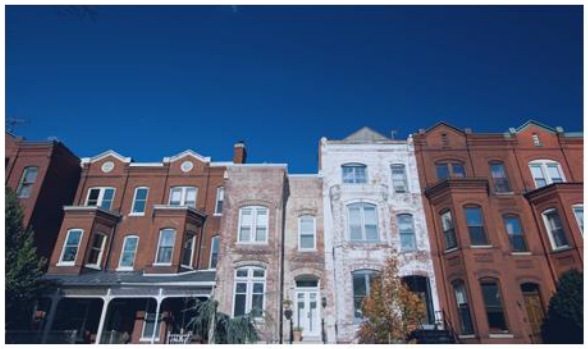
Toolkit for Advanced Transportation Policies

Improving Environmental, Economic, and Social Outcomes for States and Local Governments Through Transportation



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This report is available at www.mjbradley.com.

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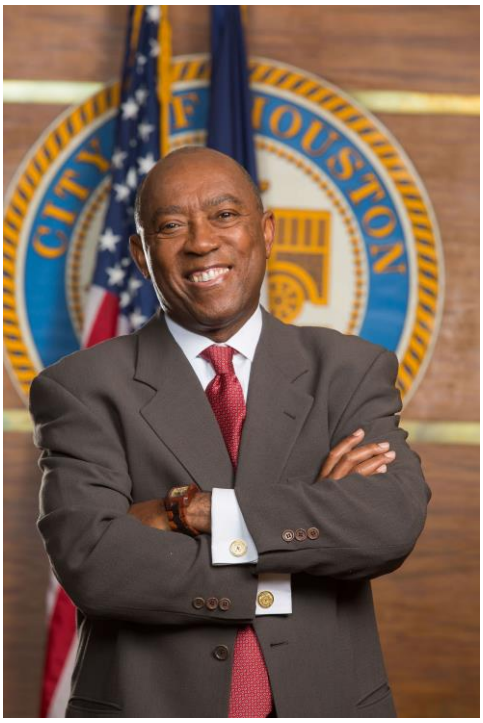
Foreword by Sylvester Turner, Mayor of the City of Houston



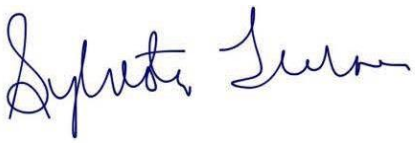
Transportation is a vital component of our modern existence. It touches almost every aspect of our lives. Our transportation networks shape our communities, define how we get to work and school, and make it possible to visit family and friends. Transportation influences the well-being of our citizens and the health of our economy, so it's no surprise that local governments are always focused on our transportation networks—and on ways to improve them.

The good news is that, thanks to new technologies, we have good options for improving our transportation networks to achieve a multitude of societal benefits. In fact, there is enormous opportunity for progress and innovation in the transportation sector. Emerging technologies offer the potential for lower pollution and better transit. Smarter vehicles and transportation systems can help Americans get where they need to go more rapidly and safely than ever before. And we can accomplish all that while also ensuring that we're protecting our climate and providing cleaner, healthier air that we all can breathe.

A modern, advanced transportation system can help us achieve multiple public health and public policy goals at once, like reducing pollution and decreasing congestion. A range of smart policies now exist that can speed the transition to the transportation systems of the future, and local governments will be a key player as we move toward the adoption and implementation of those policies. It's local and state governments that will lead the way as we adopt emerging transportation technologies.

Cities and states have an enormous opportunity right now to support cleaner and smarter transportation networks. This toolkit is designed to help seize those opportunities and put the best technologies to work. It has a menu of options that are available today that will cut pollution and improve air quality while supporting advanced, accessible transportation networks. Its pages detail a host of win-win policies that local and state government have the authority to adopt and put to work, right now.

Our cities are ready to move forward and implement solutions that will make our communities stronger. Hopefully, this toolkit will make it easier to take action.



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Introduction

The transportation sector is a critical component of a functioning, modern economy. From daily commutes to large scale goods movement, the majority of U.S. residents depend on this sector every day. In fact, the Bureau of Transportation Statistics estimates that 9 percent of U.S. gross domestic product (GDP) is attributable to transportation.

However, the transportation sector also has significant impacts on communities' health. More than half of all ground level ozone-forming nitrogen oxide (NOx) pollution comes from vehicles, and ozone can cause breathing problems especially for children, people with respiratory diseases including asthma, and even healthy adults who exercise or work outdoors. In areas that have already achieved important reductions from the electric sector, transportation sector's contribution level can be much higher. And about ten percent of nationwide fine particulate matter, and a much higher percentage of urban particulates, also comes from the transportation sector. Coarse particulate matter can cause upper respiratory tract health problems, and fine particles can cause heart attacks, strokes, asthma, and bronchitis, as well as premature death from heart ailments, lung disease, and cancer.

Additionally, the transportation sector is now the leading source of carbon dioxide (CO_2) emissions in the U.S. Climate change is increasing risks to states and local governments, from increased severe storms that place homes, communities, businesses, and critical infrastructure at risk, to long and more dangerous heat spells that make cities harder to live in, to threats to economic and agricultural output and productivity. In the face of these challenges, states and local governments are taking action to reduce CO_2 emissions to limit such impacts, as well as considering changes to local economic and urban design—including transportation systems—to adapt to changes that have already occurred.

Commuting also affects people's wellbeing as it constitutes a large and rising portion of an average day—the average U.S. daily commute is close to an hour in total, and more than 12 million Americans spend more than two hours each day on their commute.[1] Research has shown that longer commutes are linked with increased rates of negative health conditions (such as obesity and depression) and lower life satisfaction.[2]

Policies that aim to improve the transportation sector have a high opportunity for improving environmental and social justice outcomes, and indeed, can achieve numerous interlocking goals. These goals might include pollution reductions, congestion reduction, quality of life and economic productivity improvements, and even improving electric system performance. Furthermore, policymakers from across all jurisdictions, including states and local governments, have significant opportunity and ability to shape local outcomes, regardless of any federal actions.

Policies can also take advantage of the recent explosion in new transportation approaches and technologies. On the technological side, for example, the electric vehicle (EV) market is rapidly expanding, with annual sales growing by nearly a third year over year, and hundreds of fully or hybrid EVs projected to be commercially available by 2025—both of which hold significant opportunities for reducing emissions.[3] For example, General Motors has committed to adding 20 electric and fuel cell vehicles by 2023 (two by 2019).[4] And, by 2025, Volkswagen intends to globally introduce 80 new EVs, including 50 all-electric cars and 30 plug-in hybrids.[5] States and local governments are also beginning to focus on the transportation sector in economic development planning, with initiatives like Smart Cities, Transportation for America, and more placing transportation at the

center of urban planning.[*] Policymakers are also moving toward including the entire transportation sector in greenhouse gas (GHG) emissions reduction goals and programs.[†]

This paper explores the broad range of tools available to policymakers, especially at the state and city level, who are looking to improve their transportation sector. By highlighting options, key considerations, and examples of successfully implemented policies, this paper provides an introduction of policy options so that policymakers and stakeholders can consider the potential process to evaluate which policies or programs may be appropriate for a specific jurisdiction.

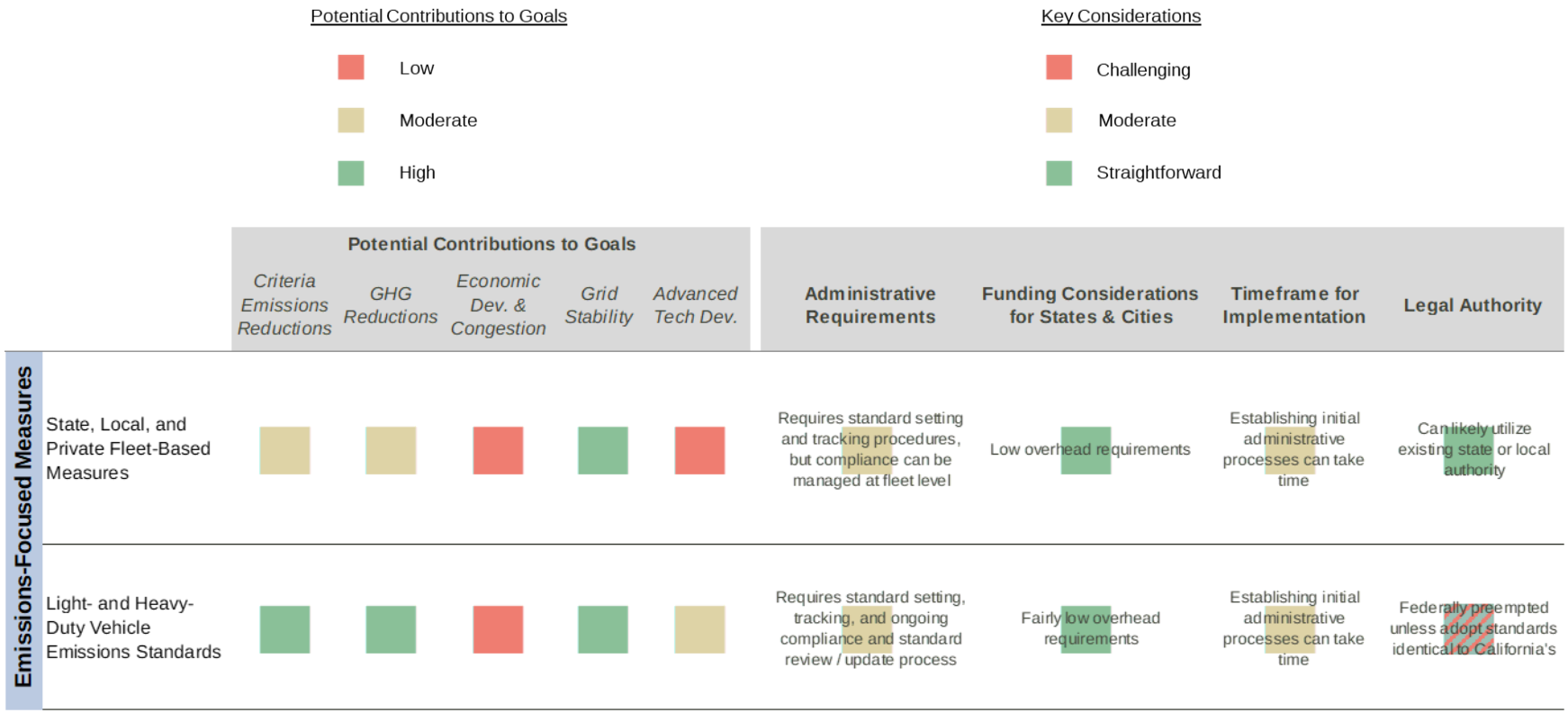
This paper first provides a detailed overview of the various overlapping goals for advanced transportation policies, and then includes a summary of states and local governments' legal authority to undertake these next generation policies. The bulk of the paper consists of the "Transportation Toolkit" of policies and programs that can serve as a reference resource for policymakers. While certainly not a comprehensive list of possible transportation policies, it focuses on those with widespread and increasing adoption, as well as some promising emerging strategies, that have the potential to capture health and environmental benefits. The Toolkit is divided into three general categories—emissions-focused programs, electrification programs, and broader programmatic measures—though there are significant overlaps among these categories as noted throughout. Figure 1 displays the range of policies and programs included in the Toolkit, including how these policies may contribute to goals as well as key administrative considerations.

[*] See section "Development Standards and Congestion Reduction Approaches" below.
[†] See section "Emissions-Focused Measures" below.

Figure 1 Summary Key for the Policy Toolkit: Potential Contributions to Goals and Key Considerations

This figure displays key aspects of each toolkit policy. First, it shows how each policy may help a policymaker achieve each of the five policy goals explored in more depth in this paper by highlighting how much, on a relative basis, a policy could potentially contribute to each goal. For example, a policy that has a large potential to reduce GHG emissions would be marked as "High," or green. It also synthesizes key administrative requirements from a city and state perspective, such as overall regulatory administrative requirements, regulatory funding considerations, timeframe, whether the regulations could be preempted by the Clean Air Act depending on their design, whether a regulator can use existing authority to develop a program or may require state legislative action. For example, the "Funding Considerations" column takes into account the funding that would be required to establish and operate the program from a regulatory perspective but does not necessarily take into account participant costs. It is important to note that these designations are broadly based on existing programs and experiences, and that local policy decisions and factors will determine ultimate program administrative requirements.

Emissions-focused measures are those that directly target reductions in emissions, including greenhouse gas emissions, particulate matter, and smog-forming NOx emissions. There are a range of policies that can target this goal and can often create numerous co-benefits in the process. Policymakers can implement direct emissions standards, requiring that individual vehicles or fleets of vehicles reach certain emissions level per mile traveled. Alternatively, policymakers can design market-based policies that create an incentive to adopt technologies or practices that lower the targeted emissions.



Potential Contributions to Goals

- Low
- Moderate
- High

Key Considerations

- Challenging
- Moderate
- Straightforward

		Potential Contributions to Goals					Key Considerations			
		Criteria Emissions Reductions	*GHG Reductions*	*Economic Dev. & Congestion*	*Grid Stability*	*Advanced Tech Dev.*	**Administrative Requirements**	**Funding Considerations for States & Cities**	**Timeframe for Implementation**	**Legal Authority**
Emissions-Focused Measures	*Market-Based Mechanisms*									
	Cap-and-Invest	High	High	High	High	High	Requires a range of administrative decisions and ongoing tasks, including tracking and compliance review	Moderate overhead requirements, but can be revenue generating	Establishing initial administrative processes and determining program format can take many years	May require state legislative approval
	Low Carbon Fuel Standards	High	High	Moderate	High	Moderate	Requires standard setting, tracking, and ongoing compliance and standard review / update process	Moderate overhead requirements, but can be revenue generating	Establishing initial administrative processes and determining program format can take many years	May require state legislative approval
	Gas Taxes or Fees	Moderate	High	Moderate	Moderate	Moderate	Requires standard setting process but once established relatively low obligations	Can generate revenue	Establishing initial administrative processes can take time	May require state legislative approval
	Feebate	Moderate	Moderate	Moderate	Moderate	Moderate	Once established, requires regular updates	If designed accordingly, program can be revenue neutral or revenue positive	Can be implemented quickly	Tax component may require state legislative approval

EVs are a rapidly growing technology with opportunity to reduce pollution, mitigate climate change, integrate with the electric grid to help improve stability, and advance technological development. Policies that support the electrification of light- and heavy-duty vehicles include direct financial incentives, support for infrastructure from state and local governments, and encouraging or facilitating electric utility support of EVs and infrastructure.

		Potential Contributions to Goals								
		Criteria Emissions Reductions	*GHG Reductions*	*Economic Dev. & Congestion*	*Grid Stability*	*Advanced Tech Dev.*	**Administrative Requirements**	**Funding Considerations for States & Cities**	**Timeframe for Implementation**	**Legal Authority**
Electric Vehicle Measures	Financial Incentives						Analysis may be useful for setting and updating incentive amounts, but simple administration	Could require funding, though could be paired with other revenue-generating program (e.g., feebate)	Can be implemented quickly	Can likely utilize existing state or local authority
	Infrastructure Support									
	Permitting and Siting						Analysis may be useful for determining appropriate reqs, but simple administration	Low overhead requirements (can in fact reduce permitting office costs)	Can be implemented quickly	Can likely utilize existing state or local authority
	Charging at Government Sites						Requires process to identify appropriate sites	May require funding, though partnering with developers can lower costs	Identification process requires lead time	Can likely utilize existing state or local authority
	Financial Support						Analysis may be useful for setting and updating incentive amounts, but simple administration	Could require funding, though could be paired with other revenue-generating program	Can be implemented quickly	May require state legislative approval (e.g., if through tax code)
	Requirements for New Construction						Analysis may be useful for determining appropriate reqs, but simple administrations	Low overhead requirements	Can be implemented quickly	Can likely utilize existing state or local authority
	Coordinated Infrastructure Planning						Working with partners and gathering and analyzing data can be challenging	Analysis may require low costs	Coordination across jurisdictions can require longer stakeholder process	Can likely utilize existing state or local authority

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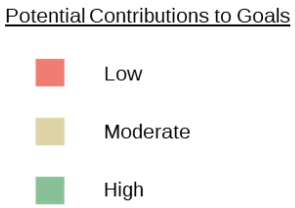
Electric Vehicle Measures	*Utility Offerings*									
	Investing in Charging Infrastructure						Typically require regulatory process for planning and approval	Funding provided by utilities (and customers) or third party	Mid-term time commitment	Need utility regulatory approval, but can typically utilize existing state regulatory authority
	Charging Rates & Programs						Typically require regulatory process for planning and approval	Can result in net cost savings for utility customers	Can be implemented quickly	Need utility regulatory approval, but can typically utilize existing state regulatory authority
	Customer Education						Typically require regulatory process for planning and approval	Limited funding necessary	Can be implemented quickly	Need utility regulatory approval, but can typically utilize existing state regulatory authority
	Vehicle Grid Integration						Will require coordination across grid operators, utility and air regulators and others, tech. advancement, and a regulatory process to update tariffs/grid rules	Limited funding necessary	May require regulatory process and phase-in period	Can likely utilize existing state or local authority
	Public Transportation Electrification						Require long-term plan, procurement and evaluation process, charging infrastructure build out	High up-front costs, though fuel savings can recover those costs	Mid- to long-term transitional typical to align with existing replacement schedule	Can likely utilize existing state or local authority

Because transportation is inextricably intertwined with economic activity of states and local governments, there are many broader programmatic measures that may not be solely transportation focused but can have significant impacts on the sector. For instance, many policies surrounding urban planning, such as development standards or economic development, have significant transportation components. In addition, marketing and educational efforts, while critical to the success of many initiatives discussed throughout this paper, are often not limited to one initiative but can span multiple programs and goals.



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Broader Programmatic Measures	*Goods Movement*									
	Vehicle Idling						Will require setting up standards and enforcement procedures	Low overhead requirements	Can be implemented quickly	Can likely utilize existing state or local authority
	Last Mile Delivery						Will require setting up standards and enforcement procedures	Low overhead requirements	May require phase-in period	Can likely utilize existing state or local authority
	Heavy Duty Vehicle Standards						Requires standard setting, tracking, and ongoing compliance and standard review / update process	Fairly low overhead requirements	Establishing initial administrative processes can take time	Federally preempted unless adopt standards identical to California's
	Diesel Retirement Programs						Will require standard setting and planning process	To the extent that heavy duty vehicles are government owned, could require significant investment	May require phase-in period	Can likely utilize existing state or local authority
	Heavy Duty Electrification						Will require standard setting and planning process	To the extent that heavy duty vehicles are government owned, could require significant investment	Will likely require mid- to long-term transition and phase-in	Can likely utilize existing state or local authority

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Broader Programmatic Measures	*Development Standards and Congestion Reduction*									
	Bus Prioritization						Mid- to long-term planning and program development process necessary	May require infrastructure transition and build out, but could also be achieved through non-infrastructure means	Likely require phase-in period	Can likely utilize existing state or local authority
	Congesting Pricing						Mid- to long-term planning and program development process necessary	Fairly low overhead requirements, can generate revenue	Likely require phase-in period	May require state legislative approval
	Parking Policies						Would require assessment and planning	Fairly low overhead requirements, can generate revenue	Likely require phase-in period	Can likely utilize existing state or local authority
	Ride-Sharing Opportunities						Would require assessment and planning, especially to establish incentives to target certain outcomes	Fairly low overhead requirements	Likely require phase-in period	Can likely utilize existing state or local authority
	Bicycle Planning						Mid- to long-term planning and program development process necessary	May require significant infrastructure transition and build out	Will likely require mid- to long-term transition and phase-in	Can likely utilize existing state or local authority

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Broader Programmatic Measures	VMT Reduction Programs						Wide range depending on measures adopted, but likely will require assessment and planning process	Wide range depending on measures adopted, but could require infrastructure investment	Wide range depending on measures adopted, but could require phase-in period	Can likely utilize existing state or local authority
	Transit-Oriented Development						Long-term planning and program development process necessary	May require significant infrastructure transition and build out	Will likely require mid- to long-term transition and phase-in	May require state legislative approval
	Education and Outreach									
	Electric Vehicle Outreach						If partnering with third party to develop, can have low administrative requirements	Third-party and expert campaign development can improve outcome but increase costs	Can be implemented fairly quickly	Can likely utilize existing state or local authority
	Idling Reduction Outreach						If partnering with third party to develop, can have low administrative requirements	Third-party and expert campaign development can improve outcome but increase costs	Can be implemented fairly quickly	Can likely utilize existing state or local authority
	Transit Education						If partnering with third party to develop, can have low administrative requirements	Third-party and expert campaign development can improve outcome but increase costs	Can be implemented fairly quickly	Can likely utilize existing state or local authority

Goals of Advanced Transportation Policies

Transportation policies can achieve numerous interlocking environmental, economic, and social goals. These goals might include emissions reductions, congestion reduction, quality of life and economic productivity improvements, and even electric system performance improvements.

Local Emissions Reductions and Health Impacts

Transportation policies can greatly reduce local criteria air pollutant levels that lead to smog and increased danger from asthma, heart disease, and other health risks. In 2014, vehicles emitted 55 percent of all NOx pollution, but in areas that have already achieved important reductions from the electric sector, the transportation sector's contribution level can be much higher.[6] Transportation is also responsible for about ten percent of nationwide fine particulate matter, and a much higher percentage of urban particulates.[7] For example, the California Air Resources Board observes that diesel particulate matter is responsible for about 70 percent of the total known cancer risk related to air toxics in California.[8] Since these emissions are often local in their effects, reducing transportation emissions can significantly improve the health and well-being of communities in urban areas or around transportation corridors, which are often low-income or otherwise vulnerable or disadvantaged communities.[9] Adverse public health outcomes disproportionately burden low-income communities and communities of color. Although low-income communities often live nearest to sources of transportation emissions, such as railyards, highways, and ports, low-income communities also face the greatest barriers to access in clean transportation and mobility.[10]

A wide variety of state and local policies can be designed to reduce local air emissions. These policies could include: (1) supporting alternative forms of low or no-emitting transportation (public transit, for example, or walking and biking); (2) encouraging the use of zero emission vehicles (ZEVs), which do not contribute to local air pollution through tailpipe emissions; or (3) reducing traffic and in-city emissions through congestion or idling reduction policies. For example, Paris and Mexico City have committed to eliminate all diesel vehicles by 2025 in order to improve local air quality.[11] Washington State, similar to many other states, is taking a broad, programmatic approach, using the opportunity through funds received in the Volkswagen Settlement to "make transformative improvements across Washington's transportation sector…by investing in advanced zero emission technologies and prioritizing publicly owned transportation fleets" with the goal of substantially reducing public exposure to transportation-related NOx and particulate emissions.[12] Actions included in the state's plan include investments in electric buses and ferries and deployment of EV charging infrastructure.

Greenhouse Gas Reduction

States and local governments have taken leadership roles in setting targets to reduce GHGs, including from the transportation sector. Twenty-two U.S. states and the District of Columbia have goals or targets for emissions reductions, the most common being an economy-wide 80 percent reduction in GHGs from 1990 levels by 2050 (see Figure 2), a commonly cited target to avoid the worst of climate change impacts. Globally, more than 7,000 cities have pledged to continue climate action and emissions reductions even in light of U.S. federal government withdrawal from domestic and international climate programs and agreements.[13] In addition, thousands of cities have made GHG reduction commitments. In the United States, 226 cities and 26 counties have signed on to the We Are Still In Declaration, a group of leaders committing to "working together to take forceful action and to ensure that the U.S. remains a global leader in reducing emissions."[14] Mayors of 75 cities, representing 42 million Americans and as part of the Climate Mayors initiative, wrote a letter to President Trump in March 2017 to "affirm our cities' commitments to taking every action possible to achieve the principles and goals of the Paris Climate Agreement, and to engage states, businesses and other sectors to join us."[15] Additionally, a subset of Mid-Atlantic and Northeast states are seeking input on strategies that they should consider to reduce carbon

emissions from the transportation sector, modernize the transportation system, and increase investments to support zero-emission vehicles.[16]

Figure 2 State GHG Reduction Goals and Targets (all reductions from 1990 levels by 2050 unless otherwise noted)

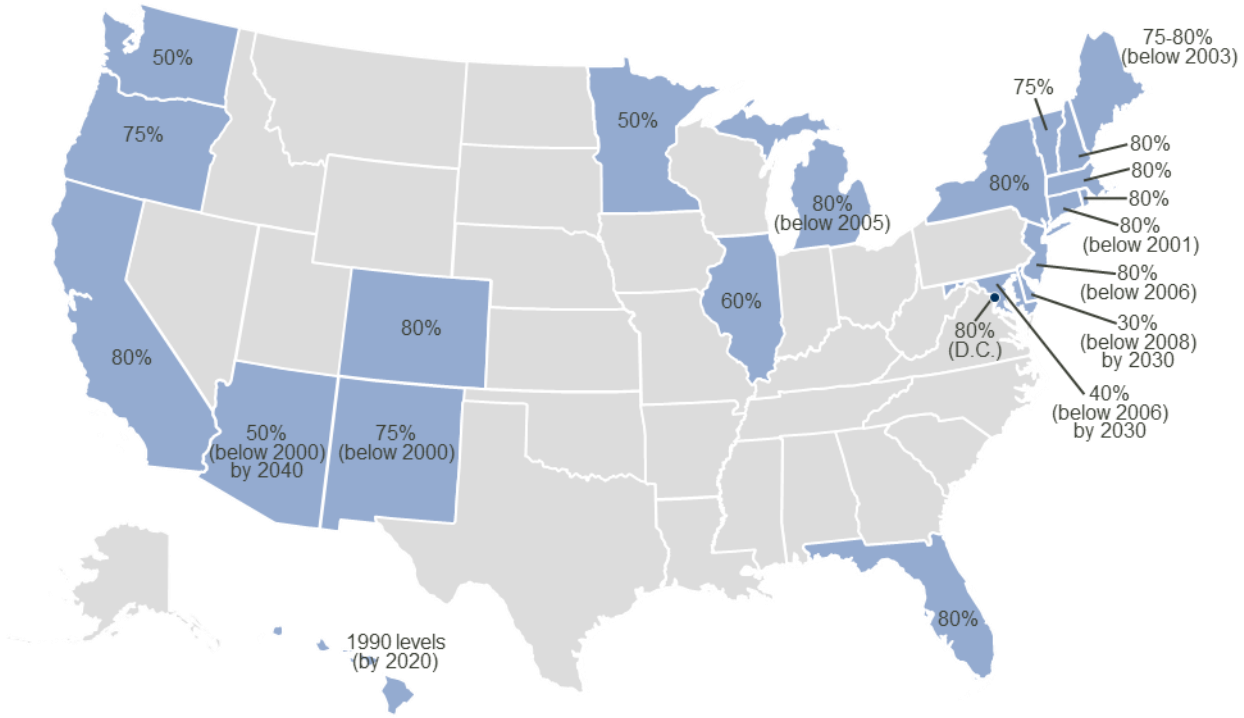
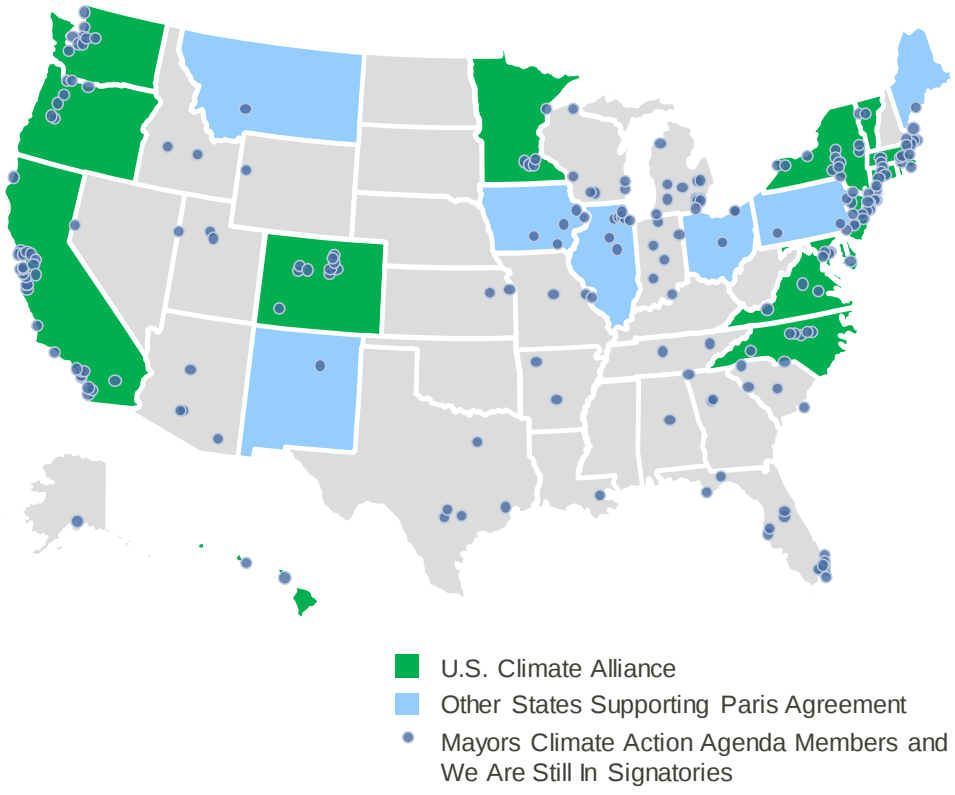


Figure 3 City and State Climate Commitments



The electric sector continues to make significant progress in reducing its GHG emissions. Since 2005, carbon dioxide (CO_2) emissions from the electric sector have fallen by more than 25 percent. As a result, emissions from the transportation sector are now the leading source of CO_2 emissions in the U.S.[17] To reach long-term greenhouse gas goals, reducing emissions from the transportation sector is critical. In 2016, the transportation sector overtook the electric sector to have the highest CO_2 emissions.[18] In addition to the need for continue improvement in fuel economy for vehicles, the level of needed long-term reductions in transportation-sector emissions are only achievable through a dramatic shift away from gasoline and diesel vehicles to low- or zero-emitting electric transportation.[19] For example, NRDC's Pathways Analysis forecasts that by 2050, under an 80 percent reduction scenario, electricity will supply 45 percent of all energy needs, up from 20 percent today, and total vehicle-miles traveled (VMT) in personal vehicles would drop significantly.[20] This includes the electrification of large portions of the vehicle fleet: EVs would account for 60 percent of car VMT, and electricity would power significant portions of medium-duty vehicles, passenger rail, and (to a lesser extent) freight rail. In California, 80 percent by 2050 planning contemplates achieving 100 percent zero emissions vehicles in the light-duty sector by 2050.[21] New York City's 80 x 50 plan notes that to reach its targets it will have to build on its planned investments in better buses, an expanded bike network, safer streets, and improved transit to explore additional ways to reduce emissions. The plan notes that increasing the use of low- or zero-emission vehicles will be critical to reach these targets.[22]

Economic Development, Advanced City Design, and Congestion Reduction

Because the transportation sector is a significant contributor to, and foundation for, economic activity, many broader economic and community initiatives have a large transportation component. Many states and local governments have policies in place to improve quality of life in cities by improving environmental conditions and developing community spaces that are clean, efficient, economically prosperous, productive, and conducive to high quality resident life. City planning can have a significant impact on transportation emissions. For example, transit-oriented development can reduce vehicle miles traveled (VMT) in private vehicles and reduce the number of vehicles on the road, which can reduce congestion and emissions. These policies can also be paired with clean

and electrified mass transit initiatives to even further reduce emissions. Other policy choices can increase opportunities for bicycling and cycling commuting, such as bike lanes and bike-friendly traffic regulations, which also improve city foot traffic and economic activity and can help reduce traffic-related injuries and fatalities.*

Congestion reduction is also a common goal of policymakers. When congestion contributes to longer commutes, it can lead to increased rates of negative health conditions (such as obesity and depression) and lower life satisfaction.[23] Congestion above certain levels can also decrease the rate of employment and productivity growth.[24] Reducing congestion by reducing vehicles on the road can contribute to lowering these negative health and economic outcomes as well as potentially lowering emissions (both through fewer cars on the road and reducing the amount of time spent emitting while stuck in traffic). However, congestion reduction does not necessarily result in emissions decreases if such reduction results in *more* vehicles in use or reduced idling emissions are offset by increases in the speed of traffic (emissions increase per mile traveled above certain thresholds).[25] Policymakers can make efforts to design programs to target emissions reductions and other environmental outcomes, such as by reducing congestion with the use of shared transport and use of non-vehicle-based transportation methods (e.g., walking, biking).

Policies can also be designed to specifically benefit low- and moderate-income and disadvantaged communities. These communities, which have the fewest resources to address environmental challenges, are often those most exposed to local air pollution and can be the most vulnerable to climate change risks. In addition, for a true market transformation across the transportation sector, it will be critical to specifically conduct outreach to and design programs that benefit disadvantaged communities.

Advanced Vehicle Technology Transformation

Transportation policies can also help to advance technological development and transformation that will be necessary for building a modern, clean, and efficient transportation sector. Already, the market for new transportation technologies is growing, as evidenced by the significant advancements in efficient new buses, EVs, and many other technologies explored in the case studies below. Policies can support this transformation through financial incentives that make new technologies more cost-effective or appealing to customers and producers, regulatory requirements for certain technologies, standards that require improved technological performance, and many other mechanisms.

This technological transformation can underlie economic development and transformation as well. A study of the U.S. Department of Energy Advanced Technology Vehicle Manufacturing program, which encourages manufacturers to build or retool factories in the United States to build fuel-efficient vehicles or components, noted that the program has created 38,000 jobs at 17 facilities across eight states. This has in turn supported more than 200,000 additional jobs in the local economy of these facilities, located across the country in states such as Ohio and Indiana.[26]

Finally, these policies can also help create a stable market that encourages increased research and development and provides the regulatory certainty for companies to invest in clean technologies with confidence. Research has shown that such policies that help to "push" technological change can lower the overall cost of GHG reductions, especially when designed to create a long-term policy signal.[27] In many ways, the effect of policy and induced technological change has already been seen in the clean transportation market. For example, in its most recent review of its Advanced Clean Cars program, California noted that EV technology is advancing faster than was

* See section on "Development Standards and Congestion Reduction Approaches" below for more detail on these policy approaches.

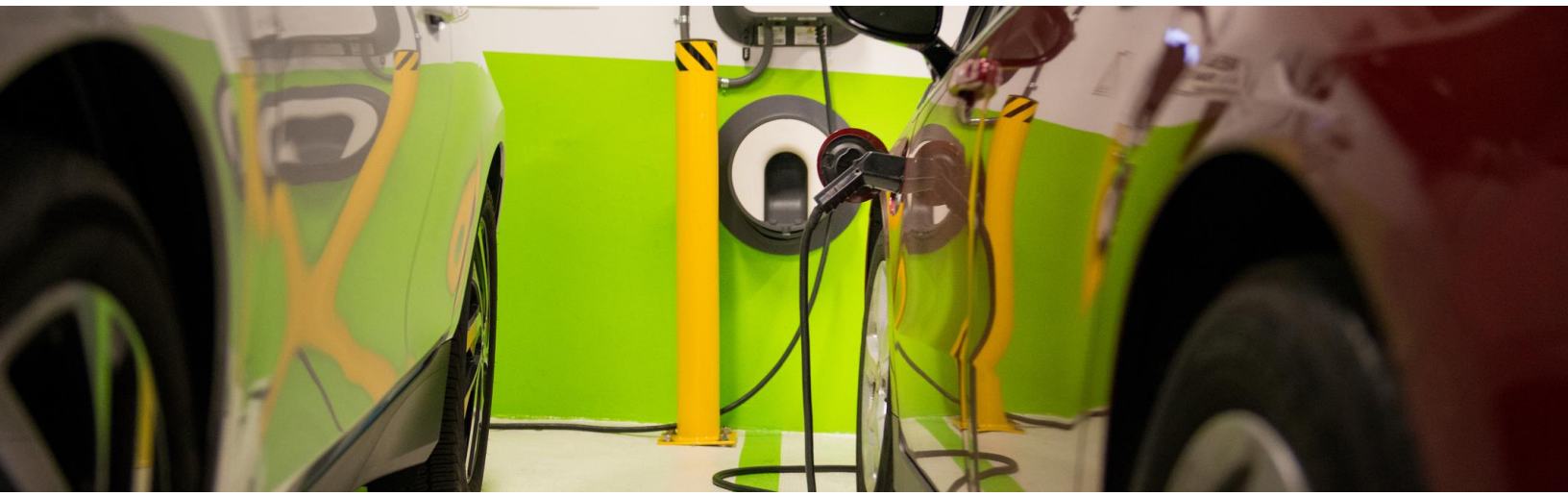
anticipated just five years ago, leading to policy achievements ahead of schedule and improved environmental performance of the transportation sector across the state.[28]

Grid Stability and Renewable Integration

Reforming the transportation sector has the potential to also help support and even improve the electric grid. Transportation electrification across all components of the sector, from heavy equipment at ports to transit vehicles to passenger light cars, will require drawing on the electric system. This increase in electricity demand will require a robust distribution system and require electric utilities and system managers to be strategic about grid upgrades and planning. If the shift toward electric transportation is done strategically, and in coordination with the electric system, it has the potential to actually serve to strengthen the grid and help to incorporate other key clean resources such as renewable wind and solar generation. For example, managed EV charging can absorb otherwise under-tapped capabilities of the grid (such as excess distribution capacity or renewable generation), which can then lead to improved revenue flows for better grid maintenance and ultimately better overall rates for all consumers. Additionally, if integrated into the electric grid well, EVs can provide grid reliability services, such as local power services, energy storage, and a foundation for resiliency measures such as microgrids. Policymakers may wish to pursue policies that specifically seek to capture these and other grid benefits.

The National Renewable Energy Laboratory (NREL) Electric Vehicle Grid Integration Project has also been exploring multiple capabilities related to EV integration. [29] For example, it has studied "managed charging" capabilities in which EVs, in combination with smart charging infrastructure, can provide value through electric load management and reduce EV charging costs, and is exploring how it can develop vehicle to grid communication systems to reduce peak-power demands.

NREL, as well as others, has explored how EVs can help to integrate intermittent renewable resources by acting as grid-connected batteries. For example, NREL is studying how EVs can support local power quality, especially in scenarios with a high penetration of renewables, by leveraging charge system power electronics to monitor and enhance local power quality and improve grid stability. A modeling exercise in Germany also showed that EVs contributed to balancing intermittent renewable resources, in part by helping to consume nighttime wind generation.[30] States are also taking action to explore EV integration capabilities. California, for example, established a working group in 2014[31] and at the end of 2017 released a whitepaper exploring interactions between EVs and the electric grid and final recommendations for regulatory actions the state could take to "unlock" the benefits of EVs for the grid.[32]



Brief History of State and Local Transportation Policy Legal Authority

State and local governments enjoy substantial authority to encourage a transition to advanced transportation. These authorities allow them to take a wide variety of actions, including those explored in this paper, to implement advanced transportation policies that improve public health, reduce emissions, and further clean transportation technologies and environmental outcomes.

Local planning and transportation policy is traditionally a matter of state and local control. As discussed in more detail in Appendix A, the Clean Air Act assigns states primary responsibility for ensuring that clean air standards are met. As the findings of the Act itself provide: "[A]ir pollution prevention (that is, the reduction or elimination, through any measures, of the amount of pollutants produced or created at the source) and air pollution control at its source is the primary responsibility of States and local governments."[33] While this general principle is limited by certain preemption provisions, Congress intended the Clean Air Act to reserve authority to state and local governments to prevent air pollution, including from mobile sources.

As a result, the advanced transportation policies identified in this paper should be legally permissible actions either because they:

- address local planning, educational efforts, or other policy arenas that are traditionally a matter of state or local control;
- address the way that vehicles may be used in certain areas, a traditional authority that is specifically reserved to state and local governments by the Clean Air Act's savings provisions;
- are regulatory actions that do not regulate tailpipe emissions directly, and therefore are not actions prohibited by the Clean Air Act's preemptive effect;
- align with the special enhanced regulatory role that Congress has reserved for the State of California for the last half century as well as for any state that adopts vehicle pollution control standard identical to California's; or
- are non-regulatory actions that may be undertaken by state or local governments as proprietary market participants.

States and local governments, therefore, can consider opportunities to implement clean transportation incentives and market-based programs, vehicle registration and use requirements, technology and infrastructure development programs, public transit initiatives, as well as many other policies without the potential of federal preemption.

In the context of setting emission standards for vehicles, state leadership has also played an important role. California has authority to adopt its own standards—subject to an EPA preemption waiver—and states may adopt California's standards provided the state has an approved State Implementation Plan. This section provides a brief background on how this policy came to be, how it has been applied in the past, and how California and other states can pursue emissions reductions opportunities consistent with this authority.

Clean Air Act and the Vehicle Emissions Waiver

Congress first authorized federal air pollution control when it enacted the Clean Air Act in 1963. In 1967, Congress amended the Act to establish the first comprehensive emissions standards for new automobiles.[34] At that time, only California had previously established comparable state-level vehicle emissions standards—in 1966. In the hearings on Clean Air Act development, Senators from states across the country lauded California's leadership in addressing harmful pollution from vehicles and recognized the benefit to the nation as a whole of California's role as a laboratory for innovation in this space. Thus, though Section 209 of the Clean Air Act barred any "State or any political division thereof" from implementing emission standards for new vehicles, it

also required EPA to waive this restriction for "any state which has adopted standards…prior to March 30, 1966"—i.e., California.[35]

Section 209(b) explains that EPA "shall" waive this restriction if California determines that its standards will be, in aggregate, at least as protective of public health and welfare as the federal standards. It states that the Administrator of the Environmental Protection Agency (EPA) must grant the waiver unless he or she establishes that any following three conditions are met:

- California was arbitrary and capricious in its finding that its standards will be, in the aggregate, at least as protective of public health and welfare as applicable federal standards;
- California does not need such state standards to meet compelling and extraordinary conditions; or
- California's standards and accompanying enforcement procedures are not consistent with Section 202(a) of the Clean Air Act, which lays out the technological feasibility and lead-time requirements for federal vehicle emission standards. [36]

When California files an application for waiver, EPA publishes a notice for public hearing and written comment in the Federal Register. [37] Once the comment period expires, EPA reviews the comments and the Administrator determines whether any of the above conditions are present. If not, the Act requires EPA to grant the wavier.

This provision has important implications for other states as well. Under Clean Air Act Section 177, other states can choose to adopt a California standard for which a waiver has been granted. [38] For a state to implement California standards in lieu of federal standards, it must adopt standards identical to California's at least two years before the standards will be effective. These states, often called "Section 177 States," are not required to seek EPA approval of this decision, though their decision to adopt California's standards is usually discussed and justified in State Implementation Plans (SIPs) that address a state's path to meeting air quality standards and that are submitted to EPA.[39]

EPA first waived the vehicle emission standard prohibition for California in 1968.[40] Since that date, California has requested and been granted waivers for regulations regarding on-road motor vehicles more than 50 times.[41] The vehicle emissions standards covered under these waivers have applied to a range of vehicle types, including light-, medium-, and heavy-duty vehicles. EPA has only fully denied one waiver request—California's GHG emission standards for 2009 and later model years—which EPA later reconsidered and granted.[42] As discussed in more detail below, the Trump Administration has recently proposed to revoke California's waiver to establish GHG emissions standards for years 2021 and beyond.[43]

> Congress "has also provided that EPA is not to overturn California's judgment lightly… California is to have the broadest possible discretion in selecting the best means to protect the health of its citizens."
>
> U.S. Court of Appeals for the D.C. Circuit, *Motor & Equipment Manufacturers Ass'n v. Nichols*, 1998

California Vehicle Standards: Incorporating GHG Emissions Standards

In 2002, the California Legislature passed a law that directed the Air Resources Board to establish the first GHG emissions standards for passenger vehicles. The California Air Resources Board (ARB) accordingly adopted regulations in 2004 that applied to passenger vehicles and light trucks beginning with the 2009 model year and extended through 2025. The ARB requested a waiver under Section 209 of the Clean Air Act in December 2005.[44] After a significant delay, on March 6, 2008, EPA denied California's waiver request after determining that California did not need its GHG standards to meet "compelling and extraordinary conditions." However, on June

30, 2009, EPA granted the waiver for the standards through 2025, reversing the previous administration's finding.[45]

With this waiver approved, California proceeded with implementing its GHG standards. The section on "Light- and Heavy-Duty Vehicle Emissions Standards" in the Toolkit below describes the current California standards.

Current Section 177 States

As discussed above, under section 177 of the Clean Air Act, states have the authority to adopt emission standards identical to California's. Such "Section 177 states" are not required to seek EPA approval before adopting a California standard provided that California has obtained a waiver from the EPA for that specific standard. Each state may have a different pathway to adopting these standards—some may do so under existing regulatory authority, while others may require legislation.

A coalition of states began adopting California's more protective vehicle emissions standards in the early 1990s.[46] As of June 2018, 13 states and Washington, D.C. have adopted or intend to adopt at least some aspect of California's more protective emissions standards.* In 2016, these states represented nearly 35 percent of the U.S. light duty vehicle market.[47] Other states may evaluate the benefits of adopting these standards as well.

Trump Administration Waiver Activity

On August 24, 2018, the National Highway Traffic Safety Administration (NHTSA) and EPA published the proposed Safer Affordable Fuel Efficient (SAFE) Vehicles Rule. The proposed SAFE Rule would establish less stringent fuel economy and GHG emissions standards for passenger cars and light trucks for model years 2021 through 2026.[48]

As part of this rulemaking, EPA has proposed for the first time to withdraw the waiver that EPA granted to California for the GHG and ZEV components of its vehicle regulations. The proposal asserts that it must withdraw the waiver based on the argument that NHTSA has proposed to issue an opinion that the Energy Policy and Conservation Act (EPCA) preempts all state standards related to fuel economy, which are linked to the CO_2 emission standards. EPA also argues that California does not need its GHG or ZEV standards to meet compelling and extraordinary conditions "because those standards address environmental problems that are not particular or unique to California." Further, EPA proposes to find that the California standards are technologically infeasible.

Additionally, the proposal would preclude the use of Section 177 by other states to adopt the California emission standards based on the argument that Section 177 only applies to criteria pollution.

EPA has not finalized this proposal. If EPA does move forward to revoke this waiver, California and multiple Section 177 states have stated that they will challenge this action in court. Legal experts have questioned whether the statute gives EPA the authority to withdraw a waiver once granted, as the Clean Air Act's text only provides the process for granting or refusing to grant a waiver upon a petition by California.[49] These experts have further argued that if any authority to revoke a waiver exists, it is limited to conditions that EPA has failed to meet in the proposed SAFE Rule.[50] These issues would likely be central to litigation challenges.

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* These states that have adopted the standards are: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington. Colorado Governor Hickenlooper has issued an executive order requiring the Department of Public Health and Environment to promulgate regulations adopting California's emissions standards and in August 2018 the Department took the first steps to promulgate these regulations.

Transportation Toolkit: Policy Options for States and Local Governments

Policies to create an advanced, clean, and efficient transportation sector can achieve multiple goals, from reducing pollution to improving economic outcomes and community development. The specific policies that a jurisdiction chooses to implement are dependent in part on what outcomes policymakers are targeting, as well as many other local considerations. The policies discussed in this paper constitute a "Transportation Toolkit" highlighting a broad range of proven options that policymakers can start with in order to explore city or state initiatives. While certainly not a comprehensive list of possible transportation policies, it focuses on those with widespread and increasing adoption and that incorporate some focus on environmental outcomes.

These policies are split into three general categories: emissions-focused programs; electrification programs; and broader programmatic measures. The first are those policies that support state and local government achievement of emissions targets, whether through a price on GHG emissions or through the creation of specific emissions standards. Electrification programs include those policies that are specifically focused on electric transportation, and for the purposes of this paper, on-road transportation, ranging from light duty vehicles to heavy-duty transit. Finally, broader programmatic measures are those that incorporate other urban planning considerations, such as development standards or economic development, and educational efforts, which can span all initiatives. As noted throughout, there are significant overlaps among and within these categories, but there are also important policy synergies highlighted.

For each policy, this paper provides a brief overview of the basic policy design and key considerations that policymakers may face in order to provide a framework for thinking about how a given policy may work in a given jurisdiction. Also included are numerous case studies and examples of programs, primarily in the U.S. but also internationally, that demonstrate successful implementation of these policies and provide policymakers with ideas for how to move forward with structuring a new program.

Emissions-Focused Measures

A primary objective of many policymakers in improving the transportation sector is to reduce GHG or local pollution emissions. While GHG emissions contribute to climate change, local pollutants are the primary cause of smog, soot, and many air quality pollution health hazards. There are a range of policies that can directly help reduce emissions and that can often create numerous co-benefits in the process. Policymakers can implement direct emissions standards for state or local government fleets, requiring that individual vehicles or fleets of vehicles reach a certain emissions level per mile traveled. States can also adopt California's emission standards under section 177 of the Clean Air Act. Additionally, policymakers can design market-based policies imposing a CO_2 price and create an incentive to adopt technologies or practices that lower those emissions.

State, Local, and Private Fleet-Based Measures

Fleet-based measures are an opportunity for more localized entities, such as municipalities, counties, and large federal functions and agencies such as the U.S. Postal Service and Department of Defense to establish vehicle fleet performance and purchasing standards as well as emissions targets and thereby drive fleet transformation at a more granular scale. Across the U.S., some state governments, local governments, and companies are directing that new vehicle purchases in fleets (e.g., vehicles owned by police and emergency services, public utilities, transit departments, maintenance departments, and more) be powered by electricity or alternative fuels, often with funding set aside to enable these municipal fleets to convert to electric, hybrid, or biodiesel-fueled vehicles.

Recent technological advancements have opened doors to improvements in fuel efficiency while new offerings for electric and hybrid cars or buses are added to the market each year. In some cases, materials have enabled

vehicles to reduce weight while retaining the ability to perform the same amount of heavy work. Additionally, some vehicles, especially new vehicles, that are equipped with telematics software can collect data on fleet usage patterns and can streamline reporting while aiding planners in gaining a better understanding of use that will ultimately inform strategies for meeting more protective standards. Prioritizing the purchase of new vehicles with advanced emissions controls can provide states and local governments an important opportunity for emissions reductions.

Fleet standards can be "formal" and "informal." A more formalized approach might be through laws and executive orders that set specific implementation pathways such as incrementally increasing the number of EVs to be added to the fleet with funding, plans, and rebates for how to meet this target. In contrast, an "informal" approach may not be founded in specific new legislative or regulatory authority. For example, policymakers could pledge key milestone years for percent reduction in fleet emissions or create a program to collect and distribute operational best practice guidance for both existing and new technologies. An informal program could also involve emissions reductions commitments implemented on a private, company-wide basis. Such informal programs would likely be most effective if also supported by support and incentives from city or state policymakers (see, e.g., the Chicago Clean Cities Coalition case study below).

Policies can have different underlying goals, such as GHG reductions, criteria pollutant reductions to improve air quality, or fuel efficiency. It is more common for the local fleet-based measures to focus on cutting emissions, especially as a mechanism for improving localized air quality. This goal is often achieved by setting targets that reduce overall fleet size and by replacing emitting vehicles within the fleet with zero-emitting or alternative fuel vehicles. Key decision points to ensure program success may include: deciding the type of target (e.g., GHG reductions or fuel efficiency standards), whether the program will require the passage of laws, and whether and how to establish and distribute funds for implementation (e.g., from appropriations processes or grant programs).

States like California, Illinois, New York and Washington have passed laws that direct that a certain number of vehicles or percentage of the fleet must be zero-emitting by a target year, and some have set aside funding for fleet management through telematics deployment, to track progress. Massachusetts has adopted regulations setting mass-based declining caps for state agencies' associated transportation emissions.[51]

Alternatively, other states like Colorado have pledged to cut fuel consumption but have not yet mandated a specific number of alternative fuel vehicles that will be needed to meet the goal. City- and company-level actions exist too, particularly in the form of funding set aside for the acquisition of greener vehicles over time.

Case Study: City of Minneapolis Green Fleet Policy

Implemented by the City in 2011, the Green Fleet Policy aims to reduce GHGs from all vehicles and heavy equipment under the jurisdiction of the City Council. The Policy inspired a city-wide commitment of 30 percent reduction in economy-wide GHG emissions from a 2006 baseline by 2025.[52] Key objectives of the 2011 Green Fleet Policy include:

- Implementing an inventory and reporting to track fleet-wide GHG emissions.
- Educating city staff on best practices of eco-driving to reduce emissions from actions such as unnecessary vehicle idling. Using advanced emissions controls to reduce tailpipe emissions.
- Purchasing new vehicles, when necessary, that are more fuel-efficient or use alternative fuels to ensure emissions reductions.

Thus far, the city has exceeded its 2015 economy-wide target of a 15 percent reduction by a few percentage points.[53] Key actions that city agencies and partners have taken include:

- Fleet reduction and optimization by "eliminating or reassigning un- or under-used vehicles while promoting car-pooling across departmental lines." [54]
- Using life-cycle economic and environmental impact analyses to provide support for the purchases of smaller, lower-emission vehicles using the EPA SmartWay list for guidance while retiring older vehicles prone to emitting more pollutants.[55]
- Reconditioning and recycling of all fleet oil, and commitment to using greener products for procedures such as vehicle body cleaning and degreasing.
- Partnership with the University of Minnesota and Minneapolis Solid Waste and Recycling to test an all-electric garbage truck.[56]
- Improvements in Metro Transit (which serves both Minneapolis and St. Paul) fleet-wide fuel efficiency by 15 percent since 2008 with improved performance of diesel buses and the addition of hybrid buses.[57] Metro Transit has altered its operations by running the larger, articulated, 60-foot buses on express routes and only during rush hours when fewer stops are made to reduce idling and improve the fuel economy of the diesel buses. Additionally, hybrid electric buses have been added to the fleet since 2002 such that they now comprise 15 percent of the fleet's more than 900 buses.

Companies can also implement fleet standards, and interest in these programs has grown with customer concern about air quality, noise pollution, and environmental stewardship. However, there can be barriers to implementing fleet goals in the private sector. Not all fleet technologies will result in savings to cover costs within a given recovery window, which can make investment difficult to justify fiscally. Local governments can support such actions by allocating funding to subsidize these transitions. Additionally, long term, strategic planning ahead of decision making can help to realize fleet transformation at the private scale: incorporating clean advanced technologies into already necessary maintenance or fleet replacement can lower overall costs (and avoid stranded investment) and provide a more appealing business case.

Such programs can have significant results. For example, Carrier Corporation, through right-sizing vehicles, reducing vehicle weights, and other measures reduced its fleet emissions by 30 percent and saves $1 million each year in fuel costs.[58] ADT Security Services, in replacing a large portion of its fleet with newer, cleaner, vehicles, cut more than $5.3 million in fuel costs each year, a nearly 20 percent reduction.[59] And New York City's acquisition of more than 2,000 EVs as part of its 29,000 vehicle fleet is expected to reduce gasoline consumption by 2.5 million gallons and reduce GHG emissions by up to 9 percent by 2025.[60]

Case Study: Chicago Clean Cities Coalition

Certain companies are also leading the way in adopting clean vehicles for their operational fleets. Each year, the Chicago Area Clean Cities Coalition recognizes green fleets from commercial to government use that are leaders in limiting the burning of fossil fuels and reducing emissions while improving air quality. The nonprofit coalition uses this list as an opportunity to highlight and praise the leaders while providing examples of what these companies are doing such that others can learn from these initiatives to inspire broader implementation in the future. In 2017, the Coalition announced the top winners including FedEx Express, Commonwealth Edison Company (ComEd), Forest Preserve District of DuPage County, Waste Management, Peapod, Chicago Transit Authority (CTA), Coca-Cola, and Watts on Wheels.[61] All fleets selected operate in the Chicago area and were recognized for their use of clean vehicle technologies and cost mitigation measures with examples of green fleet measures including:

- CTA is the primary public transit agency that serves the city and operates more than 200 hybrid buses, over 250 hybrid electric buses, and two all-electric buses, which combined reduced the fleet's 2016 fuel consumption by 130,000 gallons.
- Coca-Cola introduced nine hybrid and EVs to its Chicago-region fleet in the last year, displacing nearly 6,500 gallons of petroleum-based fuels.

Light- and Heavy-Duty Vehicle Emissions Standards

Vehicle emissions standards set individual or fleet-wide vehicle standards for emissions of pollutants, such as NOx or GHGs. In the U.S., standards for both local criteria pollutants and GHGs are primarily set at the federal level by EPA. However, as noted in the legal underpinnings section above, states can also adopt the California motor vehicle emissions standards, so long as any adopting state has an approved State Implementation Plan.* Meanwhile, the National Highway Traffic Safety Administration (NHTSA) has separate authority to set fuel economy standards.

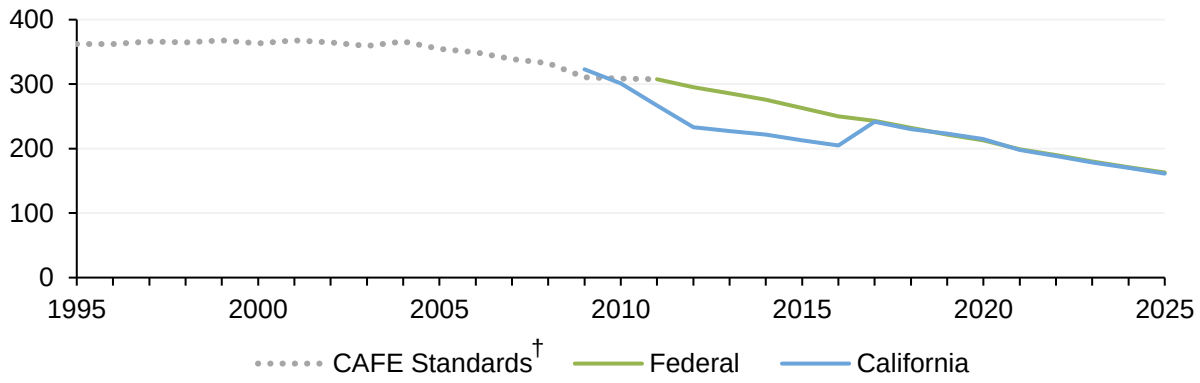
Current Status of Federal and State Emissions Standards

The Federal government adopted vehicle GHG emissions standards through a Joint Proposal in 2009 between EPA and NHTSA.[62] This proposal was the result of an agreement among EPA, NHTSA, California and the auto industry for the federal agencies to work together to set GHG and Fuel Economy standards for model year 2012 to 2016 light duty vehicles. In 2010, EPA and NHTSA issued their final rule for these standards.[63] In 2012, EPA issued emission standards for model year 2017 to 2025 light-duty vehicles.[64] NHTSA issued companion light-duty fuel efficiency rules for model years through 2021 and "augural" rules compatible with EPA's standards through 2025. EPA and NHTSA also issued emissions and fuel economy rules for medium- and heavy-duty vehicles in 2011 for model years 2014 to 2018 and in 2016 for model years 2018-2025.[65].

* As discussed in more detail above, states and local governments and private businesses can also adopt local fleet-based emissions standards.

The federal standards and California's Advanced Clean Cars Program started a process of convergence between the two light-duty greenhouse gas emission standards starting in 2017, with both programs setting similar fleet-wide GHG targets equivalent to 54.5 miles per gallon by 2025 (see Figure 4 for a comparison of GHG emissions standards).

Figure 4 Historic Fleet Average Vehicle GHG Emissions Standards (g CO_2 per mile)



† CAFE standards are not GHG emission standards. This line shows the grams per CO_2 equivalent of these efficiency standards for comparison purposes only.

Additionally, both federal and the California GHG emission programs were subject to a "Midterm Evaluation" to assess whether the standards remain "appropriate." EPA and ARB completed their reviews in early 2017, determining that their respective standards remain appropriate and that no rulemaking to modify regulations was required. However, on March 15, 2017, the Administration officially announced its intention to reconsider the Midterm Evaluation of the GHG standards for model years 2022 to 2025 and possibly including 2021. On April 13, 2018, EPA Administrator Scott Pruitt issued the Agency's reconsideration of the Mid-Term Evaluation, in which it explained that the Administrator had determined that the current standards are "based on outdated information, and that more recent information suggests that the current standards may be too stringent." Thus, EPA withdrew the previous Final Determination released by the Obama Administration on January 12, 2017. On August 24, 2018, NHTSA and EPA published the proposed SAFE Vehicles Rule. The proposed SAFE Rule would establish less stringent fuel economy and GHG emissions standards for passenger cars and light trucks for model years 2021 through 2026.[66] And, as discussed above, EPA is also proposing to withdraw the waiver that EPA granted to California for the GHG and ZEV components of its vehicle regulations.

EPA and NHTSA will be accepting and reviewing comments before finalizing either rulemaking, and it is expected that litigation will be initiated by states and other stakeholders challenging these decisions if EPA and NHTSA were to finalize such standards and the revocation of the waiver. As noted above, legal experts have questioned whether EPA has the authority to withdraw a waiver once granted and suggested that even if any authority to revoke a waiver exists, it is limited to conditions that EPA has failed to meet in the proposed SAFE Rule.[67] These issues would be a key area of focus in the expected litigation challenges.

Opportunities for Section 177 State Expansion

As discussed above, most states* have the authority to adopt the California emission standards under the Clean Air Act section 177 provided that California has obtained a waiver from the EPA for the specific standard. A coalition of states began adopting California's more protective vehicle emissions standards in the early 1990s.[68]

As of June 2018, 13 states and Washington, D.C. have adopted or intend to adopt at least some aspect of California's more protective emissions standards: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington. Colorado's Governor Hickenlooper has issued an executive order requiring the Department of Public Health and Environment to promulgate regulations adopting California's emissions standards, and on August 16 the Department released Regulation Number 20 with proposed language for adopting these standards.[69] In 2016, these states represented nearly 35 percent of the U.S. light duty vehicle market. [70] In part because of state adoption of these standards, adjusted ("real world") CO_2 emissions of new cars purchased in the U.S. have improved from 382 g CO_2 per mile in 1990 to 303 g CO_2 per mile in 2017, reflecting a more than 20 percent improvement.[71] Other states may decide to evaluate the benefits adoption as well. As noted above, while the Trump Administration has proposed to revoke California's (and Section 177 states') ability to adopt these GHG standards starting with model year 2021, numerous steps remain before such a change would be finalized, and such a decision would be subject to challenge in court.

Additional State Standard Opportunities: ZEV Targets and the ZEV MOU

As part of the Advanced Clean Cars Program, California adopted standards that include separate Zero-Emissions Vehicle (ZEV) targets, requiring an increasing share of vehicles sold to be ZEVs.[72] ZEVs generally include battery EVs, fuel cell vehicles, and plug-in hybrid EVs. Currently, nine states in addition to California are implementing the ZEV regulations: Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont. While, the Trump Administration has proposed to revoke California's (and Section 177 states') ability to adopt these ZEV standards starting with model year 2021, numerous steps remain for EPA to finalize such a decision and any decision is expected to be litigated by states and other stakeholders.

In addition to adopting ZEV requirements, the Governors of California, Connecticut, Massachusetts, Maryland, New York, Oregon, Rhode Island, and Vermont in 2013 signed the Zero-Emission Vehicle Memorandum of Understanding (ZEV MOU). On April 3, 2018, Governor Murphy also announced that New Jersey will join in signing the ZEV MOU.[73] In signing the ZEV MOU, the Governors agreed to implement policies and programs that would result in the collective deployment of 3.3 million ZEVs by 2025, along with the necessary charging infrastructure.

ZEV sales to date† toward this target are estimated to be around 450,000 vehicles, reflecting year over year growth in these states' ZEV fleets of over 50 percent.[74] The MOU also established a ZEV Task Force, which has been successful in developing and implementing actions to encourage alternative vehicle adoption, including state vehicle purchase incentives, focusing on workplace charging, promoting infrastructure deployment at public sites, and working towards equitable access to charging stations. In June 2018, the ZEV Task Force released its 2018-

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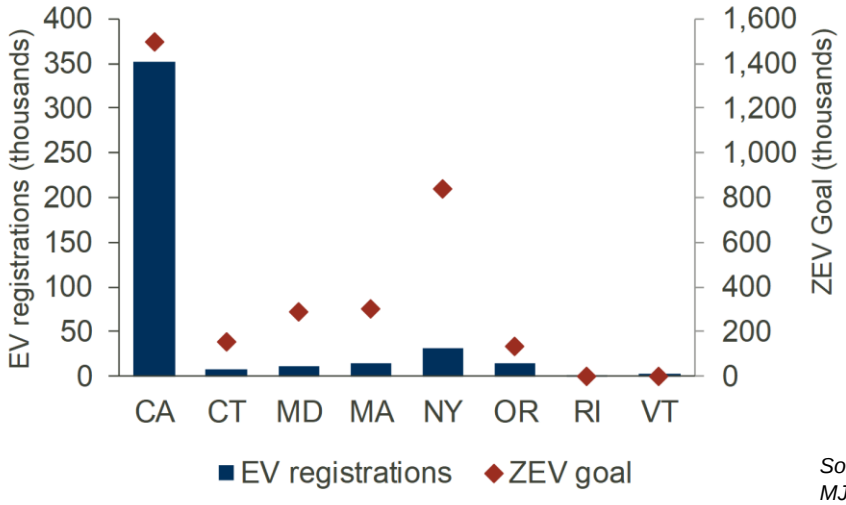
* Only those states that have been in nonattainment with federal vehicle standards or are subject to cross state air pollution regulations may choose to adopt California's standards. Hawaii, North Dakota, Oklahoma, and South Dakota are therefore ineligible.

† As of Q4 2017.

2021 Multi-State ZEV Action Plan containing more than 80 recommendations for policymakers to spur the development of the EV market.[75] Figure 5 below provides the approximate 2025 ZEV targets* and levels of PEV registrations for each of the ZEV MOU states. As discussed in the Electric Vehicle Measures chapter below, there are many additional policies that states may wish or need to establish in order to create the incentives and market conditions to support auto manufacturers in their efforts to fulfill the ZEV MOU commitments.

Figure 5 Approximate ZEV MOU State Targets for 2025 Compared to 2017 Registrations



Source: ZEV MOU, MJB&A Analysis

Market-Based Mechanisms

Market-based mechanisms to reduce transportation emissions establish a price for GHG emissions, creating an incentive to reduce emissions or switch to lower-emitting vehicles. These programs can take many forms, including a cap-and-invest program, a low-carbon fuel standard, gas tax or fee, or a feebate.

Transportation Cap-and-Invest

A cap-and-invest, or cap-and-trade program, sets an overall declining cap on emissions from a group of sources. The state or jurisdiction running the program then issues an "allowance" for every ton allowed under the cap, and compliance entities—those emissions sources that are included under the cap—must purchase an allowance to cover every ton of their emissions. If it is more cost-effective to reduce emissions than purchase an allowance, a compliance entity has an incentive to do so, leading to an incentive across the market to find the lowest cost emissions reductions opportunities. Market-based mechanisms have a long track record in the United States—they have been successfully employed in cost-effectively reducing acid rain-causing emissions from power plants, and there are currently two successful cap-and-trade programs in North America that regulate GHG emissions—the Regional Greenhouse Gas Initiative (RGGI) and the California program. As discussed in more detail in the case study, the California program includes emissions from the transportation sector.

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* It is important to note that the MOU goal is a collective target for the group of states. The values shown in the figure above are calculated by distributing the total ZEV MOU commitment across states based on vehicle registrations and incorporating state announcements where appropriate (before the addition of New Jersey). While some states have announced their own individual goals, many have not. In addition, because cross-state credit trading is allowed under the ZEV rule until 2018, the states as a whole could reach their collective target while an individual state falls short of its implied target.

Cap-and-invest programs are specifically designed to direct the revenues associated with the purchase of allowances—revenues that accrues to the implementing jurisdiction—toward complementary advanced transportation programs, policies, and technologies that can further reduce emissions. For example, revenues could be used to fund investments in transit systems, credit programs for cleaner vehicles, or EV charging infrastructure. Revenues from these programs could also be used to offset a portion of decreases in revenues from gas taxes, which may fall if fewer vehicles are gas-powered.

Designing and implementing cap-and-invest programs would require many policy and administrative choices that are discussed in detail in other papers, including where to impose the price, which sources to cover, whether to include policy mechanisms to constrain potential price impacts, how to distribute allowances, whether to allow trading of allowances with other programs, and how to direct the revenue if any allowances are auctioned.[76] Additional resources on these design considerations include work done by the Georgetown Climate Center on behalf of the Transportation and Climate Initiative (TCI), a coalition of 11 Northeast and Mid-Atlantic states and the District of Columbia. This initiative has explored key technical aspects of a hypothetical regional cap-and-invest policy, including which fuels might be covered under a policy, and which entities in the transportation fuel supply chain might be responsible for reducing emissions.[77]

Case Study: California Cap-and-Trade

The only cap-and-invest program in place in the U.S. that covers transportation is the Western Climate Initiative cap-and-trade program. Active since 2013, this cap-and-trade program covers electricity production and imports, industrial facilities, transportation fuels, and natural gas distribution; transportation has been included since 2015. In the transportation sector, the fuel distributors are responsible for purchasing allowances for every ton of emissions associated with their fuel and then pass those costs on to customers through higher gas prices. In 2016, the California Legislative Analysis Office estimated that the cap-and-trade program had caused an 11 cent per gallon increase in gasoline prices and 13 cents per gallon for diesel fuel.[78]

California creates three-year investment plans to identify uses for allowance revenues. The investment plan identifies near-term and long-term greenhouse gas emission reduction goals and targets, analyzes gaps in current State funding for meeting these goals, and identifies priority investments that facilitate GHG emission reductions. In its most recent plan, California proposed to appropriate $2.7 billion of cap-and-trade revenues to transportation and sustainable community initiatives that target 7.2 million metric tons of GHG reduction.

California has focused its attention especially on programs that support low- and moderate-income communities. Under Senate Bill 535 (2012), state and local agencies were directed to make significant investments that improve California's most vulnerable communities using cap-and-trade auction revenues. Assembly Bill 1550 (2016) increased these requirements, directing that a minimum of 25 percent of the total investments are required to benefit disadvantaged communities and that an additional 10 percent must benefit low-income households or communities.[79] As of 2017, California has far exceeded these minimums, with 50 percent of Investments (excluding those put toward high speed rail) are benefiting disadvantaged communities, and 34 percent of projects are located within disadvantaged communities. [80]

The projects proposed for funding span the transportation sector, including: heavy duty demonstration projects to accelerating commercialization of advanced technologies; light duty pilot projects in disadvantaged communities to lower costs and reduce barriers to access clean technologies while reducing exposure to toxic air contaminants; the Low Carbon Transit Operations Program to deliver cost-savings to riders by reducing the fare to ride transit; the Transit and Intercity Rail Capital Program

to reduce vehicle miles traveled and pollution from single-occupancy vehicles by increasing the availability and use of transit; and the Affordable Housing and Sustainable Communities program is bringing jobs and housing closer together to increase housing affordability while reducing commute times and passenger trips taken.[81] To date, including investments in high-speed rail, California has spent more than $4.8 billion of cap-and-trade revenues on transportation- and sustainable-community-related programs.[82]

Low Carbon Fuel Standards

Another market-based mechanism is founded on emissions standards. However, instead of establishing a standard that must be met by vehicle fleet owners or producers, a Low Carbon Fuel Standard (LCFS) program imposes an emissions standard on producers of fuels and allows compliance entities to trade credits in order to come into compliance with a fuel carbon intensity standard on a lifecycle basis that decreases over time. Suppliers of lower emissions fuels, such as biofuels, hydrogen, or electricity, generate credits because their fuels have a lower carbon intensity than the standard. Conversely, gasoline and diesel producers, whose fuels are above the standard, then purchase those credits.

Because of its low carbon fuel qualities, electricity qualifies under these programs, earning credits that can be traded to regulated parties and thus creating a value stream for using electricity as a transportation fuel. For example, California electric utilities, like PG&E, provide EV owners a $500 Clean Fuel Rebate for their use of electricity as a transportation fuel under the LCFS. Utilities or fleet owners earn credits in the LCFS program when customers use electricity at home to charge their EVs and return the value of these credits to EV customers. This type of program is most effective in a state that has regulatory authority over fuel producers (e.g., California).

Case Study: California LCFS

The California Air Resources Board established its LCFS in 2010. In effect since January 2013, it requires a ten percent improvement in the carbon intensity of transportation fuels by 2020 from 2010 levels.[83] Oregon has implemented a similar program modeled on the California LCFS called the Clean Fuels Program, set in place by legislation passed in 2015. The Oregon program requires a ten percent improvement in 2025 emissions intensity from 2015 levels.[84]

Both the California and Oregon programs have been upheld in court, with courts rejecting as unfounded claims that policies inappropriately regulate interstate commerce or fuel policy in the purview of federal agencies.[85]

Gas Tax or Fee

In addition to market-based trading mechanisms, taxes and fees can create price signals and incentives to adjust consumer and provider behavior. Gas taxes are in place at both the federal and state level. Currently, revenues from these taxes are primarily used to fund road investment and maintenance. However, recent efforts by states and proposals at the federal level have also emerged to expand the use of gas taxes to create incentives to move toward alternative transportation fuels and to fund additional policies.

Since 1993, the federal gas tax has been set at 18.4 cents per gallon of gasoline and 24.4 cents per gallon for diesel fuel, with a majority of revenue (approximately 80 percent) used to fund highways and bridges. These taxes also fund investments in public transit and bicycle and pedestrian infrastructure. In early 2018, the U.S.

Chamber of Commerce proposed to increase these rates by 25 cents per gallon in order to fund additional infrastructure investment.[86] A recent assessment of this proposal estimated that this could generate more than $840 billion in revenue by 2050. Additionally, the price signal from such a tax increase:

- would be equivalent to a $29 per ton carbon tax on the transportation sector,
- could result in more than 1.2 million additional EVs added to U.S. roads, and
- could cut total fuel use by more than 1.3 billion barrels.[87]

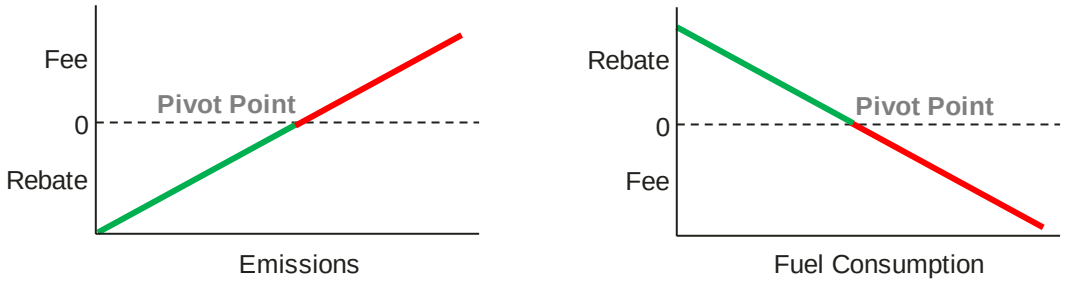
However, the proposal has received pushback from other policymakers, including from the Trump Administration.[88] Other stakeholders have noted that if revenue is used for highway expansion, the net result could be an increase in VMT and emissions.

States and local governments also impose taxes on gasoline and diesel, again with a majority of revenues used for road maintenance and construction. While the average tax nationwide is around 23 cents per gallon of gasoline and diesel, levels vary quite widely across states: the highest in early 2018, California, charges over 41 cents per gallon for gasoline while the lowest, Alaska, charges less than 9 cents per gallon.[89] However, gas taxes are generally rising. Since 2013, 23 states have raised their gas taxes.[90] Cities have also imposed gas taxes. For example, Chicago charges 5 cents per gallon of gasoline sold within the city.[91]

"Feebate" Programs

Emissions reductions and advancements in vehicle performance offer benefits for improvements in public health and the environment, and savings in fuel costs, but these alone may not be sufficient incentives to induce change and encourage adoption of cleaner vehicles. The aim of a feebate program is often to complement fuel economy standards and emissions limits with monetary incentives. In a feebate program, higher emitting vehicles may be taxed or incur fees, while lower, non-emitting, or more efficient vehicles may be incentivized and can earn rebates. The two options are often combined in one program, hence the joint name "feebates." A feebate is different from a tax in that it offers a balance between revenues and fees, referred to as the pivot point (see Figure 6).

Figure 6 Illustrative Feebate Program Designs



This figure shows how a feebate would work in relation to a vehicle's emissions or fuel consumption. Low emitting vehicles, before a "pivot point" receive a rebate (shown in green), but above that point (i.e., higher emitting vehicles) are charged a fee. A similar though reversed system could be put in place on fuel consumption: low fuel consumption vehicles are provided a rebate, while high fuel consumption vehicles are charged a fee.

A feebate program is typically implemented through vehicle registration fees, though there are other mechanisms that can be executed separately (for example, an annual tax rate can also be applied in addition to a one-time registration fee; see section below on "Electric Vehicle Financial Incentives"). Thus, feebates can be designed to be consistent with registration fees rather than "standards" or fuel economy standards, which could be preempted by federal regulations. Rebates may be adjusted annually and can ramp up over time. An adjustable feebate level can be used to keep the program stable and sustainable (i.e., self-funding, with rebates balancing fees collected) and to ensure that the incentive "pivot point" stays in line with technological and market advancement. However, policymakers may wish to balance these regular adjustments, which can help improve program performance, with the administrative requirements and calculate and implement those adjustments.

The benefits of feebates accrue to policymakers, consumers, and society at large. Feebates can help create market certainty for vehicle manufacturers and research and development, as the feebate serves to create stronger demand for low-emitting vehicles and lower demand for high emitting vehicles. Similar to most other market-based programs, a feebate also does not favor any one technology, but provides equal opportunity for emissions-lowering technologies to advance. In addition, rebates offer monetary benefits to consumers and bring fuel efficiency into consideration for their decision making. With feebates, consumers can receive an immediate payment from the future revenue stream of lowering fuel consumption. Feebates provide a direct value for consumers that reflect their contribution to the societal benefits of fuel savings and reduced emissions.[92] Finally, there is the opportunity for using the net revenues from feebates toward other government programs. While some structures may be revenue-neutral (with any revenues earned from fees directed toward rebates), others can generate revenue that could be assigned to other transportation services.

Case Study: European Feebate Examples

Numerous countries in western Europe have implemented feebates and feebate-style programs that set fees and/or rebates based on emissions or fuel consumption.

France

At the end of 2007, France implemented a feebate model through its Ministry of Ecology. This plan sets a "pivot point" between rebates and fees of 140 g CO_2/km, which is equivalent to engine efficiency of about 42 miles per gallon.[93] The highest tax of the program is €2,600 (around $3,200 in March 2018), while the highest rebate (for vehicles emitting less than 60 g CO_2/km) is €5,000 (around $6,150 in March 2018). The rebates provided are similar to those of the EV tax credit programs in the U.S. and Canada, however, France's program covers a much wider range of vehicle types. During the first year of the program, nearly half of vehicles sold were below this pivot point, and thus charged a fee.

Over this first year, average CO_2 emissions from new cars sold declined by nine percent.[94] Under the program, sales of vehicles with higher emission rates and lower rebates fell while engine power and vehicle mass declined, contributing to the emissions reductions. At the onset of the program, the costs were greater than expected because rebates paid for purchases of low-emitting cars outpaced fees brought in from high emitting cars. While the program has corresponded with a reduction in emissions, analyses evaluating the influence on manufacturers' behavior or effectiveness in driving developments in advanced technologies are still necessary over a longer time horizon to determine causational effects.[95]

Netherlands

Though not matched with a corresponding rebate, the Netherlands has imposed a carbon-based tax on new vehicles since 2005.[*] After the implementation of the tax, from 2005 to 2012, the vehicle emission rate was reduced by 6.3 grams CO_2 per kilometer (g CO_2/km).[96] In 2017, the country updated the program to exempt full electric and plug-in hybrid vehicles from the purchase tax (additional fees apply to hybrids based on emissions) as a way to drive the nation's phase out of all internal combustion engines by 2035. A study in 2009 estimated that the program contributed to a 1 percent annual improvement in vehicle efficiency.[97]

United Kingdom

The U.K. has a similar program. Beginning in March 2001, the U.K. imposed the Vehicle Excise Duty (VED) tax on all cars based on CO_2 emissions. In contrast to the registration tax in the Netherlands, the U.K.'s program includes a first-year registration tax on new vehicles as well as an additional annual tax each subsequent year. These registration taxes have been updated over time, raising the rates for both low- and high-emission vehicles to drive reductions. As of April 1, 2017, alternative fuel cars that emit less than 50 g CO2/km and all zero emitting cars are exempt from both year one registration and ongoing fees. In contrast, high-emitting cars (those that emit more than 255 g CO2/km) pay £2,000 (around $2,800 in March 2018) for one-time registration and £140 ($195 in March 2018) each subsequent year.

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[*] This registration tax is calculated based on emissions in 2001 ranging from €2 for vehicles with emission rates of 76 g CO_2/km or less and up to €475 for vehicles with emission rates exceeding 169 g CO_2/km. This emission rate per vehicle range can be thought of as 122 g/mile to 272 g/mile. This is in-line with the current EPA fleet-wide standard rate of 163 g/mile in model year 2025.

Electric Vehicle Measures

There are many ways to improve the environmental performance of vehicles by switching from traditional gasoline or diesel-powered engines to alternate forms of energy. Early in the switch to advanced transportation technologies, for example, natural gas, either in compressed (CNG) or liquified (LNG) forms has been used as a fuel in many places, especially in heavy transportation, and fuel cell vehicles have gained attention recently for their potential, especially in passenger vehicles. However, electricity as a transportation fuel rises to the top in most analyses as one of the most effective ways to power clean vehicles. This is for many reasons: EVs use energy more efficiently than internal combustion vehicles, the infrastructure to deliver the fuel—electricity lines—is mostly already in place, there are no tailpipe emissions, which greatly improves local air quality, and, importantly, as the electricity grid becomes cleaner and more renewable-dependent, so too will electric-powered vehicles. Analyses have shown that CNG- or LNG-powered light- and heavy-duty vehicles would likely reduce GHG emissions between 10 to 20 percent as compared to traditional vehicles when measured over a 100 year timeframe (though may actually increase GHG emissions when measured over shorter timeframes, due to the impact of methane leaks from the natural gas fuel cycle).[98] Renewable natural gas used in these vehicles may also be able to reduce GHG emissions by 60 percent or more. EVs, on the other hand, can reduce GHG emissions by 60 percent (national average), and in some states by more than 80 percent, even with today's mix of generation resources.[99] With an increasingly clean electric grid, these savings will only increase.

In addition, technological advances and market trends point toward a rapid increase in EVs. For example, in the light duty market, Bloomberg New Energy Finance projects EVs could account for more than 50 percent of new car sales by 2035 largely due to declining battery costs.[100] This trend toward electric transportation is global. China has surpassed the United States as the global leader in EV sales. Norway has shown particular success in implementing a suite of incentives and policies that have resulted in EVs making up nearly 30 percent of vehicle sales in 2016.[101] These trends are expected to continue, particularly in cities, which are setting the most ambitious goals: Los Angeles, London, Cape Town and nine other major cities recently announced their commitment to only buy zero-emissions buses starting in 2025[*] and to eliminate fossil fuel emissions from transportation in major areas within their jurisdictions by 2030.[102]

However, there is significant room for improvement in EV adoption. While sales are beginning to grow, battery-electric and plug-in hybrid EV sales each represented less than one percent of total U.S. vehicle sales in 2017.[103] Policy choices can help dramatically improve these adoption rates though it is important to note that other market dynamics, such as vehicle model availability and local marketing efforts are also critical to support EV adoption.

For these reasons, this section focuses on policies that support the electrification of light- and heavy-duty vehicles (though it is worth noting that some of these mechanisms, such as the financial incentives, often apply to other types of alternative fuel vehicles as well). As noted throughout, many of these policies can work together and work with other policies mentioned throughout this paper, such as development standards and education, to increase policy effectiveness. A combination of policies and supporting incentives to purchase and own EVs will be key to effectively accelerating early market development and adoption.

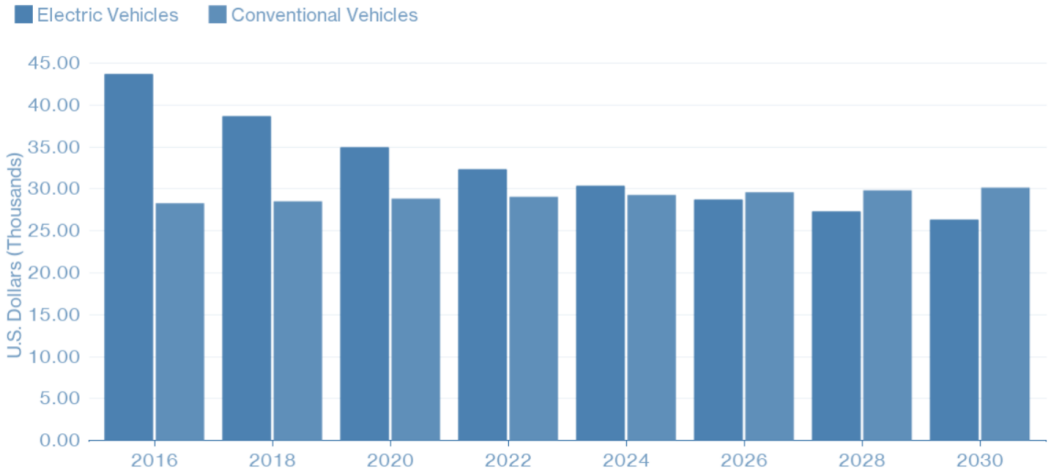
Electric Vehicle Financial Incentives

While total costs over the life of an EV are far below the costs of a traditional vehicle, the up-front cost of purchasing an EV is often the single biggest factor holding back EV adoption, with some surveys reporting the

[*] In some cases, cities may begin all-electric purchases before this date. Los Angeles, for example, replaces buses on a twelve year cycle, meaning that to meet 2030 all-electric fleet goals, it will likely begin purchasing only electric buses as early as 2019.

impact of up-front costs as more than double the next largest obstacle.[104] While a study modeling the price of various vehicle models until 2030 predicted that EVs will become price competitive on an unsubsidized basis beginning in 2025 (see, for example, Figure 7), it concluded real mass market adoption is unlikely to occur until this point without government support.[105] Encouraging signs are also emerging from EV producers, with, for example, General Motors CEO Mary Barra stating in January 2018 that GM expects to be profitable with EVs by 2021.[106]

Figure 7 Purchase Price (Without Subsidies) of Electric Cars in Comparison to Conventional Vehicles



Source: Bloomberg New Energy Finance

While consumers stand to save over the life of the vehicle due to lowered operating costs of EVs, particularly due to lowered costs of refueling,[107] information regarding potential future savings is often not made easily accessible for consumers. Even when consumers do have access to this information, many often discount the true value of future potential savings. In addition, consumers tend to resist new technologies that are considered alien or unproved.[108] Consumers' tendency to avoid risk, coupled with the larger price tag to purchase perceived "risky technology," serves as a major deterrent to purchasing an EV. Education on these issues can be a helpful tool (see "Advanced Transportation Education and Outreach" below) to address these adoption barriers. In addition, financial incentives can serve to internalize the inherent public benefit of EVs and serve as a major consumer impetus to purchase them.

The federal government currently offers a federal tax credit to lower the up-front cost of EVs.[109] States and local governments can offer additional incentives to further encourage growth of EV markets. Incentives can be catalogued by design elements including the underlying incentive type, the time at which the incentive is received in relation to the vehicle purchase, the types of vehicle technology eligible for the incentive, the ownership type eligible for the incentive, and the duration of the incentive program.

There are four main kinds of incentives:

- **Point-of-sale rebates.** Point-of-sale rebates reduce the purchase price of an EV at the point that the consumer purchases the vehicle. Car dealers sell an EV at a price reflecting the rebate and then submit a rebate application to the funding source, after which they distribute the rebate payment to the consumer. Point-of-sale rebates are commonly effective at incentivizing EV purchases because they

are an easily understandable and reliable concept and are applied directly at the point of sale to all EVs.

- **Post-purchase rebates.** Post-purchase rebates consist of financial incentives given to consumers shortly after they have purchased the vehicle, usually in the form of a check. To receive rebates, consumers commonly complete an application after purchasing an EV. While post-purchase rebates may be more easily understandable, consumers may discount their value due to the delayed receipt of the rebate and uncertainty regarding eligibility. In addition, not all consumers may qualify for a rebate or fill out a rebate application: in California, only about 70 percent of all EV purchases receive rebates (those who do not may have incomes above the $250,000 annual threshold or fail to meet other eligibility requirements).[110]
- **State income tax credit.** In addition to the federal income tax credit, state income tax credits allow EV purchasers to pay a reduced state income tax. EV purchasers receive the credit at the end of the financial year in which they purchased the car, when taxes are filed. A downside of state income tax credits is that not all buyers will be able to claim back the full amount of the tax credit: if a buyer does not have a tax liability of the full amount of the credit, they can only claim up to the level of their liability. The value of tax incentives varies substantially by state, model, and time (as some states offer funding for a predetermined period of time or until allocated incentive funds have been exhausted). Currently, Louisiana offers a state income tax credit of $2,500,[111] and Colorado offers a credit of $5,000.[112] There are ways to structure a tax credit program to make it more effective and equitable. In Colorado, for example, the credit is refundable, meaning that a purchaser will receive the full value even if they have less than $5,000 in tax liability, and assignable, allowing the purchaser to assign the credit to a financing agency and take it as a price reduction at the point of sale.
- **Other one-time vehicle tax reductions.** Lawmakers can offer to waive certain one-time taxes for consumers when purchasing the vehicle. Consumers receive this exemption at the time of vehicle purchase, effectively lowering the price of sale. For example, New Jersey exempts zero emission vehicles from the sales tax of 6.625 percent.[113] Washington, D.C. exempts purchases of EVs that achieve 40 miles per gallon during city driving from its excise tax.[114]

Table 1 Summary of Financial Credits for Electric Vehicles

Category	Summary	Typical Timing
Point-of-sale rebate	Government offers rebate to reduce the vehicle purchase price at the point of sale. Dealers fill out rebate applications to obtain the incentive.	At the time of vehicle purchase
Post-purchase rebate	Consumer applies for rebate after purchasing the EV; government mails consumer a check to refund part of vehicle	Shortly following (a few months) after vehicle purchase
Tax Exemption	Income tax credit applied against state or local income tax.	At the end of the financial year, shortly after filing taxes
	Other one-time vehicle tax reductions, such as exemptions from sales or excise taxes.	At the time of vehicle purchase

In addition to these customer-facing rebates, states and local governments may wish to consider midstream incentives to dealers. Because the profit on a vehicle sale may be only a few hundred dollars, a relatively small incentive offered to dealers can be a very effective way to motivate them to sell EVs, which can help to close the vehicle model availability gap that in many areas serves to limit consumer purchase options.

Case Study: Connecticut Dealer Incentive Rebate

The Connecticut Hydrogen and Electric Automobile Purchase Rebate (CHEAPR) program is one of two programs nationwide offering a point of sale rebate to purchasers of EVs ($5,000 rebate per vehicle). In addition, it is the only program currently providing direct incentives to dealers through a $300 dealer rebate. To date, more than $5.3 million has been distributed under this program.[115]

According to a study conducted by the program administrator, the Center for Sustainable Energy, the dealer incentive has been "moderately to very important" in convincing dealers they can make a reasonable profit on EVs, motivate their staff to sell electric cars, and spend the time required to submit rebate applications. The CHEAPR program has also significantly changed dealer perceptions of selling EVs, with 74 percent of respondents saying that the rebate has made them and their sales staff more open to EVs as an alternative to conventional vehicles. Additionally, 84 percent of respondents believed that some of their EV customers would not have chosen an EV without the consumer rebate.[116]

When choosing the type of EV incentive to offer, it is important for policymakers to consider how the vehicle market will respond and if there will be any gaps that should be addressed through other policy tools. For example, a desire to improve EV adoption among lower-income residents may be better served by a point-of-sale rebate as compared to an income tax credit, or tax credits can be designed to be refundable or assignable (as is the case in Colorado, for example). To evaluate the potential for gaps, policymakers may want to consider the funding source of the EV credit (i.e., a rebate compared to reduced tax revenue) and how money can be most easily distributed to reduce administrative burden. Policymakers may also wish to pursue partnerships with non-profits, utilities, and others to improve awareness of the incentive, reduce administrative burden, and reach a larger audience. Finally, policymakers may also want to evaluate how a certain incentive structure works to create a long-term price signal for EV purchases.

Once policymakers have decided on the type of EV incentive to offer, listed below are policy parameters to consider when structuring the incentive program:

- **Timing of Incentive for Consumer:** Research reveals that the timing of when consumers receive EV credits is a key factor in its effectiveness. On average, consumers find incentives offered at the point-of-sale (including grant subsidies or one-time vehicle purchase tax reductions) more attractive than incentives received at a future time (including income tax credits or post-purchase rebates).[117] One study found that, conditional on value, one-time sales tax waivers are associated with a seven-fold greater increase in hybrid sales than income tax credits.[118] Consumers commonly more highly value point-of-purchase incentives because they reduce the amount of upfront capital required to purchase the car, reduce uncertainty regarding whether the consumer will qualify for the incentive, and do not allow consumers to discount the value of future benefits.[119] Dealers also benefit from point-of-sale incentives, as they can market a guaranteed lower selling price to potential consumers. One dealer indicated that offering a point-of-sale subsidy of $1,500 would be more valuable than offering a post-purchase rebate of $2,500.[120]

- **Vehicle Technology Eligibility:** Policymakers must define which technologies qualify for available incentives. Policies can include hybrid EVs or only all-electric EVs and may include other technologies such as fuel cell vehicles. Policymakers can also offer a range of incentive amounts available, based on the expected carbon footprint of the vehicle, with higher incentives offered for vehicles with lower carbon footprints. Credits can also be made available on a sliding scale based on the vehicle's battery range (i.e., with higher credits given to those vehicles with longer ranges) or given only to vehicles that exceed requirements for battery range; both of these mechanisms can create larger incentives for plug-in EVs as compared to plug-in hybrid EVs. However, some state experience has shown that sliding scales or eligibility requirements make understanding the specific benefits for dealers and buyers complicated.
- **Vehicle Ownership Eligibility:** Policymakers must decide whether to offer credits only to new EVs or to also offer credits for used EVs and/or leased EVs. Leased EVs have become a significant portion of the EV market, as consumers see leasing an EV as a way to reduce technology risk. Not only has a general shift occurred from buying to leasing vehicles (from 16 percent in 2009 up to 27 percent in 2014 in the United States),[121] but the EV leasing rate in the United States is significantly higher than the overall vehicle leasing rate: while 22 percent of drivers lease a car with an internal combustion engine, 86 percent of new Nissan Leaf drivers and 44 percent of Chevrolet Volt drivers have a leased car, according to a 2013-2014 survey.[122] If choosing to offer incentives to consumers with leased EVs, policymakers can choose to establish a minimum lease range to qualify for the incentive.
- **Duration of Incentive Program:** Establishing the credit incentives for a longer time frame sends long-term, stable price signals to EV consumers, dealers, and manufacturers. However, a longer duration may require additional funding. Policymakers may choose to implement the program in phases or impose limits on funding distributed in order to mitigate this risk.

It will also be critical in designing incentives to consider the underlying fundamentals of the state or local EV market and EV availability. In many markets, vehicle dealers offer few or no EV models, and marketing may be limited. In these areas, EV incentives may also need to be paired with direct outreach and coordination with dealerships in order to improve opportunities for buyers.

Case Study: New York State Point of Sale Rebates

New York State offers point-of-sale rebates of up to $2,000 to New York residents who purchase or lease a new electric car under the New York Drive Clean Rebate. The initiative is managed by the New York State Energy Research and Development Authority (NYSERDA) and is seen as a major tool to help the state achieve its goal to reduce GHG emissions by 40 percent by 2030. The Clean Rebate works by partnering with dealerships to offer the rebate at the point of sale. Dealers offer the rebate to consumers when they purchase the EV and then apply to NYSERDA for the rebate after the sale.

To receive the rebate, New York residents purchase or lease a qualifying electric car from a participating dealer. At the point of sale, a discount of up to $2,000 is applied. Consumers also qualify for the $7,500 federal tax credit when they purchase the car. The rebate amount depends on the battery-only range of the EV; rebate thresholds are outlined in tables on NYSERDA's website. More than 30 different types of EVs are available under the Drive Clean Rebate initiative. The rebate is only available to New York State residents, businesses, and government entities. While leases are eligible, lease terms must be at least 36 months. Lastly, rebate applications must be submitted within 60 days of vehicle delivery.

New York State has allocated $55 million dollars to rebate payments. The rebate is part of the state's larger $70 million Drive Clean Initiative, which is supplemented by investments in EV charging infrastructure and outreach.

Case Study: Colorado Income Tax Credit

Colorado also has a well-established and significant alternative fuel vehicle rebate program. Since 1992, Colorado has offered an ambitious income tax credit for consumers who purchase or lease an alternative fuel vehicle, or who convert their existing vehicle to run on an alternative fuel source. To qualify for the income tax credit, a consumer must own a light, medium, or heavy-duty vehicle that is titled, registered, and licensed in Colorado and relies partly on electricity, natural gas, hydrogen fuel cells, or other alternative fuels. Vehicles qualify for the tax credit if they meet the standards regarding the vehicle's gross weight rating, maximum speed, and battery capacity.

While the Colorado credit was originally a sliding scale based on battery range and other eligibility requirements, the credit is now a flat $5,000 for purchases of new battery EVs and PHEVs. Policymakers found that the sliding scale was too complicated for dealers and consumers. After switching to a flat rebate, there was an increase in rebate claims, which suggested the simplified rebate process though such an increase could be attributable to general market improvement. In addition, the credit is refundable, which means that a purchaser will receive the full value even if they have less than $5,000 in tax liability, and assignable allowing the purchaser to assign the credit to a financing agency and take it as a price reduction at the point of sale and expands the number of consumers who can benefit from the credit. The tax credit is set to expire on January 1, 2022.

Electric Vehicle Infrastructure Support

Another significant barrier in the adoption of EVs is "range anxiety," or the concern of drivers that an EV will not be able to travel far enough for their uses without needing to return home for a charge. Vehicles with larger batteries and longer ranges are helping to mitigate these fears, but additional public charging infrastructure can help make potential EV owners more comfortable and less worried that they will be caught without access to fuel on a longer trip. Furthermore, public charging infrastructure appears to be critical for expanding the consumer base for EVs to those that do not have the option of home charging such as those who rent or who do not have dedicated parking.

There are many ways that states and local governments can support charging infrastructure development. As explained below, these may include:

- easing permitting and siting requirements;
- access to municipal or government property for infrastructure development;
- providing financial credits for charging infrastructure;
- infrastructure requirements for new commercial development and other building code or zoning requirements; and
- planning processes to identify locations for and coordinate development of charging stations.

Other works have outlined in detail steps that states and local governments can take to make their jurisdictions friendlier for EVs.[123]

Permitting and Siting

Residential and commercial EV charging stations (that exceed a simple extension cord from an existing wall outlet) require permits for the electrical work required to connect the station to the electrical grid. This process can involve submitting an application, formal inspections, and compliance with code and standard requirements, all of which can add time and expense to the charging infrastructure development process. Simplifying and modernizing the permitting processes for charging infrastructure installation can allow installers to know exactly

what information and documentation is needed to install the infrastructure, and reduce time spent on acquiring permits and conducting inspections for both developers and government. This can make charging infrastructure installation easier, faster, and more affordable.

Possible options states and local governments can take to improve the permitting process include:

- Installation guidelines: providing an outline of key steps, requirements, and calculations for the charging infrastructure installation process can help clarify the process for inexperienced developers (as most residential EV owners would be, as well as many businesses considering adding charging stations). A jurisdiction could develop a series of guides targeted at different audiences, such as homeowners, renters, or commercial installers. One specific area of focus for states or local policymakers could be multi-unit dwellings that serve low- and moderate-income families and communities; guides could provide instructions for owners as well as residents of these buildings.
- Facilitating an online permitting process: online, rather than physical or in person, permitting processes can cut down on time and expense and make understanding the permitting process more accessible to those inexperienced with electrical infrastructure permitting that may be considering investment.
- Classifying some infrastructure installations as minor work: if certain electrical conditions are met, such as location or existing electrical system, a city or state could label charging infrastructure build out as "minor work" that can lower the cost and time needed to secure the permit. This may be most appropriate for residential charging applications.
- Creating flexible inspection requirements: inspections of locations and configurations for EV charging infrastructure are important for ensuring the safety of those systems for owners and users of the charging stations. However, states and local governments could establish guidelines that allow for third-party contractors to conduct inspections on behalf of the jurisdiction, which could speed the process. States could also certify qualified installers with proven records to be subject only to random or selective inspections.

City and State Permitting Best Practices

In a 2013 study conducted for NYSERDA, Energetics Incorporated highlighted a series of statewide and city-specific best practices as shown below in Table 2 and Table 3.

Table 2. State Best Practices for Permitting EV Charging Infrastructure

New Hampshire	New Hampshire allows the homeowner to hire a professional to do the electrical work on their single-family residence without a permit.
New Jersey	New Jersey has determined that the installation of residential EVSE is considered “minor work”. This means that the homeowner or electric contractor need only provide verbal notification to the local code enforcement agency prior to starting the installation. The permit application must then be subsequently filed within five days of the notification
Oregon	Oregon has expanded its minor label program to include EVSE installations. Under the program, a licensed electrician purchases booklets of 10 minor installation labels. Eligible residential EVSE installations must be within sight of the electrical panel supplying the charging unit, have a branch circuit that does not exceed 40 amps/240 volts and are not located in a damp place. The installation labels are only about a tenth of the cost of a regular permit, and only a tenth of the installations get inspected.
Virginia	Several Virginia jurisdictions have instituted online or same-day fax permitting procedures for EVSE.

Table 3. City Best Practices for Permitting EV Charging Infrastructure

Cary, NC	The Town of Cary has implemented an online permitting process which takes approximately 2 days to process.
Charlotte, NC	The Mecklenburg County Code Enforcement and the Building Development Commission in Charlotte introduced two “self-permitting” options, the Homeowner Internet Permits[xiii] (HIPs) and Trades Internet Permits[xiv] (TIPs). Mecklenburg County’s Electric Car Initiative uses the TIP process for EVSE permit applications, reducing the permit turnaround time to 1–2 days.
Houston, TX	Houston applied its existing online express permitting process to EVSE installations. With this process, online permits are issued automatically and instantaneously for standard EVSE, and an inspection can be performed on the same day as installation.
Los Angeles, CA	Los Angeles applied its existing online Express Permit system to EVSE installations. The system enables standard EVSE customers to receive a permit automatically and instantaneously. They are allowed to start using their EVSE immediately after installation and the inspection follows within 24 hours.
Milpitas, CA	In Milpitas, single-family homeowners are not required to submit site plans when applying for an EVSE permit.
Raleigh, NC	Raleigh applied its existing "stand alone" permitting and inspection process to EVSE installations. The permit is completed as the applicant is walked through the process by permitting personnel. Getting a permit takes about one hour, and inspections can be performed the day after installation. As a result, permitting, installation, and inspection process for a simple home-based EVSE project can be completed in as few as two days.
San Francisco, CA	The City of San Francisco’s Department of Building Inspection issues same-day, over the counter permits for the necessary electrical work at a residence, and electricians registered with the Department of Building Inspection can obtain the permits instantly online.
Sunnyvale, CA	In Sunnyvale, homeowners can use an online application process for EVSE, provided the charger will be located inside a garage and can be connected to existing electrical panels.

Source: Energetics, Inc.[124]

Charging at Government Sites

States and local governments can also facilitate the development of charging infrastructure by allowing developer access to publicly owned or managed property. Because many parking structures are municipally managed, this can greatly expand the opportunities for charging development in urban areas and around key transportation corridors. This can also serve to increase the visibility of charging and have a positive educational effect, as residents see more EV options available in everyday places.

Case Study: Government Charging in New Jersey and Minnesota

In New Jersey, the town of Montclair worked with ChargePoint, a commercial charging station developer, to install two charging stations in municipal parking lots. One was located in the business district and the other in a shopping area. The city also invested in signage to help drivers find the chargers and further enhance the visibility of EVs in the town.[125] Similarly, several cities in Minnesota have added EV charging facilities in public parking lots. Eden Prairie, a suburb of the Twin Cities, added charging to its parking station at City Hall, while St. Paul has worked with commercial developers to install more than 40 EV charging stations on public lands around city parks and public parking garages. The Metropolitan Airport Commission, which runs the Minneapolis-St. Paul International Airport, also added EV charging parking spaces to its long-term parking facilities.[126]

Financial Credits for Charging Infrastructure

States and local governments can also provide direct financial incentives for infrastructure investment. These are often in the form of tax incentives or rebates. Key considerations for policymakers considering providing incentives may include what sort of infrastructure would qualify (residential or commercial, as well as size and speed of charging station), how to apply the incentive (through cash rebates or tax incentives), who can claim the credit (individuals or also large commercial developers), the amount of the credit and whether to have it adjust by charging station size or type, and whether to set and program limits on total incentives distributed.

Policymakers may also wish to consider how financial credits can be designed such that non-owners (e.g., residents of multi-unit dwellings) can take advantage of credits. In many areas, EV ownership is a requirement to receive financial credits for infrastructure. However, EV owners who rent may be unwilling (or not allowed) to pay for the installation of a charging station if they would not own that station, while a landlord that would be interested in making such an investment would not be the owner of the EV and thus ineligible for the credit. Policymakers could consider designing incentives to account for this situation by allowing owners of residential rental properties to receive infrastructure credits under certain conditions.

One emerging opportunity for state and local investment in charging infrastructure is the funding available under the Volkswagen Settlement, which partially resolves allegations that VW and various affiliates utilized “defeat devices” that allowed its vehicles to emit more than allowed under the Clean Air Act. This settlement, among other provisions, requires VW to invest $2 billion to advance ZEVs and ZEV infrastructure (“Appendix C”) and fund a $2.95 billion mitigation trust fund that states can tap into to make investments to reduce NOx emissions (“Appendix D”), 15 percent of which can be spent on EV infrastructure, including charging infrastructure for heavy-duty vehicles.[127] VW will begin investments under Appendix C through its independent subsidiary Electrify America as soon as summer of 2018, and states have already started designing and submitting plans for EV infrastructure development under Appendix D.

Case Study: Maine VW Settlement Appendix D Plan

States are beginning to submit plans and funding requests to the trust that has been established to distribute the $2.7 billion in state investment funds available under Appendix D of the Volkswagen Settlement. Maine is one of the first states to do so, filing its final Beneficiary Mitigation Plan in February and its first requests for funding in April 2018. Each state's settlement amount is determined by the number of registered vehicles identified as having defeat devices: Maine's allocation totals just over $21 million dollars.

In these documents, Maine proposes to allocate:

- 40 percent of the Trust funds to eligible priority multimodal transportation improvements via MaineDOT which will focus on repowering port tugboats, and replacing cargo equipment and drayage trucks with engines that meet current EPA emission standards;
- 20 percent of the funding to the Diesel Emissions Reduction Act (DERA) program to expand eligible projects to repowering commercial fishing vessels; replacing, repowering or engine upgrades on long-haul locomotives; replacement or repowering of agricultural, forest or construction equipment; exhaust control technologies; and support reduced idling technologies including auxiliary power units and shore power for locomotives, and marine vessels; and
- the maximum allowed (15 percent) of the Trust funds toward the deployment of light-duty zero emission vehicle infrastructure.[128]

Case Study: Plug-in Austin – Multifamily Properties

Austin Energy, a municipally run utility, has implemented a program targeted specifically at owners of multi-unit dwellings, which house more than 40 percent of the city's population.

Under this program, Austin Energy provides a rebate of up to $4,000, or 50 percent of the cost to install approved Level 2 (240V) charging stations and/or Level 1 (120V) outlets (the maximum rebate depends on the selected equipment and if the station is in an existing or new parking area). The utility also provides rebates up to $10,000 to hosts who want to install a DC Fast Charger. To qualify for these credits, the charging station must be open to all residents of the property; the utility provides a separate program for those owners who want to install charging infrastructure for dedicated or private spaces.

In addition to the financial incentives, Austin Energy provides numerous services to property owners to make the installation and management of EV infrastructure "as easy and cost-effective as possible." This includes assistance with all billing-related matters for the charging stations; providing contractors who check, clean, and perform maintenance, as needed, on the station; reimbursing hosts for electricity used during charging; and paying annual network licensing fees.

The utility also notes that installing EV charging stations will provide benefits to the property owner, including helping to attract residents and earning an Austin Energy Green Building Innovation Point.[129]

Case Study: Charge Ahead Colorado

Colorado's "Charge Ahead Colorado" program is a collaboration between the state's Regional Air Quality Council and Energy Office to provide direct refunds for investments in Level 2 and DC fast charging infrastructure investment. Refunds range from around $3,000 to $6,000 for Level 2 installations and $13,000 to $16,000 for DC fast charging installations, varying based on number of ports at the station. Installers, which can be public, private, and non-profit organizations, must submit an application to claim the credit.[130]

In addition, the state released in late April 2018 a request for applications for DC fast charging installations along six major corridors through the ALT Fuels Colorado Electric Vehicle Direct Current Fast-Charging Corridors Grant Program. Projects may be eligible for a refund of up to $380,000 of equipment costs.[131]

Requirements and Zoning or Building Codes for New Development

States and local governments can also help accelerate the development of EV charging infrastructure by requiring that new residential and/or commercial development include EV infrastructure. For example, Mountlake Terrace, Washington, a suburb of Seattle, requires that all new development larger than 10,000 square feet that includes parking equip a certain number of parking spots with EV charging stations. For qualifying multi-household residential units, at least 10 percent of parking spaces must have charging stations.[132] Zoning or building code programs like this can help to target infrastructure for specific communities, such as low- or moderate income or disadvantaged communities.

An equally important solution to increasing the availability of charging is to require that all new construction of multi-family and commercial buildings with parking structures include sufficient electrical infrastructure to support EV charging. This type of infrastructure includes correctly sized electrical service to support Level 2 charging, with the supporting infrastructure such as subpanels, breakers, and conduit/wiring routed to each parking space throughout the parking lot.

Finally, local governments can establish guidelines for multi-family zoned properties that assist individual residents in installing charging if desired. This could include ensuring that home-owner associations allow EV charging installations without burdensome approval processes.

Case Study: CALGreen and the City of Fremont

California has established the California Green Building Code (CALGreen) that requires that new residential and commercial developments are “EV capable,” meaning that they fulfill basic requirements that provide a foundation for future EV infrastructure installation (but do not necessarily include that infrastructure upon initial development).[133] The City of Fremont, California has taken this a step further with multiple EV requirements:

- Residential and non-residential new construction projects and additions where additional parking spaces are provided must include "EV Ready" parking spaces equipped with the electrical raceway, wiring, and electrical circuit as well as the EV charging unit.
- Single-family residential projects must provide one EV Ready parking spaces per each dwelling unit.
- Multifamily residential projects of 3 units or more and all non-residential projects must be “EV Ready” at approximately 10 percent of the total number of new parking spaces.[134]

Policymakers at the state and county level can also ensure that zoning laws allow for or require local governments to make investments in EV infrastructure or to incorporate EV requirements into their local regulations. Washington State, for example, requires that many local governments allow EV infrastructure in most zoning districts, including those around key interstate freeway transportation corridors and all commercial and industrially zoned areas.[135]

Coordinated Infrastructure Planning Process

Finally, states and local governments can participate in coordinated planning processes around the deployment of EV infrastructure. These processes can take many forms, from strategic planning efforts, to mapping and location-based analyses, to coordination across jurisdictions to ensure that infrastructure build out is sufficient to meet EV targets and that investment is efficiently allocated across a given region. For example, the Transportation & Climate Initiative, an organization focused in the Northeast and Mid-Atlantic states first founded in 2010, has undertaken numerous efforts to help plan for the region-wide expansion of EVs.[136] This initiative has supported the development of an EV Infrastructure Location Identification Tool that can allow users to identify suitable locations for potential fast charging infrastructure development in regional corridors based on local priorities.[137]

Case Study: REV West

In October 2017, Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming signed a memorandum of understanding (MOU) to provide a framework for creating a regional EV plan for the West.[138] The Regional Electric Vehicle Plan for the West (REV West Plan) focused on 11 major interstate transportation corridors that span around 5,000 miles. It calls for the participating states to, among other things, work cooperatively to establish policies to support the development of the EV market by improving consumer acceptance and awareness by addressing "range anxiety"; coordinating on EV charging station locations to avoid redundancy and to ensure stations are sited at a frequency and locations so as to optimize utilization and to minimize inconsistencies between charging infrastructure in each state; and leveraging economies of scale. To achieve these goals, states have formed a Coordination Group with representatives from each state that meets on a quarterly basis with regular reports.

Utility Offerings and Support for Electric Vehicles

Electric utilities are well-positioned to aid in addressing the market barriers to EVs identified above in order to enable a shift to electric transportation. Electric utilities have the capabilities to support infrastructure deployment on the scale needed to improve charging station accessibility and support a robust PEV market. They are also in the position to design rate structures that will benefit customers and society by ultimately reducing the cost of electricity and the cost of PEV ownership.

State and local authorities' ability to engage on these opportunities will be dependent on their local power market structure, and regulators will need to consider this context in evaluating which strategies are best suited for their particular needs and opportunities. States can take proactive action to encourage utilities to file proposals and develop programs as described below. Public utilities commissions and other utility regulators (e.g., boards of municipal utilities) will play an important role in scoping and approving these activities. For example, regulators can ensure that utility programs are well-designed and effectively implemented to capture the targeted benefits, including for customers, and to avoid significant stranded costs.

The text below provides a high-level overview of options available to states to involve utilities in the deployment of EVs; more details are available in past work, such as "Utility Investment in Electric Vehicle Charging

Infrastructure: Key Regulatory Considerations" from November 2017.[139]

Investing in Charging Infrastructure

During the nascent stage of the EV market evolution, the role for utilities in the development of public charging infrastructure was largely limited to connecting other parties' charging platforms to the grid. Now, however, there are many options being explored and demonstrated by leading utilities for electric utilities to take a more active role in EV infrastructure development. These approaches can stimulate the EV charging market, achieve increased investment in infrastructure, ensure that third-party developers still have access to the market, and ensure that utilities fairly recover investment costs. States can support utility involvement in the deployment of charging infrastructure in order to help accelerate electrification of the transportation sector and spark growth across the market.

There are three primary ways that utilities can invest in charging infrastructure. First, it could invest in "make-ready" installations, which include the electrical infrastructure required up to, but not including, the charging equipment itself. This may include upgrades to transformers and service capacity and/or running new service drops. In some cases, it may also mean trenching and running conduit and cable to specific areas of a host site, such as in a parking lot at a workplace. The costs associated with these "make ready" investments may be included in the utility's rate base and would be recovered by the utility through increases in distribution rates spread over a period of years. Second, a utility could fully own and operate infrastructure, which would include the make-ready components as well as the chargers itself, resulting in a single regulated entity building out and owning the electric and vehicle charging infrastructure. Third, utilities could provide host sites with financial incentives, such as rebates for all or some of the costs of the charging stations and/or the make-ready infrastructure portion.

The investment model appropriate for a given location is a function of multiple variables, including location (e.g., both type, such as residential building or shopping mall, as well as distance from existing infrastructure), the state of the existing distribution system, the state of the local charging infrastructure market, and likely customer base including income level. Table 4 summarizes these potential approaches to utility EV charging infrastructure investments, and each is summarized in more detail below.

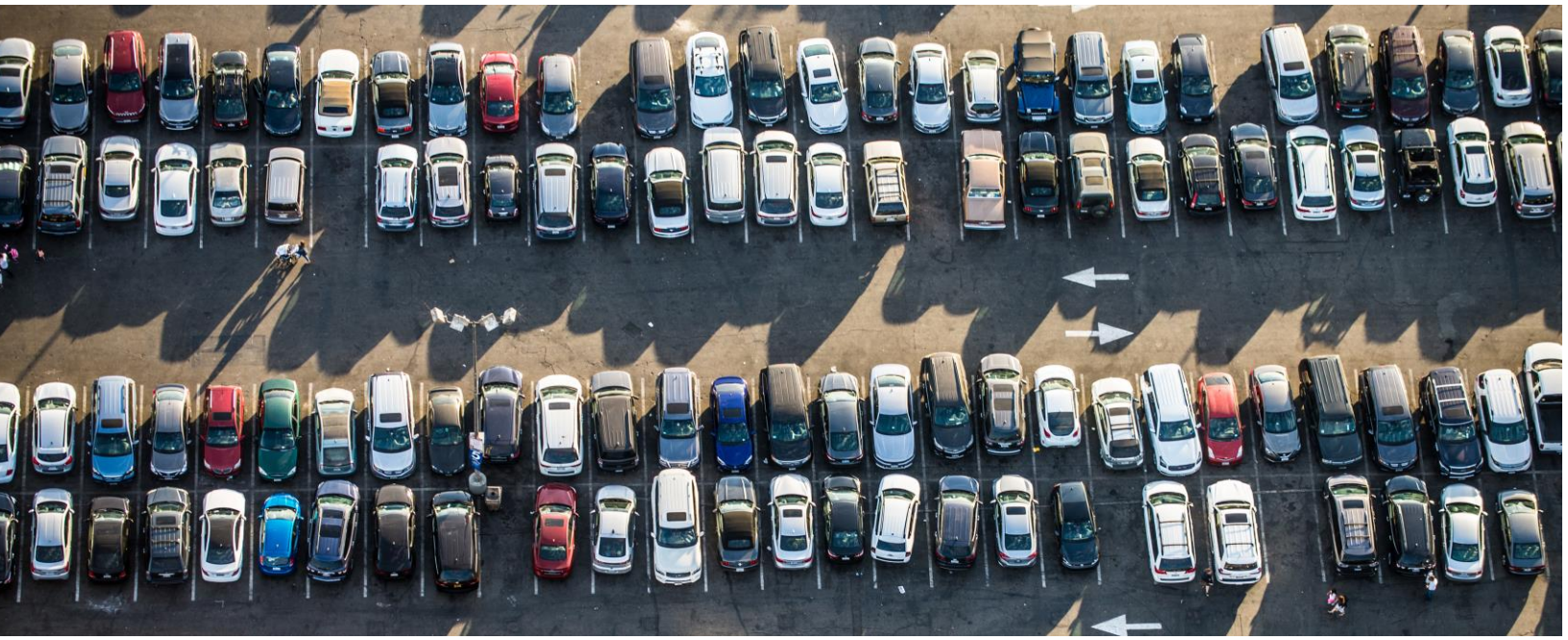


Table 4 Potential Utility Charging Infrastructure Investment Options

Utility Investment Options	Description	Implementation Attributes and Considerations
Make Ready	Electric grid infrastructure enhancements and upgrades to enable EVSE installations at host sites.	Can take advantage of utility access to capital to lower costs and increase pace of development. Utility will need to determine how investment costs will be recovered and who will pay. Approach enables flexibility of host site to choose EVSE provider and driver charging pricing plan.
Owner and Operator	Electric grid enhancements and upgrades as well as full build out and operation of EVSEs at host sites.	Streamlined program administration: utility would use experience with previous programs in all stages of developing and operating EVSE: marketing and recruitment, planning and permitting, construction and interconnection, and ongoing operation and maintenance. Could crowd out alternative providers from the market Could result in stranded cost for utilities if utilization is lower than expected, putting customer dollars at risk.
Rebates for Private and Public EVSEs	Cash rebate to private and public locations for the purchase and installation of EVSEs.	Reduces the upfront EVSE costs to all developers and customers. Can be structured to incentivize certain EVSE functionality (e.g., two-way communication capabilities). May not provide as much development support and fail to develop necessary EVSE for market.

Case Studies: Utility Investment in EV Infrastructure in Low-Income Communities

Utilities are beginning investments in EV charging infrastructure, pursuing a combination of the investment models described in more detail above. One focus of some programs is EV infrastructure that supports low- and moderate-income or disadvantaged communities. While these communities may not necessarily be early adopters of EVs, encouraging these communities to consider EVs and making that transition cost-effective will be critical for the market expansion necessary to meet many states' EV and broader emissions goals. Drives in urban areas can make ideal EV drivers as such residents usually need vehicles for only shorter trips.

Existing utility programs to invest in low- and moderate-income or disadvantaged communities are part of broader investment programs. For example, Eversource, a Massachusetts utility, recently received approval to spend $45 million on EV infrastructure, 10 percent of which is required to be in low-income communities.[140] Each of the California investor-owned utilities, which collectively were approved in 2016 to invest $197 million, are required to invest 10 to 15 percent of those funds in disadvantaged communities.[141] In January 2018, under the requirements of Senate Bill 350, the California Public Utilities Commission approved even more detailed transportation electrification plans including investment in EV (both light and heavy duty) charging systems that specifically target disadvantaged communities.[142]

Charging Rates and Programs

Through rate design, approved by state PUCs, electric utilities can influence charging behavior, and in turn, minimize costs to operate the distribution system while maximizing economic and environmental benefits of EVs. In states with high solar or wind generation, utilities may also be able to manage load in a way that coordinates peak renewable generation with increased demand from EV charging, using excess power to support this new load and reduce the need for curtailment. In addition, utilities may be able to help avoid the need for additional generation capacity by utilizing available generation and strategically managing charging behavior.

For residential charging, utilities have three primary options to manage residential EV charging: whole house "time of use" (TOU) rates, EV TOU rates, and rebates or bill credits. Whole house or EV TOU rates utilize smart meters to track the usage at a residential charging station or house with a charging station on an hourly basis. The rates are designed such that hours during higher energy demand times—typically in the middle of the day and evening—are more expensive than during off-peak times like the middle of the night. This creates an incentive for EV owners to shift their charging to those off-peak times and limits the potential strain of EVs on the distribution system. This can avoid upgrades to the utility distribution system that might otherwise be required to serve EVs.

Utilities could also offer a reward or cash incentive program that would provide monthly rewards in exchange for off-peak or controlled charging, analogous to existing demand response programs. This program could be structured as a monthly bill credit provided to customers who charge their vehicle during off-peak periods or allow the utility to control EV charging within certain parameters. A reward program could also provide off-bill credits to customers or other users of charging facilities.

Case Study: Utility EV Rate Programs

Many utilities, including Maryland's Baltimore Gas and Electric (BGE)[143] and Pepco[144] as well as PSE&G in New Jersey,[145] have implemented residential EV charging rate options as pilot programs. These programs test the effectiveness of designing rates to encourage off-peak charging and the subsequent impact of various options on load management. Each demonstrated a shift in charging behavior and shift in demand to off-peak hours resulting in savings on customer's bills as compared to standard rates. The pilots designed and offered by BGE and Pepco were successful and adopted as standard voluntary options within the utilities' tariffs.[146]

Case Study: SmartCharge New York

Con Edison is launching SmartCharge New York, a program designed to help EV owners who charge in the Con Edison service territory reduce their cost of charging and enhance electric grid efficiency and resiliency. The three-year program (2017 to 2019) will track participating customer EV driver charging behavior through Fleetcarma's C2 device—a smart grid solution that collects driving and charging data and communicates this information using the cellular network. The C2 plugs into the vehicle's on-board diagnostic (OBD) port or Tesla diagnostic connector. Participants in the SmartCharge New York program earn SmartCharge Rewards™—monthly rewards earned for charging in the Con Edison service territory, with bonuses applied for avoiding charging during peak hours in the summer months. In addition, off-peak charging is incentivized year around with per kWh rewards. SmartCharge Rewards™ can be redeemed for e-gift cards to retailers such as Amazon, Target, or REI.

Utilities can also consider providing modifications to traditional demand charge structures for commercial customers. As usually structured, demand charges are based on the peak electricity needs of a customer, and can greatly increase due to the addition of one or more EV charging stations (even though total monthly electricity usage may not increase as much). This can be a financial impediment to development of public charging stations, especially in early years when utilization of stations is low and uncertain—in these cases, the demand charges increase electricity costs but there are not enough users of the station to recover those costs. Utilities can greatly help by developing alternative rates that modify this structure, perhaps through temporary demand charge "forgiveness" or replacing the traditional structure with increased electricity rates for the first years after charging station installation (after which the typical demand charges would be reapplied).

Utilities can also use public EV charging rates to manage load and encourage investment in charging infrastructure. The optimal pricing structure will vary from location to location based on a number of site characteristics, including anticipated utilization, charger type, and ownership of charging station (i.e., utility or site owned). Ultimately, stakeholders will need to determine how to set rates in a way that provides appropriate cost recovery and incentives for infrastructure investment while also continuing to support and encourage increased adoption of EVs while fostering broad markets. The rate design levers that utilities, regulators, and others may use to reach this outcome include demand charges, TOU rates, and the pricing applied to users and/or site hosts.

Customer Education and Awareness

Many barriers currently preventing the shift to EVs relate to customer knowledge and awareness. For example, consumers experience "range anxiety" believing that EVs will not be suitable for daily use and have misconceptions about the relatively new technology. In addition, the advantages of and incentives to purchase EVs are not well understood by the public.[147]

Developing the resources necessary for consumers to make informed decisions can play a critical role in encouraging EV deployment. Electric utilities can serve as a reliable and trusted source to provide understandable and relevant information on EV options and benefits. The utility-customer relationship can be leveraged to provide education on charging needs and available rates and programs. When utilities make this information readily available, customers become more familiar with the concept of EVs and can gain a more comprehensive understanding of their benefits. Utility approaches to education and awareness are discussed in more detail below in "Advanced Transportation Education and Outreach."

Vehicle Grid Integration Programs

NREL, as well as others, have explored how EVs can help support grid operations acting as grid-connected batteries. While these applications may not yet be commercially feasible given the current state of technology (both on the grid and in EV batteries themselves), states can take action now to support research and to "future proof" policies and investments to set the foundation for these future functionalities. For example, NREL is studying how EVs can support local power quality, especially in scenarios with a high concentration of renewables, by leveraging charge system power electronics to monitor and enhance local power quality and improve grid stability. A modeling exercise in Germany also showed that EVs contributed to balancing intermitted renewable resources, in part by helping to consume nighttime wind generation.[148]

EVs can provide services individually or in aggregation (at centralized charging locations). At a minimum, managed or smart charging strategies are needed to ensure that EVs do not increase peak load, requiring additional generation or capacity expansions. Ideally, charging is coordinated with grid conditions and the ability for aggregation of EVs to respond to grid operator signals. In addition to providing grid services, these programs could provide a revenue stream to EV owners, help to reduce local distribution maintenance costs, and lower overall electricity prices in the wholesale market.

Case Study: Vehicle Grid Integration in California

California has taken a range of actions to explore and support development of programs and standards that facilitate vehicle grid integration (VGI).

Starting in 2012, the state's grid operator, the California Independent System Operator Corporation (CAISO) took the lead in drafting a VGI Roadmap in coordination with the Governor's Office, the California Energy Commission, the California Public Utilities Commission and the California Air Resources Board. The goal of the roadmap was to identify creative approaches that could lead to EV charging behavior that is beneficial (or at least not adverse) to grid reliability, as well as promote aggregation of EV resources in order to allow those resources to be bid into the CAISO wholesale market to provide grid services. In total, The VGI Roadmap provided a high-level plan to enable this combination of activities. After multiple rounds of policymaker and stakeholder review, the Roadmap was published in 2014.[149]

The California Public Utilities Commission has also established a VGI Working Group, which was created to assess how and whether the adoption of a communication protocol is necessary to enable VGI resources to more economically participate in electricity markets at scale. The working group allowed participants to review, understand, and discuss the technical details of existing communication protocols. The outputs of the working group are intended to help the Commission determine any requirements necessary for charging station investments the investor-owned utilities make, inform the California Air Resources Board SB 454 Electric Vehicle Charging Open Access Act activities, and allow the California Energy Commission to understand how to better characterize EV load and infrastructure flexibility as part of their Integrated Energy Policy Report and investment programs. The Working Group released a draft final report for public comment in spring of 2018.[150]

Finally, the state has supported pilot projects to explore VGI opportunities. Specifically, a vehicle-to-grid (V2G) demonstration project at Los Angeles Air Force Base uses a non-tactical fleet of 34 light- and medium- duty plug-in electric and hybrid vehicles and their bi-directional charging stations to not only charge their vehicles but also provide grid services back to the system, earning the revenue for the Base. Following the V2G demonstration, some batteries will be removed from the EVs to evaluate and quantify potential impacts to the batteries from V2G operational cycles and to predict potential long-term impacts.[151]

Public Transportation Electrification

The U.S. vehicle fleet contains roughly 70,000 transit buses on the road, fueled mostly by diesel, with approximately 5,000 to 6,000 of those buses replaced each year. These heavy-duty buses account for less than one percent of transportation sector CO_2 emissions each year, but the vehicle turnover rate provides significant opportunity for fleet replacement and improvement. Transit electrification, in particular, would result in national emissions reductions of up to 18 million metric tons CO_2 and improved local air quality in cities.[152] Taking diesel buses off the road can also result in large reductions in health-harming particulate pollution. Local governments can take action to specifically target these health benefits: for example, when Seattle was rolling out its electric bus system, it started with those routes in communities that face disproportionate air pollution and health impacts to "bring the benefits of zero emissions buses there first."[153]

Vehicle operators had originally expressed concerns about changes to their daily schedule including travel limitations of battery capacity and the need for convenient and efficient charging infrastructure. However, recent technological advancements are lowering these operational concerns by enabling some electric buses to be equipped with battery packs that are large enough to travel a complete typical route, and newer proprietary models can recharge rapidly, sometimes as fast as ten minutes.[154] City bus drivers have given generally positive feedback

about electric buses, noting their operational similarity yet relative quietness compared to diesel buses.[155]

The main barrier to ramping up electrification of public transit is the high upfront cost of electric buses compared to equivalent diesel buses, although research indicates that electric buses have much lower operating costs and can already be cheaper on a total cost of ownership basis than conventional buses today, and will reach unsubsidized upfront cost parity with diesel buses by 2030.[156] Additionally, fully electric buses do not require overhead wire cable infrastructure that supply electricity to trolley buses in some cities, and they also eliminate the need for any emissions from petroleum fuel sources, both minimizing unsightly infrastructure and improving local air quality. Existing gas station infrastructure can also be expanded to support the build out of fast charging stations without the need to add new stations in areas that have the sites set aside for vehicle fueling.

Cities can play a role in encouraging development of the electric bus industry, bringing down overall costs, through direct partnership and engagement efforts with electric bus manufacturers. LA Metro, for example, signed a motion in July 2017 committing the transit agency to work with the electric bus industry to ensure that manufacturers are aware of cities' demand for specific types of electric bus models.[157] Cities' direct engagement with manufacturers may encourage the industry to increase the number of electric bus models offered, giving purchasers greater options to meet their specific needs and helping with technological improvement and cost reduction.[158] In addition, some organizations are exploring utility on-bill financing to accelerate investment in transit electrification.[159]

Finally, school buses present an additional opportunity for public transit electrification. The electrification opportunity has garnered significant public support due to the health benefits children stand to gain from avoided inhalation of emissions from diesel exhaust,[160] with programs under way in California and Massachusetts.[161]

Case Study: City Conversions to Zero Emissions Vehicles

In light of the benefits and opportunities in bus electrification, cities are prioritizing the conversion through policy measures. A dozen global cities, including U.S. cities like Los Angeles and Seattle and international cities such as Auckland, Barcelona, and Vancouver, have signed the Fossil-Fuel-Free Streets Declaration, pledging them to purchase only zero-emissions buses beginning in 2025.[162] Meanwhile, other cities have already proven that full bus electric conversion is possible. Shenzhen, just north of Hong Kong and home to electric bus manufacturer BYD Motors, has a full electric bus fleet of 16,359 vehicles.[163] The city has also built 300 bus chargers over the last few years that recharge the batteries in roughly two hours. The conversion and infrastructure were made possible through substantial financial investments made by the city ($500 million in 2017 alone) with the primary goal of significantly improving air quality, while also reducing operating costs in comparison to diesel buses. The Shenzhen all-electric bus fleet is roughly three times the size of New York City's entire bus fleet and is expected to save the equivalent of 345,000 tons of diesel fuel and reduce CO_2 emissions by more than 1.3 million tons.

Case Study: Los Angeles's Transition to Electric Buses

Los Angeles County Metropolitan Transit Authority (L.A. Metro) has not had a diesel bus in service for more than six years after replacing all these higher emitting vehicles with natural gas. Now, the City of Los Angeles plans to eliminate emissions entirely from its more than 2,300 vehicle bus fleet by 2030 through transitioning to electric buses or zero-emission vehicles that run on hydrogen. This will include turnover of fleets operated by L.A. Metro, L.A. Department of Transportation (LADOT), and other neighboring transportation agencies. In 2013, L.A. Metro contracted with Chinese manufacturer BYD Motors for 25 electric buses as part of a $30 million pilot project. This has led to more contracts signed in 2017 with manufacturers like BYD for 60 more 40-foot buses and up to 100 articulated 60-foot electric buses from New Flyer to move the needle toward meeting the 2030 pledge.[164] Proterra has a contract to provide LADOT with 25 buses by 2019.[165] L.A. Mayor Eric Garcetti has noted that early implementation will both improve air quality sooner and lead to quieter streets and could eventually encourage the trucking and freight industry to make similar changes.[166]

Broader Programmatic Measures

Because transportation is inextricably intertwined with economic activity of states and local governments, there are many broader programmatic measures that may not be solely transportation focused but can have significant impacts on the sector. For instance, many policies surrounding urban planning, such as development standards or economic development, have significant transportation components. In addition, marketing and educational efforts, while critical to the success of many initiatives discussed throughout this paper, are often not limited to one initiative but can span multiple programs and goals.

Goods Movement and Delivery Standards

Freight trucks for on road transportation of goods account for a significant share of medium- and heavy-duty fleet emissions and make up over a fifth of emissions from the entire transportation sector alone.[167] Heavy-duty combination trucks used for long-haul freight movement traveled over 170,000 million miles in 2015 with average fuel economy less than six miles per gallon.[168] Though a smaller portion of overall emissions, vocational vehicles can also be some of the heaviest emitters on a per gallon basis. In 2015, Class 3 through 8 trucks, which includes trucks used for heavy hauling and towing for individual and business purposes, traveled nearly 110,000 million miles with average fuel economy around seven miles per gallon.[169] On-road delivery and service vehicles, machinery at ports for goods movement, and cement and dump trucks offer opportunities for advanced clean

technology and improved emissions standards. In addition, goods movement is often concentrated in already disadvantaged communities.[170] As such, improvements in efficiency of the goods movement system can be an important tool in lowering local air pollution hazards in these areas.

Policies and approaches to address standards for goods movement and delivery can vary greatly depending on specific use, but may include:

- Vehicle idling restrictions;
- Last mile delivery plans;
- Truck emissions and efficiency standards; and
- Electrification.

These are each explored individually through case studies below. In addition, some cities have begun pursuing comprehensive goods movement planning, combining multiple of these measures and others explored throughout this paper into one strategy.

Vehicle Idling Restrictions

Idling—running a vehicle's combustion engine when the vehicle is not moving—not only wastes fuel and raises refueling costs, but also increases the emissions of air pollutants that can cause significant public health effects. The benefits of idling reductions are seen both as cost savings through reduced fuel use and as emissions reductions and corresponding reductions in health hazards. The Department of Energy estimated that each year more than 6 billion gallons of diesel and gasoline fuel are wasted by vehicle engine idling. This costs more than $20 billion a year in fuel costs alone.[171] This can greatly increase local and GHG air pollution: if half of idling is presumed to be diesel and half from gasoline, this fuel burn would result in the emissions of nearly 62 million tons of CO_2 each year.[172]

For this reason, certain states and municipalities have enacted laws to impose fees on idlers.[173] For example, Massachusetts explicitly prohibits, and can impose a penalty for, the unnecessary operation of motor engines when a vehicle is stopped for more than five minutes.[174] The law specifically aims to cut down on air pollution and extends to delivery vehicles but exempts those in which operations require assisted power as part of the process of goods and merchandise exchange. Fines can range from $100 to $25,000 and are enforced by federal, state, and local public health officials. New York has a similar anti-idling law limiting idling to no more than five minutes, and New York City has its own law limiting trucks and buses to idling for no more than three minutes.[175]

Case Study: Ozone Transport Commission Regional Efforts

In November 2017, the Ozone Transport Commission (OTC) signed a resolution concerning state idling reduction programs.[176] The OTC is a 12-state member organization (plus D.C.), established under Sections 176A and 184 of the federal Clean Air Act, that has pledged to reduce ground-level ozone through regional actions. The resolution aimed to implement or improve idling reduction programs to reduce NOx emissions as part of improving unhealthy levels of ozone air pollution both in the OTC participant states, as well as in neighboring states. The section on education and outreach below explores some of the programs that OTC states have put in place under this pledge.

Last Mile Delivery

California's ARB has been hosting stakeholder meetings and working groups to investigate early market opportunities for zero-emission heavy-duty trucks Class 3 to 7, as part of the Advanced Clean Local Trucks program for last mile delivery and local trucks.[177] Delivery vehicles in urban areas often operate on a stop-and-go basis with periods of idling. However, because they are centrally located, they are well suited for clean

technology and any related infrastructure. ARB aims to develop advanced clean trucks as another facet in their suite of emissions reductions strategies to achieve deep decarbonization and improve air quality. Considerations as part of the program development include establishing a robust maintenance network and supply chain, understanding operational data and costs, and potential overlap with Phase 2 GHG and low NOx engine standards.

Federal Heavy-Duty Truck Emissions Standards

As discussed in the "Light- and Heavy-Duty Vehicle Emissions Standards" section of this paper, EPA and NHTSA have the authority to establish emissions standards for heavy duty vehicles. California may also set standards that other states may adopt.

Federal Phase 1 (2011) and Phase 2 (2016) regulations for Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles were finalized as part of a national program to reduce emissions and fuel consumption from combination tractors, heavy-duty pickup trucks and vans, and vocational vehicles. Phase 1 implements separate standards for engines that power combination tractors and vocational vehicles[178] while Phase 2 promotes newer and more efficient trucks and encourages the deployment of more advanced technology while remaining cost effective. [179] The 2016 Phase 2 standards, as finalized, cover model years 2018 to 2027 for certain trailers and model years 2021 to 2027 for semi-trucks, large pickup trucks, vans, buses, and work trucks. Phase 2 also include a set of rules regulating emissions from "glider" trucks, which are repurposed, old, and higher emitting engines that are placed into new truck bodies. These regulations closed a loophole under which these trucks were previously not regulated under current model year emissions standards. In the Final Rule adopting Phase 2 of these standards in October of 2016, EPA estimated that the final standards would reduce CO_2 emissions by roughly 1.1 billion metric tons, save vehicle owners $170 billion in fuel costs, and reduce oil consumption by up to two billion barrels over the lifetime of the vehicles sold under the program.[180]

California has also developed heavy duty emissions standards under its Clean Air Act designated authority. Similar to the light duty standards, in the California Phase 2 standards, California is aligning with the federal Phase 2 standards in structure, timing, and stringency, but with some minor California differences.[181]

The current administration has proposed to rescind the glider rules.[182] In addition, EPA notes that it has received numerous petitions for reconsideration of the GHG standards for medium- and heavy-duty vehicles, though it has not yet taken action to review or propose rescinding those rules.[183] If it does so, or continues in repealing the glider rules, states that want to address pollution from glider trucks could adopt a version of California's Truck and Bus Rule, which phases out pre-2010 engines by 2023.[184]

Diesel Retirement Programs

One way to promote and accelerate the replacement of diesel-powered trucks is through retirement incentive programs, which can have significant impacts on local and GHG pollution emissions. A study of a 2006 Ports of Los Angeles and Long Beach regulations establishing forced retirement timelines showed significant reductions in carbon monoxide (30 percent), oxides of nitrogen (48 percent) and infrared opacity (a measure of particulate matter, 54 percent).[185]

These programs can take numerous forms. For example, one option is direct grants for replacing diesel equipment that provide financial incentives to private and public owners of certain vehicles to retire those vehicles. These programs can be designed to target certain technologies (e.g., heavy duty diesel trucks) or emissions (e.g., only those vehicles above a certain emissions threshold are eligible for the program) and may include requirements for replacement vehicles such as existing emissions or fleet standards for new vehicles. The Texas Emissions Reduction Program (TERP), for example, is a first-come, first-served grant program to upgrade or replace diesel heavy-duty vehicles and/or equipment. [186]

Grant programs can also target emissions reductions in specific communities. For example, the California Community Air Protection Funds to Reduce Emissions in AB 617 Communities targets engine replacement, repower, and infrastructure projects in disadvantaged and low-income areas. This policy utilizes direct retirement grants through the state's Carl Moyer Memorial Air Quality Standards Attainment Program as well as clean truck efficiency improvement and repower incentives through the Goods Movement Emission Reduction Program. The program is also funded directly through cap-and-trade revenues.[187]

Additionally, states can implement policies that create incentives for retirements by allowing retirements to count toward compliance with regulatory requirements. For example, California's Fleet Rule for Public Agencies and Utilities allows a municipality or utility to retire a vehicle and have that retirement count towards the state's Best Available Control Technology (BACT) compliance requirement.[188] States and local authorities can take advantage of sources of funding to support these efforts, such as those available under the DERA program and through the VW settlement discussed earlier.

Electrification

Emissions and fuel efficiency standards can contribute to emissions reductions from heavy trucks and lead to better local air quality, but electrification will greatly enhance improvements in both. Improving diesel fuel efficiency can reduce CO_2 emissions in freight vehicles by roughly 40 percent but powering electric heavy-duty vehicles with renewable resources can reduce lifecycle emissions by more than 80 percent.[189] In late 2017, the first electric highway or eHighway in the U.S. was demonstrated near the ports of Los Angeles and Long Beach in California through a South Coast Air Quality Management District and Siemens partnership. Southern California Edison (SCE) also provided engineering support for the project, which aligns with SCE's Clean Power and Electrification Pathway proposal which calls for enhancing electrification to improve air quality, especially for vulnerable communities such as those near the ports that sit along freight corridors like the I-710 Freeway. To address this concern, state and local transit agencies have initiated the I-710 Corridor Project to use alternative electric technology to modernize the freight corridor through zero-emission vehicles and expanded transit services.[190] Benefits of the eHighway and related initiatives include emissions and air pollution reductions, as well as lower costs in goods movement that can be passed on to customers through lower prices.[191]

Comprehensive Goods Movement Strategies

While emissions reduction, air quality, health, and innovation are all necessary considerations for improvements in goods and delivery services, they are not the only considerations. Local governments must maintain the infrastructure necessary to move products efficiently and also leave room for growth of business and population.

For example, Toronto is currently working on a policy framework for Freight and Goods Movement Strategy that will determine specific actions to help the city manage growth and development while also considering the nation's commitment to climate action. The plan for the freight network will take into account the impacts of the existing goods movement system for use in future planning from an environmental impact perspective including noise pollution and GHG emissions reduction.[192] Some goals and key principles included in the policy planning process will include identifying primary routes used for goods movement and how these routes impact surrounding neighborhoods and municipalities, creating preferred travel ways for oversized loads, and enacting a policy that works with the city's existing transportation initiatives.

Development Standards and Congestion Reduction Approaches

Each time a person decides to make a trip, they choose between several options: driving, biking, walking, or public transportation. The transportation method is chosen based on many factors, including cost, transit time, comfort, availability and price of parking, the number of people with whom they are traveling, the amount of luggage, and the number of trips required.

Different modes of transportation have different characteristics and impacts. For example, walking and biking are

GHG-free forms of transportation that use public space effectively yet limit people by accessibility and distance. Cars allow for greater comfort, convenience, and distance travelled, yet are expensive, emit GHGs, and contribute to traffic congestion. Public transit represents a relatively inexpensive, low-GHG form of transportation, yet can require longer transit times and costly infrastructure investments and does not equally support all riders and all destinations.

Policymakers can develop policies and standards that prioritize improved environmental, economic, and social performance, and result in lowered emissions, traffic, or transit times. Policies commonly take one of two approaches to do so:

- ***Encouraging*** low-impact transportation modes through policies such as improved public transit, transit prioritization, and increased attractiveness of cycling or walking; and
- ***Discouraging*** high-impact transportation modes through polices such as congestion pricing or through parking policies.

The benefits of low-impact development policies are highly intertwined with and depend upon the characteristics of other modes of transportation. For example, bus prioritization policies have greater impacts if buses are electric or low-emitting. Additionally, transit and bicycle infrastructure must be utilized to be effective and recoup investment, and thus often requires marketing and outreach.

Transit Prioritization

Transit prioritization policies offer incentives to take low-carbon transportation while discouraging forms of transit that incur high amounts of pollution and/or traffic congestion. Transit prioritization policies aim to prioritize walking and biking, two forms of transportation that create no GHG emissions. Secondary priorities include public transit and high-occupancy vehicles. Policies commonly aim to actively disincentivize single-occupancy vehicles (often excluding EVs or those with alternative fuels). Incentives can range from high occupancy vehicle (HOV) lanes offered to carpoolers and/or EVs, higher parking costs, free parking EV, universal access transit pass programs, lanes dedicated to public transit buses and bikes, or taxes and/or fees for drivers. Below this section explores three commonly used and effective options: parking policies, congestion pricing, and bus prioritization.

Bus Prioritization

Buses are a flexible mode of transportation that utilize space effectively, carrying many more passengers than a private car for a given amount of road space. Buses are also able to carry passengers both along main transport corridors and to and from outlying suburban and rural areas. However, one study estimated that buses typically spend 50 to 60 percent of their run time in motion, 20 percent serving bus stops, and 20 to 30 percent stopped at a traffic signal or in a congestion delay.[193] Bus prioritization policies aim to improve the attractiveness of taking the bus by increasing their speed and reliability. Policies include physical and operational measures to achieve faster travel times, more efficient boarding operations, improved ridership experience, and a reduction in time that the bus is stopped in traffic. Benefits include increased ridership (generating increased revenue) and operational (fuel) savings, both increasing the effectiveness of bus transit.

Policies can include exclusive bus lanes, bus rapid transit, bus bypass shoulders, transit signal priority to shorten the traffic signal's red phase or extends the green phase for an approaching bus, and queue jumpers to allow buses and other vehicles in the far right turn or bus-only lane to proceed ahead of traffic in adjacent lanes. A key consideration for many of these policies is how bus prioritization policies affect traffic systems.[194] Policymakers can also develop new bus routes with attention to the design and placement of new bus stops to meet locational ridership demand and to increase rider comfort.

Case Study: Bus Prioritization Across the U.K.

In the U.K., where bus is often the main mode of public transportation (and, in many areas, the only public transit option for local trips), many municipalities have implemented a range of bus prioritization options.[195] Some key policy examples include:

- The town of Barking has benefited from the East London Transit bus prioritization scheme, with improved journey times and better links between East London business centers and to rail services. Bus ridership has increased by 20 percent since implementation of the policy.
- In Greater Manchester, the Chorlton bus prioritization policy installed bus lanes to and from Chorlton and built out bus stops to facilitate faster and easier boarding and prevent buses from traffic congestion. Parking and pedestrian crossings were concurrently redesigned to minimize conflicts between pedestrians, cyclists, drivers, and parked cars. Morning peak bus journeys became five minutes faster and ridership increased by 23 percent.
- Leeds installed two and a half miles of dedicated bus lines that can also be used by cyclists. Initial monitoring showed that bus user satisfaction with transit time and service reliability rose by 60 percent and 44 percent, respectively. Initial surveys showed increased ridership by nine percent. Bicycle trips have also increased by 33 percent.
- Mansfield built a new, fully enclosed bus station with a connecting footbridge to the railway station to encourage multimodal transit. The bus station was designed to address deficiencies in passenger comfort with the old bus station, including limited weather protection, safety and security for passengers, operational safety, accessibility, and links with the town center. A study showed that each £1 of investment by the Mansfield Public Transport Interchange delivered benefits of up to £6.5. Ridership increased by seven percent in the first year of the bus station's operation.
- South East Hampshire developed over two miles of lanes for the sole use of buses and cyclists. The new route delivered up to £6.94 in economic benefits for each £1 invested. After the first two years of service, bus ridership increased by 48 percent. Passenger satisfaction has increased by more than 20 percent on average.

Congestion Pricing

Congestion pricing, sometimes called value pricing, can take many forms, with the overall goal of charging drivers for valuable driving conditions—access to certain areas or roads, often at certain times. The policy utilizes market forces to reduce the waste associated with traffic congestion which, as discussed above, is correlated with numerous negative outcomes such as increased emissions, strain on roadways, poor health, and decreased productivity and economic activity. Fees can make drivers more conscious of these impacts by placing a price on these negative externalities. Congestion pricing plans commonly aim to shift the time, mode, route, or overall number of drivers along routes of high traffic congestion. Several variations of congestion pricing include:[196]

- **Peak/off peak charges**: time-of-day charging that seeks to shift trip times commonly away from peak commuting times;
- **Zone charges**: variable or fixed charges to drive within or into a congested area within a city, seeking to shift trips to public transit or other types of transportation;
- **Variable lane charges**: variable tolls on separated lanes within a highway, such as express toll lanes or high-occupancy toll (HOT) lanes;

- **Variable tolls on entire roadways**: variable tolls on entire roads or bridges, which can also include implementing peak-pricing on existing toll-free facilities during rush hours; and
- **Area-wide or system-wide charges**: per-mile charges on all roads within an area or on a roadway network that may vary by level of congestion.

Public transit systems and other advanced transportation programs can also benefit from the substantial revenue generated from congestion pricing: while a portion of generated revenues usually fund the operation of electronic toll-collection equipment and traffic-management systems, remaining funds collected through congestion charges can be distributed to a variety of initiatives, including public transit, cycling infrastructure improvement or road maintenance and repair.

One important consideration for congestion policies is the economic burden it could place on low-income and disadvantaged communities and potential impacts to economic activity in areas with high congestion pricing. One way to address this is to utilize funds collected through the pricing to provide toll discounts or credits to low-income families to address any disparate impacts that congestion pricing may place on low-income individuals. Additionally, it may be important to ensure that public transit is sufficiently accessible and effective for those who respond to the congestion price signal and transition to those transit systems. Education and outreach can also be important. Research suggests that to successfully gain approval of congestion pricing, proposals need to be perceived as benefiting drivers individually and not simply society at large.[197]

Case Study: New York City's Congestion Pricing

New York City's long and contested implementation of congestion pricing demonstrates many of the key considerations, and hurdles, in implementing the policy. In April 2007, New York City released a congestion pricing proposal, the first proposal of its kind for a major North American city, following in the footsteps of Singapore, London and Stockholm. The Plan, introduced by then-Mayor Michael Bloomberg as part of his comprehensive sustainability plan, plaNYC,[198] proposed a three-year pilot program to charge vehicles traveling into or within a predetermined area in Downtown Manhattan. At the end of the pilot program, the City and State would decide if the program should be made permanent.

The congestion pricing plan, though not yet enacted, generated debates at the city and state levels. Polls showed that most New York City residents supported the proposal if revenue was used for expanded transit service.[199] While a majority of New York State Senate and New York City Council members supported a modified pricing proposal, many representatives from outer boroughs and suburbs did not support the proposal. The New York State Assembly ultimately did not put the proposal to a vote, causing the proposal to fail.[200]

Since the time of that proposal, the City's traffic congestion has not improved: a 2016 study showed that New York City's traffic congestion is second worst among cities in America and third worst among cities in the world.[201] Studies have also documented the economic impacts of traffic congestion. For example, a recent study estimated that it will cost the New York metro area economy $100 billion over the next five years.[202]

However, congestion pricing has resurfaced in New York City politics. In October 2017, Governor Andrew Cuomo convened the Fix NYC Advisory Panel to develop recommendations to address the city's severe traffic congestion problems in Manhattan's Central Business District (CBD) and identify sources of revenue to pay for necessary upgrades to the city's subway system. In January 2018, the Fix NYC Advisory Panel released a report that recommended congestion zone pricing for vehicles driving in Manhattan below 60th street: $11.52 for cars, between $2 and $5 for taxis or other for-hire vehicles, and $25.34 for trucks. Collected revenue would fund repairs for the City's public transit system.[203]

Parking Policies

In many places, parking is provided as a public good, either free or cheaply available in workplaces and public places. However, access to parking can increase a driver's willingness to use a car. The cost and accessibility of parking is a key determinant of a person's choice to purchase a car, as well as their perception of a trip's speed, cost, and comfort.[204] As such, it can contribute to negative outcomes such as congestion and local air pollution as it creates hidden incentives for more cars on the road.

Policies that reflect a more accurate "cost" of parking or reduce the amount of parking spots at certain destinations can help to change these incentives, instead pushing consumers to reduce driving in compact cities. For example, policies that remove minimum parking requirements, implement maximum parking development standards and/or impose parking fees where parking capacity is abundant can help reduce work commuting by car by making alternative forms of transportation (public transportation, walking) more comparatively appealing. One study identified limited access to free workplace parking as one of the most effective ways to reduce commuting by car to work. The same study found that that the decision to drive is inversely correlated with the walking distance to one's parking spot, especially in dense urban areas.[205]

While too much parking can increase traffic congestion by encouraging more vehicle trips, too little parking can also, somewhat counterintuitively, increase traffic congestion: drivers searching for available parking, or cruising, can create large amounts of downtown traffic.[206] Policymakers must strike a balance between maintaining enough parking locations in high density places to prevent cruising-induced congestion and limiting parking supply to discourage driving.

Ride-Sharing Opportunities

Ride-sharing services have grown significantly in the past few years. Once limited to carpools and informal services, ride-sharing* is now dominated by app-based services such as Lyft, Via, and Uber, which allow users to call on-demand private rides as well as share rides with other users. Revenue from these services exceeded $11.7 billion in 2017 and is expected to grow more than 15 percent per year for the coming five years.[207] In 2016, more than half of American adults had heard of ridesharing apps like Uber and Lyft, with 15 percent using the services.[208]

The appeal of these services is both convenience and cost-related. A study conducted in New York City showed that ridesharing rides were both significantly cheaper and had lower wait times (and thus increased convenience) as compared to traditional cab rides. These effects were magnified in areas that were not typical "hot spots" for traditional yellow cab service—outer boroughs and other less trafficked areas.[209]

In addition to these personal benefits, ridesharing creates opportunities for potentially advancing other transportation goals. For example, ridesharing could be utilized to increase mobility options for low-income communities. Lack of access to transportation can be a significant issue in low-income and disadvantaged communities, limiting economic and social mobility and reducing opportunity. Transportation is also a key factor in workers' ability to find and retain employment.[210] Low-income commutes are longer than average, and low-income households spend a greater portion of their incomes on transportation (especially if the primary mode of transportation is a private car).[211] If designed appropriately, a (possibly subsidized) ride-sharing program could help improve access to low-cost transportation opportunities for these communities. Ridesharing has also been considered as a way to reduce congestion, as a significant portion of traffic in some cities, such as San Francisco and Los Angeles, is attributable to drivers searching for parking.[212] Thus, ridesharing can eliminate significant driving time, congestion, and criteria pollutant and GHG emissions.[213]

However, these benefits are far from guaranteed, and without policy intervention may be outweighed by negative impacts. Ride sharing may, for example, increase total vehicle miles, leading to increased congestion and emissions. The same study in New York City noted that ride sharing services generated an additional 600 million vehicle miles from 2013 to 2016, an amount greater than total mileage of yellow cabs in Manhattan and constituting 3.5 percent of vehicle mileage for all vehicles citywide.[214] Over half of these miles were added in "inner ring" Manhattan, leading to a seven percent increase in vehicle miles in this already crowded area, an increase that could lead to a "substantial" worsening of traffic congestion. Furthermore, this study noted that these increases are not resulting in any offsetting reduction in private car use. Instead, the study observed a decrease in bus and subway ridership.[215] A broader study found that ride-sharing trips resulted in a six percent net reduction in transit among Americans in major cities.[216] This reduction in public transportation can create funding issues for public transit systems that rely on certain ridership levels to maintain adequate revenues. The study estimates that 49 percent to 61 percent of ride-hailing trips would have not been made at all, or by walking, biking, or transit, leading the authors to conclude that ride-sharing is currently likely to contribute to growth in VMT in the major cities represented in the study, which can increase emissions and local congestion.

Thus, policymakers looking to capture the benefits of ridesharing may wish to explore new creative models for the service. These models could include targeting technological development and advancement through programs

* While this section is focused on *ride*-sharing, other services such as car2go and Zipcar provide car sharing services that allow a user to borrow a car for minutes, hours, or days.

to encourage EVs (and potentially automated EVs) to be incorporated more quickly into ridesharing fleets. Some policymakers are also exploring ways to ensure that low- and moderate-income communities can take advantage of ridesharing programs. A study at Carnegie Mellon's Center for the Future of Work is currently underway to explore how ridesharing can help disadvantaged communities "get moving."[217] Policymakers can also take lessons learned from the ridesharing experience to apply toward public transit systems and work to improve the convenience and affordability of these systems to more directly provide alternatives to car-based transportation. Cities could also consider the creation of occupancy based VMT fees on rideshare companies, in order to create additional financial incentives for pooled trips.

Case Study: Our Community CarShare Sacramento

In May 2017, Sacramento launched Our Community CarShare, a program for Sacramento residents to share electric cars.[218] Four low income communities and the Sacramento Valley Train Depot were selected to each have two EVs parked onsite in designated spaces outfitted with charging locations. Residents in the selected communities with vehicles and chargers can rent cars through the ZipCar app up to three times per week and three hours per day. Qualifying members received a free membership. The California ARB funded the memberships and expenses to purchase the cars and install the chargers through cap-and-trade revenues.[219]

Bicycle Master Planning

Bicycling is an affordable, GHG-free method of transportation with many additional benefits of providing physical activity, supporting social interaction, and reducing traffic congestion and stress on public transit.[220] Bicycles also use public space efficiently. However, many barriers prevent more people from biking, including bicyclists' perceived lack of safety, possible longer transit time compared to other forms of transportation (though in congested areas, bicycling may improve commute times), lack of adequate cycling infrastructure (such as bike racks), and lack of sufficiently connected bike routes.

Local governments can implement Bicycle Master Plans to encourage greater amounts of cycling. Bicycle Master Plans commonly aim to achieve two main goals: to increase the use of bicycling for all trip purposes and to improve the safety of bicyclists throughout the city. To do so, they commonly identify a set of actions to be completed over the long term to develop and improve bike infrastructure within a particular location. Plans typically involve the designation and expansion of new bike routes (particularly those separated from vehicles or on low-traffic routes), the creation of adequate safety barriers to protect bicyclists from parked and moving vehicles, the installation of cycling-related infrastructure (including foot rests and bicycle tire pumps), roadway crossing improvements (including safety improvements to key intersections), and comprehensive bicycle route signage systems that show distances and directions to major destinations. Bicycle Master Plans may also include plans to increase lane markings, repaint bike lines with highly visible colors, or install bicycle and pedestrian bridges to make critical connections across barriers.

Given that cycle-friendly infrastructure represents a relatively low-cost method to increase low-carbon transit, bicycle master planning can be highly attractive to policymakers. Counties and municipalities commonly develop Bicycle Master Plans that detail road-specific upgrades. Many large cities in the United States have Bicycle Master Plans, including Seattle, Los Angeles, and New York (see, e.g., the Seattle Seattle's Bike Master Plan case study below).[221]

When larger entities, such as states, develop cycling plans, they commonly delegate road-specific plans to municipalities. Plans enacted by larger entities commonly set broader goals and frameworks through which future

state transportation policy will accommodate cyclists. For example, Virginia released a State Policy Bicycle Plan in 2011 that identified current cycling conditions, programs, and policies, and then recommended four key areas of action: clarifying statewide policies, integrating bicycling into other state programs, improving outreach and coordination, and measuring and evaluating progress.[222] State and local entities may also coordinate to create, maintain, and upgrade regional bike routes.

Policymakers can also form partnerships with transit agencies, cycling alliances, local non-profits, and other service providers to ensure that bike lanes remain safe and appropriately used. Education, enforcement, and encouragement programs may be useful to educate bicyclists and motorists about how to co-exist safely on the road. Other key considerations for policymakers may include local conditions and barriers such as stretches prone to accidents, urban density, expected future traffic patterns, and topographical and road barriers to cycling route connectivity. Plans may require additional traffic analysis, neighborhood involvement, and/or revisions to ensure proper implementation of the plan and achievement of its goals. Plans can also be supplemented by education programs for motorists and bicyclists about bicycle safety that also serve to encourage more cycling.

Case Study: Copenhagen Cycle Policies

Copenhagen is commonly cited as a world-class leader in bicycle master planning. Through decades of strategic planning, the city transition from one in 1960 dominated by automobile traffic to one of the most bicycle-friendly metropolises worldwide. The city encourages cycling "not as a goal in itself but rather a highly prioritized political tool for creating a more livable city."[223] Copenhagen sees adequate cycling conditions as a crucial element to meeting the city's goal of achieving CO_2 neutrality by 2025.[224]

The city releases periodic Cycle Policies to prioritize development and road upgrades that increase the viability of cycling in the city. Released in 2011, the city's bicycle strategy plan for 2011 to 2025 identifies two central principles to guide bicycle planning: prioritizing and innovation.[225] Prioritizing of bicycle-friendly infrastructure involves giving more space to cyclists on main transportation roots, moving existing routes farther away from vehicles, employing traffic calming policies near areas with high cyclist activity, and creating short cuts for cyclists to decrease travel times. Doing so increases safety and comfort of existing and potential riders, makes it more possible for cyclists to ride at their preferred speed, and allows for a greater number of cyclists on the road. The Plan's second goal of innovation involves developing and piloting new types of infrastructure, such as creating new types of bicycle parking, exploring how to turn cobblestone streets into attractive cycle routes, or making certain streets one-way for cars in order to increase space for cyclists.

Copenhagen's efforts to increase cycling have had profound results: in 2017, the distance cycled annually has increased by 22 percent since 2006. In the same period, cyclists' feeling of safety has increased by 43 percent while the relative risk of having a serious bicycle accident has been reduced by 23 percent. In 2017, 41 percent of all trips to work and study to and from Copenhagen were by bike.[226] Copenhagen hopes to increase that percentage to 50 percent of all trips by the end of 2025.[227]

For policymakers considering the development of a Bicycle Master Plan, the National Association of Cities and Transportation Officials (NACTO) has released an Urban Bikeway Design Guide.[228] The Guide's purpose is to provide guidance to urban designers and planners in the design of cyclist-friendly infrastructure. The Guide profiles best practices for bicycle facility design and application.

In cities in the United States, rates of bicycle commuting are much lower on average than those of other international cities. In the United States, only 0.38 percent of trips are cycled nationally, including suburban and rural areas.[229, 230] In Washington, D.C., the population's low portion of car-owners (almost 37 percent of DC households do not have access to a motor vehicle, compared to a 10 percent nationally[231]), coupled with the city's high-density land use development pattern, create a large pool of potential cyclists. Starting in 2005, the District has implemented Bicycle Master Plans and started innovative bikesharing programs to effectively harness the city's cycling potential. As a result, the city's portion of regular bike commuters has risen from 1.16 percent in 2005, to 2.2 percent in 2010, to more than 4 percent in 2015. Peak hour cycling increased by more than 200 percent citywide from 2000 to 2012, and from 2004 to 2014, commute trips by bicycle in D.C. quadrupled. The city serves as an example of advanced and effective bike prioritization in the United States.

Case Study: Seattle's Bike Master Plan

In 2014, the Seattle Department of Transportation (SDOT) released the Seattle Bicycle Master Plan (BMP), guided by the vision that riding a bicycle is a comfortable and integral part of daily life in Seattle for people of all ages and abilities.[232] This vision is supported by five goals and associated performance targets:

- *Ridership* – quadruple ridership for all trip purposes between 2014 and 2030
- *Safety* – improve safety for bicycle riders in Seattle by reducing bicycle collision by half between 2013 and 2030 and achieving zero serious injuries and fatalities by 2030
- *Connectivity* – complete construction of a high-quality bicycle network that connects to places people want to go and provides a time-competitive travel option by 2035
- *Equity* – improve bicycle riding for all with zero areas of the City lacking bicycle facilities by 2030
- *Livability* – Complete a bicycle network in which 100 percent of households in Seattle are within a quarter mile of an all-ages and abilities bicycle facility by 2035

To achieve the plan's vision and goals, SDOT releases implementation plans, updated annually, that detail specific projects SDOT plans to build each year, serve as an accountability and reporting tool, and guide future budget requests. Implementation plans assess whether the plan is meeting the performance targets of each of the five goals. In April 2017, SDOT released its most recent implementation plan to assess progress and establish project priorities for 2017 to 2021.[233]

Seattle's proactive bike planning measures provide the infrastructure to support and enable the city's recent surge in the use of dockless (free-floating) bikes. In July 2017, SDOT launched a year-long pilot program that permitted three private operators to provide low-fee dockless bikes at no cost to the City. A June 2018 study of the pilot showed that the number of dockless bikes in Seattle jumped from zero in July to more than 100,000 six months later, representing nearly a quarter of all dockless bikes nationwide. Seattle's dockless bikes were ridden at least 468,000 times during this six-month period.[234]

Vehicle Miles Traveled Reduction Measures

Vehicle miles traveled (VMT) is a measure often used to define the usage of light duty (and occasionally heavy-duty) vehicles. Reducing VMT, a conservation approach to transportation planning, can result in significant GHG and local criteria emission reductions. The national VMT trend is increasing largely due to development sprawl: since 1980, the number of miles Americans drive has grown three times faster than population and nearly twice as fast as vehicle registrations. If this trend continues, it could result in a nearly 50 percent increase in national VMT between 2005 and 2030.[235] To meet GHG targets and other goals, states will need to identify opportunities to slow and reverse this trend. For example, NRDC projects that to meet nationwide 80 percent below 2050 targets, VMT would have to fall per capita by 24 percent (coupled with significant increases in efficiency and a transition to electrified transportation).[236]

There are myriad policies that can be implemented or designed to reduce VMT, including many of those discussed in this section and in other reports.[237] These strategies may lead consumers to use alternative forms of transportation (such as walking, carpooling, or public transportation) or reduce the need for transportation at all (through land use and urban design policies). Policy options fall into four general categories:

- *Pricing mechanisms*: more accurately reflecting the costs of individual vehicle use can lead consumers to alternative forms of transportation. As discussed above, these mechanisms may include congestion pricing, parking policies, or VMT-based fees (that may replace fixed fee vehicle registration fees or even gas taxes). For example, Oregon is piloting a voluntary VMT-based charge to replace traditional fuel taxes, under which participants would pay a road usage charge for the amount of miles they drive, instead of the fuel tax.[238]
- *Alternative transportation support:* policies that make alternative transportation easier can help reduce VMT in individual vehicles. These can include bicycle planning and incentives, transit investment and prioritization, and outreach efforts to encourage the use of these modes of transit.
- *Transportation demand management:* these programs provide incentives or requirements to reduce transportation demand. One example of such a policy would be a fleet- or company-wide VMT reduction requirement, though such a target would likely require complementary policies to support its achievement. Other demand reducing programs could include workplace programs, such as telecommuting, incentives for living near work (particularly effective for organizations with multiple locations, such as restaurant franchises, banks, or grocery stores), compressed work week, or incentives for carpooling. Universal access transit pass programs are often a core element of transportation demand management programs. One city in which a combination of such policies has been successful is Seattle, Washington—achieving a 75 percent non-single occupancy vehicle (SOV) mode share as of 2017 through transit, rideshare, pedestrian, and bicycle policies and programs.[239]
- *Shared mobility programs*: these programs including car-sharing, ride-sharing, bike- and scooter-sharing, car-hailing, and ride-sourcing. These programs can also be considered transportation demand management programs though, as discussed in "Ride Sharing Opportunities" above, policymakers may need to consider carefully the possible rebound effects of such programs. Shared mobility alternatives can provide users more transportation choices, offer first and last mile solutions for riders to connect with transit, reduce traffic congestion, lessen parking pressures, and reduce vehicle miles traveled and GHG emissions. They can also reduce household transportation costs by allowing individuals to forego the cost associated with purchasing and maintaining a vehicle. At the same time, car owners can earn extra income by renting out excess vehicle capacity.
- *Development standards and policies:* development standards and policies can help states, cities, and other local areas to proactively manage VMT growth by targeting compact development and integration of alternative forms of transport (see Transportation-Oriented Development below, as well). Such standards can focus on "infill" of existing developed areas as well as requirements for expanding development. For

example, a state or local city government could create a series of tax credits or other incentives to encourage development in existing areas and the rehabilitation of existing buildings to encourage infill rather than building in greenfields and contributing to sprawl. Policymakers could also provide financial support, such as discounted loans or increased tax deductions, for housing and other private development projects in locations where VMT will be minimized. Downtown revitalization programs can also help draw new investment to already developed areas and incentivizes denser, more efficient development. Finally, states and local governments could require GHG and/or VMT evaluations in land use policymaking, regulation, and legislation. Resources such as the LEED Neighborhood Development Guide can provide a high-level overview of possible best practices for such evaluations.[240]

- *Improvements to local zoning laws*: in many areas, local zoning laws typically prohibit denser development. These laws may limit the impact of VMT reduction efforts through development height limits, minimum parking requirements, or other zoning requirements that limit the ability to expand housing and development in urban areas. This has historically lead to an increase in sprawl to accommodate growing populations. Revisions to zoning laws may be an important precursor to VMT reduction policies that depend on improving development of housing near urban areas or other employment and commercial centers. In California, for example, State Senator Scot Weiner introduced a measure to encourage denser development in part by prohibiting local zoning restrictions on residential development within half a mile of transit lines.[241] Though the measure failed, it may serve as a model for other measures, such as Los Angeles' Exposition Corridor Transit Neighborhood Plan.[242]

Case Study: California's Sustainable Communities and Mobile Source Strategies

California has targeted a 15 percent reduction in VMT by 2050 as part of its larger strategy to reduce GHG emissions 80 percent from 1990 levels by 2050.[243] A key component of the policies behind this target is the state's Sustainable Communities program established under Senate Bill 375 (2008). Under the Sustainable Communities Act, the California ARB sets regional targets for GHG emissions reductions from passenger vehicle use; the most recent designations (In March 2018) range from 3 to 19 percent reductions from 2005 levels starting in 2018.[244] Each metropolitan planning area is then required to prepare a "sustainable communities strategy" as a part of its regional transportation plan that will guide the transportation policies and investments for the region. These strategies must contain land use, housing, and transportation strategies that, if implemented, would allow the region to meet its GHG emission reduction targets. The Sustainable Communities Act also established incentives to encourage local governments and developers to implement the local strategies. For example, developers can obtain relief from certain environmental review requirements under the California Environmental Quality Act if their new residential and mixed-use projects are consistent with a regional sustainable community's strategy that meets the targets.[245]

California notes in its 2017 Scoping Plan update that the Sustainable Communities program will enable the state to make significant progress toward VMT reduction goals, but that additional programs will be necessary to meet 2050 targets. The state is continuing to explore additional state-level policies to reduce VMT and promote sustainable communities, including:

- accelerating equitable and affordable transit-oriented and infill development through new and enhanced financing and policy incentives and mechanisms;
- promoting stronger boundaries to suburban growth through enhanced support for sprawl containment mechanisms such as urban growth boundaries and transfer of development rights programs;

- identifying performance criteria for transportation and other infrastructure investment to ensure alignment with GHG reduction goals and other state policy priorities and expand access to transit, shared mobility, and active transportation choices;
- promoting efficient development patterns that maximize protection of natural and working lands; developing pricing mechanisms such as road user/VMT-based pricing, congestion pricing, and parking pricing strategies;
- reducing congestion and related GHG emissions through commute trip reduction strategies, and
- programs to maximize the use of alternatives to single-occupant vehicles, including bicycling, walking, transit use, and shared mobility options.[246]

Case Study: Minneapolis Shared Mobility Action Plan

In October 2017, the Shared-Use Mobility Center (SUMC) released a Shared Mobility Action Plan for the Minneapolis-St. Paul region.[247] Developed in collaboration with transportation leaders including the Metropolitan Council, Nice Ride Minnesota, and the Knight Foundation, the plan is designed to expand shared mobility and public transit options, including car-sharing, ride-sharing, bike- and scooter-sharing, car-hailing, and ride-sourcing, to help the Twin Cities address anticipated population growth by expanding service, meeting increased demand, and improving access in low-income and low-density areas.

The plan aims to reduce traffic congestion and emissions while maintaining the region's affordability and livability with an interim goal of removing 20,000 private cars from Twin Cities Roadways within the next five years and a long-term goal of removing 50,000 within the next decade. The plan aims to do so by:

- Attracting 30,000 new daily transit riders;
- Sustaining 600 total carshare vehicles;
- Adding 800 bikeshare bikes;
- Adding 1,000 daily vanpool users; and
- Adding 2,000 microtransit and ride-splitting users.

According to SUMC's analysis, achieving the long-term goal of removing 50,000 cars off the road would reduce annual VMT by 500 million, avoiding nearly 200,000 metric tons of GHG emissions annually, and saving residents more than $185 million in annual household transportation costs.[248]

Transit-Oriented Development

Transit oriented development combines regional planning, city revitalization, and suburban renewal to create dense, walkable, mixed-use communities centered around high-quality train systems.[249] Transit oriented development aims to maximize the amount of residential, business, and leisure space within walking distance of public transportation. Doing so ideally minimizes car dependence, which reduces congestion and fuel consumption while improving emissions. Components can include a train center as a prominent feature of the town center, mixed-use development (containing offices, retail, residential, and civic buildings), secondary transit systems (such as streetcars, light rail, or buses), reduced and managed parking removed but within close access to the town center, and public space. At its core, the community is typically designed with pedestrian comfort as the highest priority.[250]

Studies on transit-oriented development have shown a wide range of benefits, including higher quality of life; greater mobility and reduced car dependence; increased transit ridership; reduced traffic congestion, car accidents, and injuries; healthier lifestyle with increased walking; increased foot traffic and consumers for local businesses; and reduced household spending on transportation.[251]

Case Study: Los Angeles Promise Zones

Los Angeles' "Promise Zones" are an example of transportation-oriented development. The Housing and Urban Development's Promise Zone initiative began in 2014 as a way to provide special opportunities to low-income communities to obtain federal funding for encouraging economic growth and alleviating poverty in the region. In 2015, a neighborhood in south Los Angeles, the South Los Angeles Transit Empowerment Zone, or SLATE-Z, was designated as a Promise Zone. Nearly half of the population are first-generation immigrants and 46 percent of residents live in poverty.[252] The neighborhood is located along South L.A.'s transit corridors, which have historically lacked access to public transportation.

SLATE-Z has identified the safety, affordability, and use of public transit, particularly for students and low-income residents, as a key technique to stimulate economic development and as a main goal for its Promise Zone plan. Other goals of the program include increasing transit-oriented development along recently expanded light rail lines, increasing local jobs around local transit stops, implementing bus prioritization policies, and providing funding for affordable housing, community development, and job creation around the neighborhood's new transit hubs.[253]

Case Study: Columbus, Ohio, a Smart City

Columbus, Ohio has also pursued transportation-oriented development with the support of the Department of Transportation's Smart City Initiative. Launched in 2016, the Smart City Challenge called for mid-sized cities across America to develop a pitch for an integrated, innovative, and smart transportation system. Columbus, Ohio beat 77 cities to win the challenge, winning $40 million from DOT to complete 15 projects and $10 million from Vulcan, Inc. to complete an additional four.

Projects that Columbus is pursuing under the Smart City Initiative include:[254]

- A phone-based application to increase the ease of multimodal trip planning, by pulling transit information into one place;
- Smart mobility hubs that house necessary infrastructure for biking, driving, and bus in the same place to encourage multimodal transit;
- Pilot programs to install LED street lighting to improve safety for pedestrians and Wi-fi connectivity to increase the comfort of pedestrian transit; and
- Event parking management technology, which tells users where parking exists and helps them access it in order to reduce traffic congestion.

While the U.S. DOT projects are in development now, with expected roll out beginning in mid- to late-2018, DOT has published a report, "Smart City Challenge: Lessons for Building Cities of the Future," to highlight lessons learned and innovative solutions to meet transportation challenges facing American cities.[255] This study noted that many cities highlighted similar transportation and transit issues, such as transit data collection and communication, intracity goods movement, optimizing traffic flow to avoid congestion, and reducing parking inefficiencies.

Advanced Transportation Education and Outreach

While removing financial, technological and logistical barriers can be critical for moving forward advanced transportation systems and policies, spurring consumers to modify behavior can be equally crucial to the success and adoption of those policies. Targeted education efforts and marketing campaigns can increase awareness and understanding of, as well as enthusiasm for, various advanced transportation policies.

Educational campaigns are often employed to target two main aspects of consumer behavior that can act as barriers to the adoption of advanced transportation opportunities:

- **Consumer Awareness:** Research shows that people are commonly unaware of transportation policies and incentives to participate in them.[256] Educational efforts can raise awareness of new technology and/or policies, as well as associated benefits and incentives. Educational initiatives can also dispel myths and misconceptions about advanced technologies.
- **Consumer Choice:** In addition to helping make consumers aware of options, educational efforts can provide consumers with the resources to evaluate and make choices based on values such as on cost, public health, air pollution, and time. Well-executed educational campaigns can empower consumers to make choices that are better for both them and the environment.

Marketing, education, and outreach initiatives can improve the outcomes of a variety of policy measures discussed above.

Electric Vehicle Education & Outreach

Consumer distrust and misconception about the relatively new technology behind EVs is a major barrier to widespread EV adoption. Consumers also generally lack a strong understanding of what electric vehicles are, what benefits they offer, the models that are available, and the associated incentives. For example, only 21 percent of respondents to a survey said they know a "fair amount" about electric vehicles and far fewer reported knowing a "great deal" about them.[257] Another study indicated that less than half of U.S. consumers, only 48 percent, are able to name a specific plug-in EV make and model.[258] Even among consumers who could correctly name any EV model, 95 percent of the respondents could only name either the Nissan Leaf or Tesla Model S, indicating low awareness about the diversity of available models.[259]

In addition to general unawareness about EVs, consumers often fall prey to several misconceptions and/or misunderstandings surrounding EV technology, including:

- **Consumers either do not understand or properly account for the lower fuel and maintenance costs of EVs**, instead focusing on the vehicle's high upfront cost in comparison to vehicles with internal combustion engines. One of the tangible advantages of owning an EV is the energy cost savings associated with refueling: given current power and fuel prices, each mile of travel with electricity costs 60-80 percent less than a mile with gasoline. However, consumers appear to either not value this benefit very highly or are unaware of the potential cost savings.[260]
- **Consumers experience "range anxiety" about electric vehicles, not realizing the ranges of EVs are suitable for daily use by the vast majority of consumers.** Most EVs in the market have more than sufficient range to satisfy most customers on a typical day: a study showed that 87 percent of vehicles on the road could be replaced by a low-cost electric vehicle today, even without the possibility to recharge during the day.[261] However, consumers are likely to overestimate their necessary vehicle range.[262]
- **Consumers do not properly understand or know of the advantages of and incentives to purchase EVs.**[263] Nationwide, only 44 percent of people were aware of the federal tax incentive for EV purchase.[264] Another study found that only 49 percent of new car purchasers in California were aware of the federal tax incentive and only 33 percent were aware of California's state-level incentive.[265]

- **Consumers perceive EVs as "risky technology," reducing likelihood of paying a larger upfront cost.** A survey determined that consumer attitudes and uncertainty regarding EV battery technology and the sustainability of fuel sources may be a barrier to widespread adoption, and that this uncertainty may stem from a lack of understanding and familiarity.[266]

EV educational outreach campaigns aim to expand public awareness and comfort with EV technology. State and municipal policymakers can initiate these campaigns. Some state or local agencies with existing programs have also utilized the help of outside partners, such as communications and advertisement firms to develop the campaign. Policymakers can also form partnerships and collaborations with automakers, dealerships, employers, electric utilities, and community groups, among others, to reach a wider audience.

Electric utilities can also play a vital role in conducting outreach and education campaigns to improve consumer awareness of EVs and the benefits of ownership. As utilities stand to benefit from the purchase of EVs due to increased electric demand, they are incentivized to implement educational initiatives to further EV awareness and adoption. Utilities can do so successfully by working cooperatively with other entities and harnessing existing consumer relationships. Additionally, utilities can provide valuable access to information and resources to encourage EV adoption.

Case Study: Southern California Edison (SCE) Charge Ready

For example, as part of Southern California Edison's Charge Ready Program Pilot, which aimed to increase the availability of long dwell-time EV charging infrastructure, the utility launched a concurrent campaign to communicate about EVs and the benefits of electric charging. In order to reach a wider audience, the campaign produced outreach content for a variety of media platforms, with translations available in English, Spanish, Korean, Chinese, and Vietnamese. Media platforms included:

- Paid media, including digital banners, search engine marketing, sponsored social media ads, and radio;
- Local booth sponsorship at EV-related events;
- Direct messaging, including mail or email to targeted consumer populations; and
- Other channels, including bill inserts, messaging on SCE.com, and social media on SCE sites.

Three months into the campaign, SCE also conducted two outreach events to increase consumers' awareness of EVs and to provide consumers an overview of SCE's Charge Ready program, among other things. The events included a local government kickoff workshop, with 200 estimated attendees, and a second collaborative event with the San Joaquin Valley EV Partnership (SJVEVP), with an estimated 50 attendees. The second event featured an EV display in the parking lot, with presentations on EVs, charging equipment, purchasing incentives, and workplace charging options.

Three months after the start of the campaign, the campaign has increased unique visitor counts on the campaign's landing page by 13 percent and has more than doubled the repeat visitor account.

Ultimately, the goal of educational campaigns is simple: to increase public awareness of and comfort with electric vehicle technology to encourage further adoption. As consumers with greater knowledge or experience of EVs are more likely to highly value EVs, consider them as a future purchase option, and be willing to pay a higher upfront cost for the technology,[267] efforts to educate consumers regarding the convenience and potential benefits of EV technology can help to fundamentally expand the EV market. Educational initiatives also offer the opportunity to dispel myths surrounding new technology and educate consumers about the benefits of EVs.

Policymakers should identify their target audience—who should the educational or outreach campaign reach. Education and outreach campaigns can vary tremendously regarding their budget, scope, and duration. Advertising the availability of incentive to purchase a vehicle may be more effective than advertising the long-term fuel savings of EVs,[268] although the lower overall cost of ownership compared to conventional gas vehicles can also be emphasized. Messaging will likely vary slightly depending on the target audience of the campaign. However, there is some research on messaging strategies for encouraging EVs that is helpful for policymakers to consider.[269]

Case Study: Plug-in America: Drive Electric

Plug-In America's Drive Electric Campaign has adopted targeting marketing strategies. Plug-In America is a national, non-profit advocacy group that aims to accelerate the shift to EVs by providing practical, objective information to help consumers purchase EVs that fit their lifestyle and needs. The group has been recognized as a champion of EV market growth and awareness. The group provides consumer information on EVs through websites, seminars, ride-and-drive events, and other outreach. Plug-In America has also organized events to connect EV owners with potential future consumers, to foster peer-to-peer information diffusion. They also founded National Drive Electric Week in 2011, with organizing help from the Sierra Club and the Electric Auto Association, to heighten awareness of availability of EVs and connect potential drivers with resources.

The Drive Electric Campaign aims to highlight that EVs can be fun and exciting to drive, they are easier and cheaper to fuel, they are cheaper to maintain, and that the EV industry is quickly gaining momentum. The campaign's messaging aims to appeal to the lifestyle of potential consumers. The Drive Electric Week commonly includes an "electric tailgate party," in which electric vehicles are gathered in a parking lot to show off the cars and provide information, an "EV showcase" at eco-fair, farmers' market, auto showroom, or other event, an EV parade, and ride-and-drives, in which potential EV consumers take EVs for a test drive. The week aims to celebrate EVs at all associated events: some communities hold EV award ceremonies that present awards to a local company, public official, agency, or community organization that has particularly helped to promote EV-readiness in the community. In 2017, the seventh annual Drive Electric Week welcomed over 120,000 attendees across 276 events, spanning all 50 states and the District of Columbia, seven Canadian provinces and six countries

Advertising Campaign: Drive Change, Drive Electric

The Drive Change, Drive Electric campaign is an example of a broad-based education initiative that has a goal to increase awareness, consideration and acceptance of all types of EVs among audiences likely to purchase a car in the next three to five years. Key backers of the campaign include the Alliance of Automobile Manufacturers, the Association of Global Automakers, and seven Northeast states, including New York, with facilitation support from the Northeast States for Coordinated Air Use Management (NESCAUM) and vehicle manufacturer partners. A third party professional advertising agency is responsible for shaping and developing the messaging.

The campaign identifies three distinct market segments and develops messaging unique to each segment. While messages will be targeted by segment, all will utilize accessible, approachable, and aspirational messaging that focuses on the affordability, reliability, safety, comfort and performance benefits of EVs. In total, the campaign is focused on making the case that EVs as a technology are convenient and easy to incorporate into daily life. Launched at the 2018 New York International Auto Show, the campaign will utilize a variety of media platforms, including e-newsletters, websites, earned and paid social media, and lifestyle events such as National Drive Electric Week. The campaign aims to create a "toolkit" of initiatives and lifestyle events that can be replicated across multiple markets.

Idling Reduction Education

As discussed earlier in the Goods Movement and Delivery Standards section, certain states and municipalities have enacted laws to impose fees on idlers. However, idling can also be reduced through educational efforts that focus on simple behavioral change of drivers, without any specific penalties imposed for idling. For this reason, idling reduction through behavioral change is often referred to as the "low hanging fruit" of fuel economy. This behavioral change can be encouraged through educational initiatives that inform consumers about the benefits of idling reduction, including using less fuel, therefore reducing air pollution and GHG emissions.[270]

A variety of entities can implement idling reduction initiatives including state agencies, counties, and regional air quality associations and coalitions (such as Mid-Atlantic Regional Air Management Association, Northeast States for Coordinated Air Use Management). Entities may be able to use forms of outside funding, such as state funding from the Diesel Emission Reduction Act (DERA).

Case Study: State Anti-Idling Outreach

A few states have already introduced anti-idling outreach and educational initiatives. Connecticut's Department of Energy and Environmental Protection (DEEP) introduced an anti-idling signage program to target areas prone to idling complaints, such as schools, Department of Motor Vehicle locations, and State Parks. DEEP provided more than 2,500 anti-idling signs to Connecticut K-12 schools and nearly 80 percent of Connecticut school districts participated in the program. DEEP also distributed anti-idling signs, posters, and informational brochures encouraging idling reduction.[271]

The Washington, D.C. metropolitan area also created a multi-jurisdictional idling reduction campaign to address idling from heavy-duty vehicles. The Metropolitan Washington Council of Governments (COG), Maryland Department of the Environment (MDE), District Department of the Environment (DDOE) and the District Department of Transportation (DDOT) formed a Steering Committee to develop and manage the project, which was paid for with funds from the American Recovery and Reinvestment Act of 2009 (ARRA). Campaign content was developed by a marketing consultant and targeted trucking and bus companies, related trade organizations, and business groups.[272]

Additionally, Maryland used DERA funds to start a Diesel Idling Reduction campaign to elevate awareness of the financial and environmental benefits of diesel idle reduction and to encourage compliance with idling regulations. The Campaign targeted diesel vehicle drivers, acknowledging and rewarding those who comply with idling reduction laws. The program cost a total of $20,145.[273]

For policymakers considering implementing an anti-idling campaign, the U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy administers IdleBox, an electronic education and outreach toolkit on vehicle idling reduction. The toolkit offers resources to engage with and educate others on the value of idling reduction. Resources include fact cards, tip sheets, posters, bumper stickers, outreach letter drafts, press releases, pledge forms, and technical resources to calculate idling reduction savings.[274]

Transit Education Initiatives

Many states and municipalities also hope to increase public transit ridership. In addition to reduced GHGs and improved air quality and traffic congestion, increased public transit ridership offers other benefits of increased revenue for transit agencies and lowered overall cost per rider to the transit administrator.

Transit education campaigns serve to educate consumers about the different available methods of public transportation and their associated benefits, including lower cost, avoided stress, and lower environmental footprint. Campaigns are commonly deployed through print and/or digital advertisements, as well as through

social media. Municipal and state policymakers can work with advertisement and communication firms to identify target audiences, consisting of populations that might be more likely to consider public transit as an option suitable for their daily lives. Educational campaigns can then be deployed to target selected audiences.

Case Study: Chicago "Ride On" Campaign

Chicago's Ride On campaign provides an example of an effective education campaign in a very large transit market. The regional transit system of Chicago is the nation's third largest, with ridership of more than two million people each day on bus and rail services in six counties. However, the Chicago region is also the nation's third-most congested. This is partially attributable to low rates of transit usage by young adults in the Chicago area.[275]

To increase transit ridership and awareness of public transportation in the Chicago region, the Regional Transportation Authority (RTA), in conjunction with the Chicago Transit Authority (CTA), and Metra and Pace Suburban Bus, teamed up with a Chicago-based communications firm to launch a multi-year marketing campaign. The campaign's goal was to encourage more Chicago area residents to start riding public transportation and ride more frequently.

The communications firm identified occasional riders and tourists aged 25-54 years old as primary target audiences, with secondary audiences of reverse commuters and older adults. The strategy was to highlight the benefits of public transportation by associating it with making the most of riders' time, money and lifestyle. The campaign would simultaneously highlight the "shared real-life pain points of driving" through humorous, relatable messaging, and encourage consumers to take public transit to take advantage of the benefits.

The agencies' "Ride On" campaign featured traditional and digital ad content, including ads for cable television, radio, social media, and digital billboards. After launching in January 2015, the campaign was able to meet, or exceed, all performance targets. RTA has managed to successfully and effectively resonate with their audience as they observed a usage rate of over half a million for their Trip Planner. The campaign resulted in increased awareness of the viability of the Chicago region transit system, as well as improvement in consumers' perception of the system. [276]

Conclusion

This report outlines the significant latitude and range of policies that state and local governments can employ to design a wide range of policies and programs that support and incentivize the use and deployment of advanced transportation technologies and approaches. States and local governments can design policies to address specific needs and goals of an area whether they pursue actions that govern vehicle operations, use, or movement; engage in non-regulatory efforts as market participants; or establish emission standards and zero emission vehicle sales requirements (through adopting California's program).

The range of options discussed in this paper can result in important environmental and social justice benefits such as pollution reduction, congestion reduction, and quality of life and economic productivity improvements. In evaluating the potential polices and goals, states and local governments will also need to examine the administrative requirements for various policy options and the time period to realize potential benefits. Additionally, some policies generate funds that can be invested in transportation infrastructure, offset any ratepayer impacts, or be directed to other programs that further reduce emissions, while other policies may require more resources and investment from state and local governments. Thus, policymakers may look to consider the opportunities for implementing complementary policies to generate needed funding to support continued investment in an advanced transportation system.

States and local governments will also need to consider the legal authority to implement the policies. As discussed, many of the polices explored in this paper do not directly set emission standards and thus can be implemented consistent with state and local authorities. In doing so, states should be mindful of the need to root their policies in justifications related to aggregate greenhouse gas emissions, reductions in conventional air pollutants and broader public polices, rather than in fuel efficiency considerations or individual vehicle emissions, where there may be somewhat greater constraints on state and local actions. State and local governments enjoy substantial liberty to implement policies that promote clean transportation systems and advance environmental and social outcomes.

Through the broad range of policies explored in this paper, policymakers can explore what opportunities exist for their states and local governments to capture the benefits of advanced transportation system.

Appendix: Legal Authority for State and Local Transportation Policies

As highlighted at the start of this paper, state and local governments enjoy substantial authority to encourage a transition to advanced technology vehicles. These authorities, based on state and local legal authorities, allow them to address and take a wide variety of actions, including those explored in this paper, to implement advanced transportation policies that improve public health, reduce emissions, and further clean transportation technologies and related socioeconomic and environmental outcomes.[*]

Even in the arena of pollution control, this availability of state and local authority largely holds true. While the Clean Air Act generally preempts states and local governments from adopting and enforcing emission standards and other emission-related requirements from new motor vehicles, such preemption does not extend to state and local authority to regulate the use, operation, and movement of in-use motor vehicles. Furthermore, section 209(b) of the CAA [42 U.S.C. § 7543(b)] authorizes California to adopt and enforce its own new motor vehicle emission standards and other emission related requirements, provided that it first obtains a waiver of preemption from section 209(a) of the Clean Air Act [42 USC 7543(a)] from the EPA Administrator. Once California obtains a waiver for specified emission standards, other states that are noncompliant with federal ambient air quality standards may elect to adopt those waived standards as their own, provided such state standards are identical to California's standards. [CAA § 177 – 42 U.S.C. § 7507].

The advanced transportation policies identified in this paper should be legally permissible actions either because they:

- address local planning, educational efforts, or other policy arenas that are traditionally a matter of state or local control;
- simply limit the way that vehicles may be used in certain areas, a traditional authority that is specifically reserved to state and local governments by section 209(d) of the Clean Air Act;
- are regulatory actions that do not regulate tailpipe emissions directly, and therefore are not actions prohibited by the Clean Air Act's preemptive effect;
- align with the special regulatory role that Congress has reserved for the State of California for the last half century, as well as for any state that adopted a vehicle pollution control standard identical to California's; or
- are non-regulatory actions that may be undertaken by state or local governments as proprietary market participants.

Congress Explicitly Preserved State Authority to Regulate the Use, Operation, and Movement of Motor Vehicles

The Clean Air Act addresses the air pollution challenge through a system of "cooperative federalism" that seeks to balance uniform federal standards with a recognition of California's unique standard-setting capabilities and the traditional powers of states.[277] The Clean Air Act also explicitly preserves state and local authority over the use and operation of vehicles. For half a century, and through multiple revisions, Congress has had in place a basic architecture for protecting public health from air pollution that depends upon dual federal and state regulation under the Clean Air Act to deliver healthy air to the nation. Under this approach, the federal government establishes nationwide public health air quality standards and the states retain the responsibility for devising the strategies to meet these standards in a timely fashion.[278] Indeed, "so long as the ultimate effect of the

[*] This appendix does not evaluate state limits of authority or the need for a state or local authority to seek legislative approval.

State's choice of emissions limitations is compliance with the national standards for ambient air, the State is at liberty to adopt whatever mix of emissions limitations it deems best suited to its particular situation."[279]

Congress expressly preserved states' and local governments' rights to enact certain laws regulating motor vehicles in Section 209(d) of the Clean Air Act. That provision states:

> [n]othing in this title shall preclude or deny to any State or political subdivision the right otherwise to control, regulate, or restrict the use, operation, or movement of registered or licensed motor vehicles.[280]

Thus, state and local governments retain their authority "to continue regulating the way vehicles are used in local areas."[281]

Consistent with this broad state and local authority, Congress has allowed and even encouraged states to use a wide range of innovative methods to meet their obligations under the Act. That statute specifies that a state can implement programs for improved public transit, restrict certain roads and lanes for passenger buses or high occupancy vehicles, and create traffic flow improvement programs that achieve emissions reductions.[282] Likewise, states can create economic incentive programs that include "incentives and requirements to reduce vehicle emissions."[283] Moreover, there is no doubt about the authority of states with serious, extreme, or severe nonattainment areas to enforce enhanced vehicle inspection and maintenance programs and impose traffic control measures on more heavily polluting vehicles. As the Air Quality Act Senate Report explained, the statute provides "for Federal preemption of the right to set standards on new motor vehicles and new motor vehicle engines only," while including "[s]pecific language indicating the committee's position on **the rights of the states to control the movement, operation, and use of licensed or registered vehicles**."[284]

For example, states have the authority to not only designate fees for vehicle purchase and registration—a common approach—but also fees that apply to vehicle use.[285] More broadly, as the U.S. Court of Appeals for the District of Columbia Circuit has observed, "the longstanding scheme of motor vehicle emissions control has always permitted the states to adopt in-use regulations—such as carpool lanes, restrictions on car use in downtown areas, and programs to control extended idling of vehicles—that are expressly intended to control emissions."[286]

Thus, actions which may have an effect on emissions, but do not directly set emissions standards, are not excluded from state and local regulatory authority. Congress did not limit state and local authority in section 209(d) to actions "not affecting emissions," which it plainly could have specified.[287]

Congress Limited Only State Standards Directly Controlling Tailpipe Emissions

The Clean Air Act, in Section 209, preempts state standards relating to motor vehicle emission controls for new motor vehicles that are different from those promulgated by the U.S. Environmental Protection Agency (EPA). However, importantly, the scope of this preemption is bounded and subject to waiver for California standards, as discussed further below. Section 209(a) of the Clean Air Act states:

> No State or any political subdivision thereof shall adopt or attempt to enforce any standard relating to the control of emissions from new motor vehicles or new motor vehicle engines subject to this part.[288]

Congress thus ensured that the federal standards would be "both a floor and a ceiling" regarding tailpipe emission controls.[289]

"Preemption analysis 'start[s] with the assumption that the historic police powers of the States were not to be superseded by the Federal Act unless that was the clear and manifest purpose of Congress.'"[290] "When . . . Congress adopts a statute that provides a reliable indication of Congressional intent regarding preemption, the scope of federal preemption is determined by the statute. . . . 'Congress' enactment of a provision defining the pre-emptive reach of a statute implies that matters beyond that reach are not pre-empted.'"[291]

The effect of the Clean Air Act's express preemption provision is relatively straightforward. "Where Congress or a federal agency explicitly preempts state laws on a given subject, states are barred from adopting and enforcing their own regulations."[292] Here, the Clean Air Act provides that its preemptive effect extends only to state motor vehicle "standards" relating to the direct control of emissions, with important exceptions for California and Section 177 states that are described further below.

Litigation before the Supreme Court has clarified that the term "standard" as it applies to emissions from motor vehicles and motor vehicle engines under Title II of the Clean Air Act includes requirements that a vehicle or engine must not emit more than a certain amount of a given pollutant, must be equipped with a certain type of pollution-control device, or must have some other design feature related to the control of emissions. Thus, where a regulation "neither dictates permissible pollutant levels nor mandates emission control technology," it is not a "standard" under section 209 of the Clean Air Act.[293] For this reason, an incentive-based approach, such as providing "head-of-the-line" privileges at any taxicab holding or dispatch area for compressed natural gas vehicles, has been seen by courts as a permissible action that does not involve standard setting. [294]

This definition of "standard" stems from a 2004 Supreme Court case holding that rules requiring operators of certain fleets to buy cleaner-fueled vehicles for fleet replacement or additions constituted "standards" subject to federal preemption.[295] There, the South Coast Air Quality Management District had adopted rules requiring operators of certain types of vehicular fleets—such as transit buses, trash trucks, airport shuttles and taxis, street sweepers and heavy-duty utility trucks—to buy certain cleaner-fueled vehicles when replacing or adding to their fleets. The Court found that these regulations were standards preempted by section 209. Thus, the Court not only prohibited state mandates imposed on manufacturers, but those affecting the purchasers of vehicles as well, regardless of whether the purchase requirements could be met without requiring manufacturers to alter the design of their engines.[296] The Court held that "a command, accompanied by sanctions, that certain purchasers may buy only vehicles with particular emission characteristics is as much an 'attempt to enforce' a 'standard' as a command, accompanied by sanctions, that a certain percentage of a manufacturer's sales volume must consist of such vehicles."[297, 298]

Another consideration when enacting state-level policies related to motor vehicles is that alongside the Clean Air Act's limits on emission controls, the Energy Policy and Conservation Act (EPCA) also imposes certain limits on state fuel efficiency regulations. EPCA requires the National Highway Traffic Safety Administration (NHTSA) to set Corporate Average Fuel Economy (CAFE) standards. EPCA prohibits states or political subdivisions from adopting or enforcing fuel economy standards for automobiles covered by federal standards.[299] Notwithstanding that express preemption, the Supreme Court has recognized that that the Clean Air Act "creates a statutory obligation wholly independent of DOT's mandate to promote energy efficiency."[300] Employing this rationale, courts have declined to impose EPCA's preemption provisions in the context of evaluating state clean air motor vehicle regulatory actions.[301] Thus, state and local actions affecting emissions, rather than efficiency levels, should be subject to analysis under the Clean Air Act's preemption provisions.

Caselaw underscores the importance of clarifying the distinction between EPCA and the Clean Air Act in enacting state and local governmental action. For example, courts have struck local regulations that would have regulated the hybrid vehicle composition of private taxi fleets.[302] These cases turned on the regulations' rationale related to fuel efficiency that implicated the broader EPCA preemption provision,[303] rather than on a Clean Air Act rationale. These holdings suggest that in-use restrictions tailored to emissions reductions, such as preferential pick up and drop off lanes favoring advanced technology vehicles may have an advantage in avoiding issues of preemption.

In the recently proposed SAFE Rule, EPA and NHTSA have argued that EPCA preempts all state standards that "relate to" fuel economy standards, including preempting state GHG emission standards because they are "unavoidably and overwhelming dependent upon substantially increasing fuel economy standards." The proposal states that NHTSA and EPA disagree with the decisions by two federal district courts that held the opposite: that the GHG emission standards in Vermont and California were not preempted under EPCA (*Green Mountain Chrysler v. Crombie* and *Central Valley Chrysler-Jeep, Inc. v. Goldstone*). The proposal further states that the decisions "erroneously concluded that 'related to' language in EPCA's preemption clause should be construed 'very narrowly'" and that the courts failed to recognize case law relating to the broad effect of other preemption provisions.[304] If EPA finalizes the SAFE Rule as proposed, it is expected that stakeholders will challenge these arguments, and a court would need to consider this caselaw.

State Vehicle Emissions Standards: California's Unique Role and Opportunities for Other States

Congress has granted California broad latitude to undertake motor vehicle emissions control and recognized the authority of other states to be able to align their actions with California. The Clean Air Act expressly authorizes California to impose its own standards, for which EPA must waive preemption unless the Administrator makes certain statutory findings.[305]

EPA is required to grant a waiver unless it finds that: (1) "the determination of the state is arbitrary and capricious," (2) "such State does not need such State standards to meet compelling and extraordinary conditions," or (3) "such State standards and accompanying enforcement procedures are not consistent with section 7521(a) of this title"[306] (which courts have read to mean that there must be adequate "lead time to permit the development of technology necessary to meet the proposed requirements, giving appropriate consideration to the cost of compliance within [the proposed] time frame"[307]).

These narrow grounds are the exclusive reason for which EPA may reject a waiver request. As the U.S. Court of Appeals for the District of Columbia Circuit has remarked, Congress "has also provided that EPA is not to overturn California's judgment lightly," and that "California is to have the broadest possible discretion in selecting the best means to protect the health of its citizens."[308]

> "The Committee amendment is intended to ratify and strengthen the California waiver provision and to affirm the underlying intent of that provision, i.e., **to afford California the broadest possible discretion in selecting the best means to protect the health of its citizens and the public welfare**."
>
> U.S. Congress, House Committee Report, 1977

California's unique authority can be understood in the context of the broader goals and history of the Clean Air Act. Courts have explained that history as follows:

> As originally introduced in the Senate, the Air Quality Act of 1967 did not contain an express preemption provision, though the topic of preemption quickly arose and immediately became the object of intense debate. The debate sharpened the differences between the states, which wanted to preserve their traditional role in regulating motor vehicles, and the manufacturers, which wanted to avoid the economic disruption latent in having to meet fifty-one separate sets of emissions control requirements. The bill that emerged from the Senate Committee contained a compromise: Subsection (a) preempted state programs of emissions control for new motor vehicles; subsection (b) provided an exception for California if that State determined that its standards would be "more stringent" than applicable federal standards. The Senate Committee explained: "On the question of preemption, representatives of the State of California were clearly opposed to displacing the State's right to set more stringent standards to meet peculiar local conditions. The auto industry conversely was adamant that the nature of their manufacturing mechanism required a single national standard in order to eliminate undue economic strain on the industry. The committee has taken cognizance of both of these points of view. Senator Murphy convinced the committee that California's unique problems and pioneering efforts justified a waiver of the preemption section to the State of California. S. Rep. No. 403, 90th Cong., 1st Sess. 33 (1967). . . .
>
> According to the Committee, the advantages of the California exception included the benefits for the Nation to be derived from permitting California to continue its experiments in the field of emissions control, benefits the Committee recognized might "require new control systems and design," *id.* and the benefits for the people of California to be derived from letting that State improve on "its already excellent program" of emissions control, *id.* . . .
>
> Congress had an opportunity to restrict the waiver provision in making the 1977 amendments, and it instead elected to expand California's flexibility to adopt a complete program of motor vehicle emissions control. Under the 1977 amendments, California need only determine that its standards will be "in the aggregate, at least as protective of public health and welfare than applicable Federal standards," rather than the "more stringent" standard contained in the 1967 Act. This change originated in the House. The House Committee Report explained: "The Committee amendment is intended to ratify and strengthen the California waiver provision and to affirm the underlying intent of that provision, i.e., **to afford California the broadest possible discretion in selecting the best means to protect the health of its citizens and the public welfare.**" H.R. Rep. No. 294, 95th Cong., 1st Sess. 301-02 (1977), U.S. Code Cong. & Admin. News 1977, p. 1380 (emphasis added).[309]

Indeed, much of the thrust of the Clean Air Act's structure and legislative history has been "to ensure that the federal government did not second-guess state policy choices."[310]

In addition to recognizing California's leadership and capabilities in establishing motor vehicle emissions controls, Congress also sought to recognize that State's unique air quality challenges. This recognition has consistently animated EPA's review of California's waiver application. EPA, for example, acknowledged that this concern extends to the impacts of climate change in its 2013 evaluation of a California wavier application:

> Record-setting fires, deadly heat waves, destructive storm surges, loss of winter snowpack—California has experienced all of these in the decade and will experience more in the coming decades. California's climate— much of what makes the state so unique and prosperous—is already changing, and those changes will only accelerate and intensify in the future. Extreme weather will be increasingly common as a result of climate change. In California, extreme events such as floods,

> heat waves, droughts and severe storms will increase in frequency and intensity. Many of these extreme events have the potential to dramatically affect human health and well-being, critical infrastructure and natural systems.[311]

States Aligning with California Standards

States have the authority to adopt the California emission standards under the Clean Air Act section 177. States that do so are informally referred to as "Section 177 States." Such states are not required to seek EPA approval before adopting California's standards provided that California has obtained a waiver from the EPA for the specific standard. However, states must remain mindful of the identicality requirement to qualify for this provision.[312]

A coalition of states began adopting California's more stringent vehicle emissions standards in the early 1990s.[313] As of June 2018, 13 states and Washington, D.C. have adopted or intend to adopt at least some aspect of California's more stringent emissions standards,[*] and depending on the federal government's decision related to the federal standards for model year 2021 and 2022 through 2025 as well as the Administration's decision on whether to revoke California's waiver to establish GHG emissions standards for years 2021 and beyond, other states may decide to evaluate the benefits as well as the need to defend their authority of doing so.[314] These states collectively comprise a significant portion of the market—approximately 35 percent—and can have a notable impact on the approach that automakers take to the design, production, and marketing of their vehicles.[315]

Congressional Prohibitions on A "Third Car" Do Not Pertain to Non-Regulatory Activities of State and Local Governments Acting as Market Participants

State and local actions that govern internal operations as a market participant, such as local governmental fleet purchasing rules, are not subject to analysis as regulatory actions and the consequent preemptive effects. Recent caselaw has clarified that preemption does not apply because the governmental entity is acting as a market participant.

The court cases finding preemption discussed above are not to the contrary—they similarly recognized that non-regulatory governmental actions may not implicate emissions standard setting. In the *South Coast* case, the Supreme Court remanded for further consideration of whether some of the rules may be characterized as internal state purchasing decisions. Likewise, state purchasing programs that do not impose regulatory requirements—either because they provide for voluntary incentives or because they affect purely internal government operating decisions—are likely permissible under the Supreme Court's reading of Section 209(a).[316,317]

On remand in the *Engine Manufacturers* case, the U.S. Court of Appeals for the Ninth Circuit more clearly spelled out this market participant doctrine. As that court explained,

> Actions taken by a state or its subdivision as a market participant are generally protected from federal preemption. The doctrine was originally developed in a series of dormant Commerce Clause cases. In *Hughes v. Alexandria Scrap Corp.*, 426 U.S. 794 (1976), the Supreme Court held that Maryland did not violate the Commerce Clause by favoring in-state processors of scrap metal when participating in the market for scrap metal. *Id.* at 809-10. . . . The Court stated that in market

[*] These states include Colorado, Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington.

> participant cases, courts undertake "a single inquiry: whether the challenged program constituted direct state participation in the market." *Id.* at 435 n. 7.
>
> After the development of the market participant doctrine in these dormant Commerce Clause cases, the Supreme Court and the lower federal courts have applied the doctrine to protect proprietary state action from preemption by various federal statutes. *See, e.g., Building & Constr. Trades Council v. Associated Builders & Contractors* ("Boston Harbor"), 507 U.S. 218, 226-27 (1993) (National Labor Relations Act); *Tocher*, 219 F.3d at 1048-50 (Federal Aviation Administration Authorization Act of 1995 ("FAAA")); *Associated Gen. Contractors v. Metro. Water Dist.*, 159 F.3d 1178, 1183 (9th Cir. 1998) (Employee Retirement Income Security Act of 1974). In the statutory preemption context, the market participant doctrine is based on the proposition that "pre-emption doctrines apply only to state regulation." *Boston Harbor*, 507 U.S. at 227. "Not all actions by state or local government entities . . . constitute regulation, for such an entity, like a private person, may buy and sell or own and manage property in the marketplace." *Sprint Spectrum L.P. v. Mills*, 283 F.3d 404, 417 (2d Cir. 2002). Thus, even where a federal statute pre-empts state regulation in an area, state action in that area is not preempted so long as it is proprietary rather than regulatory.[318]

In applying these principles, the Ninth Circuit held that significant portions of the Fleet Rules at issue in the case were permissible as non-regulatory proprietary actions. The court found that "these provisions directing state and local governmental entities to purchase, procure, lease, or contract for use of vehicles meeting specified air pollution criteria constitute direct state participation in the market."[319] Nor was that court dissuaded from this conclusion by the existence of enforcement mechanisms to ensure compliance with these requirements.[320] These subsequent cases demonstrate the relatively limited effect of the Supreme Court's decision and the relative consistency of court interpretations of state and local authorities under the Clean Air Act, as well as an enhanced understanding of the permissible grounds on which state actions may still have significant motor vehicles emissions reduction consequences. These cases clarify that actions that are internal fleet procurement decisions would not run afoul of any preemption concerns.

End Notes and References

[1] U.S. Census Bureau, 2016 American Community Survey, *Travel Time to Work* (B08303), https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_16_1YR_B08303&prodType=table.

[2] Margo Hilbrecht et al., *Highway to health? Commute time and well-being among Canadian adults*, 51, World Leisure Journal, ed., Routledge, April 8, 2014, https://uwaterloo.ca/canadian-index-wellbeing/sites/ca.canadian-index-wellbeing/files/uploads/files/highway_to_health_commute_time_and_well-being_among_canadian_adults.pdf; Mags Andersen, Mercer, *Long Commutes Costing Firms a Week's Worth of Staff Productivity* (May 17, 2017), https://www.uk.mercer.com/newsroom/britains-healthiest-workplace-flexible-working-and-commuting.html.

[3] Jeffrey Rissman, *The Future of Electric Vehicles In The U.S., Part 1: 65%-75% New Light-Duty Vehicle Sales by 2050*, Forbes (September 14, 2017), https://www.forbes.com/sites/energyinnovation/2017/09/14/the-future-of-electric-vehicles-in-the-u-s-part-1-65-75-new-light-duty-vehicle-sales-by-2050/#69d08e33e289.

[4] General Motors, Corporate Newsroom, *GM Outlines All-Electric Path to Zero Emissions* (October 2, 2017), http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2017/oct/1002-electric.html.

[5] Stephen Edelstein, Digital Trends, *Every automaker's electrification plans for the next few years explained* (October 21, 2017), https://www.digitaltrends.com/cars/automaker-electrification-plans/.

[6] U.S. Environmental Protection Agency, *2014 National Emissions Inventory Data* (2014), https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data.

[7] U.S. Environmental Protection Agency, *2014 National Emissions Inventory Data* (2014), https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data.

[8] California Air Resources Board, *Methods to Assess Co-Benefits of California Climate Investments: Air Pollutant Emissions* (November, 2017), https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/carb_air_pollutant_emissions_nrw.pdf.

[9] Bonnie Holmes-Gen & Will Barrett, American Lung Association in California, *Clean Air Future: Health and Climate Benefits of Zero Emission Vehicles* (October 2016), http://www.lung.org/local-content/california/documents/2016zeroemissions.pdf; U.S. Environmental Protection Agency, *See How Mobile Source Pollution Affects Your Health*, https://www.epa.gov/mobile-source-pollution/how-mobile-source-pollution-affects-your-health.

[10] California Air Resources Board, Low-Income Barriers Study, Part B: Overcoming Barriers to Clean Transportation Access for Low-Income Residents (February 2018), https://www.arb.ca.gov/msprog/transoptions/sb350_final_guidance_document_022118.pdf.

[11] C40 Cities, C40 Blog, *Daring Cities Make Bold Air Quality Commitment to Remove All Diesel Vehicles by 2025* (December 1, 2016), http://www.c40.org/blog_posts/daring-cities-make-bold-air-quality-commitment-to-remove-all-diesel-vehicles-by-2025.

[12] State of Washington, Department of Ecology, *Proposed Volkswagen Beneficiary Mitigation Plan* (October 2017), https://ecology.wa.gov/DOE/files/41/417a6510-a669-4a10-927d-4ebc02282f4a.pdf.

[13] Daniel Boffey, The Guardian, *Mayors of 7,400 cities vow to meet Obama's climate commitments* (July 28, 2017), https://www.theguardian.com/environment/2017/jun/28/global-covenant-mayors-cities-vow-to-meet-obama-climate-commitments.

[14] We Are Still In, *We Are Still In Declaration*, https://www.wearestillin.com/we-are-still-declaration.

[15] Climate Mayors, *#ClimateMayors Letter to President Trump on Roll back of U.S. Climate Actions* (March 2017), http://climatemayors.org/actions/letters-and-statements/.

[16] Transportation & Climate Initiative of the Northeast and Mid-Atlantic States, *Northeast and Mid-Atlantic States Seek Public Input as They Move Toward a Cleaner Transportation Future* (November 13, 2017), http://www.transportationandclimate.org/northeast-and-mid-atlantic-states-seek-public-input-they-move-toward-cleaner-transportation-future.

[17] John Olivieri, U.S. PIRG, *New federal data show transportation sector now the largest source of carbon pollution in the United States, first time in nearly 40 years* (August 4, 2016), http://www.uspirg.org/news/usp/new-federal-data-show-transportation-sector-now-largest-source-carbon-pollution-united.

[18] U.S Energy Information Administration, *Power sector carbon dioxide emissions fall below transportation sector emissions* (December 19, 2017), https://www.eia.gov/todayinenergy/detail.php?id=34192.

[19] Marco Miotti et al., *Personal Vehicles Evaluated against Climate Change Mitigation Targets*, Environmental Science & Technology (September 27, 2016), http://pubs.acs.org/doi/full/10.1021/acs.est.6b00177; *see also* California Air Resources Board, *California's Advanced Clean Cars Midterm Review*, ES-34 (January 18, 2017), https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_summaryreport.pdf.

[20] Vignesh Gowrishankar & Amanda Levin, Natural Resources Defense Council, *America's Clean Energy Frontier: The Pathway to a Safer Climate Future* (September 2017), https://www.nrdc.org/sites/default/files/americas-clean-energy-frontier-report.pdf. (Gowrishankar et. al. 2017)

[21] California Air Resources Board, *California's 2017 Climate Change Scoping Plan* (November 2017) at p. 77, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf (California ARB Nov. 2017)

[22] The City of New York, NYC Sustainability, *Transportation*, https://www1.nyc.gov/site/sustainability/codes/transportation.page.

[23] Margo Hilbrecht et al., *Highway to health? Commute time and well-being among Canadian adults*, 51, World Leisure Journal, ed., Routledge, April 8, 2014, https://uwaterloo.ca/canadian-index-wellbeing/sites/ca.canadian-index-wellbeing/files/uploads/files/highway_to_health_commute_time_and_well-being_among_canadian_adults.pdf; Mags Andersen, Mercer, *Long Commutes Costing Firms a Week's Worth of Staff Productivity* (May 17, 2017), https://www.uk.mercer.com/newsroom/britains-healthiest-workplace-flexible-working-and-commuting.html.

[24] Matthias Sweet, *Traffic Congestion's Economic Impacts: Evidence from US Metropolitan Regions*, 51 Urban Studies Journal 10 (2014), http://journals.sagepub.com/doi/full/10.1177/0042098013505883.

[25] Intelligent Transportation Systems Lab, Department of Civil and Environmental Engineering, Maseeh College of Engineering and Computer Science, Portland State University, *Traffic Congestion Mitigation as an Emissions Reduction Strategy* (June 2011), https://www.pdx.edu/cecs/sites/www.pdx.edu.cecs/files/Bigazzi%20MS%20Summary.pdf.

[26] BlueGreen Alliance, *Advanced Technology Vehicles Manufacturing Loans: Employment Impacts* (2016), https://www.bluegreenalliance.org/wp-content/uploads/2016/11/ATVM-employment-impacts-and-potential-FINAL.pdf.

[27] Lawrence H. Goulder, Stanford University & Pew Center on Global Climate Change, *Induced technological change and climate policy* (October 2004), https://www.c2es.org/document/induced-technological-change-and-climate-policy/.

[28] California Air Resources Board, *California's Advanced Clean Cars Midterm Review* (January 18, 2017), https://www.arb.ca.gov/msprog/acc/mtr/acc_mtr_finalreport_full.pdf.

[29] National Renewable Energy Lab, *Electric Vehicle Grid Integration*, https://www.nrel.gov/transportation/project-ev-grid-integration.html.

[30] David Dalligner & Martin Wietschel, *Grid integration of intermittent renewable energy sources using price-responsive plug-in electric vehicles*, 16 Renewable and Sustainable Energy Reviews 3370 (June 2012), https://ac.els-cdn.com/S136403211200113X/1-s2.0-S136403211200113X-main.pdf?_tid=0b9b905c-fd49-11e7-bc64-00000aab0f26&acdnat=1516387763_073749dd896e32e22bd8a07a631f3faf.

[31] California Public Utilities Commission, *Vehicle-Grid Integration Communication Protocol Working Group*, http://www.cpuc.ca.gov/vgi/.

[32] California Public Utilities Commission, Working Group Energy Division Staff Report, Assigned Commissioner's Ruling Seeking Comment on Vehicle Grid Integration Communication Protocol, R. 13-11-007 (December 2017), http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M211/K654/211654688.PDF

[33] 42 U.S.C. § 7401(a)(3) (2000); *Huron Portland Cement Co. v. Detroit*, 362 U.S. 440, 442 (1960) ("Legislation designed to free from pollution the very air that people breathe clearly falls within the exercise of even the most traditional concept of what is compendiously known as the police power. In the exercise of that power, the states and their instrumentalities may act, in many areas of interstate commerce . . ., concurrently with the federal government.").

[34] The Air Quality Act of 1967. Public Law 90-148. 90th Congress, S. 780 (November 21, 1967).

[35] 42 U.S.C § 7543; S. Rep. No. 90-403, at 632 (1967) and *Motor and Equipment Manufacturers Association v. EPA (MEMA I)* 627 F.2d 1095, 1101 fn. 1 (D.C. Cir. 1979).

[36] 42 U.S.C § 7543(b)

[37] U.S. Environmental Protection Agency, *Vehicle Emissions California Waivers and Authorizations ("Waiver Process")*, accessed March 2018, https://www.epa.gov/state-and-local-transportation/vehicle-emissions-california-waivers-and-authorizations

[38] 42 U.S.C § 7543(e)(2).

[39] *See, e.g.*, 72 Fed. Reg. 48936 (August 27, 2007) and 73 Fed. Reg. 8200 (February 13, 2008), in which EPA discusses and approves New Jersey's adoption of California's second generation low emission vehicle program for light-duty vehicles, LEV II, beginning with the 2009 model year, and New Jersey's low emission vehicle program related to the manufacture and sale of zero-emission vehicles, consistent with California's current low emission vehicle regulations, respectively.

[40] U.S. Environmental Protection Agency, Vehicle Emissions California Waivers and Authorizations, https://www.epa.gov/state-and-local-transportation/vehicle-emissions-california-waivers-and-authorizations.

[41] U.S. Government Accountability Office, letter to Congressional Requesters, Re: Clean Air Act: Historical Information on EPA's Process for Reviewing California Waiver Requests and Making Waiver Determinations (January 16, 2009), https://www.gao.gov/assets/100/95940.pdf.

[42] Notice of Decision Granting a Waiver of Clean Air Act Preemption for California, 74 Fed. Reg. 32744, 32761 (July 8, 2009).

[43] The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, 83 Fed. Reg. 42,986 (August 24, 2018), https://www.federalregister.gov/documents/2018/08/24/2018-16820/the-safer-affordable-fuel-efficient-safe-vehicles-rule-for-model-years-2021-2026-passenger-cars-and.

[44] U.S. Environmental Protection Agency, California State Motor Vehicle Pollution Control Standards - Request for Waiver of Preemption Under Clean Air Act Section 209(b) for Greenhouse Gas Emissions (Docket EPA-HQ-OAR-2006-0173). Available at https://www.regulations.gov/docket?D=EPA-HQ-OAR-2006-0173.

[45] Notice of Decision Granting a Waiver of Clean Air Act Preemption for California, 74 Fed. Reg. 32744, 32761 (July 8, 2009).
[46] Letter from Arthur Marin, Executive Director, Northern States for Coordinated Air Use Management, to Fred Congressmen Fred Upton and Henry Waxman, *Section 177 States' Support for EPA and California Authority to Establish Motor Vehicle GHG Emissions Standards* (February 8, 2011), www.nescaum.org/documents/nescaum-ltr-to-reps-caa-ghg-mv-stds-20110208.pdf.
[47] M.J. Bradley & Associates analysis based on data from Auto Alliance, *Autos Drive America Forward* (accessed March 2018), https://autoalliance.org/in-your-state/
[48] The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, 83 Fed. Reg. 42,986 (August 24, 2018), https://www.federalregister.gov/documents/2018/08/24/2018-16820/the-safer-affordable-fuel-efficient-safe-vehicles-rule-for-model-years-2021-2026-passenger-cars-and.
[49] Denise A. Grab, et al., Institute for Policy Integrity, *No Turning Back -- An Analysis of EPA's Authority to Withdraw California's Preemption Waiver Under Section 209 of the Clean Air Act* (2018), http://policyintegrity.org/files/publications/No_Turning_Back.pdf
[50] Id. at 16.
[51] 310 CMR 60.05-.06 (2018).
[52] City of Minneapolis, *Minneapolis Greenhouse Gas Emissions Tracking*, http://www.minneapolismn.gov/sustainability/climate-action-goals/ghg-emissions.
[53] City of Minneapolis, *Green Fleet Policy* (2010), http://www.minneapolismn.gov/www/groups/public/@council/documents/webcontent/convert_259214.pdf.
[54] *Id.*
[55] U.S Environmental Protection Agency, *SmartWay*, https://www.epa.gov/smartway.
[56] City of Minneapolis, Public Works, *Fleet*, http://www.minneapolismn.gov/publicworks/green/public-works_pw_green_fleets.
[57] Metro Transit, Metropolitan Council, *Our Vehicles*, https://www.metrotransit.org/our-vehicles.
[58] Environmental Defense Fund, *Reducing Emissions for Corporate Fleets: Carrier cuts emissions with telematics*, http://business.edf.org/files/2014/03/carrier-cuts-emissions.pdf.
[59] Grace Suizo & Thi Dao, *Fleets Set Out to Cut GHG Emissions*, Automotive Fleet (September 2010), http://www.automotive-fleet.com/channel/green-fleet/article/story/2010/09/fleets-set-out-to-cut-ghg-emissions.aspx.
[60] Zach McDonald, *How Public Fleets Use Electric Vehicles to Meet Emissions Targets*, FleetCarma (September 20, 2018), https://www.fleetcarma.com/public-fleets-use-electric-vehicles-meet-emissions-targets/.
[61] Chicago Area Clean Cities, *Chicago Area Clean Cities Recognizes Top 5 Green Fleets for 2017* (December 8, 2017), http://chicagocleancities.org/chicago-area-clean-cities-recognizes-top-green-fleets-2017/.
[62] U.S. Environmental Protection Agency, Regulatory Announcement: EPA and NHTSA Propose Historic National Program to Reduce Greenhouse Gases and Improve Fuel Economy for Cars and Trucks (September 2009), https://nepis.epa.gov/Exe/tiff2png.cgi/P1005POO.PNG?-r+75+-g+7+D%3A%5CZYFILES%5CINDEX%20DATA%5C06THRU10%5CTIFF%5C00000612%5CP1005POO.TIF.
[63] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, 75 FR 25323 (May 7, 2010).
[64] 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 77 FR 62623 (October 15, 2012).
[65] Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 76 Fed. Reg 57106 (September 15, 2011); Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2, 81 Fed. Reg. 73478 (October 25, 2016).
[66] The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, 83 Fed. Reg. 42,986-43,500 (August 24, 2018), https://www.federalregister.gov/documents/2018/08/24/2018-16820/the-safer-affordable-fuel-efficient-safe-vehicles-rule-for-model-years-2021-2026-passenger-cars-and
[67] Denise A. Grab, et al., Institute for Policy Integrity, *No Turning Back -- An Analysis of EPA's Authority to Withdraw California's Preemption Waiver Under Section 209 of the Clean Air Act* (2018), http://policyintegrity.org/files/publications/No_Turning_Back.pdf
[68] Letter from Arthur Marin, Executive Director, Northern States for Coordinated Air Use Management, to Fred Congressmen Fred Upton and Henry Waxman, *Section 177 States' Support for EPA and California Authority to Establish Motor Vehicle GHG Emissions Standards* (February 8, 2011), www.nescaum.org/documents/nescaum-ltr-to-reps-caa-ghg-mv-stds-20110208.pdf.
[69] Colorado Air Quality Control Commission, *Regulation No. 20: Colorado Low Emission Vehicle Program* (August 16, 2018), https://www.colorado.gov/pacific/sites/default/files/081618_Reg20-materials.pdf.
[70] M.J. Bradley & Associates analysis based on data from Auto Alliance, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100TGDW.pdf

[71] U.S. EPA, *Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2017* (January 2018), https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100TGDW.pdf

[72] *See* Cal. Code Regs., 13 §§ 1962.0-1962.2 (2018).

[73] Office of Governor Phil Murphy, "Governor Murphy Reaffirms Support for Federal Fuel Emissions Standards, Will Sign Multi-State Agreement on Clean Vehicles," (April 3, 2018), https://nj.gov/governor/news/news/562018/approved/20180403b_emissions_standards.shtml.

[74] Global Automakers, *Quarterly market Report Q4 2017* (March 15, 2018), http://www.globalautomakers.org/ZEV%20market%20report%20Q4%202017_1.pdf

[75] ZEV Task Force, Multi-State ZEV Action Plan: Accelerating the Adoption of Zero Emission Vehicles from 2018 to 2021 (June 2018), http://www.nescaum.org/documents/2018-zev-action-plan.pdf.

[76] *See, e.g.*, Richard Newell et al., Resources for the Future, *Carbon Markets: Past, Present, and Future* (December 2012).

[77] Drew Veysey et al., Georgetown Climate Center, *Reducing Transportation Emissions in the Northeast and Mid-Atlantic: Fuel System Considerations* (November 13, 2017), http://www.georgetownclimate.org/files/report/GCC_TransportationFuelSystemConsiderations_Nov2017.pdf.

[78] Letter from Mac Taylor, Legislative Analyst's Office, California Legislature, to Hon. Tom Lackey, Assembly Member for California's 36th District (March 4, 2016), http://www.lao.ca.gov/reports/2016/3438/LAO-letter-Tom-Lackey-040716.pdf.

[79] California Air Resources Board, *Maps to Support the Disadvantaged Communities Investment Guidelines* (accessed March 2018), https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/535investments.htm.

[80] California Air Resources Board, *California Climate Investments: 2017 Annual Report* (March 2017), https://arb.ca.gov/cc/capandtrade/auctionproceeds/cci_annual_report_2017.pdf.

[81] *Id.*

[82] California Air Resources Board, *Auction Proceeds: Funded Programs and Events* (last reviewed February 16, 2018), https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/ggrfprogrampage.htm#Transportation.

[83] California Air Resources Board, *LCFS Pathway Certified Carbon Intensities* (last updated January 30, 2018), https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm.

[84] Oregon Department of Environmental Quality, *Oregon Clean Fuels Program*, http://www.oregon.gov/deq/aq/programs/Pages/Clean-Fuels.aspx.

[85] *Rocky Mt. Farmers Union v. Corey*, 730 F.3d 1070 (9th Cir. 2013); *Am. Fuel & Petrochemical Mfrs. v. O'Keeffe*, 134 F.3d 1270, 1288 (D. Or. 2015).

[86] Speech by Thomas Donohue, President and CEO, U.S. Chamber of Commerce, *America's Infrastructure Summit: Time to Modernize* (January 18, 20128), https://www.uschamber.com/speech/america-s-infrastructure-summit-time-modernize.

[87] Robbie Orvis, Energy Information: Policy and Technology LLC, *Effects of a $0.25 Federal Gas Tax Increase on U.S. Economy, Fuel Use, Fleet Composition*, (February 2018), http://energyinnovation.org/wp-content/uploads/2018/02/US-Gas-Tax-Research-Note_FINAL.pdf.

[88] White House, *Economic Report of the President* (February 2018), https://www.whitehouse.gov/wp-content/uploads/2018/02/ERP_2018_Final-FINAL.pdf.

[89] American Petroleum Institute, *Motor Fuel Taxes: State Gasoline Tax Reports*, http://www.api.org/oil-and-natural-gas/consumer-information/motor-fuel-taxes.

[90] Amy Harder, *The 23 U.S. States that have hiked gas taxes since 2013*, Axios (February 27, 2018), https://www.axios.com/one-cool-chart-23-us-states-have-hiked-gas-taxes-since-2013-9610c9b5-ab23-45fc-a836-8bf837a76e32.html.

[91] 3 Municipal Code of Chicago §3-52.

[92] John German & Dan Meszler, The International Council on Clean Transportation, *Best Practices for Feebate Program Design and Implementation* (April 2010), https://www.theicct.org/sites/default/files/publications/ICCT_feebates_may2010.pdf.

[93] *Id.*

[94] Green Car Congress, *French Government Declares Car Feebates System a Success* (August 28, 2008), http://www.greencarcongress.com/2008/08/french-governme.html.

[95] Thomas Klier & Joshua Linn, Resources for the Future, *Using Vehicle Taxes to Reduce Carbon Dioxide Emissions Rates of New Passenger Vehicles* (August 2012), http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-12-34.pdf.

[96] Cambridge Econometrics, *The effectiveness of CO2-based 'feebate' systems in European passenger vehicle market context* (November 1, 2013), https://www.theicct.org/sites/default/files/publications/CambridgeEconometrics_ICCT_feebate_rpt_Nov2013.pdf.

[97] Netherlands Environmental Assessment Agency (PLB), *Energy Labels and Autotype Choice: Effect of energy label on the purchase of new passenger cars by consumers* (2009), http://docplayer.nl/1361262-Energielabels-en-autotypekeuze-effect-van-het-energielabel-op-de-aanschaf-van-nieuwe-personenauto-s-door-consumenten.html.

[98] Jason Mathers, *Upstream methane reductions crucial to future of natural gas trucks*, Environmental Defense Fund (August 23, 2017), http://blogs.edf.org/energyexchange/2017/08/23/upstream-methane-reductions-crucial-to-future-of-natural-gas-trucks/.

[99] Department of Energy, Advanced Fuels Data Center, *Emissions from Hybrid and Plug-In Electric Vehicles* (accessed April 2018), https://www.afdc.energy.gov/vehicles/electric_emissions.php.

[100] Bloomberg New Energy Finance, Electric Vehicle Outlook 2017 (July 2017), https://about.bnef.com/electric-vehicle-outlook/#toc-download.

[101] Nic Lutsey, The International Council on Clean Transportation, *The Rise of Electric Vehicles: The Second Million* (January 31, 2017), http://www.theicct.org/blogs/staff/second-million-electric-vehicles.

[102] Alister Doyle, Twelve big cities to buy zero emissions buses, extend green areas, Reuters (October 23, 2017), https://www.reuters.com/article/us-climatechange-cities/twelve-big-cities-to-buy-zero-emissions-buses-extend-green-areas-idUSKBN1CS13J.

[103] U.S. Energy Information Administration, *Annual Energy Outlook 2018* (February 6, 2018), https://www.eia.gov/outlooks/aeo/pdf/AEO2018_FINAL_PDF.pdf.

[104] Plug In America, *Evaluating Methods to Encourage Electric Vehicle Adoption* (October 2016), https://pluginamerica.org/wp-content/uploads/2016/11/PEV-Incentive-Review-October-2016.pdf.

[105] *Id.*

[106] https://www.reuters.com/article/us-gm-electric-insight/gm-races-to-build-a-formula-for-profitable-electric-cars-idUSKBN1EY0GG

[107] As of April 2019, the U.S. Department of Energy estimated that on average, it costs about half as much to drive an electric vehicle the same distance one could drive on a gallon of unleaded gasoline in a similar car, with a price of regular gasoline averaging at $2.65 and an electric eGallon averaging at $1.11. For more information, *see* https://energy.gov/articles/egallon-how-much-cheaper-it-drive-electricity.

[108] Ona Egbue & Suzanna Long, *Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions*, 48 Energy Policy 717 (September 2012), https://www.sciencedirect.com/science/article/pii/S0301421512005162.

[109] The federal Internal Revenue Service (IRS) tax credit consists of $2,500 to $7,500 per new EV purchased for use in the United States. If a buyer does not have a tax liability of this amount they can only claim up to the level of their liability. This means that not all buyers will claim back the full amount Reduction of annual consumer taxes that would otherwise be paid (when there is tax liability). The size of the tax credit depends on the size of the vehicle and its battery capacity and is not available for used or leased electric vehicles. The tax credit is available until 200,000 qualified EVs have been sold in the United States by each manufacturer. As of February 2018, no manufacturers have been phased out. For more information, *see* the U.S. Department of Energy's website at https://energy.gov/eere/electricvehicles/electric-vehicles-tax-credits-and-other-incentives.

[110] Zifei Yang et al., The International Council on Clean Transportation, *Principles for Effective Electric Vehicle Incentive Design* (June 2016), https://www.theicct.org/sites/default/files/publications/ICCT_IZEV-incentives-comp_201606.pdf.

[111] S.B. 172, 2017 Reg. Leg. Session, (La. 2017), http://www.legis.la.gov/legis/ViewDocument.aspx?d=1052430.

[112] H.R. 16-1332, 70th Gen. Assembly, 2nd Sess. (Co. 2016), http://www.leg.state.co.us/CLICS/CLICS2016A/csl.nsf/fsbillcont3/D29A1044569D6D5987257F2400642E3F?Open&file=1332_rer.pdf.

[113] N.J. Admin. Code § 54:32B-8.55 (2016).

[114] D.C. Mun. Regs., 50 § 2201.03 (2018).

[115] http://www.ct.gov/deep/cwp/view.asp?a=2684&q=565018&deepNav_GID=2183

[116] https://energycenter.org/article/auto-dealership-survey-evaluates-connecticut-ev-sales-incentive

[117] Transportation Research Board & National Research Council, *Overcoming Barriers to Deployment of Plug-in Electric Vehicles*, The National Academies Press (2015), https://www.nap.edu/catalog/21725/overcoming-barriers-to-deployment-of-plug-in-electric-vehicles; Kevin Gallager & Erich Muehlegger, *Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology*, 61 Journal of Environmental Economics and Management 1, 1-15 (2011), https://econpapers.repec.org/article/eeejeeman/v_3a61_3ay_3a2011_3ai_3a1_3ap_3a1-15.htm.

[118] Kevin Gallager & Erich Muehlegger, *Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology*, 61 Journal of Environmental Economics and Management 1, 1-15 (2011), https://econpapers.repec.org/article/eeejeeman/v_3a61_3ay_3a2011_3ai_3a1_3ap_3a1-15.htm.

[119] Transportation Research Board & National Research Council, *Overcoming Barriers to Deployment of Plug-in Electric Vehicles*, The National Academies Press (2015), https://www.nap.edu/catalog/21725/overcoming-barriers-to-deployment-of-plug-in-electric-vehicles.

[120] Eric Cahill, *Distribution Strategy and Retail Performance in the U.S. Market for Plug-in Electric Vehicles: Implications for Product Innovation and Policy* (2015) (unpublished Ph.D. dissertation, University of California-Davis), https://search.proquest.com/openview/fec1605c98cfb9bcbc08dff21dcf9fc5/1?pq-origsite=gscholar&cbl=18750&diss=y.

[121] Jeff Kessler, *Assessing Low-Carbon Fuel Technology Innovation Through a Technology Innovation System Approach*, Institute of Transportation Studies (December 2015), https://www.researchgate.net/publication/297410200_Assessing_Low-Carbon_Fuel_Technology_Innovation_Through_a_Technology_Innovation_System_Approach.

[122] Transportation Research Board & National Research Council, *Overcoming Barriers to Deployment of Plug-in Electric Vehicles*, The National Academies Press (2015), https://www.nap.edu/catalog/21725/overcoming-barriers-to-deployment-of-plug-in-electric-vehicles.

[123] WXY Architecture + Urban Design & Energetics Incorporated, *Creating EV-Ready Towns and Cities: A Guide to Policy and Planning Tools*, New York State Energy Research and Development Authority & Transportation and Climate Initiative (November 2012), http://www.transportationandclimate.org/creating-ev-ready-towns-and-cities-guide-planning-and-policy-tools.

[124] Energetics Incorporated, *Residential EVSE Permit Process Best Practices*, New York State Energy Research and Development Authority (April 2013), https://www.nyserda.ny.gov/-/media/Files/Programs/ChargeNY/Permit-Process-Streamlining.pdf.

[125] Sustainable Jersey, *Public Electric Vehicle Charging Infrastructure* (updated June 2017), http://www.sustainablejersey.com/actions-certification/actions/, follow "Innovation & Demonstration Projects," then follow "Electric Vehicles."

[126] Brian Ross & Katelyn Bocklund, Great Plains Institute for Sustainable Development, *Making your city "EV Ready"* (November 30, 2017), http://www.driveelectricmn.org/making-your-city-ev-ready/.

[127] https://www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement

[128] http://www.maine.gov/mdot/vw/

[129] Austin Energy, *Plug-in Austin – Multifamily Properties*, https://austinenergy.com/ae/green-power/plug-in-austin/multifamily-properties.

[130] Regional Air Quality Council & Colorado Energy Office, *Charge Ahead Colorado: Grant Application Guide* (2015), https://raqc.egnyte.com/dl/q67J2egDh5/Charge_Ahead_Colorado_Grant_Application_Guide.pdf_.

[131] https://www.colorado.gov/pacific/energyoffice/ev-fast-charging-corridor-grant-program

[132] MTMC, § 19.126.040 (2017). http://www.codepublishing.com/WA/MountlakeTerrace/html/MountlakeTerrace19/MountlakeTerrace19126.html#19.126.

[133] Cal. Code Regs., 4 § 106.4 (2016).

[134] FMC, 15 § 48.030-.060 (2017); FMC, 18 § 183.172-4 (2017).

[135] Wash. Admin. Code 51-50-0427 (2016).

[136] For more information, see the Transportation & Climate Initiative, https://www.transportationandclimate.org/

[137] M.J. Bradley & Associates and Georgetown Climate Center, *EV Corridor Analysis Tool for Northeast and Mid-Atlantic States*, (February 12, 2018), http://www.georgetownclimate.org/articles/new-ev-corridor-analysis-tool-for-northeast-and-mid-atlantic-states.html

[138] Memorandum of Understanding between Colorado, Idaho, Montana, Nevada, New Mexico. Utah and Wyoming, Regional Electric Vehicle Plan for the West (October 4, 2017), https://www.colorado.gov/pacific/sites/default/files/021518_REF_MOU-ElectricalVehiclePlan.PDF.

[139] Georgetown Climate Center and MJB&A, *Utility Investment in Electric Vehicle Charging Infrastructure: Key Regulatory Considerations* (November 2017), https://www.mjbradley.com/reports/utility-investment-electric-vehicle-charging-infrastructure-key-regulatory-considerations.

[140] Massachusetts Department of Public Utilities, DPU 17-05, *Order Establishing Eversource's Revenue Requirement* (November 30, 2017), https://www.mass.gov/files/documents/2018/01/26/17-05_Final_Order_Revenue_Requirement_11-30-17.pdf.

[141] California Public Utilities Commission, *Zero Emissions Vehicles - Infrastructure Pilot Programs* (accessed March 2018), http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Infrastructure/RDD_and_Emerging_Programs/Alternative_Fuel_Vehicles/IOUInfrastructurePrograms.pdf

[142] California Public Utilities Commission, D. 18-01-024, *Decision on the Transportation Electrification Priority Review Projects* (January 17, 2018), http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K670/204670548.PDF

[143] Baltimore Gas and Electric, *Charging & Rates*, *https://www.bge.com/SmartEnergy/InnovationTechnology/Pages/ChargingRates.aspx*.

[144] Pepco, *Electric Vehicle Program (MD)*: *Plug-in Vehicle Offering*, https://www.pepco.com/SmartEnergy/InnovationTechnology/Pages/ElectricVehicles/MD/ElectricVehicleProgram.aspx.

[145] Public Service Enterprise Group, *PSE&G's Residential Electric Rates*, https://www.pseg.com/info/environment/ev/rlm-rs_rates.jsp.

[146] Baltimore Gas and Electric, *Charging & Rates*, *https://www.bge.com/SmartEnergy/InnovationTechnology/Pages/ChargingRates.aspx*; Pepco, *Electric Vehicle Program (MD)*: *Plug-in Vehicle Offering*, https://www.pepco.com/SmartEnergy/InnovationTechnology/Pages/ElectricVehicles/MD/ElectricVehicleProgram.aspx.

[147] Sanya Carley, *Intent to Purchase a Plug-In Electric Vehicle: A Survey of Early Impressions in Large US Cities*, Transportation Research Part D: Transportation and Environment (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2222170.

[148] David Dalligner & Martin Wietschel, *Grid integration of intermittent renewable energy sources using price-responsive plug-in electric vehicles*, 16 Renewable and Sustainable Energy Reviews 3370 (June 2012), https://ac.els-cdn.com/S136403211200113X/1-s2.0-S136403211200113X-main.pdf?_tid=0b9b905c-fd49-11e7-bc64-00000aab0f26&acdnat=1516387763_073749dd896e32e22bd8a07a631f3faf.

[149] California ISO, *California Vehicle-Grid Integration (VGI) Roadmap: Enabling vehicle-based grid services* (February 2014), http://www.caiso.com/documents/vehicle-gridintegrationroadmap.pdf.

[150] California Public Utilities Commission, Vehicle-Grid Integration Communication Protocol Working Group, http://www.cpuc.ca.gov/vgi/.

[151] California Energy Commission, *California Energy Storage Showcase: Air Force Vehicle-to-Grid Demonstration*, http://www.energy.ca.gov/research/energystorage/tour/af_v2g/.

[152] U.S. Energy Information Administration, *Annual Energy Outlook 2017* (January 5, 2017), https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf.

[153] Rob Gannon (King County Metro Transit General Manager), *With some all-electric buses, Metro Transit rides into the future*, Seattle Times (October 2, 2017), https://www.seattletimes.com/opinion/with-some-all-electric-buses-metro-transit-rides-into-the-future/

[154] Liane Yvkoff, *In the Race to Full Electrification, Buses May Take First Place*, Forbes (September 12, 2016), https://www.forbes.com/sites/lianeyvkoff/2016/09/12/in-the-race-to-full-electrification-buses-may-take-first-place/#6c3a4cd17c09.

[155] Sven Boren et al., *Preferences of Electric Buses in Public Transport; Conclusions from Real Life Testing in Eight Swedish Municipalities*, 10 Int'l Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering 3 (2016), https://www.diva-portal.org/smash/get/diva2:911643/FULLTEXT01.pdf.

[156] Bloomberg New Energy Finance, *Electric Buses in Cities: Driving Towards Cleaner Air and Lower CO2* (March 29, 2018), https://about.bnef.com/blog/electric-buses-cities-driving-towards-cleaner-air-lower-co2/.

[157] Steve Hymon, *Metro Board approves purchase of 95 electric buses and goal of full electric fleet by 2030*, The Source (July 27, 2017), https://metro.legistar.com/LegislationDetail.aspx?ID=3108965&GUID=87E0C160-1252-42CB-BF00-C792E6C6760A&FullText=1.

[158] Bloomberg New Energy Finance, *Electric Buses in Cities: Driving Towards Cleaner Air and Lower CO2* (March 29, 2018), https://about.bnef.com/blog/electric-buses-cities-driving-towards-cleaner-air-lower-co2/.

[159] *See, e.g.*, Clean Energy Works, *Tariffed On-Bill Finance to Accelerate Clean Transit,"* http://cleanenergyworks.org/clean-transit/

[160] Mary Lunetta, *Children Deserve to Ride on Zero-Emissions School Buses*, Sierra Club (January 18, 2018), https://www.sierraclub.org/compass/2018/01/children-deserve-ride-zero-emission-school-buses.

[161] Massachusetts Executive Office of Energy and Environmental Affairs, *Baker-Polito Administration Awards Electric School Bus Grants to Four Schools* (June 11, 2016), https://www.mass.gov/news/baker-polito-administration-awards-electric-school-bus-grants-to-four-schools ; Sean Bennett, *Sacramento County Unveils Fleet of Electric School Buses*, CBS Sacramento (May 12, 2017), http://sacramento.cbslocal.com/2017/05/12/sacramento-electric-school-buses.

[162] C40 Cities, C40 Fossil-Fuel-Free Streets Declaration, http://c40-production-images.s3.amazonaws.com/other_uploads/images/1418_Fossil_Fuel_Free_Streets_Declaration.original.pdf?1508742654.

[163] Steve Hanley, *Shenzen Completes Switch to Fully Electric Bus Fleet. Electric Taxis Are Next.*, Clean Technica (January 1, 2018) https://cleantechnica.com/2018/01/01/shenzhen-completes-switch-fully-electric-bus-fleet-electric-taxis-next/.

[164] David Roberts, *Electric buses are coming, and they're going to help fix 4 big urban problems*, Vox (October 25, 2017), https://www.vox.com/energy-and-environment/2017/10/24/16519364/electric-buses.

[165] https://www.proterra.com/press-release/los-angeles-department-of-transportation-wins-fta-low-no-grant-and-selects-proterra-to-provide-25-zero-emission-buses-for-one-of-californias-largest-bus-fleets/

[166] Laura Nelson, *L.A. Metro wants to spend $138 million on electric buses. The Goal: An emission-free fleet by 2030*, L.A. Times (July 21, 2017), http://www.latimes.com/local/lanow/la-me-ln-metro-electric-buses-20170721-story.html.

[167] U.S. Energy Information Administration, *Annual Energy Outlook 2017* (January 5, 2017), https://www.eia.gov/outlooks/aeo/pdf/0383(2017).pdf.

[168] Stacy Davis et al., Oak Ridge National Laboratory, *Transportation Energy Data Book*, Edition 35, 5-1 – 5-11 (December 2017), http://cta.ornl.gov/data/index.shtml.

[169] *Id.*

[170] *See, e.g.*, Morello-Frosch, R.; Jesdale, B. M, *Separate and unequal: Residential segregation and estimated cancer risks associated with ambient air toxics in US metropolitan areas*, Environmental Health Perspectives 2006, 114 (3), 386−393 *or* Su, J. G.; Morello-Frosch, R.; Jesdale, B. M.; Kyle, A. D.; Shamasunder, B.; Jerrett, M, *An index for assessing demographic inequalities in cumulative environmental hazards with application to Los Angeles*, California. Environmental Science Technology 2009, 43 (20), 7626−7634.

[171] U.S. Department of Energy, *Idle Reduction Benefits and Considerations, https://cleancities.energy.gov/blog/heavy-duty-vehicle-idle-reduction*

[172] Analysis based in factors provided by U.S. Environmental Protection Agency, *How much carbon dioxide is produced from burning gasoline and diesel fuel*? (May 2017), https://www.eia.gov/tools/faqs/faq.php?id=307&t=11.

[173] U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, IdleBase: Engine Idling Laws and Ordinances for All Classes of On-Road Vehicles, https://cleancities.energy.gov/files/docs/idlebox_idlebase_database.xlsx.

[174] 310 Mass. Code Regs. 7.11 (2017).

[175] 6 CRR-NY 217-3.2; 24 NYC Admin. Code, § 24-163 (2017).

[176] Ozone Transportation Commission, *Resolution of the Ozone Transportation Commission Concerning State Idling Reduction Programs* (November 15, 2017), http://www.otcair.org/upload/Documents/Formal%20Actions/IdlingResolution_Final.pdf.

[177] California Air Resources Board, *Advanced Clean Local Trucks*, (last updated January 24, 2018), https://www.arb.ca.gov/msprog/actruck/actruck.htm.

[178] Greenhouse Gas Emissions Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, 76 Fed. Reg. 57,105 (September 15, 2011) (codified at 40 CFR Parts 85, 86, 600 *et al*. and 49 CFR Parts 523, 534, 535).

[179] Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2, 81 Fed. Reg. 73,478 (October 25, 2016) (codified at 40 CFR Parts 9, 22, 85, 86, 600, 1033, 1036, 1037, 1039, 1042, 1043, 1065, 1066, and 1068 and 49 CFR Parts 523, 534, 535, and 538).

[180] *Id.*

[181] California Air Resources Board, *CA Phase 2 GHG*, accessed March 2018, https://www.arb.ca.gov/msprog/onroad/caphase2ghg/caphase2ghg.htm

[182] Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits, 82 Fed. Reg. 53,442 (November 16, 2017).

[183] U.S. Environmental Protection Agency, *Petitions for Reconsideration of Phase 2 GHG Emissions and Fuel Efficiency Standards for Medium and Heavy Duty Vehicles* (accessed March 2018), https://www.epa.gov/regulations-emissions-vehicles-and-engines/petitions-reconsideration-phase-2-ghg-emissions-and-fuel

[184] California Air Resources Board, *California's top air agency strongly condemns EPA's move to allow high-polluting, older trucks on roads* (December 4, 2017), https://ww2.arb.ca.gov/news/californias-top-air-agency-strongly-condemns-epas-move-allow-high-polluting-older-trucks-roads.

[185] Bishop GA, Schuchmann BG, Stedman DH, Lawson DR, *Emission changes resulting from the San Pedro Bay, California Ports Truck Retirement Program*, Environ Sci Technol. 2012 Jan 3;46(1):551-8.

[186] Texas Commission on Environmental Quality, *Rebate Grants Program*, https://www.tceq.texas.gov/airquality/terp/rebate.html

[187] California Air Resources Board, *Community Air Protection Funds to Reduce Emissions in AB 617 Communities* (accessed March 2018), https://www.arb.ca.gov/msprog/cap/capfunds.htm.

[188] California Air Resources Board, *Fleet Rule for Public Agencies and Utilities - Vehicle Retirement*, https://www.arb.ca.gov/msprog/publicfleets/retirement.htm

[189] Marissa Moultak et al., The International Council on Clean Transportation, *Transitioning to Zero-Emission Heavy-Duty Freight Vehicles* (September 2017), https://www.theicct.org/sites/default/files/publications/Zero-emission-freight-trucks_ICCT-white-paper_26092017_vF.pdf.

[190] The Los Angeles County Metropolitan Transportation Authority, *I-710 Corridor Project*, https://www.metro.net/projects/i-710-corridor-project/.

[191] Julia Roether, *First Electric Highway in U.S. Unveiled Near Ports of L.A. and Long Beach*, Inside Edison (November 9, 2017), https://www.insideedison.com/stories/first-electric-highway-in-u-s-unveiled-near-ports-of-l-a-and-long-beach.

[192] Toronto Transportation Services, Toronto Report for Action: Freight and Goods Movement Strategy Framework (October 3, 2017), https://www.toronto.ca/legdocs/mmis/2017/pw/bgrd/backgroundfile-107508.pdf.

[193] Metropolitan Washington Council of Government, National Capital Region Transportation Planning Board, *Bus Priority Treatment Guidelines* (April 2011), https://nacto.org/docs/usdg/bus_priority_treatment_guidelines_national_capital_region_trans_planning_board.pdf.

[194] Metropolitan Washington Council of Government, National Capital Region Transportation Planning Board, *Bus Priority Treatment Guidelines* (April 2011), https://nacto.org/docs/usdg/bus_priority_treatment_guidelines_national_capital_region_trans_planning_board.pdf.

[195] Bus Priority Works, *Bus Priority in Practice*, http://www.busprioritywworks.co.uk/in-practice.

[196] U.S. Department of Transportation Federal Highway Administration, *Congestion Pricing—A Primer* (Last modified February 1, 2017), https://ops.fhwa.dot.gov/publications/fhwahop08039/cp_prim1_03.htm.

[197] Bruce Schaller, *New York City's congestion pricing experience and implications for road pricing acceptance in the United States*, 17 Transport Policy 266, 266-273 (August 2010), https://www.sciencedirect.com/science/article/pii/S0967070X10000326.

[198] City of New York, *PlaNYC: A Greener, Greater New York* (2007), http://www.nyc.gov/html/planyc/downloads/pdf/publications/full_report_2007.pdf.

[199] Quinnipiac University, *Kelly Tops List for New York City Mayor, Quinnipiac University Poll Finds; Voters Back Congestion Pricing, If Funds Go To Transit*, (March 13, 2008), https://poll.qu.edu/new-york-city/release-detail?ReleaseID=1157.

[200] Bruce Schaller, New York City Department of Transportation, *New York City's Congestion Pricing Experience and Implications for Road Pricing Acceptance in the United States* (2010), http://www.nyc.gov/html/dot/downloads/pdf/schaller_paper_2010trb.pdf.

[201] Inrix, Inc., *Inrix 2017 Global Traffic Scorecard* (February 2018).

[202] The Partnership for New York City, *$100 Billion Cost of Traffic Congestion in Metro New York* (January 2018), http://pfnyc.org/wp-content/uploads/2018/01/2018-01-Congestion-Pricing.pdf.

[203] Fix NYC, *Advisory Panel Report* (January 19, 2018), http://www.hntb.com/HNTB/media/HNTBMediaLibrary/Home/Fix-NYC-Panel-Report.pdf.

[204] Petter Christiansen et al., *Parking facilities and the built environment: Impacts on travel behavior*, 95 Transportation Research Part A: Policy and Practice 198 (January 2017), https://www.sciencedirect.com/science/article/pii/S0965856416301525.

[205] *Id.*

[206] Richard Larson and Katsunobu Sasanuma, Massachusetts Institute of Technology, *Congestion Pricing: A Parking Queue Model*, (August 2007), https://pdfs.semanticscholar.org/fac4/1da5bdbc77a524ca6fcac885fbb8fd596844.pdf.

[207] Statista, *Ride Sharing* (accessed March 2018), https://www.statista.com/outlook/368/109/ride-sharing/united-states#market-revenue

[208] Hahn, Robert and Metcalfe, Robert, *The Ridesharing Revolution: Economic Survey and Synthesis*, Brookings Institution (January 10, 2017), https://www.brookings.edu/wp-content/uploads/2017/01/ridesharing-oup-1117-v6-brookings1.pdf (Hahn 2017)

[209] *Id.*

[210] Crisp, R., Gore, T, and McCarthy, L, *Addressing transport barriers to work in low income neighborhoods: a review of evidence and practice*, Sheffield Hallam University Centre for Regional Economic and Social Research (June 2017), https://www4.shu.ac.uk/research/cresr/sites/shu.ac.uk/files/jrf-addressing-transport-barriers.pdf

[211] Puentes, R. and Roberto. E, *Commuting to Opportunity: The Working Poor and Commuting in the United States*, Brookings Institution (March 2018), https://www.brookings.edu/research/commuting-to-opportunity-the-working-poor-and-commuting-in-the-united-states/

[212] Winston, C., On the performance of the US transportation system: Caution ahead (2013), Journal of Economic Literature, 51: 773-824

[213] Hahn 2017; https://www.cogitatiopress.com/urbanplanning/article/view/937/937

[214] Schaller Consulting, *Unsustainable? The Growth of App-Based Ride Services and Traffic, Travel and the Future of New York City* (February 2017), http://www.schallerconsult.com/rideservices/unsustainable.pdf (Schaller Consulting 2017)

[215] Schaller Consulting 2017

[216] Clewlow, R. and Mishra, G. S., Disruptive Transportation: *The Adoption, Utilization, and Impacts of Ride-Hailing in the United States* (October 2017), U.C. Davis Institute of Transportation Studies, https://htv-prod-media.s3.amazonaws.com/files/ucd-ride-hailing-report-1508296368.pdf

[217] Carnegie Mellon University, Center for the Future of Work (Initiative of the Block Center For Technology and Society), https://fow.heinz.cmu.edu/center-projects/.

[218] Our Community CarShare Sacramento, http://ourcarshare.org/.

[219] California Climate Investments, *2018 Project Profiles*, http://www.caclimateinvestments.ca.gov/2018-profiles/2018/2/16/our-community-carshare-program-sacramento-county

[220] Douglas Shinkle & Anne Teigen, National Conference of State Legislatures, *Encouraging Bicycling and Walking: The State Legislative Role* (November 2008), http://www.ncsl.org/documents/transportation/encouragingbicyclingwalking.pdf.

[221] Seattle Department of Transportation, *Seattle Bicycle Master Plan: 2017-2021 Implementation Plan* (April 2017), http://www.seattle.gov/transportation/document-library/modal-plans/bicycle-master-plan; County of Los Angeles Public Works, *Bicycle Master Plan* (March 2012), https://dpw.lacounty.gov/pdd/bike/masterplan.cfm; New York City Department of Transportation, *New York City Bicycle Master Plan* (May 1997), https://nacto.org/wp-content/uploads/2011/03/New-York-City-Bicycle-Master-Plan-1997.pdf.

[222] Virginia Department of Transportation, *State Bicycle Policy Plan* (September 2011), http://www.virginiadot.org/programs/resources/bike/VDOT_Bicycle_Policy_Plan.pdf.

[223] City of Copenhagen Traffic Department, *Good, Better, Best: The City of Copenhagen's Bicycle Strategy 2011-2025* (2011), http://www.eltis.org/sites/default/files/case-studies/documents/copenhagens_cycling_strategy.pdf.

[224] *Id.*

[225] *Id.*

[226] Morten Steen, Cycling Embassy of Denmark, *New figures on cycling in Copenhagen break the record* (June 1, 2017), http://www.cycling-embassy.dk/2017/06/01/new-figures-cycling-copenhagen-break-record/.

[227] Jakob Schiøtt Stenbæk Madsen &Maria Streuli, Cycling Embassy of Denmark, *New Bicycle Track Priority Plan for Copenhagen* (September 15, 2017), http://www.cycling-embassy.dk/2017/09/15/new-bicycle-track-priority-plan-copenhagen/.

[228] National Association of City Transportation Officials, *Urban Bikeway Design Guide*, 2nd edition (March 2014), https://nacto.org/publication/urban-bikeway-design-guide/.

[229] The League of American Bicyclists, *Bike Commute Rate and Percent Change in Bicycle Commuting* (2015), http://bikeleague.org/sites/default/files/2015ACSlargecities.pdf.

[230] City Clock, *Cycling Mode Share Data for 700 Cities* (August 8, 2014), http://www.cityclock.org/urban-cycling-mode-share/#.WoLz0OjwaM8.

[231] District Department of Transportation, *District of Columbia Bicycle Master Plan* (April 2005), https://ddot.dc.gov/sites/default/files/dc/sites/ddot/publication/attachments/bicycle_master_plan_2005_final_document_0.pdf.

[232] Seattle Department of Transportation, Seattle Bicycle Master Plan (April 2014), https://www.seattle.gov/Documents/Departments/SDOT/About/DocumentLibrary/BicycleMasterPlan/SBMP_21March_FINAL_full%20doc.pdf.

[233] Seattle Department of Transportation, Seattle Bicycle Master Plan: 2017-2021 Implementation Plan (April 2017), https://www.seattle.gov/Documents/Departments/SDOT/About/DocumentLibrary/BicycleMasterPlan/BMP_Imp_Plan_2017_vr32.pdf.

[234] Seattle Department of Transportation, Free-Floating Bike Share Pilot Evaluation Report (June 5, 2018), http://seattle.legistar.com/View.ashx?M=F&ID=6282625&GUID=35E77DEF-C77F-45D3-9141-93263D6C5B4D.

[235] Ewing, R., K. Bartholomew, S. Winkelman, J. Walter and D. Chen, *Growing cooler: the evidence on urban development and climate change*, Urban Land Institute (2017), https://www.nrdc.org/sites/default/files/cit_07092401a.pdf

[236] Gowrishankar et. al., Natural Resources Defense Council, *America's Clean Energy Frontier: The Pathway to a Safer Climate* (2017), https://www.nrdc.org/sites/default/files/americas-clean-energy-frontier-report.pdf.

[237] *See, e.g.*, Smart Growth America, *Driving Down VMT: Curbing Climate Change with Smart Growth & Transportation Top State-Level Policies*, https://www.smartgrowthamerica.org/app/legacy/documents/smartgrowthclimatepolicies.pdf; Boarnet, M, Handy, S., *A Framework for Projecting the Potential Statewide Vehicle Miles Traveled (VMT) Reduction from State-Level Strategies in California*, National Center for Sustainable Transportation (March 2017), https://ncst.ucdavis.edu/wp-content/uploads/2017/03/State-Level-VMT-Strategies-White-Paper_FINAL-03.2017.pdf ; The Transportation & Climate Initiative, *Summary of Policy Options in State Climate Action Plans*, http://www.georgetownclimate.org/files/report/TCI-SummaryofPolicyOptionsinClimateAction(1).PDF; Byars, M., Wei, Y., Handy, S., *State-Level Strategies for Reducing Vehicle Miles of Travel*, University of California Institute of Transportation Studies (September 2017), https://d3n8a8pro7vhmx.cloudfront.net/climateplan/pages/44/attachments/original/1509403808/2017-PTA-Handy_UCDavis_VMT_Report_1.pdf.

[238] Oregon Department of Transportation, *OreGo* (accessed March 2018), http://www.myorego.org/.

[239] Commute Seattle, 2017 Mode Split Survey Results, https://commuteseattle.com/modesplit-2017/.

[240] U.S. Green Building Council, *LEED v4: Neighborhood Development Guide* (accessed March 2018), https://www.usgbc.org/guide/nd .

[241] California Senate Bill 827, *Planning and zoning: transit-rich housing bonus*, Introduced January 3, 2018 by Senator Wiener, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB827

[242] Los Angeles Transit Neighborhood Plans, Expo Corridor Transit Neighborhood Plan (May 2018), http://www.latnp.org/expo-line/expo-draft-plan/.

[243] California Air Resources Board, *California's 2017 Climate Change Scoping Plan: Executive Summary* (November 2017), https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017_es.pdf.

[244] California Air Resources Board, SB 375 Regional Greenhouse Gas Emissions Reduction Targets (2018), https://www.arb.ca.gov/cc/sb375/finaltargets2018.pdf.

[245] California Air Resources Board, Sustainable Communities (last updated April 4, 2018), https://www.arb.ca.gov/cc/sb375/sb375.htm.

[246] California Air Resources Board, *California's 2017 Climate Change Scoping Plan: Executive Summary* (November 2017), https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017_es.pdf.

[247] Shared-Use Mobility Center, Twin Cities Shared Mobility Action Plan (October 2017), http://sharedusemobilitycenter.org/wp-content/uploads/2017/10/SUMC_TWINCITIES_Web_Final.pdf.

[248] Shared-Use Mobility Center, Shared-Use Mobility Reference Guide (September 25, 2015), http://sharedusemobilitycenter.org/wp-content/uploads/2015/09/SharedUseMobility_ReferenceGuide_09.25.2015.pdf.

[249] Transit Oriented Development Institute, http://www.tod.org/.

[250] *Id.*

[251] *Id.*

[252] U.S. Department of Housing and Urban Development, *South Los Angeles Transit Empowerment Zone* (June 2016), https://www.hud.gov/sites/documents/SOUTH_LOS_ANGELES_ZONE_3RD.PDF.

[253] SLATE-Z, *Overview of South Los Angeles Transit Empowerment Zone* (March 2016), http://slatez.org/wp-content/uploads/2016/03/SLATE-Z-Summary-v4.pdf.

[254] The City of Columbus, *Smart Columbus*, https://www.columbus.gov/smartcolumbus/projects/.

[255] U.S. Department of Transportation, *Smart City Challenge: Lessons Learned*, https://www.transportation.gov/policy-initiatives/smartcity/smart-city-challenge-lessons-building-cities-future.

[256] Sanya Carley, *Intent to Purchase a Plug-In Electric Vehicle: A Survey of Early Impressions in Large US Cities*, Transportation Research Part D: Transportation and Environment (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2222170.

[257] Consumer Federation of America, *Knowledge Affects Consumer Interest in EVs, New EVs Guide to Address Info Gap* (October 29, 2015), https://consumerfed.org/press_release/knowledge-affects-consumer-interest-in-evs-new-evs-guide-to-address-info-gap/.

[258] Mark Singer, National Renewable Energy Laboratory, *Consumer Views on Plug-in Electric Vehicles – National Benchmark Report* (January 2016), https://www.afdc.energy.gov/uploads/publication/consumer_views_pev_benchmark.pdf.

[259] Kenneth Kurani et al., University of California, Davis Institute of Transportation Studies, *New Car Buyer's Valuation of Zero-Emission Vehicles: California* (March 31, 2016), https://www.arb.ca.gov/research/apr/past/12-332.pdf.

[260] Sanya Carley, *Intent to Purchase a Plug-In Electric Vehicle: A Survey of Early Impressions in Large US Cities*, Transportation Research Part D: Transportation and Environment (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2222170.

[261] Zachary Needell et al., *Potential for Widespread Electrification of Personal Vehicle Travel in the United States*, Nature Energy 1 (August 15, 2016), https://www.nature.com/articles/nenergy2016112.

[262] Kalman Gyimesi & Ravi Viswanathan, IBM Institute for Business Value, *The Shift to Electric Vehicles: Putting Consumers in the Driver's Seat* (November 2011), http://www.ehcar.net/library/rapport/rapport021.pdf.

[263] Sanya Carley, *Intent to Purchase a Plug-In Electric Vehicle: A Survey of Early Impressions in Large US Cities*, Transportation Research Part D: Transportation and Environment (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2222170.

[264] Presentation from Ken Kurani & Gil Tal, University of California, Davis Institute of Transportation Studies, *Growing PEV Markets?*, to California Energy Commission (December 11-12, 2014), http://docketpublic.energy.ca.gov/PublicDocuments/Migration-12-22-2015/IEPR/2014%20IEPR/14-IEP-1B/TN%2074178%2012-11-14%20Kurano%20and%20Tal%20Presentation%20-%20Sustainable%20Trasportation.pdf.

[265] Kenneth Kurani et al., University of California, Davis Institute of Transportation Studies, *New Car Buyer's Valuation of Zero-Emission Vehicles: California* (March 31, 2016), https://www.arb.ca.gov/research/apr/past/12-332.pdf.

[266] Ona Egbue & Suzanna Long, *Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions*, 48 Energy Policy 717 (September 2012), https://www.sciencedirect.com/science/article/pii/S0301421512005162.

[267] Consumer Federation of America, *Knowledge Affects Consumer Interest in EVs, New EVs Guide to Address Info Gap* (October 29, 2015), https://consumerfed.org/press_release/knowledge-affects-consumer-interest-in-evs-new-evs-guide-to-address-info-gap/; Paul Larson et al., *Consumer Attitudes about Electric Cars: Pricing Analysis and Policy Implications*, 69 Transportation Research Part A: Policy and Practice 299, 299-314 (November 2014), https://www.sciencedirect.com/science/article/pii/S0965856414002134; Kalman Gyimesi & Ravi Viswanathan, IBM Institute for Business Value, *The Shift to Electric Vehicles: Putting Consumers in the Driver's Seat* (November 2011), http://www.ehcar.net/library/rapport/rapport021.pdf.

[268] Joseph Krupa et al., *Analysis of a Consumer Survey on Plug-in Hybrid Electric Vehicles*, 64 Transportation Research Part A: Policy and Practice 14, 14-31 (June 2014), https://www.sciencedirect.com/science/article/pii/S0965856414000500.

[269] *Id.;* Sanya Carley, *Intent to Purchase a Plug-In Electric Vehicle: A Survey of Early Impressions in Large US Cities*, Transportation Research Part D: Transportation and Environment (2013), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2222170.

[270] U.S. Department of Energy Alternative Fuels Data Center, *Idle Reduction Benefits and Considerations*, https://www.afdc.energy.gov/conserve/idle_reduction_benefits.html.

[271] Ozone Transport Commission, *Overview of Efforts to Reduce Idling in the Ozone Transport Region* (April 11, 2016), http://www.otcair.org/upload/Documents/Reports/OTC%20MSC%20-%20Overview%20of%20%20Idling%20Reduction%20in%20the%20OTR%20-%20Final.pdf.

[272] *Id.*

[273] *Id.*

[274] U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, *IdleBox Toolkit for Idling Reduction Projects*, https://cleancities.energy.gov/technical-assistance/idlebox/.

[275] Roughly three-fourths of residents in the Chicago area between the ages of 18 to 34 said that they drove or carpooled to work from 2009 to 2013, a figure that has remained relatively stable over the last 30 years. In addition, less than 40 percent of regional households ride transit at least once a month. For more information, *see* http://38.100.36.184/adwheel2016/effectiveness/awe_key5C358C71-DBF9-4539-84E4-5BC4A9642181.html.

[276] Regional Transportation Authority, *"Ride On" Marketing Campaign*, http://www.rtachicago.org/plans-programs/ride-on-marketing-campaign.

[277] Henry A. Waxman et al., *Cars, Fuels and Clean Air: A Legislative History of Title II of the Clean Air Act Amendments of 1990*, 21 Environmental Law 1947, 1998-2001 (1991).

[278] *See, e.g., Chevron, U.S.A., Inc. v. Natural Res. Defense Council, Inc.*, 467 U.S. 837, 845-46 (1984); *Train v. Natural Res. Defense Council, Inc.*, 421 U.S. 60, 64-65 (1975).

[279] *Train*, 421 U.S. at 79.

[280] 42 U.S.C. § 7543(d).

[281] Martineau and Novello, *The Clean Air Handbook* (American Bar Ass'n, 2nd ed. 2004) at 325

[282] 42 U.S.C. § 7408(f)(1).

[283] 42 U.S.C. § 7511a(g)(4).

[284] S. Rep. No. 90-403, at 34 (1967) (emphasis added).

[285] *See, e.g., Jensen Family Farms, Inc. v. Monterey Bay Unified Pollution Control Dist.*, 644 F.3d 939 (9th Cir. 2011) (upholding agricultural fees on registration and use of diesel engines).

[286] *Engine Mfrs. Ass'n v. EPA*, 88 F.3d 1075, 1094 (D.C. Cir. 1996). One further limit on state action is that it may not unduly burden interstate commerce when weighed against the state's public health and safety interests. *See Pike v. Bruce Church, Inc.*, 397 U.S. 137 (1970)*; Hughes v. Alexandria Scrap Corp.*, 426 U.S. 794 (1976). While the contours of this limitation are not well defined in this arena, actions such as state and local incentive programs should be permissible under these standards.

[287] *See City of Chicago v. Environmental Defense Fund*, 511 U.S. 328, 338 (1994) (citing *Keene Corp. v. United States*, 508 U.S. 200, 208 (1993) ("It is generally presumed that Congress acts intentionally and purposely" when it" includes particular language in one section of a statute and omits it in another."). Courts have also established a requirement that that state emission controls of used vehicles and engines must be sufficiently delayed from the initial sale of new vehicles and engines to ensure that the burden of compliance does not effectively fall on vehicle and engine manufacturers to regulate the design of new vehicles. *Allway Taxi v. City of New York*, 340 F.Supp. 1120 (S.D.N.Y, 1972

[288] 42 U.S.C. § 7543(a).

[289] Glicksman and Levy, *A Collective Action Perspective on Ceiling Preemption by Federal Environmental Regulation: The Case of Global Climate Change*, 102 Northwestern Univ. L. Rev. 579, 583 (2008).

[290] *City of Columbus*, 536 U.S. at 438, (quoting *Medtronic, Inc. v. Lohr*, 518 U.S. 470, 485 (1996)).

[291] *Id.* (quoting *Cipollone v. Liggett Group, Inc.*, 505 U.S. 504, 517 (1992)).

[292] Jonathan Adler, *When Is Two a Crowd? The Impact of Federal Action on State Environmental Regulation*, 31 Harvard Env L Rev 67 (2007) (*citing Pac. Gas & Elec. Co. v. State Energy Res. Conservation & Dev. Comm'n*, 461 U.S. 190 (1983) ("It is well established that within Constitutional limits Congress may preempt state authority by so stating in express terms.")).

[293] *Ass'n of Taxicab Operators v. City of Dallas*, 720 F.3d 534 (2013). *Also see Nat'l Ass'n of Home Builders v. San Joaquin Valley Unified Air Pollution Control Dist*., 627 F.3d 730, 734–35 (9th Cir. 2010), cert. denied, 132 S. Ct. 369 (2011).

[294] *Id.*

[295] Engine Manufacturers Association v. South Coast Air Quality Management District, 541 U.S. 246 (2004).

[296] 541 U.S. at 263 (Souter, J., dissenting).

[297] 541 U.S. at 254. *See* 3 Regulation of Emissions from New Mobile Sources." National Research Council. 2006. *State and Federal Standards for Mobile-Source Emissions*. Washington, DC: The National Academies Press at 78 (available at https://www.nap.edu/read/11586/chapter/5#77). Because the Supreme Court neglected to discuss the holding in *Allway Taxi, Inc. v. City of N.Y.*, 340 F. Supp. 1120 (S.D.N.Y. 1972), *aff'd* 468 F.2d 624 (2d Cir. 1972), it is unclear whether its principles survive the *Engine Manufacturers* ruling. *Allway* involved whether a city could impose "in-use" requirements, including enhanced emissions controls, upon taxis as part of their licensing. The District Court focused on the limitation of the Clean Air Act's preemption provision to "new" motor vehicles. The court found that a separate state standard would not be preempted if it (1) relates to existing motor vehicles that are already in the hands of ultimate purchasers, and (2) where the burden of compliance falls not on the manufacturer but on individual owners. The court was mindful that a state or locality should not be "free to impose its own emission control standards the moment after a new car is bought and registered," because that would be "an obvious circumvention of the Clean Air Act and would defeat the congressional purposes of preventing obstruction to interstate commerce. The preemption sections, however, do not preclude a state or locality from imposing its own exhaust emission control standards upon the resale or reregistration of the automobile. Nor do they preclude a locality from setting its own standards for the licensing of vehicles for commercial use within that locality. Such regulations would cause only minimal interference with interstate commerce, since they would be directed primarily to intrastate activities and the burden of compliance would be on individual owners and not on manufacturers and distributors." *Id.*

While the Supreme Court in *Engine Manufacturers* found similar program requirements preempted, that decision focused not on the new vehicle limitation nor on the reservation of state authority under § 209(d), but on the definition of a "standard related to the control of emissions." Accordingly, *Allway Taxi* may offer a further rationale for some narrowly tailored state requirements.

Notably, courts and EPA have broadly construed the in-use requirement in a way that is consistent with *Allway Taxi* after the *Engine Manufacturers* ruling, with one court noting that under *Allway* "[a]cceptable in use requirements include setting fuel requirements, operational conditions or limits on equipment use, fuel quality specifications, and operational modes or characteristics or measures that limit engine or equipment use." *Nat'l Ass'n of Home Builders v. San Joaquin Valley Unified Air Pollution Control Dist.*, No. 07-0820, 2008 WL 4330449, at *17 (E.D. Cal. Sept. 19, 2008), *aff'd* 627 F.3d 730 (9th Cir. 2010). *See also, e.g.*, *In re: Volkswagen "Clean Diesel" Marketing, Sales Practices, & Products Liab. Litig.*, 264 F. Supp. 3d 1040, 1051-52, 1056 (N.D. Cal. 2017) (citing *Allway*); *State v. Volkswagen AG*, No. 2016-903390, 2017 WL 6551054, at *12 (Ala. Cir. Ct. Dec. 19, 2017) (same); Approval and Promulgation of Implementation Plans; California Air Resources Board—In-Use Heavy-Duty Diesel-Fueled Truck and Bus Regulation, Drayage Truck Regulation and Ocean-Going Vessels Clean Fuels Regulation, 76 Fed. Reg. 40,652, 40,658 (July 11, 2011).

[298] Similarly, the Ninth Circuit found that the corollary provision of section 209 for marine engines preempted local efforts to control emissions from marine port operations. *Pacific Merchant Shipping Ass'n v. Goldstene*, 517 F.3d 1108, 1114 (9th Cir. 2008).

[299] 49 U.S.C. § 32919(a).

[300] *Massachusetts v. EPA*, 549 U.S. 497, 533 (2007).

[301] *See, e.g. Central Valley Chrysler-Jeep, Inc. v. Goldstene*, 529 F.Supp.2d 1151 (E.D. Cal. 2007); *Cent. Valley Chrysler Jeep v. Witherspoon*, 456 F. Supp. 2d 1160, 1163 (E.D. Cal. 2006); Green Mountain Chrysler Plymouth Dodge Jeep, et. al. v. Crombie, 508 F.Supp.2d 295 (D. Vt. 2007).

[302] *See Metro. Taxicab Bd. of Trade v. City of New York*, 615 F.3d 152, 155 (2d Cir. 2010), *cert. denied*, 131 S.Ct. 1569 (2011) (finding EPCA preemption for taxicab fleet hybrid purchase requirements related to fuel economy, without reaching Clean Air Act issues); *Ophir v. City of Boston*, 647 F. Supp. 2d 86 (D. Mass. 2009) (same).

[303] 49 U.S.C § 32919.

[304] The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, 83 Fed. Reg. 42,986 (August 24, 2018), https://www.federalregister.gov/documents/2018/08/24/2018-16820/the-safer-affordable-fuel-efficient-safe-vehicles-rule-for-model-years-2021-2026-passenger-cars-and.

[305] 42 U.S.C. § 7543(b).

[306] 42 U.S.C. § 7543(b)(1).

[307] *Motor Vehicle Mfrs. Ass'n of the United States v. N.Y. State Dep't of Envtl. Conservation*, 17 F.3d 521, 526 (2d Cir. 1994).

[308] *Motor & Equipment Manufacturers Ass'n v. Nichols*, 142 F.3d 449, 463 (D.C. Cir. 1998) (citations and quotation marks omitted).

[309] *Motor & Equipment Mfrs., Inc. v EPA*, 627 F.2d 1095 (D.C. Cir. 1979). *Accord Central Valley Chrysler-Jeep, Inc. v. Goldstene*, 529 F. Supp. 2d 1151 (2007) (citations omitted).

[310] Notice of Decision Granting a Waiver of Clean Air Act Preemption for California's Advanced Clean Car Program, 78 F.R. 2112, 2115 (January 9, 2013).

[311] *Id.* at 2129.

[312] The First and Second Circuits have in past instances found that state Zero Emissions Vehicle (ZEV) provisions did not fully reflect the earlier changes California had made to its ZEV standards removing the sales mandate, and on that basis found prior versions of those states' ZEV standards preempted under section 209(a), where their "purpose and effect of [which] is to affect a quantitative reduction in emissions." *Ass'n Int'l Auto. Mfrs. v. Commissioner*, 208 F.3d 1, 7 (1st Cir. 2000); *American Auto. Mfrs. Ass'n v. Cahill*, 152 F.3d 196, 200 (2d Cir. 1998) (same).

[313] Letter from Arthur Marin, Executive Director, Northern States for Coordinated Air Use Management, to Fred Congressmen Fred Upton and Henry Waxman, *Section 177 States' Support for EPA and California Authority to Establish Motor Vehicle GHG Emissions Standards* (February 8, 2011), www.nescaum.org/documents/nescaum-ltr-to-reps-caa-ghg-mv-stds-20110208.pdf.

[314] The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks, 83 Fed. Reg. 42,986 (August 24, 2018), https://www.federalregister.gov/documents/2018/08/24/2018-16820/the-safer-affordable-fuel-efficient-safe-vehicles-rule-for-model-years-2021-2026-passenger-cars-and.

[315] Dave Guilford, *ZEV Mandates get harder to ignore*, Automotive News (June 27, 2016), www.autonews.com/article/20160627/OEM11/306279987/zev-mandates-get-harder-to-ignore.

[316] *Engine Mfrs.*, 541 U.S. 246 (Souter, J. dissenting at 7).

[317] This analysis is similar to the consideration of whether the Port of Los Angeles was acting as a market participant, not as a regulator invoking the force and effect of law (such as criminal sanctions), when it was addressing emissions and safety consequences of drayage truck operations. *See American Trucking Ass'ns v. City of Los Angeles*, 569 U.S. 641. 133 S.Ct. 2096 (2013) (under FAA Authorization Act of 1994).

[318] *Engine Mfrs. Assn v. SCAQMD*, 498 F.3d 1031, 1040-41 (9th Cir. 2007). The Ninth Circuit also indicated that this analysis would apply to localities. It noted that, "[a]long with three other circuits, we have held that the market participant doctrine's protection of state proprietary action includes proprietary action by states' political subdivisions. *Big Country Foods, Inc. v. Bd. of Educ.*, 952

F.2d 1173, 1178-79 (9th Cir. 1992); *accord Nat'l Solid Waste Mgmt. Ass'n v. Williams*, 146 F.3d 595, 599-600 (8th Cir. 1998); *Smith Setzer & Sons, Inc. v. S.C. Procurement Review Panel*, 20 F.3d 1311, 1319-20 (4th Cir. 1994); *Trojan Techs., Inc. v. Pennsylvania*, 916 F.2d 903, 911 (3d Cir. 1990); *see also City of Columbus*, 536 U.S. at 437 ("The principle is well settled that local governmental units are created as convenient agencies for exercising such of the governmental powers of the State as may be entrusted to them in its absolute discretion.") (quoting *Wis. Pub. Intervenor v. Mortier*, 501 U.S. 597, 607-08 (1991)); *Bldg. & Constr. Trades Dep't, AFL-CIO v. Allbaugh*, 295 F.3d 28, 34 (D.C. Cir. 2002) (upholding under market participant doctrine a rule prohibiting federal agencies and entities receiving federal construction funds from requiring contractors to enter, or prohibiting them from entering, project labor agreements). *But see W.C.M. Window Co. v. Bernardi*, 730 F.2d 486, 495-96 (7th Cir. 1984) (as amended) (holding that state regulation did not fall within market participant exception because it was not limited to the state's contracts, but also included those of local government entities)."

[319] *Id.* at 1045.

[320] *Id.*