Market Transformation in the Zero-Emission Era: New Policy Roles for Emission Standards, Codes, and Incentives

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ABSTRACT

Achieving market transformation to equitably decarbonize the building sector will require coordinated deployment of different policy levers—both carrots and sticks—whose roles will need to evolve from their roles in traditional market transformation. Emission standards for HVAC and hot water equipment and building/energy codes targeting zero-emission new construction (with a focus on deep efficiency and electrification) will establish ambitious, forward-looking requirements aligned with climate targets, rather than lock in progress at the end of a market transformation. Incentive and subsidy programs will help equitably *meet* these ambitious requirements, especially in existing buildings, rather than focusing on technologies that *exceed* code requirements. And these policies' somewhat disparate traditional goals—from efficiency to air quality—will need to be aligned, applying policy paradigms such as climate-driven efficiency and utility compliance attribution, to achieve equitable decarbonization objectives without creating market confusion.

This paper proposes a framework for coordinating emission standards, building codes, and utility incentive programs with the wide range of government support, including the IRA, to achieve climate-aligned market transformation. That framework draws on case studies and policy analysis from the ten U.S. Climate Alliance member states that have committed to exploring zero-emission equipment standards. Under the proposed framework, zero-emission standards serve as North Star policies that guide the development of complementary policies to accelerate market transformation and ensure it proceeds equitably. Applying the framework, we offer recommendations for integrating zero-emission standards into comprehensive building decarbonization policy strategies in these ten leading states and beyond.

Introduction

Zero-emission standards for HVAC and water heater sales have enormous potential to drive the transition to decarbonized buildings powered by clean, efficient equipment. These standards work by requiring new equipment sales to be zero-emitting. They're similar to energy efficiency standards for new equipment, but they regulate emissions, rather than efficiency. Zero-emission equipment is defined as equipment that does not produce any direct emissions of the target pollutant at the point of use. The pollutant targeted by a zero-emission standard may be either carbon dioxide or a regulated health-harming pollutant such as nitrogen oxides (NOx). Combustion equipment like gas furnaces and water heaters directly emit significant amounts of these pollutants, while zero-emitting alternatives like electric space and water heaters (whether they use heat pumps or electric resistance heating) do not. Unlike efficiency standards, which require reductions in energy consumption within specific equipment categories such as furnaces or heat pumps, zero-emission standards set more broadly-applicable requirements that can be

met by shifting from one equipment type to another, such as installing an electric heat pump instead of a gas furnace. (For a primer on zero-emission standards, see Levin et al. 2024, Dennison 2022, Dennison, Louis-Prescott, and Gruenwald 2021.) One regional air district in California has enacted zero-emission standards that take effect starting in 2027, and similar standards are under development statewide in California (CARB 2024). Zero-emission standards can fill a critical role in the building decarbonization policy landscape. This paper will explore that role by examining a group of states considering development of zero-emission standards.

At Climate Week NYC in September 2023, a bipartisan coalition of 24 governors called the U.S. Climate Alliance announced a target of installing 20 million heat pumps by 2030 (USCA 2023). To advance these building decarbonization efforts, ten member states committed to "explore the adoption of zero-emission standards for space and water heating equipment" (CA, CT, HI, MA, MD, NY, OR, PA, RI, and WA).

In February 2024, nine states led by the Northeast States for Coordinated Air Use Management (NESCAUM) signed a memorandum of understanding that builds on the USCA commitment (CA, CO, ME, MA, MD, NJ, NY, OR, and RI) (NESCAUM 2024). The NESCAUM MOU sets a shared goal for heat pumps to make up 65% of residential equipment sales by 2030 and 90% by 2040, and outlines steps the states will take to plan and prepare for policies that will meet this goal. The MOU was signed by the directors of the states' environmental agencies, which would be tasked with developing zero-emission equipment standards, and the market tracking and planning steps it outlines could facilitate the development and implementation of such standards.

The states exploring zero-emission equipment standards will need to decide what role these standards will play in their overall building decarbonization strategies, and how standards can be designed and coordinated with the states' other policies to play that role most effectively. This paper offers guidance for navigating these questions by proposing a framework that adapts the traditional market transformation framework to meet the needs of equitable building decarbonization, discussing the policies that can play the different roles within that framework with examples from states that are developing and deploying these policies, and offering recommendations on how policies can be designed to most effectively play their respective roles and harmonize with the policies playing other roles. Specifically, zero-emission standards can play a North Star role to help guide the policies decarbonizing the building sector, and a Backstop role to help ensure that the market reaches that goal.

Section I describes our proposed market transformation (MT) framework. Section II describes the roles that common building decarbonization policies can play in that framework, and why zero-emission standards are especially well-suited to serve as North Stars and Backstops. Section III discusses ways to harmonize multiple building decarbonization policies using our proposed framework. Section IV concludes.

I. A Framework for Climate-Aligned Market Transformation

Responding to climate change requires a different kind of market transformation than has traditionally been applied in energy efficiency efforts. The traditional MT model starts with a market dominated by an incumbent technology, and applies market interventions to move toward a more efficient technology through stages of adoption (early adopters, majority, and laggards), without a pre-determined adoption timeline. Three key features of the climate crisis require us to augment the traditional MT model: **urgency** (the need to achieve MT on defined timelines to

meet climate targets), **scope** (the need for transformative change to decarbonized energy systems rather than incremental efficiency improvements), and **equity** (the need to bring everyone along in a managed, equitable transition).

To address these features, we propose an updated MT paradigm that starts with the end goal of an equitable, decarbonized buildings sector and offers a framework for the policy types needed to get there.[1] Figure 1 illustrates our proposed framework (left) and compares it to the S-curve diagram frequently used to illustrate the traditional MT framework (right) (de la Rue du Can et al. 2014). Our framework is represented by a map that moves from initial efforts (Proof of Concept) to policies that cement market outcomes (Backstops), with Accelerators and Equalizers working in parallel to drive progress along the way, and North Star policies guiding and coordinating these efforts throughout the journey. Policies that drove traditional MT efforts are included as key components (usually Accelerators) in this broader policy framework.

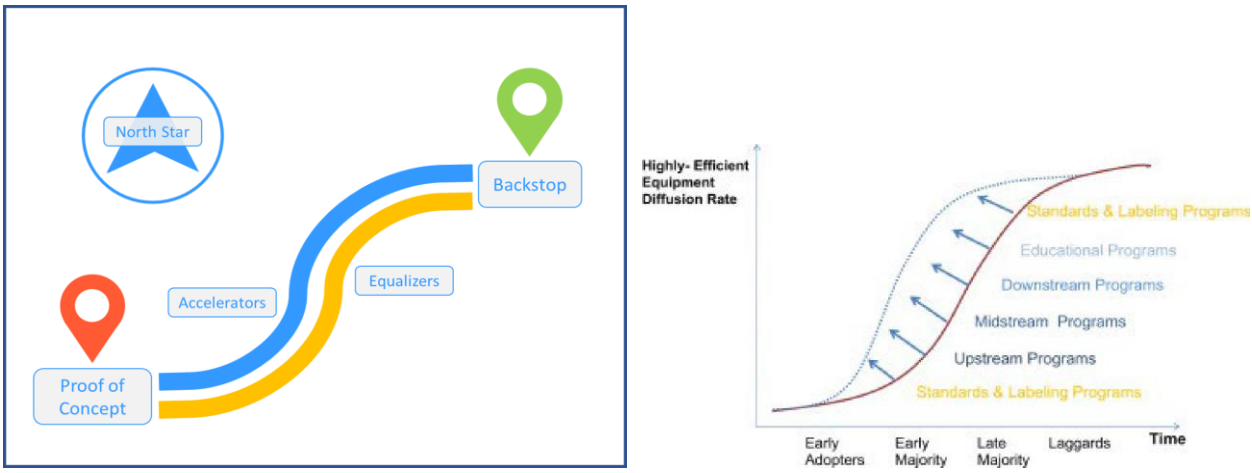

Figure 1. Proposed Map MT Framework Compared to Traditional MT S-Curve.

Our proposed "map" framework incorporates the five policy roles described below.

Proof of Concept: Demonstrates the feasibility of adopting a technology or implementing a policy. This role can be played by pilot programs, examples of the policy or technology adoption from other jurisdictions or market segments, and policies aimed at early adopters. A Proof of Concept can start the conversation about an opportunity (for example, a neighboring jurisdiction's clean heat standard can serve as a template for developing one) or it can demonstrate how a particular market barrier can be overcome (for example, a zonal electrification pilot can show how to prune portions of the gas system and overcome barriers to participation by all affected customers, which may be needed for successful pruning).

North Star: Identifies and commits to an end goal that aligns with climate targets, such as limiting global warming to 1.5°C or meeting a state's economywide decarbonization goal. North Star policies are necessary to meet the climate urgency described above, and to provide a clear target that can help determine the sequencing of other policies and send clear signals to

[1] We recognize that building decarbonization depends on an even wider range of policies than we address in this paper, such as developing the clean energy generation, transmission, and load management that will serve additional and more variable electric load. Our policy focus in this paper is the equitable deployment of zero-emitting equipment and the phaseout of fossil fuel equipment, so we view related policy areas like electric grid development through the lens of how they affect that deployment.

inform planning and investment by all market participants. This role may be played by emission caps, clean heat standards, and zero-emission standards, as discussed further in Section II.

North Star policies are often regulatory standards of some kind. This is a key difference between the Map Framework and the traditional MT framework: Rather than being enacted at the end of a market transformation to lock in achievements, in the Map Framework standards can be enacted early in the transition but phased in over time to guide the complementary efforts that take place during the phase-in. Indeed, the earlier that North Star standards can be established, the more effective they will be as regulatory signals to market actors that need time to plan and prepare for compliance. Standards are commonly used to send regulatory signals in areas other than energy efficiency, such as environmental regulation (Dennison 2022, 4), and codes-driven MT has been described by Gupta et al. 2022.

Accelerators: Remove or reduce market barriers to accelerate the pace of technology adoption as required to meet North Star policy goals. Many of the market interventions deployed under the traditional MT paradigm can play this role, including rebates and tax incentives, customer and contractor education, removal of administrative or technical barriers to adoption, utility rate design, and climate-forward efficiency programs. (This comes as no surprise, because the Map Framework is meant to augment, not replace, the traditional MT framework). The specific set of Accelerators used to support zero-emission equipment adoption, and the timing of their implementation, can be guided by North Star policies as discussed in Section III.

Equalizers: Ensure that all residents can participate in and equitably benefit from the building decarbonization transition. Electrification is a significant shift with many affordability and equity implications, both within individual homes and at the utility level. Equalizer policies are needed to support disadvantaged communities throughout the transition. Rather than letting higher financial, social, and other barriers relegate disadvantaged communities to the "laggard" phase of the transition after those who can be cost-effectively incentivized to electrify have done so, policies and funding must be designed to center these communities and address the structural barriers that prevent them from sharing in the benefits of electrification at every stage of the transition. This will involve reducing the traditional MT framework's emphasis on incentive programs designed to cost-effectively nudge consumers to select a preferred above-baseline technology, and emphasizing the development of programs that provide needed support for those who cannot shoulder the costs of pre-electrification and electrification retrofits alone. It will also involve tenant protections, workforce provisions, policy support for zonal electrification projects (which can prune segments of the gas system thereby reducing system costs that, absent intervention, will be disproportionately borne by those who lack the means to electrify early on), and more. NEEP 2024's Equity and Workforce category describes some of the policies that can serve the Equalizer role.

Equalizers should be deployed in tandem with Accelerators, and again the strategy and sequencing of these policies will be informed by North Star goals. Importantly, equity should inform the design and implementation of all building policies, not just Equalizers. But in addition to this overarching focus on equity, we have identified Equalizers as one of the policy roles that must be filled in a climate-aligned MT framework because some of the necessary outcomes can only be achieved through dedicated policies. For example, air quality agencies may not have the legal authority or access to funding necessary to develop income-qualified rebate programs. So while it is important for air agencies to design zero-emission equipment standards in a way that

facilitates and is compatible with these rebate programs, the programs ultimately must be developed separately by the entities with appropriate authority.

Backstop: Ensures that North Star targets are achieved by providing an enforcement mechanism. If a North Star policy itself is enforceable (which many are, including zero-emission standards), that same policy may also function as a Backstop. A standard that is enacted without significant lead time or that doesn't directly express a key goal may serve as a Backstop but not a North Star (and this is closer to the role contemplated for standards in the traditional MT framework). Where a jurisdiction has one or more Backstops that are distinct from its North Star(s), important considerations include whether the timing and ambition of the Backstop match those of the North Star and whether the Backstop and the North Star target the same or a different set of market actors.

A given policy may have attributes of more than one role, and it may play different roles in efforts to transform different segments of a market. For example, a building code that encourages or requires all-electric construction may serve as a North Star for new construction policy if it is enacted early in a state's building decarbonization efforts, a Backstop as its compliance dates approach, and a Proof of Concept for subsequent policies that target existing buildings.

One benefit of the Map Framework is that it can be applied at multiple scales as policymakers work toward interim destinations on the way to a decarbonized building sector. For example, a state may first pursue electrification of new construction, water heating, or commercial buildings, followed by other building and equipment types. Our framework can help map out the set of policies used to achieve an interim target, and incorporate that interim target as an element of the broader framework achieving an equitable, decarbonized building sector.

II. Significant Building Decarbonization Policies and Their Best Roles

The range of building decarbonization policies has expanded quickly, making it more important than ever to consider how these policies fit together and what roles each policy type is best suited to play. This Section summarizes some of the major policy types and the attributes that can make them most appropriate for different policy roles, with a focus on attributes that make zero-emission equipment standards an effective North Star and Backstop.

Building codes have served as a backstop in the traditional MT framework, locking in efficiency measures that have achieved market transformation (de la Rue du Can et al. 2014, 59). All-electric building codes—as well as all-electric building ordinances and electric-preferred codes—can play a similar role in our Map Framework, but for only part of the target market (which also includes existing buildings). For the retrofit part of the market, codes can serve as Proof of Concept, signaling the direction all buildings will need to move and demonstrating cost-effective ways to electrify new buildings (some of which can be replicated in retrofits). Washington is a good example of this dynamic: Now that it has enacted strong, electrification-friendly codes, the state can turn its attention to a strong North Star policy for electrifying existing buildings. Codes with pre-electrification requirements, such as adequate wiring and panel space, can also serve as Accelerators for future retrofits.

Incentives, whether from governments, utilities, or other entities, are classic Accelerators, and can also serve as Equalizers if designed effectively. The IRA acts as a major Accelerator (both by directly funding programs and incentives, and by catalyzing the state

programs involved in implementing it), and its funding for income-qualified retrofits and environmental justice projects plays an Equalizer role (Malinowski et al. 2023). However, successfully implementing the IRA is a massive undertaking with wide variation across the different states and situations where its many provisions are being deployed. While this variation makes the IRA and other incentives effective at overcoming a range of market barriers, it does not express a clear target that can serve as a North Star, and it does not guarantee uptake or outcomes in a way that a Backstop must.

Building Performance Standards can act as a North Star and Backstop for large commercial and multifamily buildings, especially if they are designed to reach a net zero emissions requirement on a climate-aligned timeline. Seattle's Building Emission Performance Standards and New York's Local Law 97 are good examples (Seattle OSE 2024, Urban Green Council 2024). However, because building performance standards cover only a subset of the building stock, policies with application to the broader market can be more effective as North Stars.

Carbon Reduction Obligations are a category of policies used in NEEP 2024 to describe utilities' (and sometimes fuel providers') obligations to reduce customer emissions over time. These include carbon cap programs (such as Washington's Climate Commitment Act, Oregon's Climate Protection Program, or California's AB 32) and clean heat standards (such as Colorado's Clean Heat Statute and standards under development in Massachusetts and Maryland—see MassDPU 2023, MDE 2023, 40-41). These policies can serve as North Stars because they express declining emissions trajectories for regulated entities, which are often based on economy-wide state decarbonization targets. They can also serve as Backstops to the extent these emission trajectories are mandatory, and the electrification programs that utilities develop to comply with them can serve as Accelerators and Equalizers.

However, carbon reduction obligations do not apply to all building market segments—consider areas served by unregulated municipal utilities—and they often allow multiple compliance pathways, like alternative pipeline gasses, that can distract investments away from proven paths such as building electrification and towards further gas system investments. These features can reduce their effectiveness as North Star policies. Additionally, some carbon reduction obligations like California's AB 32 apply to broad swathes of the economy, with little or no direct requirements to decarbonize buildings. Economy-wide policies can create unclear market signals for the most relevant market actors in the building sector, like utilities. Thus, while broad emission caps are effective in setting statewide decarbonization policies, sector-specific policies with clear obligations for relevant market actors can be more effective as North Stars for building decarbonization.

Equipment Standards regulate new equipment sales in different ways, including efficiency standards, two-way AC standards (see Pantano et al. 2021), and zero-emission standards. Efficiency standards can act as Accelerators by helping improve heat pump performance, but they cannot require manufacturers to phase out polluting fossil fuel equipment. Two-way AC standards can similarly accelerate heat pump adoption in one part of the market where it is particularly cost-effective to do so (because heat pumps' technical similarity and comparable costs to air conditioners make them easy to substitute). But alone, they aren't enough to express the overall market transformation's North Star goals.

Zero-emission equipment standards are the best policies at capturing the North Star goals of building decarbonization and Backstopping achievement of those goals. First and

foremost, they clearly express the end-goal of building decarbonization: a phaseout of all new emitting equipment sales by a date certain that aligns with climate targets. This makes them more effective as a North Star than a policy that indirectly expresses some kind of proxy goal (such as energy efficiency standards), or that expresses an abstract goal that may be a less effective market signal (such as the declining emission rates expressed by the more open-ended carbon reduction obligation policies). Zero-emission standards can also cover all market segments, making them an effective sector-wide North Star and Backstop. Finally, zero-emission standards can be enacted at the regional (air quality management districts), state, and national levels, allowing more localized policies to lead the way to nationwide standards that provide a strong, uniform market signal.

A group of leading equipment manufacturers recently developed a Joint Vision for a Decarbonized Marketplace that recognizes the need for clear regulatory signals and highlights many of the characteristics that make zero-emission standards an effective North Star and Backstop (BDC 2023, 4). In particular, the Joint Vision states "the marketplace will not scale without clear regulatory requirements," which "must be simple and transparent enough to send an unmistakable signal to the market place" without rigidly stifling needed innovations. Zero-emission standards strike this balance by setting a clear criterion (emissions-free equipment sales) without being overly prescriptive about which specific technologies must be used to meet it. The Joint Vision also recognizes the value of "policies and programs that encourage climate-appropriate heat pumps as replacements for existing equipment" upon failure.

Of course, zero-emission standards cannot transform markets alone, and (like any North Star/Backstop) need to be paired with complementary policies in a comprehensive policy portfolio, as described in Section III below. While they can and should be designed to work with other policies for an equitable transition, standing alone they do not fill the Equalizer role. And while they send an effective overall market signal, other policies can most effectively signal the need for certain intermediate steps, such as AC to heat pump conversions (which do not directly reduce emissions) and gas system branch pruning (which are not addressed by natural equipment replacement cycles without additional coordination). Finally, because equipment standards do not create compliance obligations for utilities (which have both an enormous stake in the transition and an enormous potential to leverage their balance sheets and customer relationships to accelerate the transition), pairing them with policies like clean heat standards can help ensure that utilities appropriately incorporate building decarbonization into their resource planning and incentive programs.

Table 1 below summarizes the typical attributes of the building policy types described above that are relevant to the role(s) they can play in our MT framework.

Table 1: Features of Building Decarbonization Policy Types

	Building Construction Codes[2]	Incentives & Financial Mechanisms	Building Performance Standards[3]	Carbon Reduction Obligations	Zero-Emission Equipment Standards
Best Role(s)	Partial Backstop, others	Accelerator, Equalizer	Partial North Star & Backstop	Accelerator, Backstop	North Star, Backstop
Enacting Entities	State/local code bodies	Governments, utilities, other	State/local legislatures	State legislatures	Air quality agencies
Outcomes Targeted	Efficiency, starting to include GHGs	Governments; flexible Utilities: historically efficiency, increasingly GHGs & equity	GHGs, efficiency	GHGs	Air quality, GHGs
Market Segments Targeted	New construction, major retrofits	All	Large buildings	All building types	All equipment replacements
Local/State/ National	Local/state	Local/state/national	Local/state	State	Local/state/ national
Targeted Entities	Builders	Consumers, sometimes suppliers	Building owners	Utilities, sometimes fuel suppliers	Manufacturers, installers
Carrot/Stick	Stick	Carrot	Stick	Stick	Stick
Adoption Process & Timeline	Typically 3-year code cycles	Generally fast	Legislative process (~1 year if successful)	Legislative process (~1 year if successful)	Agency rulemaking process (~1+ years)
Implementation Timeline	Constrained by building stock turnover	Generally fast	Emissions phase down over decades	Emissions phase down over decades	Ideally multi-year lead time
Strength of Market Signal	Strong (mandatory)	Varies	Strong (mandatory)	Medium (multiple compliance pathways)	Strong (mandatory)
Key Gaps	Existing buildings (except major retrofits)	Actors not motivated by economics (laggards)	Small buildings	Unregulated municipal utilities	Intermediate steps (AC conversions, branch pruning)
Leading Examples	CA, NY, WA	IRA, Efficiency Maine, TECH (CA)	New York City, Seattle	CO, MA/MD (in development)	BAAQMD, CARB/ SCAQMD (in development)

[2] Construction codes generally cover both new construction and retrofit events. For the purposes of this table and related text, we focus on new construction, although codes for retrofit events in existing buildings can be a critical component of a market transformation policy portfolio.

[3] In general, BPS can employ metrics that address either building energy performance or building emissions performance. In this table and related text, we focus on BPS with emissions metrics, which most clearly illustrate

III. Harmonizing Policies in a Building Decarbonization Portfolio

Creating a portfolio of policies to achieve marketwide building decarbonization requires understanding how to design each policy for smooth and least-cost market transformation in a given timeframe. This Section analyzes four key issues to consider when combining policies into a portfolio: (1) sequencing policy adoption and implementation, (2) avoiding gaps in coverage, (3) aligning policies' different goals and metrics, and (4) adapting policies to account for the changing roles of key market actors (especially utilities). Using our Map Framework, we recommend strategies for addressing these issues and avoiding conflicts that may arise from combining multiple policy types.

Table 2 summarizes recommendations for addressing the four key issues above when developing each of the major building decarbonization policy types described in Section II. Recommendations for addressing each issue are discussed further below.

Table 2: Policy Design Levers to Align Building Decarbonization Portfolio

	Building Construction Codes	**Incentives & Financial Mechanisms**	**Building Performance Standards**	**Carbon Reduction Obligations**	**Zero-Emission Equipment Standards**
Sequencing of Adoption	Adopt early; new construction codes lead market and retrofit policy	Magnitude and type can depend on mandatory policies	Adopt early; enables building owners to plan electrification retrofits	Align utility obligations with other policies/ goals	Adopt early, ideally with multi-year lead time
Timing of implementation	Roadmaps of codes to zero provide best signals; best backed by statutory dates	Should precede or coincide with mandatory requirements	Need baseline data to implement; BPS roadmaps to zero provide best signals; best backed by statutory dates	Declining emission targets timed to support market	Phase in implementation dates to prepare market for wide coverage and deep (zero-emission) stringency
Metrics to drive policy outcomes	Energy savings, some new codes include GHGs	Historically efficiency, increasingly GHGs (e.g. IRA)	Energy savings or emissions reductions	GHGs	Air quality, GHGs
Breadth of Policy: Building Types, New Construction v. Retrofits	New construction is small portion of building stock, but sends strong signal of market readiness	Should be broad and varied to ensure equitable access and coverage of all market sectors	Avoid coverage loopholes and exclusions where possible; covers large existing buildings	Covers only regulated energy providers and incented actions	Can cover sales for construction and replacement events, can target use-cases through covered equipment types/sizes

BPS's role in decarbonization policy and their interactions with equipment standards. For detailed BPS policy design considerations, see ASHRAE 2023.

1. Sequencing Policy Adoption and Implementation

An ideal building decarbonization portfolio will involve some amount of advance coordinated planning by a Governor's office. This will help ensure that across disparate agencies, all of the needed policies are being enacted, and in roughly the right order. The leadership of USCA Governors is a good example of using this central coordination to identify a state's building decarbonization goals and some of the key policies needed to get there. Maryland Governor Wes Moore recently set a strong example of such leadership by signing a comprehensive executive order on climate change that directs his Department of Environment to propose zero-emission heating equipment standards, as well as a clean heat standard (Moore 2024).

Additionally, many states have performed comprehensive decarbonization planning, which often identifies specific strategies for the building sector (see, e.g., MDE 2023). These economy-wide plans can both inform and be informed by sector-specific planning, such as utility commissions' "future of gas" investigations, in an iterative planning process that should continue throughout the transition (see CPUC 2024). For example, Maryland's Climate Pollution Reduction Plan recognizes the state's "current policies [that] already support reductions in fossil fuel combustion" in buildings, and seeks to align them with "new policies [that] will accelerate those efforts" while pursuing key elements of a managed, affordable, equitable transition (MDE 2023, 35).

Whether or not states have a formal planning process in place, we recommend they follow this basic trajectory: As soon as sufficient Proof of Concept exists to identify a technologically and economically feasible path to decarbonizing buildings in line with state climate targets, adopt a North Star policy to provide a clear market signal to all stakeholders and as much lead time as possible before the Backstops take effect. As discussed in Section II, we recommend zero-emission equipment standards as a North Star policy. The California Air Resources Board (CARB) is pursuing this approach: it is in the process of developing zero-emission standards that could be adopted next year and take effect by 2030, and it is actively evaluating ways to coordinate with other agencies on the development of key complementary policies that use CARB's standards as a North Star, as shown in Figure 2 below (CARB 2024, 7).

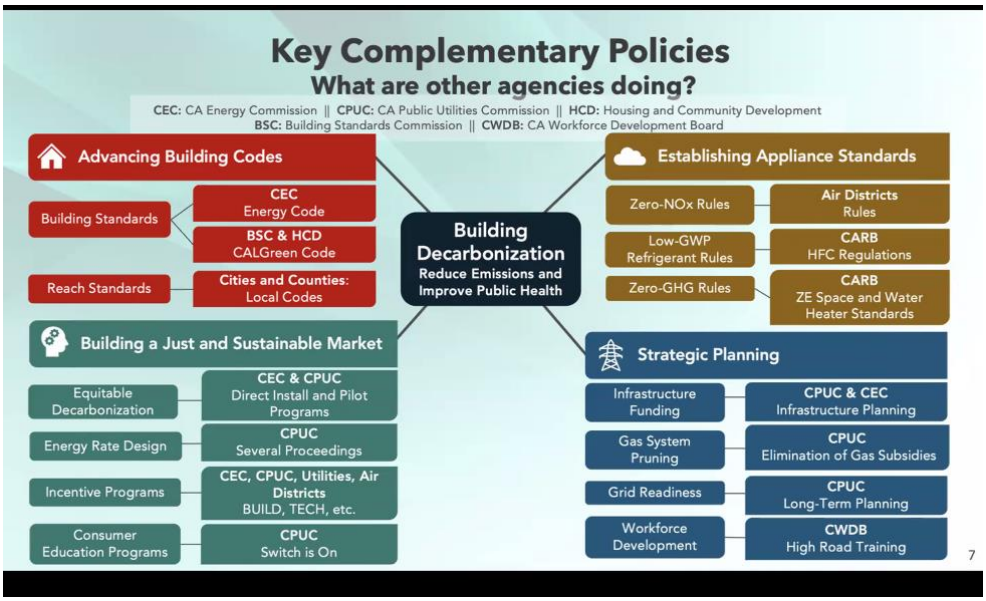

Figure 2. CARB Summary of Zero-Emission Standards and Key Complementary Policies.

Once states adopt one or more North Star policies, they should adopt and implement Accelerators and Equalizers on a timeline that aligns with the North Star's implementation dates. For example, meeting a 100% zero-emitting equipment sales standard by 2030 will require all installers to complete any required training before then. A monetary incentive for installers who complete training and perform their first heat pump installation by 2028 could help ensure this market barrier is overcome in time to implement the standard. Similarly, agencies should coordinate to align the timelines of regulatory requirements to minimize inconsistencies and the administrative burdens of complying with different policies. For example, if a state's clean heat standard contemplates electrifying 15% of buildings by 2028, its building performance standard should set a requirement that contemplates electrifying a compatible percentage of covered buildings on a similar timeline, with both standards' requirements aligning with electrification of 100% of new equipment sales by 2030 under the state's zero-emission equipment standard. Note that in aligning these timelines, policymakers will need to consider how each requirement is expressed (e.g., percentage of covered buildings that have been electrified vs. percentage of new equipment sales that are zero-emitting), applying conversion factors and adjustments as appropriate. California's Bay Area Air Quality Management District (BAAQMD) has established an implementation working group to help ensure the needed complementary policies will be in place in time to achieve the compliance dates of the District's zero-emission equipment standards, which will phase in starting in 2027 (BAAQMD 2024).

Importantly, Equalizers must be deployed in parallel with Accelerators from the outset to ensure that everyone can access the benefits of electrification on roughly equal timelines. Many of the potential barriers that BAAQMD's implementation working group is exploring relate to affordability and equitable implementation.

Within some jurisdictions, the actual sequence of policy development and implementation will need to vary from the recommended trajectory under the Map Framework. It may take some states years to propose and develop a North Star policy like a zero-emission equipment standard. This should not halt progress on other policy types until the North Star is in

place. Instead, we recommend that states assess the barriers they face to enacting a North Star policy, develop Proofs of Concept that will help to overcome those barriers, and pursue flexible Accelerators and Equalizers that will advance progress to the expected North Star goal. If a state faces challenges to enacting zero-emission standards as a North Star policy, this may be a sign that additional Proof of Concept is needed before the North Star goal is seen as being attainable in that state. This Proof of Concept should aim to address the key barriers to enacting a North Star policy: for example, if technical feasibility is the main barrier in a cold-climate state, pilots and demonstration projects can serve as Proof of Concept. States should also continue to pursue Accelerators and Equalizers, aiming to align their timing and implementation details with the North Star goal, to the extent it is known (and maintaining more flexibility if there is more uncertainty about the forthcoming North Star). Accelerators and Equalizers can also play a similar role as Proofs of Concept by starting to address the key barriers and concerns that delay development of a North Star. These are examples of applying the Map Framework at multiple scales, as described above, by coordinating policies to achieve an interim target that is then incorporated as an element of a broader market transformation.

2. Avoiding Gaps in Policy Coverage

As states progress toward their North Star goals, they should continuously evaluate whether their existing and planned policies adequately address all the known and expected barriers to achieving those goals. For example, a variety of Equalizers is needed to ensure that resources are not limited to those with access to particular types of incentives and programs, such as tax credits and utility rebates alone. Policymakers will also want to ensure that one or more policies fills each of the roles in the Map Framework, that they have a balance of carrots and sticks, and that all major stakeholders (utilities, equipment installers, large and small consumers, etc.) are addressed by one or more policies. Applying strategies from the traditional MT framework can be very effective at ensuring that all significant market barriers are identified and addressed, as long as those strategies are accompanied by Equalizers and deployed with North Star goals in mind.

3. Aligning Disparate Policy Goals and Metrics

Climate, air quality, and energy/efficiency policies have different goals, target different market actors, and use different requirements, criteria, and metrics of success. But these goals are related and can often be met using the same strategies (such as installing heat pumps). A diversity of policy approaches can actually be an asset (e.g., by leveraging multiple sources of expertise and regulatory authority), as long as the policies are not inconsistent and do not cause different regulated entities to work at cross-purposes.

A salient example of the need to align different policies' goals and metrics is the contrast between energy efficiency programs, which typically focus on *cost-effectiveness for reducing energy consumption*, and climate policy, which can be described as focusing on *least-cost pathways for reducing GHG emissions*. An effective North Star policy, such as a zero-emission equipment standard or a clean heat standard, can help incorporate climate targets into utility planning and investments by identifying the requirements to solve for in a *least-cost* way. For example, if a gas utility is required by a clean heat standard to reduce its emissions by a certain amount (or to deploy a certain number of heat pumps), and incentivizing customers to electrify is

the least-cost way to do that, the utility's resource planning should lead it to invest in those incentives (even if these electrification investments would not be found cost-effective as a traditional energy efficiency measure based purely on the energy savings they could produce). Similarly, if a zero-emission equipment standard is expected to steadily reduce gas demand as equipment stock turns over, this should be captured in utilities' load forecasts, prompting them to minimize stranded gas infrastructure investments and plan for a managed transition.

These are just a few of the ways utility planning and incentive programs can be aligned with building electrification policy objectives. For additional recommendations on climate-forward efficiency programs, see Specian, Gold, and Mah 2022, Specian and Gold 2021, and Nadel 2020. As electrification strategies advance, they will benefit from additional research on areas of need and opportunity to align policies in the distinct but related fields of climate, air quality, and energy efficiency.

4. Adapting Policies to Changing Market Roles

The transition to a decarbonized buildings sector will fundamentally change the roles of many market actors—most notably gas utilities—and the relevant regulatory structures will need to adapt to these changes. One illustrative risk is that after zero-emission equipment standards take effect, incumbent cost-effectiveness and least-cost frameworks may not provide a role for utility involvement in the standards' implementation. But there likely will be important work remaining, from supporting customers as they make electrification retrofits (which can remain somewhat costly where building systems need to be reconfigured to run on electric equipment, even as equipment and installation costs decline) to winding down the gas system and supporting gas workers in a just transition.

Fortunately, there are opportunities to adapt existing attribution frameworks to recognize the roles utilities can play in developing and ensuring compliance with zero-emission standards. Others have already developed frameworks to grant credit toward utilities' energy conservation goals for the utilities' work developing and supporting compliance with building codes and appliance efficiency standards (Miziolek and DoVale 2022, NEEP 2022, NEEP et al. 2013). These frameworks could be adapted to grant utilities credit toward their energy conservation or clean heat targets for helping develop and implement zero-emission equipment standards.

There may also be opportunities to update the assumptions used in cost-effectiveness tests for energy efficiency programs to make them more compatible with electrification (in the spirit of climate-forward efficiency). For example, zero-emission equipment requirements can generally be met with electric resistance heating, so a reasonable assumption is that some customers would replace existing gas furnaces with resistance heating upon burnout, absent incentive support for a more efficient heat pump solution. Under this assumption, there is a strong case for continuing incentive support for heat pumps, and higher support for more efficient heat pumps, even after zero-emission standards take effect. This will be especially important for lower-income customers who are less likely to opt for the heat pump's higher upfront costs.

Finally, there may be opportunities for utilities' role in supporting electrification to evolve as the transition progresses and zero-emission standards take effect. For example, work on rate reform will likely remain important as the profile of customers' energy use continues to change, including the increasing need to manage load to support the electric grid. This work isn't likely to be impeded by the existence of zero-emission standards. And financing arrangements

such as on-bill financing for heat pumps (which will hopefully be developed during the transition as Accelerators/Equalizers) may remain useful for smoothing out retrofit costs, even if other incentives like rebates phase out over time.

Again, these are just a few illustrative examples of the policy changes that will be needed on the road to decarbonized buildings, and the types of solutions that can be developed by applying the Map Framework of market transformation.

IV. Summary and Conclusion

The urgency, scope, and equity implications of building decarbonization make it a different challenge than traditional energy efficiency, necessitating updates to the market transformation tools used to pursue it. We have proposed a "map" framework that builds on the traditional MT framework by emphasizing zero-emission equipment standards' great potential as North Stars and Backstops, and the importance of deploying Equalizers in tandem with Accelerators throughout the market transformation. We have described the roles that several key building decarbonization policies can play in the Map Framework (drawing on examples from the ten USCA states that have committed to exploring zero-emission standards) and discussed ways that different policies can be designed to best fit their roles in the framework and work harmoniously together.

Based on this framework and analysis, we offer these recommendations for USCA states and NESCAUM MOU signatories as they pursue building decarbonization strategies that incorporate zero-emission equipment standards:

- Involve diverse stakeholders early in the policy adoption, development and implementation processes to ensure that cost, equity, and feasibility are fully addressed.
- Adopt climate-aligned zero-emission equipment standards as North Star policies early, with enough lead time before their implementation dates to serve as a market signal.
- Consider what other policies will be needed to ensure an equitable transition to implementing zero-emission standards. Be sure to fill each role in the Map Framework, have a balance of carrots and sticks, and direct policies at all major market actors.
- Ensure that different policies' requirements and timelines are compatible with each other and with the North Star target of 100% zero-emission new equipment sales.
- Adapt existing policy frameworks as needed to fit with a decarbonizing buildings sector and changing roles for key market actors.

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