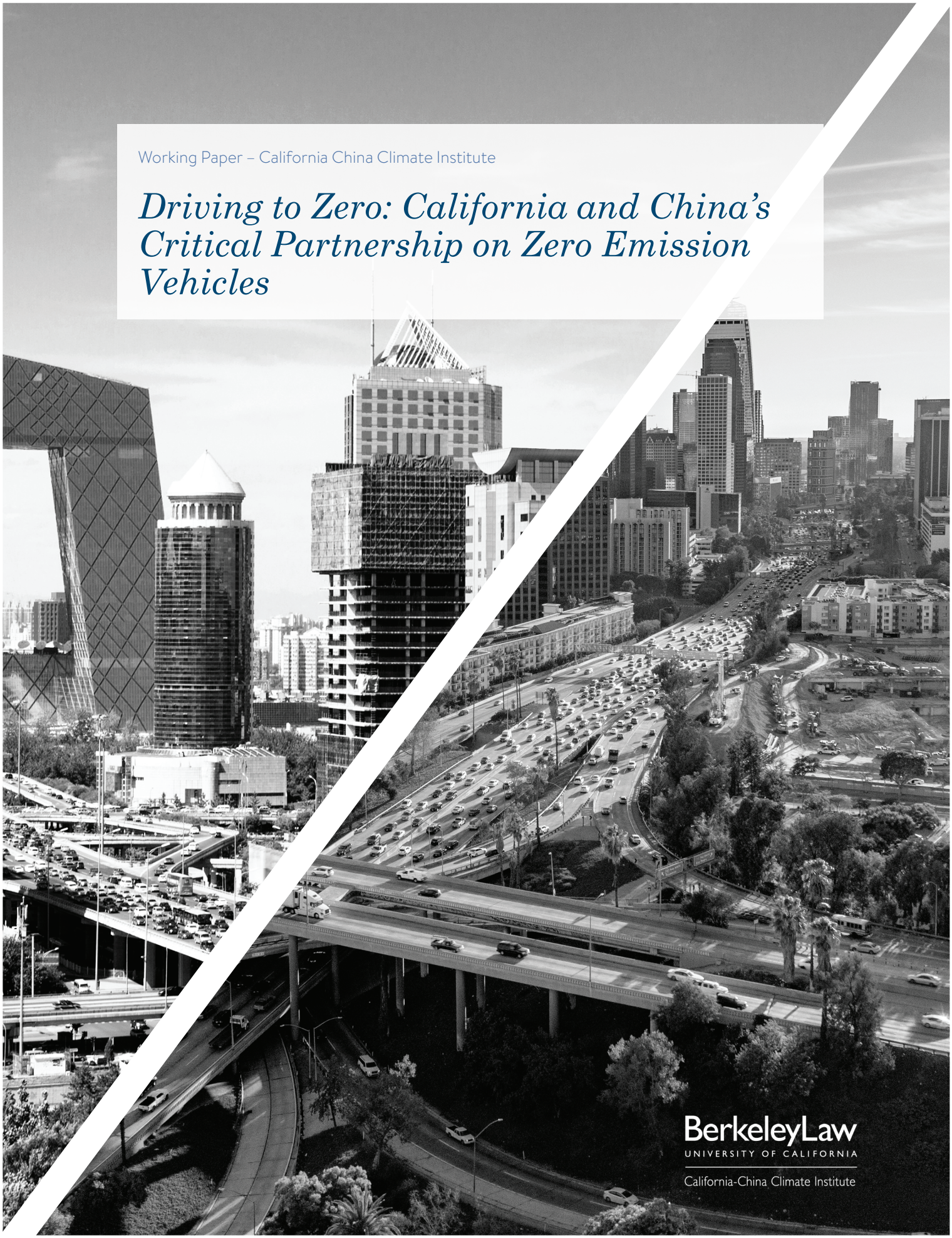
Working Paper – California China Climate Institute

Driving to Zero: California and China's Critical Partnership on Zero Emission Vehicles



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Introduction & Executive Summary

California and China are well positioned to collaborate and lead a global transition to zero-emission transportation, a highly polluting sector that affects both air quality and climate change. Transportation accounts for 14% of global greenhouse gas (GHG) emissions. In China, the sector accounts for 65% emissions in major cities such as Shenzhen. In California, the sector accounts for 50% of emissions when factoring in gasoline and diesel fuel production. The two also experience shared air quality challenges from transportation pollution, especially particular matter ($PM_{2.5}$) from diesel heavy-duty vehicles and ozone (O_3) from light- and heavy-duty vehicles.

To address the pollution challenges, China and California can leverage a longstanding history of collaboration on vehicles, given their market size and roles as manufacturing centers and zero-emission vehicle policy leaders. As a result of their leadership, global sales of zero-emission vehicles (ZEVs, which are primarily battery electric but also hydrogen fuel cell vehicles) have increased dramatically over the past decade. Yet sales momentum has stalled recently due to declining demand. The urgency of climate change calls for much greater rates of adoption.

This policy report outlines key ways in which China and California can partner to begin accelerating zero-emission vehicle deployment, through steps to align their vehicle goals, policies, research and investment, including:

- **Harmonizing zero-emission vehicle market-share targets**, which could take the form of a numerical goal for sales of new vehicles or an overall goal for zero-emission vehicle market share by a future date.

- **Considering targets for phasing out new sales of internal combustion engine vehicles by a date certain**, which would send a significant market signal to spur private sector investment to boost zero-emission vehicle demand.

- **Coordinating credits for automaker compliance with zero-emission vehicle mandates**, which would provide China an additional tool to boost zero-emission vehicle adoption and expand market share by harmonizing China not only with California but with other US states that have adopted California's approach.

- **Developing expanded zero-emission vehicle procurement targets for public fleets**, which would send an important market signal, given the significance of both governments' demands for vehicles.

- **Synchronizing goals on zero-emission vehicle charging infrastructure**, such as through mutual charging infrastructure targets and expanded shared research on market opportunities and technological innovation, from the battery to the charger.

- **Boosting overall market demand for zero-emission vehicles** through sharing best practices, expanding public-private-nonprofit partnerships, and supporting demonstration projects to deploy hydrogen fuel cell technologies.

- **Encouraging private sector zero-emission vehicle innovation and investment through public sector research and development** by allowing and encouraging zero-emission heavy-duty and passenger vehicle manufacturers to compete in their respective markets, while continuing to expand government and business-to-business investment, loans and grants focused on research and development of new technologies, as well as workforce development.

Coordinating these China-California policies and investments and furthering research on innovation, would help the world achieve long-term climate goals and zero-emission vehicle deployment targets, while boosting local economies and providing a counterweight to the economic blows caused by the global pandemic. While global zero-emission vehicle sales grabbed 2.2% market share over the first 10 months of 2019, more action is needed. Global climate policy

is certainly at stake, with tremendous market opportunities for both China and California – if they act in a strategic and coordinated fashion going forward.

This policy report details the recommendations above and describes the existing emission profiles of transportation in China and California, as well as current policies in both places to address air quality and greenhouse gas emission reductions from the transportation sector. It also identifies gaps in the existing policy landscape as well as the opportunities for the two to lead the rest of the world on the transition to zero-emission transportation.

Transportation & Emissions China and California

Transportation is responsible for roughly 14% of global greenhouse gas (GHG) emissions (IPCC, 2014), with light duty vehicles (i.e. cars and vans) making up half of that total. With increasing car ownership and mileage traveled, transportation has become one of the most significant sources of carbon emissions and a major source of air pollution.

Transportation emissions in China make up a smaller share of total greenhouse gas emissions but contribute significantly to air pollution, particularly $PM_{2.5}$ from diesel heavy-duty vehicles and O_3 from light-duty and heavy-duty vehicles. Transportation emissions are a larger share of total GHGs in California but similarly accounts for O_3 non-compliance in southern California and the San Joaquin Valley.

In China, analysts estimate that transportation emissions constitute more than 9% of the country's overall carbon footprint – and that share is expanding rapidly. In cities, transportation accounts for a significantly larger share of emissions. As much as 65% of carbon emissions in Shenzhen and 45% of the total particulate matter concentrations in Beijing come from transportation.[1]

In California, 41% of overall emissions come from transportation, due mostly to passenger vehicles. The share rises to nearly 55% when carbon emissions from producing gasoline and diesel are factored in. Notably, transportation emissions have continued to increase in California due largely to increased driving miles, while emissions in nearly every other sector have declined steadily in recent years. For the United States as a whole, transportation emissions accounted for 28% of greenhouse gas emissions in 2017,[2] though policy makers expect transportation emissions to decrease 10% between 2019 and 2030, driven primarily by policies at state levels.[3]

California Transportation Challenges & Policies

In California, mobile sources — primarily cars, trucks, and off-road vehicles — are the primary sources of air pollution and GHG emissions. Mobile sources account for approximately 80% of the state's nitrogen oxides (NO_x) emissions, 90% of its particulate matter (PM) emissions, 40% of its GHG emissions through direct combustion, and approximately 50% of its GHG emissions including emissions from upstream oil refining.[4]

[1] http://www.wri.org.cn/sites/default/files/%E5%8C%97%E4%BA%AC%E4%BD%8E%E6%8E%92_0918_0.pdf
[2] https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions
[3] https://www.eia.gov/outlooks/aeo/
[4] https://ww3.arb.ca.gov/board/books/2020/042320/20-4-3pres.pdf

Two regions in California, the South Coast and the San Joaquin Valley, do not meet national ambient air quality standards for 8-hour ozone (O_3), and the San Joaquin Valley does not meet 24-hour and annual standards for fine particulate matter ($PM_{2.5}$). The South Coast and San Joaquin Valley must comply with increasingly stringent O_3 standards by 2024 (1997 standard) and 2032 (2008 standard); the San Joaquin Valley must comply with $PM_{2.5}$ standards by 2024 (24-hour 2012 standard) and 2025 (annual 2012 standard).

In parallel, California has set ambitious goals for reducing the state's greenhouse gas emissions over the next three decades, namely reducing emissions by 40% below 1990 levels by 2030 and achieving "carbon neutrality," or net zero GHG emissions, no later than 2045, and negative thereafter. Given infrastructural inertia and other challenges related to reducing emissions in other sectors, the California Air Resources Board (ARB) estimates that achieving the 2030 goal will require 35-40% reductions in transportation sector emissions over the next decade.[5] Recognizing that air quality and GHG emissions were part of the same problem, ARB developed a Mobile Source Strategy in 2016, outlining strategies the state can adopt to meet air quality standards, achieve greenhouse gas emission reduction targets and reduce petroleum consumption by 2030.[6]

China Transportation Challenges & Policies

In China, air pollution control has historically been focused on smokestacks. More recently, "modern pollution" problems have been acknowledged, including the emergence of $PM_{2.5}$ as a larger problem than O_3. Diesel trucks and buses are major contributors to China's $PM_{2.5}$ problem, while cars, trucks, and buses contribute significantly to O_3.

Perhaps the most significant step in China's push for $PM_{2.5}$ reduction was its adoption of the Air Pollution Action Plan. Released in September 2013, it required $PM_{2.5}$ reductions over a five-year period from 2013-2017 in key regions, including a reduction of 33% in Beijing.[7] One study in 2019 found that as a result of the plan, the estimated national population-weighted annual mean $PM_{2.5}$ concentrations decreased from 61.8 to 42.0 $\mu g/m^3$ from 2013 to 2017, representing a decline of approximately 47%.[8] The Chinese government's standard on $PM_{2.5}$ levels allows an average of 35 $\mu g/m^3$.

China's 13th Five Year Plan was the first of China's Five Year Plans to directly address $PM_{2.5}$ pollution. The Chinese government set a target in 2016 to decrease $PM_{2.5}$ by at least 18% from 2015 levels in cities of prefectural or higher level by 2020.[9] It also required an 18% decrease for the number of days when levels of $PM_{2.5}$ exceed allowable limits. Some cities additionally set more ambitious targets in their five-year plans.

In 2018, the Chinese government developed a Three-Year Action Plan that placed a new focus on O_3 reduction by setting targets for reduction of volatile organic compounds (VOCs) and NOx.[10] (Ozone is created when VOCs react with NOx.) The plan required a reduction of 10% for VOCs and 15% for NOx by 2020. The next Five Year Plan, which will be drafted fall 2020, is expected to require continued reductions in $PM_{2.5}$ as well as O_3.

Given the substantial impact of diesel heavy-duty vehicles on $PM_{2.5}$ and light- and heavy-duty vehicles on O_3, China will need to target emissions from the transportation section to achieve its air pollution reduction goals.

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[5] https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf

[6] Available at: https://ww2.arb.ca.gov/resources/documents/2016-mobile-source-strategy (accessed August 28, 2020).

[7] https://www.gov.cn/zwgk/2013-09/12/content_2486773.htm

[8] https://www.pnas.org/content/116/49/24463

[9] https://en.ndrc.gov.cn/policyrelease_8233/201612/P020191101482242850325.pdf

[10] http://www.gov.cn/zhengce/content/2016-12/05/content_5143290.htm

Zero-Emission Vehicle Deployment and Policy Gaps in California and China

A global transition to zero-emission cars, vans, and trucks is already underway. Both California and China have set world-leading zero-emission vehicle goals to reduce emissions from their respective transportation sectors and meet their climate goals. Due to severe air pollution problems in the Los Angeles basin beginning in the 1950s, California became the only state in the US authorized by the Clean Air Act to adopt motor vehicle emission standards more stringent than the federal standards.[11] Currently, there are nine states that have adopted California's ZEV regulations, as well as low-emission vehicle regulations, promulgated under California's Advanced Clean Cars Program: Connecticut, Maine, Maryland, Massachusetts, New York, New Jersey, Oregon, Rhode Island, and Vermont.[12]

Table 1: ZEV numbers and adoption targets in California and China

	California	China
Total # of light-duty vehicles on the road today (mil)	15	250
# of ZEVs on the road today (mil)	0.7	3.81
ZEV % of light-duty vehicles on the road today	4.7%	1.5%
ZEV target (in # of vehicles) by 2025 (mil)	1.5	
ZEV target (as a % of total vehicles on the road) by 2025	10%	
ZEV target (in # of vehicles) by 2030 (mil)	5	
ZEV target (as a % of total vehicles on the road) by 2030	33%	

* There is no available data on China's ZEV targets for 2025 and 2030.

The rate of emissions reductions achieved in California between 2020 and 2030 needs to roughly double from the rate achieved in the previous decade.[13] Given that transportation emissions account for almost half of the state's emissions, strategies for this sector must be a significant part of the solution. Energy Innovation's Energy Policy Simulator[14] found that a business-as-usual policy portfolio would leave the state about 25 MMTCO2e above its 2030 target, with transportation as a significant contributor to that delta. This analysis means that the state must develop new and/or updated research, investment, policies, and commitments to deploy ZEVs at the scale needed to help close the gap between its current ambition and its medium- and longer-term goals. Likewise, for China, additional action on ZEVs represents a critical component of ratcheting up the country's climate ambition and meeting its goals for addressing the nation's air pollution epidemic.

In part as a result of these policies, California and China are now dominating the global zero-emission vehicle market, deploying a significant share of these vehicles on our roads. In fact, China is the number one market in the world for plug-in electric vehicles, accounting for 54% of the world's 2.26 million vehicles sold last year. And by the end of 2019, 3.8 million plug-in vehicles were on China's roads. Similarly, California accounted for nearly half of America's plug-in vehicle sales in 2019 with 156,101 vehicles sold and approximately 700,000 vehicles on the state's roads.

While these figures are encouraging, the road ahead is long and winding. In 2019, plug-in vehicles represented just 8.26% of California's annual new vehicle sales, and overall sales of these vehicles declined year-over-year by 12%. And after years of zero-emission vehicle sales

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[11] Clean Air Act § 209.

[12] Other states may adopt California's standards under CAA § 177 but may not develop independent standards.

[13] https://www.next10.org/publications/2019-gii

[14] https://energyinnovation.org/wp-content/uploads/2020/01/Insights-from-the-California-Energy-Policy-Simulator_1.16.20.pdf

growth, China saw a similar trend in 2019, recording a 4% decline in sales year-over-year. In China, experts attribute this drop primarily to demand-side subsidy cuts. In California, the expiration of federal tax credits for purchases from many of the major manufacturers was a contributing factor.

These recent declines in demand, driven at least in part by reduced policy incentives, threaten to undermine both California and China's progress on their ZEV and greenhouse gas emissions goal. China currently aims to have 25% of their total vehicle sales come from zero-emission vehicles by 2025. That proposed target officially increases to 40 - 50% of total sales by 2030. To achieve its targets, in 2017 China developed a "new energy vehicle credits" (NEV) rule that roughly equates to a requirement that 3-4% of new vehicles be ZEVs by 2019, and a higher percentage in 2020. Meanwhile, California aims to have 1.5 million zero-emission vehicles on the road by 2025 and 5 million by 2030. California has its own zero-emission vehicle regulations, including a mandate that automakers meet credit-based requirements. Manufacturers are subject to a 22% credit requirement in 2025, expected to result in a zero-emission vehicle market share of about 8% by 2025. Hainan Province of China also set a target for 100% of new vehicle sales by 2030 to be zero emission.

Closing the Gap: Paths Forward and the Importance of Collaboration

What can California and China do to reverse recent trends and encourage much faster adoption of zero-emission vehicles? A logical place to start is to accelerate cooperation, which means taking steps to align California and China's zero-emission vehicle goals, policies, research and investment. These steps could include the following (summarized in the table below):

- **Harmonizing zero-emission vehicle market-share targets**, which China set at 4% by 2020 and California set at 8% by 2025 (compared to European Union goals of 15% by 2025 and 35% by 2030). Coordinated target-setting could take the form of a numerical goal for sales of new vehicles, as the ZEV Alliance has instituted, or an overall goal for zero-emission vehicle market share by a future date certain. California and China might also consider enlisting other significant players to develop coordinated targets, such as the European Union, UK, Canada, and Mexico.

- **Considering targets for phasing out new sales of internal combustion engine vehicles by a date certain**. Within China and California, only Hainan Province currently has such a target, scheduled for 2030, with no national target in China or state-level legislation in California yet. A shared goal for such a phase-out between California and China would send a significant market signal to spur private sector investment, which could help boost demand by increasing vehicle options and lowering prices through increased manufacturing scale. China and California could further coordinate on this target with other major international players such as the European Union.

- **Coordinating credits for automaker compliance with zero-emission vehicle mandates**, which require auto manufacturers to produce a specific number of zero-emission vehicles each year based on the total number of vehicles sold by the manufacturer in the state. These credit programs are otherwise different in each economy and therefore not comparable. China's credits currently are slated for 12% by 2020 and 18% by 2023, while California's ZEV credits will be 22% in 2025 (European Union's targets are voluntary and non-binding). China could adopt and adapt California's credit-based zero-emission vehicle mandate, which would help provide China an additional tool to boost zero-emission vehicle adoption and expand market share by harmonizing China not only with California but with other US states that have adopted California's approach. California

and China might also consider enlisting the EU, Canada, and other willing partners to collaborate.

- **Developing zero-emission vehicle procurement targets for public fleets**. Both China and California are responsible for significant amounts of vehicle purchases each year for public services and government agencies. Both have zero-emission vehicle targets, which China set in 2014 at 30% for all categories of vehicles in public service in cities. Starting in 2023, California requires 25% of new bus purchase in a calendar year by large transit agencies to be zero emission, increasing to 50% by 2026 and 100% by 2029. In addition, the state requires fixed route airport shuttles serving California's 13 largest airports to transition to 100% zero-emission vehicle by 2035. Increasing and expanding these procurement targets would send an important market signal, given the significance of both governments' demands for vehicles.

- **Synchronizing goals on zero-emission vehicle charging infrastructure**, which would boost demand by increasing customer access and help this industry innovate and expand. China already plans to have 4.8 million electric vehicle charging stations by 2020, while California seeks to have 250,000 electric vehicle charging stations by 2025 (by comparison, the European Union plans for 1.3 million public charge points by 2025 and 3 million by 2030). The two could agree to mutual charging infrastructure targets, while also expanding and sharing research on market opportunities and technological innovation, from the battery to the charger.

- **Boosting overall market demand for zero-emission vehicles.** China and California could collaborate on innovative ways to drive zero-emission vehicle market demand, including sharing best practices, expanding public-private-nonprofit partnerships (such as Veloz or Go Ultra Low), and supporting demonstration projects to deploy hydrogen fuel cell technologies, which may be particularly well suited for long-distance transportation.

- **Encouraging private sector zero-emission vehicle innovation and investment through public sector research and development**. China currently spends at least $1 billion in local government and industry support for ZEVs, while California spends approximately $1.2 billion in battery technology investment, particularly through its California Energy Commission grants and research opportunities. The two could leverage these investments to allow and encourage zero-emission heavy-duty and passenger vehicle manufacturers to compete in their respective markets, while continuing to expand government and business-to-business investment, loans and grants focused on research and development of new technologies, as well as workforce development. Policy makers could further encourage companies like Tesla to continue investing in China to boost passenger ZEV deployment, while California decision makers could promote involvement by China's BYD and other e-bus makers in the state to help bring down the cost of heavy-duty ZEVs like e-buses and e-trucks. In addition, both sides could explore demonstration projects deploying hydrogen fuel cell technologies at municipal and local levels.

Coordination among these China-California policies and investments, along with further research on innovation, would help the world at large achieve its long-term climate goals and ZEV deployment targets. While global EV sales grabbed 2.2% market share over the first 10 months of 2019, more action will be needed to ramp this deployment up. Global climate policy is certainly at stake, with tremendous market opportunities for both China and California – if they act in a strategic, coordinated fashion going forward.

Table 2: Comparison of ZEV Policy in China, California and the EU

Alignment of policies/ policy areas	China	California	The EU
ZEV market share target15	NEV 4% by 202016	8% by 2025 17	15% by 2025 and 35% by 203018
Internal combustion engine vehicle phase out schedule	2030 (Hainan Province), national goal in discussion	None	2025 (Norway) 2030 (Sweden) 2035 (UK)
ZEV mandate (credit-to-EV conversions are different in each economy; therefore not comparable)	NEV credits 12% by 2020, 18% by 2023	ZEV credits 22% in 2025	Voluntary and non-binding targets
Procurement requirements	30% of new procurement should be zero emission for all categories of vehicles in public service in ZEV prompting cities starting 201419	Starting in 2023, 25% of new bus purchase made in a calendar year by large transit agencies shall be zero emission; 50% by 2026, 100% by 2029; Fixed route airport shuttles serving California's 13 largest airports will be required to transition to 100% ZEVs by 2035	Adopted binding targets for zero- and low-emission vehicles in public procurement in each member state, with two phases (2020-2025, and 2025-2030)20
R&D Funding	At least $1 billion in local government and industry support	At least $1.2 billion in battery technology investment	At least $1.2 billion in battery technology investment
Charging Infrastructure	4.8 million EV charging posts by 202021	250,000 EV charging stations by 2025	1.3 million public charge points by 2025, and 3 million by 203022

Conclusion – Coordinating Action for Global Leadership

Current geopolitical tensions and the COVID-19 crisis complicate the partnership between California and China, but this uncertainty should remind us that climate change leaves us no time to waste. The University of California-wide California-China Climate Institute, working in partnership with the Institute of Climate Change and Sustainable Development at Tsinghua University, stands ready to drive this collaboration forward. And as California and China continue to work more closely together, the two can enlist other players like the European Union, United Kingdom, Canada and Mexico. This global mobilization could help achieve a goal of deploying more zero-emission vehicles on the world's roads before the next United Nations climate talks. By furthering this collaboration, China and California will send a clear message to the world: zero-emission vehicles are the future.

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[15] ZEVs in new passenger vehicle sales
[16] ICCT, 2018. https://theicct.org/sites/default/files/publications/China_NEV_mandate_PolicyUpdate%20_20180525.pdf
[17] CARB, 2019. https://ww2.arb.ca.gov/sites/default/files/2019-06/zev_regulation_factsheet_082418_0.pdf
[18] ICCT, 2019. http://eupocketbook.org/wp-content/uploads/2019/12/ICCT_Pocketbook_2019_Web.pdf
[19] China State Council, 2014, http://www.gov.cn/zhengce/content/2014-07/21/content_8936.htm
[20] EU, 2019. https://ec.europa.eu/transport/themes/urban/clean-vehicles-directive_en
[21] China NDRC, 2016. https://www.ndrc.gov.cn/xwdt/ztzl/xxczhjs/ghzc/201605/t20160511_971925.html
[22] EU, 2020. https://www.transportenvironment.org/sites/te/files/publications/01%202020%20Draft%20TE%20Infrastructure%20Report%20Final.pdf

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