

*33<sup>rd</sup> Electric Vehicle Symposium (EVS33)  
Portland, Oregon, June 14 - 17, 2020*

# **The Colorado Approach: An innovative pathway to zero-emission vehicle standard adoption and implications for future vehicle standards**

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## **Summary**

Colorado recently became the first state in a decade to adopt zero emission vehicle (ZEV) regulations, and the first ever to do so through a negotiated rulemaking with industry. The near-term expectation is that this action will accelerate the availability of clean car choices for Colorado consumers. Lessons learned from this process can inform future policy considerations for other states, industry, and the federal government.

*Keywords: zero emission vehicles, government, regulation, electric vehicle*

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## **1 Introduction**

In August 2019, Colorado became the first state in a decade to adopt ZEV regulations, and the first ever to do so through a negotiated rulemaking with the auto industry. The near-term expectation is that adoption of the rule will accelerate the availability of clean car choices for Colorado consumers. Additionally, lessons learned from the process of evaluating and ultimately adopting the ZEV rule raise a number of forward-looking policy considerations — for other states, for industry, and for future federal policy. As the ZEV market continues to mature (it comprised roughly 2% nationwide and 2.6% in Colorado as of 2019), changing market dynamics may inform policy choices for other states and regulatory bodies in the future.

In addition, the broader energy and transportation policy context has shifted substantially since the last time that major changes were made to the ZEV regulations, and in the decade since the last state adopted ZEV standards. The threat posed by global climate change is now far more widely understood, and the international community has adopted a set of emission targets that will require deep emissions cuts from light duty transportation (as well as other sectors) over the next three decades, likely requiring an almost complete transition to ZEVs over this time period. Thus, it becomes important to think about future policy design that takes into account the current state of the market, as well as complementary policies that are needed to support the wide scale adoption of ZEVs over approximately three vehicle replacement cycles.

Specifically, this paper raises forward-looking questions about four areas: 1) the balance of underlying regulatory policy missions, including emissions reductions and climate change mitigation, consumer savings, and energy security; 2) federalism and the respective roles of federal and state government relative to clean vehicle regulation; 3) regulatory structure including differences between technology neutral versus technology forcing standards, as well as differences between footprint-based standards and the ZEV credit system; and 4) the relationship between clean vehicle standards — ZEV in particular — and policies pertaining to transportation infrastructure and land use more broadly. While we do not offer specific recommendations, we believe that it is important to articulate these issues

and explain the context surrounding them, as federal and state policy makers prepare for debate about the next generation of light-duty vehicle standards.

## **1.1. Background: Early ZEV history and the changing context for Colorado ZEV**

### **1.1.1. Early ZEV policies focused on building a nascent market**

Until recently, policies promoting ZEVs, which include plug-in electric as well as fuel cell electric vehicles (FCEVs), evolved in a context that implicitly assumed that these technologies were a small share of the passenger car and light truck fleets (known collectively as light-duty vehicles). These initial policies were focused on early adopters and research and technology development that led to cost reductions.

At the federal level, ZEV policies historically focused on subsidizing research, development, and deployment of technology elements, such as high performance batteries and charging infrastructure, and on providing consumer-based incentives for early adopters. For example, the American Recovery and Reinvestment Act (ARRA) included \$5.4 billion for research, development, and deployment of electric vehicles and associated infrastructure [1]. Congress established a federal tax credit of up to \$7500 per vehicle in 2008 to promote early adoption [2] — making the credit available for a fixed number of vehicles (200,000) per manufacturer. Implementation of that policy has revealed a significant design flaw — automakers that invested early to develop better electric models lose access to the credit earlier than later adopting automakers who benefit from others' upfront investment and the boost to sales once those early adopters phase out of the program. This tax credit was always envisioned a temporary measure designed to spark a new market rather than as a permanent policy, though the current status of the ZEV market would justify an extension of the credits for some period of time, as there remains a significant, but steadily decreasing, upfront price premium on ZEVs.

At the state level, California and other states set sales targets for ZEVs that were aimed at a relatively small share of the overall light-duty vehicle fleet. California first adopted ZEV in 1990 with a group of other, mostly northeastern, states adopting them between model years (MY) 1993 – 2011 [3], with a hiatus of about a decade before Colorado took its recent action. In participating states, standards require manufacturers to sell ZEVs that result in a certain number of “credits.” Different numbers of credits are awarded per vehicle based on a number of factors such as battery range and extent of electrification (a plug-in hybrid is worth fewer credits than a fully electric vehicle). Within the California system, credit requirements were established such that they required ZEV sales amounting to about 4.5% of sales in 2018 [4].

While the federal Environmental Protection Agency (EPA) provided California with the authority to implement ZEV regulations, federal regulatory requirements are primarily focused on new internal combustion engines within the light-duty fleet. Pursuant to Section 209 of the Clean Air Act, EPA issued a “Waiver of Preemption” that allowed California to establish ZEV regulations, under the auspices of regulating criteria pollutants (a more recent action attempting to pull that authority granted to California has resulted in now-pending federal litigation). Additionally, the Clean Air Act (Section 177) allows other states to opt into the California program [5]. However, federal regulations are focused on establishing a cleaner vehicle fleet through efficiency targets established under the Corporate Average Fuel Economy (CAFE) program (originally created under the Energy Policy Conservation Act in the 1970s, as amended by the Energy Independence and Security Act in 2007) as well as under the Clean Air Act. These programs — implemented through streamlined regulations during the Obama Administration following efforts during the George W. Bush Administration to strengthen CAFE standards — do not prescribe specific technologies, but rather require the USDOT to set maximum feasible fuel economy and specific greenhouse gas (GHG) emissions targets for each manufacturer. Compliance has historically focused on improvement of internal combustion engines (ICEs), impacting a much broader number of new vehicles sold versus the ZEV requirements that, in early years, only impact a portion of the overall light-duty fleet. Since the mid-2000s, when the Bush Administration reinstated work to increase CAFE standards due to concerns about dependence on imported oil, fuel efficiency of new light duty vehicles has improved by about a quarter [6].

Both the supply side and the demand side have historically been constrained by the realities of new and relatively limited technology. This included high price points associated with the costs of emerging technology and limited, fairly niche, production volumes [7]. In 2012, there were only 13 plug-in models available in the U.S., many of which were only available in California [8]. In the mid-2010s, ZEV sales were primarily of the Tesla Model S (MSRP

\$57,400), the Nissan Leaf (MSRP \$32,780, and only 100 miles of range) and the Chevy Volt (MSRP \$40,000) [9]. On the infrastructure side, capability for charging — especially public charging — was also limited, which, coupled with the limited drive range of many early vehicle models, constrained consumer interest and purchases. Moreover, the market for charging and consistent pricing has only recently begun to develop and become more commonplace, and relies on yet a different set of parties — including the utility sector — which have not traditionally overlapped with the vehicle manufacturing and distribution markets [10].

### **1.1.2. Policymakers and manufacturers recognized challenges of promoting a nascent market**

Given market limitations, past ZEV regulation tended to prioritize broader state participation over stringency. Conversely, auto industry objections to ZEV have highlighted the limitations of sales mandates absent a strong market and corresponding incentives and charging.

For states adopting ZEV policies, levels of actual required adoption were relatively low — especially for the northeast states who followed California’s program. Due to somewhat low requirements and regulatory flexibility in meeting those requirements, automakers were able to accrue credits above what was required in early years [11].

Regulatory flexibilities that were available until recently in states other than California reduced automakers’ regulatory compliance needs, and also limited the need for states to have strong ZEV markets in order to participate in the program [12]. Specifically, a policy called the “travel provision,” which expired in 2017 for battery electric vehicles (but still exists for fuel cell electric vehicles), provided credits in all ZEV states regardless of where the vehicle was purchased. Thus, a BEV sold in Maine received credits in every ZEV state as if it had been sold in California and also proportionally in every ZEV state. This limited the required volume of ZEVs to those that would be required in California and allowed those ZEVs to be sold in any ZEV state. With this provision, California regulations effectively prioritized broader participation in the program over a higher barrier to entry [13].

Traditionally, manufacturers have not favored ZEV sales mandates for a variety of reasons—including market limitations as well as a preference for performance targets that apply to the broader fleet and are “technology neutral.” The auto industry supported the “One National Program” of streamlined emissions targets that was established initially in 2009 (for MY2012-2016), and have continued to advocate for a single set of steadily increasing performance standards nationwide. They have commented in the past that ZEV standards, which require more specific technology adoption, apply a different priority than the federal performance targets — and indeed, the different program choices may compel automakers to make different investment choices when determining whether to invest in improving ICE performance versus EV or FCEV technologies.

Additionally, manufacturers have expressed concerns that, while compliance responsibilities fall to their companies, earning compliance credits is contingent on cooperation from multiple other parties across the supply and distribution chains — including technology suppliers, dealers, and ultimately consumers, making a choice about what kind of vehicle to drive. A number of these concerns were outlined in a series of letters sent to northeast ZEV states in 2018 [14], which articulated some of these interdependencies, and recommended additional policies for ZEV states to adopt in order to assess them moving forward. Roughly concurrently, manufacturers initially urged Colorado not to adopt ZEV because the state had an above average percentage of ZEV sales [15].

### **1.1.3. Colorado adopted ZEV amidst a confluence of growth in the ZEV market and the increasingly urgent climate threat**

In the roughly ten years that lapsed between prior states adopting ZEV and Colorado’s regulatory process, the state of the market evolved significantly, as did the urgency around curbing transportation emissions. While ZEV sales remain a relatively small share of new sales nationwide, rates of uptake are significantly increasing in markets like Colorado [16], with product offerings expected to burgeon in the coming years, while prices drop. At the same time, challenges associated with transportation emissions are also intensifying.

Virtually all automakers have announced or begun to implement significant investments in ZEVs, the price point of these options is dropping as production increases, and driving range improves. More affordable and longer range options combined with greater socialization of ZEVs has begun to shift them out of the fringe and into the mainstream [17]. A recent study from MIT projected that the current upfront price differential is about \$10,000 and

is expected to decrease by about half in the next decade [18]. Some studies project that sedans will reach price parity by the mid-2020s [19].

On the research and development side, automakers' sunk-costs are significant — influenced not only by regulation in the US but by global trends, including regulatory pressure from Europe and China, that have accelerated investments. Industry is dedicating tens of billions of dollars to developing electric vehicles, on top of significant investments by the federal government, as discussed earlier [20]. This creates pressure on the industry side because, with heavy investments and limited uptake, additional investments in marketing, infrastructure, and policy outreach are difficult to justify. Getting over the “tipping point” would help automakers make a profit and consumers get lower prices because of greater sales volumes and on-going technological improvements in battery technology.

Moreover, consumer demand is growing — more so in Colorado's market than in many other parts of the country. Infrastructure has become more readily available, with faster and more visible charging options that, in Colorado, are enhanced by significant government investment and additional legislative proposals that have been adopted. This investment has obvious practical ramifications but also addresses harder to measure factors like range anxiety, awareness, and general consumer comfort level.

However, despite efficiency gains in transportation technology, the transportation sector — including light duty vehicles as well as other sectors like trucking and aviation — has become the number one source of GHG emissions nationwide, and Colorado is on track to see the same pattern [21]. While overall fuel economy for the entire light duty fleet has increased significantly, vehicle miles travelled by both passengers and freight are increasing [22]. This is in part a function of a strong economy, compounded by low fuel prices in recent years that have made driving cheaper, and larger cars (which consume more fuel) more attractive to consumers [23]. This demonstrates the limits of current policies, from an emissions perspective, especially in an environmental context like Colorado, where the Denver area – the most populous part of the state – is an ozone nonattainment area with serious air quality challenges [24]. It also shows some of the market challenges of policymaking, especially in a strong economy. All of these factors were relevant in the adoption of ZEV in Colorado and specifically in establishing context for working with automakers in a collaborative fashion.

## **2 Adopting ZEV in today's landscape: Lessons learned from Colorado**

### **2.1. Overview of negotiation and process**

From the outset, state agencies sought a negotiated approach that would facilitate collaboration between multiple government and industry partners. This process began immediately after Governor Polis issued his Executive Order in January 2019 [25], which called for the initiation of a ZEV rulemaking. State agencies took the view that good faith dialogue and effective communication could help optimize outcomes during a pivotal time for the deployment of ZEVs, with great promise for significant continued growth in market penetration in Colorado.

Within the state government itself, there were multiple organizations that participated in the effort. The Colorado Department of Transportation (CDOT) and the Colorado Energy Office (CEO) serve as key leads for transportation electrification issues within the state government, though the regulatory purview falls to a third Department – the Colorado Department of Public Health and the Environment (CDPHE) – and regulations must be voted on by the state's Air Quality Control Commission (AQCC).

Shortly after Governor Polis initiated the process, agency leadership and the two automaker associations, the Alliance of Automobile Manufacturers [26] (Auto Alliance) and the Association of Global Automakers (Global Automakers), considered multiple potential approaches before Colorado ultimately determined to move forward with the ZEV regulation. Between February and June 2019, the parties discussed possible alternatives to adoption of a ZEV rule under which manufacturers would agree to certain voluntary commitments. These discussions, which included individual automakers, as well as the associations, significantly improved the state's understanding of certain operational constraints that automakers face— such as differences between market-demand in different regions, variability associated with different OEM product cycles, the reliance of some automakers on credit purchase options to establish compliance plans, and limitations under franchise rules as to manufacturers' ability to influence dealers' uptake of specific vehicle models.

In June 2019, Colorado drafted a proposed term sheet for a voluntary agreement, which the agencies discussed with the auto trade groups as well as with several environmental stakeholders. All of the stakeholders articulated serious concerns with adopting an unfamiliar and complex approach. Following determination that this alternative approach would not be viable, the two automaker associations issued statements expressing appreciation for engaging in a good faith dialogue, and committing to work constructively with Colorado in the rulemaking process. CDOT, CEO, and CDPHE released a statement outlining similar appreciation and expressing optimism that discussions in the rulemaking context would result in accelerating ZEV sales in Colorado. Notably, both CEO and CDOT filed as parties to the rulemaking, in order to ensure that these conversations would continue within the formal rulemaking context.

Consistent with their commitment to work constructively with agencies during the rulemaking process, the associations presented to CDOT and CEO, on June 7, 2019, a proposal for an alternative rulemaking, initiating a discussion about whether various parties could submit a joint proposal. While the alternative proposal itself was not feasible from the perspective of state agencies (taken together, the regulatory relief offered in the alternative proposal would have exceeded the regulatory requirement itself), it was nonetheless significant in that it marked the first instance in a ZEV rulemaking where major industry groups had formally introduced an alternative within the rulemaking context, rather than objecting to adoption altogether.

That alternative proposal included two main components: 1) a request for granting a credit bank in Colorado, proportional to the size of the credit bank in California, for those manufacturers who agreed to make models available to Colorado dealers two years before the effective date of the rulemaking; and 2) establishment of “early action” credits for ZEV sales during the model years ahead of the effective date of the rule in MY2023. CDOT and CEO submitted a separate alternative proposal offering three years of “early action” credits, responding through a different approach than industry groups to the underlying industry concern about needing to build up a base credit bank ahead of regulatory enactment. These two alternative proposals by state agencies and industry stakeholders effectively established parameters for subsequent negotiations leading up to the joint proposal, which the two industry trade groups as well as CDOT and CEO filed ahead of the Air Quality Control Commission hearing regarding the rule.

Ahead of the AQCC’s August hearing, CEO, CDOT, the Auto Alliance and Global Automakers reached a consensus proposal regarding revisions to the rulemaking [27]. This consensus included the key elements above, balancing the desire to increase ZEV adoption and provide air quality benefits but also ensure the automakers can implement the regulation efficiently [28].

The joint proposal that was adopted provides proportional credits but restricts the use of those credits during MY2023-2025. This restriction on the use of proportional credits ensures automakers continue to increase ZEV sales in the state of Colorado while providing automakers with a credit bank to smooth their transition into the Colorado ZEV program. Under the proposal, automakers can choose one of two options to use proportional credits. If automakers elect to accumulate early credits, then they can use proportional credit to meet no more than 23% of their MY 2023-2025 requirements. If they do not take early action credits, then there is a 36% cap on the use of proportional credits. Part of the logic is that whatever successor program is developed for post MY 2025 will likely include provisions to address the large credit banks that manufacturers have accumulated in states that have been in the ZEV program for a decade or longer, and that granting proportional credits that cannot be used until after MY 2025 will put manufacturers on an equal footing in Colorado as in other states for future regulatory development.

Because automakers are at different stages of maturity in their ZEV platforms, the state felt that this approach provided flexibility for automakers that will make it more efficient for each of them to implement the program. Further, the expectation is that this approach will encourage early sales of ZEVs from automakers who are ready to do so. This compromise proposal will provide new purchase options for Coloradans, and this continued collaboration with industry is intended to promote these vehicles and incentives available at the state and federal level.

## **2.2. Lessons for other states considering ZEV**

The intricate process that ultimately yielded a negotiated regulatory proposal, adopted by the AQCC, highlighted a number of lessons that may be useful to other states contemplating ZEV. These include:

- ❖ **Early and consistent communication is key – avoid surprises:** Even before the formal regulatory process ensued, Colorado reached out to industry to initiate discussion about how to implement ZEV policy in a way that

would get cars available to consumers faster. The timing of that communication was key, as was the fact that all parties kept each other informed throughout the process, both of good news and bad news. All public communications were coordinated between parties, including when state agencies and industry groups initially failed to reach agreement. This coordination helped with maintaining goodwill and trust, and with keeping lines of dialogue open long enough to ultimately reach agreement during the rulemaking phase. Information was also shared with the public and environmental stakeholders to ensure transparency throughout the process;

- ❖ **Patience and attention to technical detail kept the process focused on substance:** In recent years, policymaking related to clean cars has become politically charged, though it is historically bipartisan. Participants in the Colorado negotiation remained focused on particulars of the discussion, distinct from broader debates related to fuel economy;
- ❖ **Regulations were contemplated as part of a holistic suite of policies supporting ZEV deployment, rather than in isolation:** It is important to take a holistic approach if considering ZEV in order to set the policy and real world context up for success (incentives, charging infrastructure, utility engagement, education, etc.). It is also important to couple with regulatory requirements or other strategies to decarbonize electricity generation;
- ❖ **States are at different stages of readiness, which must be considered in establishing policies:** States have different “starting points” but limited flexibility in terms of regulatory options because of the structure of the Clean Air Act. There are some tools available to navigate this tension (e.g. proportional credits, early action credits) but these are limited at present. Relatedly, there are administrative challenges associated with states adopting California’s regulatory program at different snapshots in time, without the appropriate “ramp up” policies to support consumer adoption and use;
- ❖ **Despite its imperfections, the familiar structure of ZEV made it easier to work within the program than outside of it:** While discussions started with talks of a voluntary agreement, it became clear that the consistency of how the ZEV credit market operates across states made it a much easier negotiating platform; and that manufacturers are strongly incentivized to direct model availability and marketing to ZEV states, making it difficult to create an alternative approach;
- ❖ **The built environment must be considered when adoption ZEV policies:** In Colorado, for example, we recognize differences between what will work in urban versus rural areas, and have been candid with ourselves and partners about where different vehicle types are likely to take off. It is very important to have choices that work for people in different environments based on weather, elevation, and other factors. In urban areas, efforts to promote EVs are more closely tied to thinking about mobility choice — including ridesharing and other uses more applicable in denser areas where range is less of an issue but air quality often more so. Frequently, discussions about clean cars exist in a separate silo from discussions about infrastructure and the built environment, but these need to be intertwined.

### 3 Considerations for post-2025 clean vehicle policymaking

In addition to lessons that are relevant immediately for other states contemplating ZEV, Colorado’s experience raises a number of thought-provoking questions that should be considered as policy makers consider future clean vehicle regulations. Importantly, both the current federal program as well as California’s current program — under which other ZEV states operate — remain constant at the MY2025 level and do not increase in stringency thereafter, but substantial reductions are still needed to attain environmental goals. This situation means that federal and state entities need to contemplate future rulemaking in the next few years beyond MY 2025 requirements. While debate over the last three years of the current CAFE/GHG program and dynamics between the Trump Administration and the State of California have dominated the national headlines, and the parties are now engaged in litigation regarding a number of matters including the issue of federal preemption, it is important to begin turning to a constructive conversation about the next generation of regulations, and Colorado’s recent case study can be helpful in offering insights.

#### 3.1. Revisiting the balance between regulatory missions

Since the 1960s, regulators have debated the underlying justification for rules controlling vehicle emissions— oscillating over time between a focus on the environment, energy security, and later on consumer savings [29]. All of these factors are important and need to be considered in setting standards, but it is also critical to periodically revisit the mission of underlying regulatory programs to ensure that they are balanced in a manner best suited to contemporary challenges and opportunities.

In California, early regulations preceded the federal program regulating vehicle criteria pollutant, or smog-forming, emissions and focused on achieving air quality and environmental goals. California's regulations were some of the first that led to the development of catalytic converters, and later to onboard diagnostic systems, as well as other initial controls on automobile emissions. Over time, California's regulatory program has consistently focused on environmental impacts.

The establishment of the CAFE program in the 1970s created the first federal controls on fuel economy, centering federal regulation around energy security. This framework responded directly to the experience of the Arab Oil Embargo, and focused specifically on conserving oil rather than the emissions impact — though in practicality there is much overlap between the effect of putting controls on these respective factors. The program was placed under the jurisdiction of the U.S. Department of Transportation (which was delegated to the National Highway Traffic Safety Administration) rather than the Environmental Protection Agency (EPA), a distinction industry has historically preferred because it placed fuel economy under the same regulatory umbrella as controls on motor vehicle safety and encouraged balancing a number of different policy considerations in regulatory analysis.

In 2007, the Supreme Court Decision in *Massachusetts v. EPA* shifted the balance in the debate by clarifying that the Clean Air Act gives EPA jurisdiction to regulate GHG, if the EPA found, as they since have, that carbon dioxide emissions pose a health danger to the public. That same year, the Energy Independence and Security Act (EISA) [30] modernized the CAFE program under the aegis of energy security. In 2009, EPA and USDOT initiated a joint rulemaking program, in coordination with the State of California, which had been considering a separate GHG rule. The resulting One National Program streamlined implementation of their respective authorities in a program that coupled USDOT's statutory focus with increased emphasis on clean air, as well as a focus on consumer savings — an issue that was of particular relevance during the Great Recession and given high oil prices as the Obama Administration was assessing its regulatory program through MY2025. The program included a mid-term evaluation to reevaluate whether standards for the final years of the program should be adjusted up or down, or stay the same [31].

At present, it is reasonable to re-evaluate the balance of regulatory missions, something that the Trump Administration focuses on in their proposed “Securing America's Future Energy” or “SAFE” rule, in which they argue that low oil prices and high domestic production diminish the energy security argument for fuel economy standards [32]. Notwithstanding that the historically cyclical nature of oil prices and production would challenge this argument, it is nonetheless valid to question whether the nature of underlying regulatory need has changed in today's environment — the urgency associated with climate change and air pollution, in particular, coupled with new technologies that are available and the increased consumer benefits of clean vehicles, would argue for a restructuring of how automobile regulation is structured in the future.

### **3.2. The respective roles of federal and state government**

ZEV polices bring together two aspects of regulation — vehicle regulation and regulation of the electricity sector. These have historically balanced federalism very differently. With the coming together of these policy areas, it is worth parsing this contrast to inform future discussion about cooperative federalism and the relationship between the federal government and states in advancing cleaner vehicles.

**The move towards clean electricity generation is being driven by states.** One of the major changes is the transformation of electricity generation to a much cleaner mix, which is both increasing the near term emissions benefits of EVs compared to ICE vehicles, and is also creating a pathway towards true near zero emission transportation by significantly limiting upstream emissions from ZEVs. In Colorado, legislation passed in 2019 requires the largest electric utility in the state to achieve an 80% reduction in GHG emissions below 2005 levels by 2030 and a 100% reduction by 2050, while other legislation has set the stage for rule-making requiring similar reductions from other utilities [33]. In much of the western U.S., the decline of coal has been replaced primarily with wind and solar generation, while coal has been replaced largely with natural gas in the rest of the country [34].

One of the factors that has enabled rapid decarbonization of electricity generation in some states is that they have a great deal of autonomy in how they regulate electricity generation. This is quite different than in the automotive sector, where the federal government has primacy, with a limited state role in emissions regulations set by Sections 209 and 177 of the Clean Air Act.

By contrast, it is the federal government that has a limited role in electricity regulation, primarily fulfilled by the Federal Energy Regulatory Commission (FERC), which has jurisdiction over interstate transmission and wholesale sales. State governments have regulatory jurisdiction over generation and over local distribution networks. The EPA also regulates emissions from power plants, but state governments have clear authority to set tighter requirements for GHG emissions from electric utilities, including the ability to set requirements that apply to entire systems, as opposed to just regulation of individual power plants, and states have the ability to set regulatory requirements and create financial incentives for zero carbon sources such as renewables and nuclear power [35].

The Trump Administration has made recent attempts to assert greater FERC authority, essentially attempting to define any clean energy or renewable standards and any state financial support for clean energy as market manipulation, justifying FERC intervention to maintain the integrity of the wholesale capacity markets. While this is currently limited in geographical scope to the Pennsylvania, Jersey, Maryland Power Pool (PJM) area, and is likely to be overturned in litigation, it does represent a potential new challenge to state authority.

Electricity generation also provides an example of a sector where early deployment of renewables was driven almost solely by policy. Twenty years ago, wind and solar were far more expensive than coal or gas generation, and the market by itself delivered almost no renewables. Supportive policies such as tax incentives and research and development funding created a market in which participants were able to learn by doing, benefit from technical innovation, and foster economies of scale and international competition. As a result, wind and solar are now the cheapest ways to generate electricity [36].

**Pathways to deep emissions reductions, driven largely by state-level policy on the generation side, have implications for promulgating cleaner vehicles through both federal and state policy.** As renewables become cheaper and more readily available, especially in certain regions, this creates a pathway to deep carbon reductions elsewhere if sectors that traditionally burn fossil fuels directly switch to clean electricity. This is the case with ZEVs [37]. A recent Vibrant Clean Energy analysis concludes that the uptake of renewables and aggressive electrification of transportation and buildings in Colorado would both reduce emissions by 69% below 2005 levels and yield net consumer savings of nearly \$30 billion by 2040 [38] [39]. Nationally, it is very difficult to conceive of a pathway towards deep (80-100%) carbon emissions reductions that does not require a large scale shift away from ICE vehicles, and the benefit will be maximized by pairing with state and national policies that significantly advance clean electricity.

**However, the efficacy of state ZEV requirements is dependent on other policies – including those related to energy generation, electrification infrastructure, and policies that impact the demand side.** Specifically, the impact of ZEV regulations is dependent on complementary measures that support charging infrastructure as well as consumer adoption. Colorado was in a strong position to adopt ZEV standards because of all of the work that had been done in the state to build consumer demand through consumer incentives, charging investments, and education and outreach. Since then, at least three other states including Minnesota, Nevada, and New Mexico have begun the process of adopting these standards, but since each state is at a different place in terms of the market development and consumer demand, state-specific consideration will be vital as they weigh the benefits of adopting a ZEV requirement.

State level policies can also be aligned with measures to address travel demand and help spread the compliance responsibilities associated with emissions reductions to roadway users in addition to vehicle manufacturers. For example, there are opportunities to identify policies that pertain to ridesharing and the growing trend towards Mobility as a Service (MaaS), as well as the likely rise of autonomous vehicles. Potential policy levers to help reduce emissions associated with vehicle miles traveled through these platforms could build on the “clean miles” standard adopted by California, which requires a faster transition to ZEVs used in MaaS, justified due to the high VMT associated with these vehicles [40]. By encouraging fleets and other users of these services to transition to cleaner vehicles, and reduce vehicle miles traveled, these policies can complement ZEV and spread compliance burden more broadly – not to mention raise consumer awareness and understanding regarding ZEVs.

Affording more flexibility to states may help encourage better integration of vehicle standards with other types of investments, incentives and complementary policies that are needed for success, such as the examples noted above.



However, current “identity” requirements under the Clean Air Act limit states’ flexibility to make minor modifications of the California program. While this requirement has helped automakers avoid a patchwork of state regulations, it may be worth questioning whether identity requirements for state standards make sense in a context where the primary regulatory tool is ZEV percentage requirements. Unlike more traditional emissions requirements, states setting differing ZEV requirements does not lead to the problem of manufacturers needing to develop different engines or emissions control equipment for each state. The same makes and models of vehicles could be sold in each state, but in some states the mix of ZEVs would need to be higher – raising considerations, instead, about allocation of supply versus realistic consumer demand in each state.

### 3.3. Structural options for future regulation

Both industry and outside experts have noted that the structural differences between CAFE/GHG standards and ZEV merit future discussion about the need for reconciliation [41] [42]. While the programs support one another in some ways, they also drive towards somewhat different endpoints that can be at times inconsistent [43].

Specifically, CAFE and current GHG standards are technology neutral, meaning that they set targets for increased fuel economy and GHG reduction that can be achieved through a range of technology pathways. While EPA’s program offers some credit incentives for ZEVs, the standards, as a whole, promote more efficient ICEs by requiring automakers to meet individual fleetwide targets. Generally speaking, given current stringency levels and the footprint-based approach whereby automakers’ targets are set based on the nature and geometry of the models they actually produce (e.g. larger vehicles classified as light trucks have lower targets than small cars), the most cost effective approaches for fleets to comply have been technologies to improve capabilities of ICE vehicles, incrementally.

By contrast, ZEV standards require specific technologies— some of which are not the same as those that a company optimizing for cost of current CAFE/GHG levels would select. Thus, meeting ZEV could drive up a company’s CAFE/GHG compliance costs in the short term, especially while ZEV sales remain a relatively low share of total sales. However, over the long term ZEV technologies can achieve much greater savings per vehicle than a high performing ICE vehicle, particularly as ZEV costs continue to drop and the electricity generation mix becomes cleaner [44].

This contrast between regulatory structure creates some tradeoffs over the coming years, as scholars at the University of Indiana and elsewhere have noted. To that end, some specific questions for state and federal regulators as well as industry to consider include:

**Should the structure of future standards focus more on electrification than on incremental improvement of internal combustion engines (ICE)?** Historically, standards have been focused on incremental year-over-year increases in fuel economy (CAFE) and decreases in GHG emissions, rather than attempting to force particular technology outcomes. In fact, analysis during the Obama Administration argued that standards (MY 2022-2025) could be met primarily by improvements to ICE engines, vehicle light-weighting, and other approaches that do not require the use of electrification, and thus that compliance costs were quite low [45]. But, given the environmental need to achieve additional orders of magnitude in terms of emissions reductions across the transportation sector (including but not limited to light-duty vehicle efficiency), there are a number of questions that should be grappled with as both the federal government and states develop the post-MY2025 standards. Should federal standards be explicitly designed to lead to a large scale transition towards ZEVs? For example, should there be consideration of a federal ZEV standard that defines a trajectory towards 100% ZEV sales over the next few decades? Is there a point at which having both a GHG and a ZEV standard becomes redundant, such that the goal might shift from improving ICE vehicles to focusing primarily on ZEV transition?

**Should regulators consider some near-term fuel economy tradeoffs to further accelerate the transition to ZEVs?** If so, such a tradeoff could argue for the next generation of regulations, post-MY2025, to taper annual increases to or potentially freeze fleetwide fuel economy targets, perhaps reaching current EPA 2025 levels set by the Obama Administration (albeit potentially adding 2-3 years flexibility to help automakers reach those levels), in order to focus the next iteration of regulations on faster deployment of ZEV models into the fleet, with those MY2025 levels (or something similar) serving as a floor and avoid back-sliding. In this approach, the fleet could be required to

sustain those targets once they are achieved, but subsequent additional requirements might be focused on ZEV deployment rather than continuing to push additional incremental fuel economy as well;

**Should automakers revisit their historical posture on technology-forcing ZEV standards in light of their investments and sunk costs?** While automakers have typically objected to technology-forcing standards and the structure of a sales mandate, the automaker industry’s willingness to reach a negotiated agreement with Colorado suggests that the extent of their investments in ZEV technology — combined with the seeming proximity of a potential market tipping point — could change their view. Automakers have often favored or tolerated safety standards that force certain technologies (e.g. airbags, seatbelts, rear view cameras more recently) to become mainstream — in part because these mandates force costs of these technologies to be shouldered more equitably across the industry;

**What are the respective benefits of footprint-based standards, credit systems, or other compliance models, and how can regulatory structure be optimized for the future?** Footprint-based standards have effectively provided a sliding scale for vehicles of different sizes to achieve compliance, but also have unintended consequences, such as pushing manufacturers to focus significantly on efficiency for smaller cars, where the actual compliance requirements were much more stringent, and creating false distinctions in categories such as “crossover SUVs.” However, it is also worth evaluating the performance of the ZEV credit model, which offers different numbers of credits for various types of ZEVs, based on features such as drive range and whether a car is fully or partially electric. A credit system could accommodate additional nuance (e.g. incentives for electrifying larger and less fuel efficient vehicles) by increasing the gradations of credits similar to how vehicles are differentiated using a footprint model. It may be more efficient to pick and refine one system of compliance (credit or footprint), rather than perpetuating both.

If future standards focus primarily on ZEV, an alternative approach might define realistic pathways towards ZEVs for a few different vehicle classifications, and set trajectories that are on different timelines – so that, for example, perhaps sedans would effectively need to be 100% ZEV by the early 2030s while larger SUVs and pickups would need to hit 100% towards the end of the decade. Conversely, it could also make sense to consider an approach that focuses on transitioning larger vehicles to electric first, since those are higher emitters. All of these considerations merit further discussion.

**Should regulatory jurisdiction be streamlined to ease implementation?** Since 2009, regulation has depended on technical and operational collaboration between two federal agencies and the State of California — effectively working as proxy for other states. It would be worth exploring whether jurisdiction should be simplified at the federal level, in order to focus the discussion more acutely on ensuring effective coordination between different levels of government. For example, as states implement their authority both with respect to the Clean Air Act and with respect to promoting a cleaner energy mix on the generation side, it might simplify matters to deal principally with one federal agency — perhaps EPA — with a clearer and modernized set of statutory authorities governing the clean vehicle program, and prioritizing the imperative to reduce GHG emissions from vehicles.

**Should federal infrastructure investments align with a national ZEV standard?** To date, there has been very little coordinated federal planning and investment in charging infrastructure. The USDOT has designated Alternative Fuel Corridors, but has not provided funding. The federal settlement that created the Volkswagen Environmental Mitigation Trust did require Volkswagen to create their Electrify America subsidiary for deploying charging, and provided approximately \$2.7 billion to states, 15% of which could be used for light duty vehicle charging infrastructure, and there have been some DOE grants for deployment. However, there is no ongoing program for planning and funding the large-scale deployment of charging infrastructure. This has fallen largely to the states. A number of states have authorized (or required) regulated electric utilities to invest in charging infrastructure. If the federal government were to act to significantly expand ZEV deployment through a combination of extending ZEV tax credits and enacting a national ZEV standard, it would likely also require a federal investment to ensure that the necessary level of infrastructure is available nationwide.

### **3.4. Relationship between clean vehicle standards and the built environment**

Finally, it is important to recognize that the efficacy of a clean vehicle program is reliant on a host of land use policies, both in terms of installing sufficient ZEV infrastructure and the vehicle miles traveled (VMT) impact of any policy regulating mobile source emissions in the light duty sector.

Notably, overall transportation GHG emissions have increased in recent years even while fuel economy continues to improve. In the light duty sector, this reflects increased VMT. While VMT tends to correlate to the strength of the economy, land use policies play an important role in influencing driving habits — including both the extent of reliance on cars as well as the length of average commutes [46]. Thus, it is impossible to explore the practical impact of clean car policies without also looking at how they interface with the growth of the built environment. In addition, converging trends in the mobility sector, such as shared mobility, ridehailing services (like Uber or Lyft), automation, and connected vehicles could enhance or deter progress on reducing transportation emissions. At the federal level, significant changes should be made to transportation infrastructure funding in order to encourage tools that help reduce emissions and improve air quality.

In a similar vein, as we explore the build out of electrification infrastructure in relation to the increasing range capabilities of electric vehicles, the infrastructure needs should be considered alongside typical driver behavior in metropolitan and rural areas, respectively. For example, the buildout of EV corridors for long-distance drives is critical, which is why Colorado is working to increase access along corridors like I-70.

However, increasing range to as much as 300 hundred miles per charge should virtually eliminate practical range issues for passenger cars within metropolitan areas, even more so in cities where denser development patterns reduce daily commuting distances.

## 4 Conclusion

While in some respects limited in duration and scope, Colorado’s adoption of ZEV standards yielded a number of specific lessons for states considering similar policies, and also prompts longer term questions that may be useful for both regulators and industry, looking towards longer term policies and market shifts. Colorado looks forward to continuing to work with public and private partners to adapt to this changing landscape moving forward.

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