), is a commonly used methodology, aimed at providing a global, standardized framework for measuring and managing emissions from private and public sector operations, value chains, products, cities, and policies. International Organization for Standardization (ISO) 14064 similarly offers a standardized methodology for GHG accounting and verification. Many cities also use the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) as an accounting and reporting standard for cities, which adapts the structure of the *2006 Guidelines* for an urban context (Fong et al. 2021). State-level uniform frameworks are less available, and model building energy codes could be a key tool in closing that gap.

In absence of a standardized framework, a patchwork of methodologies has emerged from jurisdiction to jurisdiction. One area of tension has emerged around the question of accounting for energy imported across borders: for example, whether to use production- or consumption-based accounting. California, for example, tracks its buildings sector emissions from both operational and embodied carbon; the state is currently spending considerable time and effort developing a framework for the latter to push toward consumption-based accounting for building materials (CARB 2026). Oregon, by contrast, already utilizes a consumption-based inventory (CBEI), which measures the GHG emissions produced around the world for goods and services consumed within the state. This difference in methodology leads to drastically different results: Oregon's consumption-based emissions are 47 percent higher than what its previous production-based methods originally suggested (Erickson et al. 2012).

As the call for carbon accounting and reporting grows increasingly stronger on the international stage – and as states and cities continue to play a larger role in this accounting – jurisdictions will increasingly need a framework for comprehensive and consistent reporting methodologies. Model codes offer an opportunity to set these frameworks for the buildings sector.

GHG Risk Management Needs in the US

Subnational Governments and the Buildings Sector

Buildings and the built sector constitute a priority of Parties' for GHG reporting and for achieving the world's climate mitigation targets. The IPCC has identified low-emission infrastructure, including buildings, as a priority for keeping the world's warming below 1.5°C (de Coninck et al. 2018). Electrification, efficiency, and increasing renewables are among the key strategies that can successfully lower energy use and decarbonize energy supply in the built environment, especially in buildings. In acknowledgement of this trend, 69 percent of Parties identify building strategies that offer high mitigation potential: these include constructing new buildings with high energy performance; increasing the efficiency of lighting, appliances, and equipment; avoiding demand for energy services; producing and using on-site renewable energy; and improving existing building stock (UNFCCC 2022).

The most recent NDC submitted by the US relies on advances in building and energy codes to achieve its targets of reducing economy-wide GHG emissions by 61-66 percent below 2005 levels by 2035. It also illustrates the ways that regulatory collaboration among the federal government and the country's subnational governments are essential to achieving the nation's targets (United States 2024). When it comes to the buildings sector, emissions reduction opportunities outlined by the US NDC include the promotion of energy efficiency, electrification, on-site clean energy, lower embodied carbon, and lower global warming potential refrigerants (United States 2024). However, federal capacity to pursue these goals relies mainly on incentives through funding and assistance. The primary regulatory authority lies with subnational entities. The NDC acknowledges the many ways that jurisdictions are in a stronger position to promote advances in the buildings sector that will help it to achieve the nation's 2035 target by way of instituting zoning reform, supporting utility regulation, and adopting building and energy codes. The federal role in instituting these goals therefore involves the support and acceleration of subnational policy, including by "strengthening standards" and "supporting stronger building codes and building performance standards" (United States 2024). Federal support is interwoven through these policies. When it comes to understanding the codes for adoption, subnational governments largely rely on federal analysis of model codes to understand their impacts on their GHG inventories. The DOE Building Energy Codes Program (BECP) has evaluated national and state-level impacts of residential and commercial energy codes including the *IECC* and *ANSI/ASHRAE/IES Standard 90.1* for their prospective impacts on energy savings since the early 1990s and has since added determinations for their impacts on GHG emissions (US DOE 2026).

Today, the role of subnational governments in the US continues to strengthen. Despite the US' recent withdrawal from the Paris Agreement, nearly half of its states have held to their commitments to the Agreement's targets. In 2021, 130 US cities joined the UN Cities Race to Zero Campaign, under which they have committed to contributing to the halving of global emissions by 2030 (C40 Cities 2021). States have also joined the US Climate Alliance, where they have committed to implementing policies that act in service to the Paris goals. Many of these jurisdictions identify and prioritize actions within the buildings sector to address emissions in a cost-effective manner. Many states have adopted legislation specifically identifying building and energy codes as the primary policy tools for addressing emissions in the buildings sector (Building Decarbonization Coalition 2025).

Jurisdictional Needs

With the build-up of global pressure and prevalence of ambitious jurisdictions, carbon accounting with consistent, uniform, and standardized reporting methodologies for subnational governments will become increasingly important. The IPCC's call for consistent accounting and reporting through the *2006 Guidelines* acknowledges the fact that these represent a necessary first step toward achieving meaningful emissions reductions. It is difficult to mitigate what has not been measured, and gathering information to create a baseline allows for tracking of future progress against current conditions. There currently lacks a consistent accounting framework for new construction; standardization would help to inform a minimum foundation of understanding across the buildings sector about how the emerging building stock fits into the full picture of state and jurisdictional emissions as well as national-level inventories submitted via NDCs.

In the buildings sector in the US, building energy codes and standards, which are adopted at the state and jurisdictional levels, have the potential to hold the responsibility for establishing GHG accounting and reporting methodologies for new construction. Other policies, such as Building Performance Standards (BPS), are suited to governing the existing building stock. These policies and systems interact and can be designed to be complementary. Energy code reporting provisions, for example, can be aligned with those in BPS programs and may be set up to create the consistent, upstream data foundation that BPS programs may depend on downstream. Projects would also be better positioned for future BPS compliance when they already have accurate, code-based inventorying in place for the new buildings that will be subject to BPS requirements down the line. Finally, energy codes are well positioned for accounting provisions in part because some jurisdictions have already identified them as suitable for integrating emissions reduction strategies, and these two steps naturally interact and inform one another.

Some jurisdictions have moved beyond reporting by pursuing reductions despite the absence of a uniform accounting framework, in acknowledgement of the urgency to mitigate climate change. A handful of the country's most ambitious states have gone beyond the model *IECC* by drafting their own codes that meet their carbon-oriented needs. The state of New York, for example, developed a stretch energy code available to municipalities looking for a more energy-efficient alternative to the minimum state energy code. California also offers a reach code to jurisdictions looking to exceed its statewide building code, Title 24. This code offers language for requiring additional efficiency, electrification, solar energy, and others. Colorado's Model Low Energy and Carbon Code, effective in July 2026, will become the state's new minimum energy code, meaning that local jurisdictions updating their building codes after that date must adopt the model code. The code focuses on "affordable pathways to reduce energy use and greenhouse gas pollution" (CEO 2026).

Jurisdictions are spending significant resources formulating their own methodologies to reduce their buildings sector emissions. These are strong and well-formulated codes, but a patchwork scenario is emerging, in which ambitious jurisdictions are generating new codes that approach carbon reduction in divergent ways as they aim to fill the gap that model codes have left. The ICC itself has acknowledged the opportunity for model codes to provide jurisdictions with a framework for addressing GHG emissions: "Given its strong foundation in the development of practical and respected solutions for the building industry and communities, the Code Council is ideally situated to provide leadership and policy and programmatic tools to help meet energy efficiency and GHG emission goals" (ICC 2021).

Codes and Carbon Today

ICC, ASHRAE, and 2030 Commitments

Model codes act as useful resources for jurisdictions that do not have the capacity to develop their own codes from scratch, and their reach is significant. The ICC is a predominant organization responsible for developing, updating, and maintaining the family of International Codes: model codes available for adoption by states and jurisdictions around the world. In the US, jurisdictions in all 50 states have incorporated these model codes. Some adopt them in full, while others amend them to fit their own needs and circumstances. ASHRAE is another major organization responsible for the development of consensus-based technical standards, which establish requirements for topics such as energy performance, sustainability, building operations and grid-building interactivity, and others. Adoption of ASHRAE standards is also prevalent: two-thirds of American states, for example, have adopted recent versions of *ASRHAE 90.1* as their energy code (Woll Jr. and Lindsey 2025).

Model codes are designed to be adopted by reference. Their text is incorporated into legislation, statutes, ordinances, and city or state codes. Building energy codes in the US have long been hampered by an uncoordinated patchwork of state and federal regulations, as code adoption is left to states and, in some cases, cities. Some states have not updated their codes since 2009 or, when they have adopted a newer version, have weakened model versions to 2009 equivalency (DOE 2025). Additionally, *EPCA* regulations from the 1970s preempt states from regulating appliance efficiency levels, making it more difficult to align local building regulations with emissions management policies (Cheslak and Edelson 2022; Long et al. 2024).

Despite these challenges, progress has been made in the past few decades on model code development and adoption (Cheslak et al. 2023). In 2005, the American Institute of Architects (AIA) 2030 Commitment and corresponding Architecture 2030 Challenge were founded and gained widespread popularity in the architecture, engineering, and construction (AEC) industries. While many wished to have a decarbonized building energy code in place by 2006, the AIA Commitment and other related efforts set 2030 as a target year to provide the industry with a 25-year glide path toward 2030 codes adequately suited to the challenges, risks, and complexities associated with built assets. By 2021, both ICC and ASHRAE had formally committed to ensuring the 2030 and 2031 model energy codes would be net zero and decarbonized.

Codes Backpedaling on Climate

The commitments made by ICC and ASHRAE in the early 2020s were impactful. ASHRAE's 2022 *Position Document on Building Decarbonization* reaffirmed its 2020 commitment that, by 2031, "all new buildings must be net zero GHG emissions in operation" (ASHRAE 2022). ICC's 2021 *Leading the Way to Energy Efficiency* also committed to ensuring the 2030 *IECC* included a net zero pathway, observing, "[c]oncern is growing in communities around the world about the impacts of a changing climate. Communities are looking for strategies to support increased energy efficiency and reduced GHG emissions to meet their policy goals" (ICC 2021). The 2024 *IECC* codified this commitment in its Scope and Intent.

By the early 2020s, multiple states had climate laws in place that required decarbonization in building energy codes. Dozens of cities had their own climate laws or action plans, also calling for decarbonized energy codes. In 2021, it appeared that the ICC and ASHRAE codes were heading in the direction of decarbonization to serve jurisdictional needs.

As of 2026, these prospects have changed, at least for the short term. The DOE has changed its course on policy and has introduced strong penalties on domestic decarbonization efforts. The US has again pulled out of the Paris Agreement, and renewable energy development has been deprioritized. A push for "consumer choice" has become an agenda funded by fossil fuel lobbies, which has influenced localities' abilities to regulate emissions (Nolette et al. 2026).

In this context, both ICC and ASHRAE have also changed direction, taking a split pathway approach to the 2030 and 2031 model energy codes. ASHRAE's development of *90.1-E* will provide guidance on enhanced operational energy emissions performance for commercial buildings. In January 2026, the ICC Board of Directors published a draft framework for the 2030 *IECC*, which split the scope and intent into two scopes: the base *IECC* and Expanded *IECC*, or *IECC-X*. The base *IECC* will be limited to base efficiency provisions, while the *IECC-X* may include optional or mandatory provisions incorporating additional efficiency and GHG reduction resources and provisions. Per this decision, the intent of the 2030 *IECC* will include the line, "This code shall not regulate broader policy objectives including GHG emissions reduction, social cost of carbon, embodied carbon, net-zero targets, or life-cycle cost analysis of materials or construction methods" (ICC 2026).

In effect, this decision on the part of the ICC Board of Directors will remove carbon measures from the code just in time for 2030: the target deadline in place since 2005 for fully incorporating climate and carbon into the energy code. This loses sight of the prior intent of model codes. Greenhouse gas mitigation is an essential element of any energy code suited to the 21st century.

A Uniform Code for the 21st Century

The evolution of building codes over the past century serves as a reminder that the next step of bringing carbon accounting and reduction within the scope of codes is well justified from a public policy perspective. The 1920s saw the first wave of building code scoping. The 1930s through 1960s saw a second wave, adding risk management elements for complex MEP requirements for modern skyscrapers and tall buildings. The 1970s saw a third wave of code scope expansion, addressing risk of energy shortages and air pollution resulting from energy consumption. Now, a fourth wave has emerged.

One of the most prevalent risks of this century is the GHG-intensive nature of energy supply systems across the globe; there is a high likelihood that intergovernmental, federal, state, and local policy frameworks will continue to emerge to manage this risk out of necessity. With a global population exceeding 8 billion, the world's energy demand reached 654 Exajoules (EJ) in 2024; emissions totaled 38 Gigatons (Gt) of carbon dioxide (CO_2), up from 25 Gt CO_2 in 2000 (EIA 2025). Residential and commercial buildings in the US are responsible for 75 percent of electricity use and 35 percent of the nation's emissions (Heinz et al. 2025). As vehicles electrify, the share of emissions attributed to buildings drawing from the grid will increase. Codes and standards such as ASHRAE's Standard 228 are already establishing frameworks for this, making clear that emissions sources of many kinds will be aggregated through buildings over the next two decades. As one study has shown, "without improvements and policy interventions, the energy used in buildings can increase by 46–73 percent in 2050 from the 128 exajoules (EJ) used in 2019, driven by population growth, greater diffusion and use of energy-consuming devices, and increasing living standards in low and middle-income Countries" (Heinz et al. 2025).

Buildings sector accounting is essential for understanding and managing these trends. Without the leadership of model codes organizations to provide the tools and framework for carbon accounting and reporting, the nation will face the risk of further splintering into a patchwork of local methodologies with little uniformity. Inconsistencies in approaches can add costs and complexities to AEC industries and professionals, which can impair energy and construction affordability. Additionally, discrepancies in practice will burden subnational governments managing their emissions inventories and will impair the accuracy of national-level reporting through NDCs. The administration of energy codes is suited to capture the data that will adequately inform buildings sector reporting at the *2006 Guidelines'* tiers 2 and 3 levels: this includes data on building stock, envelope performance, equipment efficiency, energy use, and rates of code compliance.

GHG reduction among developed nations is also already underway, and the ability to manage emissions is already a jurisdictional need (IPCC 2023). Regardless of how decarbonization policies evolve in the short-term in the US, policies targeted toward emissions reductions will inevitably be needed to adequately meet growing energy demand and the vulnerabilities associated with it. Reducing buildings sector electricity consumption is a critical factor in increasing energy reliability and in mitigating the vulnerabilities and hazards associated with electricity generation; model energy codes are a key policy mechanism set up to accomplish this. This will entail enabling new construction to manage grid electricity consumption in more complex ways, expanding beyond conservation measures in the scope and intent of the code.

Incorporating these types of frameworks for GHG accounting and reduction is essential for keeping model codes relevant and adequately addressing the risks of the 21st century.

The "IECC" – The International Energy and Carbon Code

The following offers an illustrative example of how an *International Energy and Carbon Code (IECC)* could be structured to address the prevailing risks associated with energy systems and the built environment in the 21st century. The intent is not to provide rigorously developed code language, but rather to demonstrate that a coherent *IECC* is possible and can be structured logically to encompass both energy efficiency conservation measures as well as carbon management provisions that address both accounting and reductions.

Figure 1 provides a blueprint for how this proposed code may be made readily adoptable, coherently organized, and scoped for the prevailing energy-related risks of the 21st century. The proposed framework sets the boundary for the energy code at carbon emissions and atmospheric pollution; it does not attempt to address broader issues of environmental performance or management of other planetary boundaries. These would best be addressed through a green code (Rockström et al. 2009). The scope and intent of this proposal covers grid reliability and energy management; carbon emissions are regulated under this proposal insofar as they are a result of grid energy consumption.

International Energy and Carbon Code (IECC)

[CE] CHAPTER 4 COMMERCIAL ENERGY EFFICIENCY

C401 General
C402 Building Thermal Envelope Requirements
C403 Building Mechanical Systems
C404 Service Water Heating
C405 Lighting and Electrical Power
C406 Simulated Building Performance
C407 Maintenance Information and System Commissioning
C408 Calculation of the HVAC Total System Performance Ratio

[CE] CHAPTER 5 COMMERCIAL CARBON MANAGEMENT

C501 General
C502 Carbon Accounting and Reporting Methods
C503 Grid-Interoperability and Load Management
C504 Electrification, Energy Storage, and EV Charging
C505 On-Site Energy Generation Systems
C506 Decarbonization and Additional Efficiency

Figure 1. Reimagining the *IECC* for the 21st century.

The proposed structure essentially introduces one new *Carbon Management* chapter, adding on to the existing provisions that fall under an *Energy Conservation* chapter. This framework provides standardized approaches at two levels: GHG accounting and reporting as a minimum baseline requirement, and voluntary mitigation and decarbonization options as made available for those jurisdictions that are ready to go further toward achieving reductions. Explicit decarbonization elements are notably placed in a single section at the end, rather than being scattered across the code, making them easy for jurisdictions to locate, amend, or adopt according to their own priorities and circumstances. Few or no appendices exist in this code.

While this proposal only covers the commercial chapters, residential sections may be organized in a similar fashion. The existing buildings chapter – currently Chapter 5 – would become the new Chapter 6, and all subsequent chapters bumped down a number.

Chapter 4: The basic architecture of this proposal is built on the premise of distinguishing energy conservation policy objectives and carbon emissions management policy objectives. Energy conservation measures address mechanical, electrical, plumbing, and structural or architectural elements of the building, focusing on ensuring that waste energy is eliminated. A building with waste energy, compared to one with a more energy efficient design, has higher operational energy consumption with no gain in services provided to occupants. Energy conservation objectives seek to eliminate waste energy to the largest degree possible, aiming towards an ideal of zero waste energy. Energy savings metrics are often appropriate to determine how effective a particular intervention is, and, in the US, it has commonly been assumed that marginal gains in waste energy elimination in buildings can only be justified financially: valuable only up to the point where additional waste elimination interventions cost less to construct than the dollar amount saved on future energy bills over a defined horizon.

Chapter 5: This chapter houses the regulatory mechanisms that address climate pollution accounting, reporting, attribution, and inventorying. The intent is to provide jurisdictions with a suite of requirements that are commonly accepted as market-ready, cost-effective strategies that any modernized building built in the US in the 21st century should contain at a minimum. While the exact specifications and details of what would be required around EVs and onsite energy generation or storage will remain a matter of debate over the next several years, this framework demonstrates that incorporating such measures into the body of the code can be simple and easy to navigate. Under this structure, the code may deprioritize onsite renewable requirements in favor of ensuring that efficiency is accomplished and that trade-offs between energy systems and high-performance envelopes are discouraged. Advanced energy efficiency, carbon accounting tools, and grid interoperability capabilities are deemed as the three most necessary features of any building energy code suitable for the 21st century.

Section C506: Energy efficiency and conservation measures in this proposal are kept distinct from measures addressing climate and carbon policy measures. The one point of overlap is in the proposed C506, addressing "additional efficiency." This section would include a mechanism for allowing further upfront investments in energy cost savings measures of the proposed Chapter 4, which would go beyond simple ROI values and incorporate considerations of climate and societal benefits. While such mechanisms may already exist in some portions of the current model energy codes, this proposal shows that they may be more cleanly separated in a way that provides uniformity as well as flexibility for each individual city to adjust based on its local climate targets and priorities.

Chapter 5 also includes a section on carbon attribution and accounting. To date, as decarbonization elements have been incorporated into model energy codes at the request of cities who need them to accomplish their own climate policy objectives and mandates, a mixture of carbon accounting and carbon reduction measures have emerged. This proposed structure sorts measures by these policy objectives. Streamlining carbon accounting methods and standardizing practices by which carbon emissions are attributed to buildings – and, more importantly, the methodology and approved equations by which emission reductions from a reference baseline are calculated – can be more easily facilitated by a code which organizes measures by policy objective type and keeps in sight the policy objective behind each measure.

Conclusion

Model building and energy codes are pieces of a broader web of risk management governance frameworks and must be adequately equipped to deal with the prevailing risks of the 21st century, including climate pollution. Even as domestic decarbonization policies have been impeded in recent years, carbon management standards and tools are already needed by nations around the world as well as by states and jurisdictions at home. Model building energy codes are well-equipped to meet these needs by providing a standardized framework for carbon accounting and decarbonization of the buildings sector.

Objection to including carbon in model energy codes has been growing stronger in recent years, with many maintaining that carbon falls outside of the scope of energy regulations. For decades, model building and energy codes have served as mechanisms for managing risk. The 21st century faces a prevailing risk of a carbon-constrained energy supply damaging the economic feasibility of the US's electrical grid. By mid-century, carbon emissions will represent a supply-side constraint for energy generation systems, and demand-side pressures are not anticipated to weaken. The overwhelming scientific consensus makes it clear that there is only so much climate pollution that can be absorbed: there is a global atmospheric carbon budget.

As a result, a global system of carbon inventory has already taken shape. By mid-century – given the context of ever-advancing scientific evidence and international climate treaties – a global carbon budgeting system will likely mean that emitting carbon will come with a cost. If the energy grid in the US fails to adequately decarbonize, the cost of waste output from supply generation will become a major constraint.

This momentum makes clear that uniform carbon emissions management tools will be needed. Subnational governmental entities and jurisdictions informing national emissions inventories will need adequate regulatory mechanisms for measuring and managing the carbon in their buildings. The most sensible way to standardize requirements for these practices in the buildings sector is through a set of uniform, flexible, and enforceable carbon management measures in model building energy codes.

References

ASHRAE (American Association of Heating, Refrigerating and Air-Conditioning Engineers). 2022. *ASHRAE Position Document on Building Decarbonization.*

Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. London: Sage.

Building Decarbonization Coalition. 2025. *Mapping Decarb Momentum: 2025 Building Decarbonization Legislation Trends.* https://buildingdecarb.org/2025-building-decarbonization-legislation-trends.

C40 Cities. 2021. *More than 100 American Cities Make Historic Pledge to Accelerate Net-Zero Emissions, Deliver Action Needed to Meet National Climate Goals.* https://www.c40.org/news/american-cities-net-zero-climate-goals.

CARB (California Air Resources Board). 2026. *Current California GHG Emission Inventory Data.* https://ww2.arb.ca.gov/ghg-inventory-data.

Cheslak, Kim, and Jim Edelson. 2022. "Energy Codes, Climate Policy, and Federalism in the United States." Paper presented at ACEEE Summer Study.

CEO (Colorado Energy Office). 2026. "Colorado's New Model Low Energy and Carbon Code Will Cut Energy Costs, Improve Indoor Air Quality, and Enhance Resiliency." Accessed March 2026. energyoffice.colorado.gov/press-releases/colorados-new-model-low-energy-and-carbon-code-will-cut-energy-costs-improve-indoor.

Daly, Herman E., and Kenneth N. Townsend, eds. 1993. *Valuing the Earth: Economics, Ecology, Ethics*. Boston: The MIT Press.

de Coninck, H., A. Revi, M. Babiker, P. Bertoldi, M. Buckeridge, A. Cartwright, W. Dong, J. Ford, S. Fuss, J.-C. Hourcade, D. Ley, R. Mechler, P. Newman, A. Revokatova, S. Schultz, L. Steg, and T. Sugiyama. 2018. *Strengthening and Implementing the Global Response.* Cambridge, UK and New York, NY, USA: Cambridge University Press.

Edelson, Jim, Kim Cheslak, Kim Eley, and David Goldstein. 2023. "The Limits of 'Net Zero' for Specifying Building Performance." Paper presented at ACEEE Summer Study.

EIA (U.S. Energy Information Administration). 2025. "World Energy Outlook 2025." Energy Information Association.

Erickson, P., Allaway, D., Lazarus, M., and Stanton E. A. 2012. "A Consumption-Based GHG Inventory for the U.S. State of Oregon." *Environmental Science & Technology* 46 (7): 3679-3686.

FEMA (Federal Emergency Management Agency). 2006. *IS-393.a: Introduction to Hazard Mitigation*.

Fong, W. K., Sotos, M., Doust, M., Schultz, S., Marques, A., Deng-Beck, C. 2021. *Global Protocol for Community-Scale Greenhouse Gas Inventories: An Accounting and Reporting Standard for Cities Version 1.1.* World Resources Institute (WRI).

Harvard Law School. 2026. "Paris Climate Agreement." Accessed March 2026. eelp.law.harvard.edu/tracker/paris-climate-agreement/.

Heinz, Erin, Benjamin K. Sovacool, Thomas Kwan, and Vincent Petit. 2025. "Critically Reviewing the 50 Sociotechnical Risks of Building Sector Decarbonization: Conceptualizing Risk as a Proximity Spiral." *Energy and Buildings* 344.

ICBO (International Conference of Building Officials). 1927. *Uniform Building Code: 1927*. International Conference of Building Officials. Los Angeles.

ICC (International Code Council). 2026. *2030 IECC, IRC Chapter 11, IECC Expanded (IECCX) Scope & Intent, Draft for Public Comment.* International Code Council.

—. 2021. *Leading the Way to Energy Efficiency: A Path Forward on Energy and Sustainability to Confront a Changing Climate.* International Code Council.

IPCC (Intergovernmental Panel on Climate Change). 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Japan: Institute for Global Environmental Strategies (IGES).

—. 2023. *Sections In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Geneva, Switzerland: IPCC.

Jaeschke, Aleksandra. 2022. *The Greening of America's Building Codes: Promises and Paradoxes*. Princeton, NJ: Princeton Architectural Press.

Long, Jamie, Daniel Carpenter-Gold, Joey Vossen, and Cliff Majersik. 2024. "Equitable Building Decarbonization Options in a Changing Legal Landscape." Paper presented at ACEEE Summer Study.

NIBS. 2006. *A Study of the HUD Minimum Property Standards for One- and Two-Family Dwellings and Technical Suitability of Products Programs.* HUD. Accessed January 2026.

NOAA (National Oceanic and Atmospheric Administration). 2025. *Climate Change Impacts.* www.noaa.gov/education/resource-collections/climate/climate-change-impacts.

Nolette, Vincent, Daniel Metzger, Olivia Guarna, and Amy Turner. 2026. “Navigating State Law in Local Climate Action.” *Sabin Center for Climate Change Law*.

Rockström, Johan, Will Steffen, Kevin Noone, et al. 2009. “A Safe Operating Space for Humanity.” *Nature* 461, no. 7263: 472–75.

Rogelj, J., D. Shindell, K. Jiang, S. Fifita, et. al. 2018. *Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development.* Cambridge, UK and New York, NY, USA: Cambridge University Press.

Takemura, Alison. 2025. “New York Pauses Its Landmark Gas Ban in New Buildings.” Canary Media. Accessed January 2026.

United States. 2024. *The United States of America Nationally Determined Contribution: Reducing Greenhouse Gases in the United States: A 2035 Emissions Target.* unfccc.int/sites/default/files/2024-12/United%20States%202035%20NDC.pdf

UNFCCC (United Nations Framework Convention on Climate Change). 2026a. “United Nations Framework Convention on Climate Change.” Accessed March 2026. unfccc.int/process-and-meetings/united-nations-framework-convention-on-climate-change.

—. 2026b. “Conference of the Parties (COP).” Accessed March 2026. unfccc.int/process/bodies/supreme-bodies/conference-of-the-parties-cop.

—. 2026c. *Non-State Actor Zone for Climate Action (NAZCA).* Accessed March 2026. climateaction.unfccc.int/.

—. 2022. *Nationally Determined Contributions Under the Paris Agreement: Synthesis Report by the Secretariat.* UNFCCC. unfccc.int/sites/default/files/resource/cma2022_04.pdf

US Congress. 2025. *U.S. Withdrawal from the Paris Agreement: Process and Potential Effects.* March 2026. www.congress.gov/crs-product/R48504.

US Department of Energy (DOE). 2025. *Energy Code Field Studies.* Building Energy Codes Program. Accessed January 2026.

—. 2026. *Model Energy Code Determinations.* www.energycodes.gov/determinations.

Waite, Michael. 2024. *International Code Council Caves to Special Interests, Axes Decarbonization Measures from Model Building Code.* ACEEE. Accessed January 2026.

Woll Jr., David C. and Lindsey, Todd. 2025. *Adoption of Energy Efficiency Standards for New Construction of HUD- and USDA-Financed Housing; Notice for Comment.* Federal Register.