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Supply Side Regulations for Vehicles: A Necessary and Sufficient Condition for ZEV Transitions in Mexico

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Introduction

Supply side regulations (SSRs)¹ have been demonstrated to be an effective part of a comprehensive policy framework to drive market transformation and industrial transition to fuel efficient and zero emission vehicles (ZEVs). Most jurisdictions with higher than the global average of EVs such as China, the EU, the UK and California have strong SSRs, in the form of CO₂ emission standards, fuel economy standards, ZEV sales requirements, or ICE bans (or a combination) (see **Table 1**). Countries with high adoption rates without strong SSRs, Norway and Iceland, rely on high levels of fiscal and non-fiscal incentives to drive EV adoption, which put significant burden on public budgets.

In this policy brief, we describe the role of SSRs, review existing literature on the effectiveness of SSRs, and provide recommendations for Mexico.

Role of SSRs

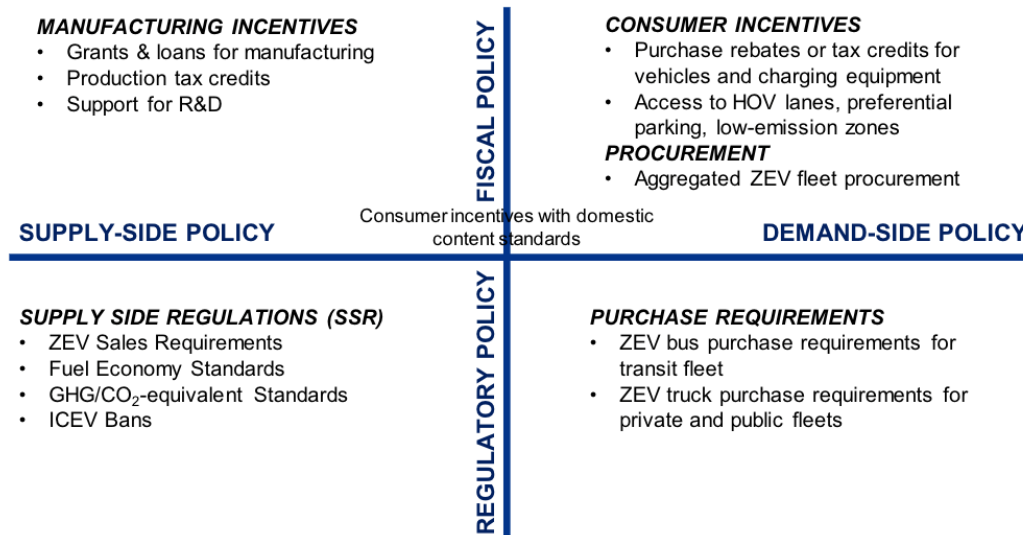
EV transitions can address multiple policy objectives of governments including economic growth and environmental considerations. SSRs are a key enabler in driving market transformation towards ZEVs in a resource efficient and effective manner. As shown in Figure 1, SSRs are part of a comprehensive policy framework that includes industrial policy, consumer market transformation, and infrastructure and grid readiness in addition to emissions reduction.

Table 1. Jurisdictions with high EV adoption rates and key policy drivers

Region	2024 EV Sales Share	Key Policy Driver
Norway	80%	Strong fiscal and non-fiscal consumer incentives
Iceland	43%	Strong fiscal and non-fiscal consumer incentives
China	44%	Strong incentives, fuel economy and EV sales requirements
California	25%	Strong CO ₂ standards and 100% ZEV sales requirement by 2035
United Kingdom	25%	Strong CO ₂ standards and 100% ZEV sales requirement by 2035
EU27	22%	Strong CO ₂ standards, 0 grams/km by 2035
Israel	24%	2030 ICE vehicle import ban
World Average	20%	

¹ Examples of SSRs are fuel economy standards, CO₂ standards, zero emission vehicle (ZEV) sales requirements, or bans on internal combustion vehicle imports or sales.

SSRs are Critical Part of Policy Framework for ZEV Transition



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Figure 1. Policy Framework for ZEV Transition

SSRs fundamentally create market certainty for EV sales and play a key **industrial policy role** ensuring supply by requiring manufacturers to produce and offer more efficient, and zero emission vehicles. The **regulatory certainty** of a SSR creates the **market certainty** that de-risks investments by vehicle manufacturers, suppliers and infrastructure providers as well as government. By creating transparency on the volumes and timing of ZEV adoption, SSRs also enable greater coordination and long-term planning among stakeholders, allowing fuel infrastructure providers to make the necessary investments in a timely manner.

SSRs can increase the **fiscal efficiency** of government resources. Relying heavily on demand incentives alone to encourage consumer adoption, can be costly and may have limited long-term impact. Supply-side policies require lower budget allocations and can be

more cost-effective for governments to implement (Lindsell et. al., 2024²).

Manufacturing incentives are more likely to leverage greater private capital if coupled with an SSR that requires them to produce increasing volumes of ZEVs. Consumer incentives can also be more efficiently designed if there is an expectation that they can be reduced as prices decrease with increasing production volumes. By reducing the need for consumer and manufacturer incentives, government resources can more efficiently be allocated to areas like charging infrastructure.

SSRs can also provide a strong incentive for innovation. By setting a clear ZEV adoption pathway, production targets and penalties for non-compliance, these policies create positive competition for OEMs and push automakers to innovate and develop new and more affordable EV models, driving economies of scale, and

² Lindsell, H., McNamara, M., & Soat, R. (2024, November 20). Driving the Zero-Emissions Vehicle Transition: The Role of Supply-Side Policies. RMI. <https://rmi.org/driving-the-zero-emissions-vehicle-transition-the-role-of-supply-side-policies/>

Supply Side Regulations create Market Certainty

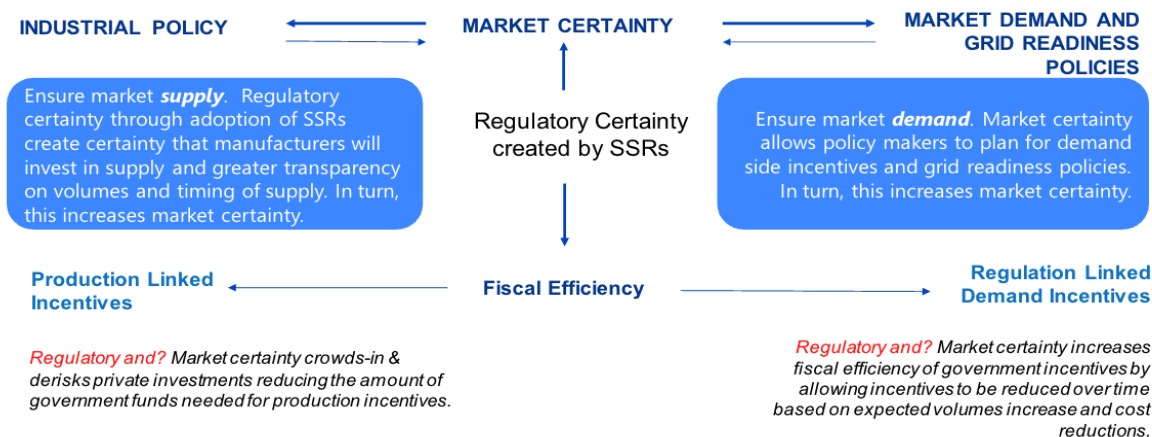


Figure 2. Role of SSRs in ZEV Transition

innovations in manufacturing and technology. Strong standards with credit trading provisions can encourage a “race to the top” by allowing EV market leaders to sell credits to EV market laggards, thus creating a strong incentive for all manufacturers to invest in their own competitive EV products. The best example is Tesla which has earned US\$10.7 billion in revenue from selling SSR compliance credits to other automakers, accounting for one-third of its profits since 2014³.

Finally, fuel economy and CO₂ emission standards also play an important role in **ensuring fleet-wide improvements in emissions and fuel consumption**. At lower volumes, the benefits of ZEV sales alone can be offset by market trends towards larger and less fuel-efficient ICE vehicles. To drive the transition to EVs, hybrid policies that combine ZEV sales requirements with fuel economy or CO₂ standards can be effective.

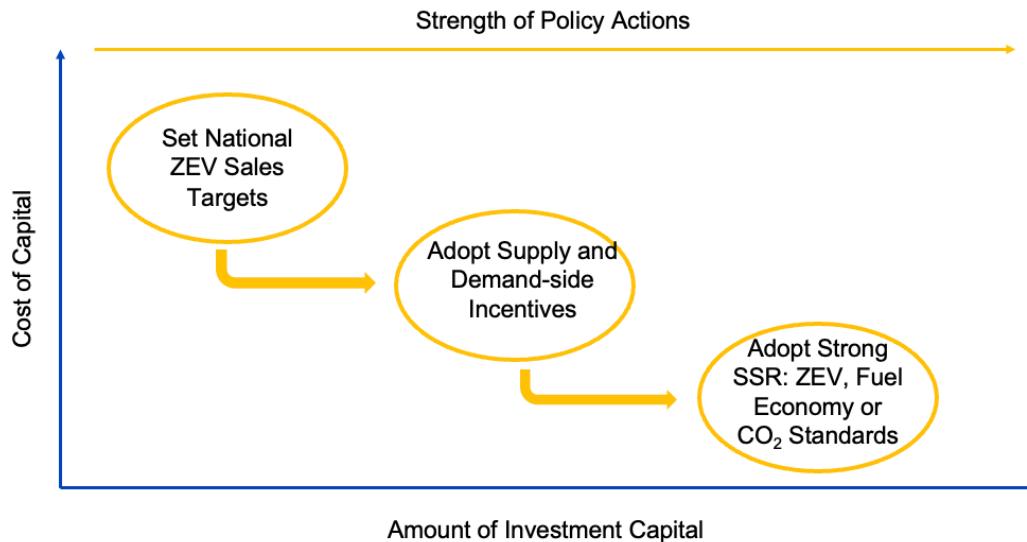
Key Findings from Research

ZEV Sales Requirements have Increased EV Sales Volumes and Model Availability

In California, the ZEV sales requirement has been successful in driving EV adoption as the state surpassed its goal of 1.5 million ZEVs sold two years ahead of schedule in 2023. EVs accounted for 25% of all new cars sold in California in 2023, and ZEVs made 86% of that share. ZEV sales requirements have boosted EV sales in Canada, from 8% in 2022 to 14% of total LDV sales in 2024, and is expected to surpass 25% share by 2026. In the UK, EV sales accounted for 24.7% of total LDV sales in 2024, surpassing the government sales target of 22% under the ZEV mandate. In 2024, the UK became Europe’s largest EV market. The used

³ Hiar, C. (2025, January 15). Tesla built Musk’s vast wealth through climate credits. Trump may end them. E&E News. <https://www.eenews.net/articles/musk-made-a-fortune-on-climate-credits-trump-is-targeting-them/>

Supply Side Regulations De-risk and Enhance Capital Flows



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Figure 3. SSRs Role in Enhancing Investments

EV market also grew by 57.4%, making EVs more accessible to consumers⁴.

Armitage and Pinter (2022) analyzed the U.S. ZEV mandate between 2009 and 2017, concluding that it significantly increased EV model availability.⁵ Manufacturers introduced new low-volume EV models specifically to comply with the regulation, expanding consumer choices. Their study contrasted supply-side mandates with demand-side incentives (such as tax credits), finding that mandates were more effective in stimulating product availability, while incentives primarily increased demand for existing models.

Fuel Economy or CO₂ Standards can Drive EV Adoption If Sufficiently Stringent

If fuel economy (FE) standards are sufficiently stringent, they can promote EV adoption making compliance with traditional ICE efficiency targets costly, thereby incentivizing automakers to shift investments towards zero-emission alternatives. Studies have shown that stringent FE regulation targets and their continued success cannot be achieved without a significant increase in ZEV market share, and that more ambitious policies lead to faster ZEV diffusion (Yang and Bandivadekar, 2017; Xie and Lin, 2017; Fritz et al., 2019⁶).

⁴ Binns, T. (2025, February 11). Used electric car sales surge in the UK, up 57.4% year-on-year. ElectricDrives. <https://electricdrives.tv/used-electric-car-sales-surge-in-the-uk-up-57-4-year-on-year/>

⁵ Armitage, S., & Pinter, F. (2022). Regulatory Mandates and Electric Vehicle Product Variety. Job market paper. https://www.frankpinter.com/Pinter_JMP.pdf

⁶ Yang, Z., & Bandivadekar, A. (2017). Light-duty vehicle greenhouse gas and fuel economy standards. International Council on Clean Transportation.; Xie, F., & Lin, Z. (2017). Market-driven automotive industry compliance with fuel economy and greenhouse gas standards: Analysis based on consumer choice. *Energy Policy*, 108, 299–311.; Fritz, M., Plötz, P., & Funke, S. A.

In the EU, implementation of ambitious fleet-wide CO₂ emission reduction targets along with fiscal penalties has driven automakers to heavily invest in EVs to avoid fines. To comply with standards, manufacturers are accelerating their EV development and production plans, with estimates suggesting they will need to increase their BEV share to about 28% by 2025 (Dornoff, 2024)⁷. Research by Zhang et al. (2011)⁸ and Sen et al. (2017)⁹ suggests that FE regulations play a crucial role in accelerating ZEV adoption. Findings by Sen et al. (2017) for the U.S. suggested that CAFE regulations could boost EV market share by over 25% compared to a scenario without such regulations, while reducing ICEV sales by nearly 64% by 2030. When effectively implemented alongside existing government incentives, these regulations can further accelerate the transition away from conventional vehicles.

ZEV Sales Market Mechanisms are More Effective at Driving EV Adoption than Fuel Economy standards or Incentives Alone

Gnann et al. (2018)¹⁰ reviewed international EV market diffusion models and found that fuel economy regulations alone result in slower EV adoption, while ZEV mandates create a more direct, guaranteed pathway for market transition. Anilan and Vij (2024)¹¹ emphasized that if fuel economy regulations are

implemented without ZEV mandates, there is a risk that compliance is met through high-efficiency ICE vehicles rather than EV sales. However, when ZEV mandates complement CO₂ targets, automakers are compelled to invest in EV production at scale.

Axsen et al. (2022)¹² found that the most cost effective (\$/ton CO₂e) policy package for achieving 100% ZEV sales by 2035 in Canada is a ZEV sales standard followed by a ZEV sales standard combined with a vehicle efficiency standard. They further note the main reason is that the ZEV mandate is directly focused on the ZEV sales goal, while providing a range of strategies to comply, including R&D investments, cross-price subsidies, increased EV model variety, and increased charging availability. Axsen et al. (2022) also found that an incentive alone (or a ‘feebate’) approach leads to relatively worse cost-effectiveness since it focuses more narrowly on one compliance mechanism: changing consumer behavior by lowering the purchase price of ZEVs and increasing the purchase price of conventional vehicles. Demand-side incentive policies on their own fail to provide a sufficiently strong supply side incentive for manufacturers to invest in the production of greater, more affordable EVs.

Overly Generous Credits Can Undermine Emission Benefits

(2019). The impact of ambitious fuel economy standards on the market uptake of electric vehicles and specific CO₂ emissions. *Energy Policy*, 135, 111006.

⁷ Dornoff, J. (2024). Within reach: The 2025 CO₂ targets for new passenger cars in the European Union. International Council on Clean Transportation. <https://theicct.org/publication/2025-co2-manufacturers-targets-oct24/>

⁸ Zhang, T., Gensler, S., & Garcia, R. (2011). A study of the diffusion of alternative fuel vehicles: An agent-based modeling approach. *Journal of Product Innovation Management*, 28(2), 152–168.

⁹ Sen, B., Noori, M., & Tatari, O. (2017). Will Corporate Average Fuel Economy (CAFÉ) Standard help? Modeling CAFÉ’s impact on market share of electric vehicles. *Energy Policy*, 109, 279–287.

¹⁰ Gnann, T., Stephens, T. S., Lin, Z., Plötz, P., Liu, C., & Brokate, J. (2018). What drives the market for plug-in electric vehicles? A review of international PEV market diffusion models. *Renewable and Sustainable Energy Reviews*, 93, 158–164.

¹¹ Anilan, V., & Vij, A. (2024). Taking the wheel: Systematic review of reviews of policies driving BEV adoption. *Transportation Research Part D: Transport and Environment*, 136, 104424.

¹² Axsen, J., Bhardwaj, C., & Crawford, C. (2022). Comparing policy pathways to achieve 100% zero-emissions vehicle sales by 2035. *Transportation Research Part D: Transport and Environment*, 112, 103488, 1–20.

As countries develop their FE regulations, it is crucial to ensure that credits and multipliers are structured effectively to drive real improvements in ICE vehicle efficiency and increase EV adoption, rather than allowing manufacturers to meet compliance requirements without meaningful progress. Super credits, which assign multipliers to ZEVs and PHEVs and off-cycle credits if set generously high, can significantly impact the effectiveness of CO₂ reduction targets. In China, Wang et al. (2018)¹³ found that high multipliers (above 2.5) diluted regulatory impact, enabling automakers to achieve targets without substantial EV sales, whereas optimal multipliers (1.5–2.0) lower compliance costs while ensuring meaningful EV adoption. If manufacturers maximize the higher magnitude off-cycle and super credits, the actual fleet-wide CO₂ emissions may be significantly higher than regulatory targets (Yang and Bandivedakar, 2017; Khan et al., 2025¹⁴).

Countries Must Adopt Own Regulatory Framework to Ensure EV Market Growth

A study by Sykes and Axsen (2017)¹⁵ highlights that even in regions where stringent ZEV mandates have led to significant EV market growth, spillover effects remain limited. Free riding on another region's regulations does not result in sufficient EV adoption to meet long-term decarbonization targets. This suggests that each country must establish its own regulatory framework to drive EV uptake, rather than

depending on global market forces or policies. In this context, emerging markets must actively shape their own EV policies in combination with their industrial and trade policies to secure a competitive position in the global EV supply chain. Strategic supply-side regulations can help foster domestic battery production, strengthen local EV supply chains, and create economic opportunities, rather than leaving these benefits to external manufacturers that dominate the global market.

SSRs can Support Domestic Economic Growth and Job Creation

Tamba et al. (2022)¹⁶ find that when EVs make up more than 60% of the total vehicle fleet in the EU and UK by 2050, employment in BEV manufacturing is two to three times higher than in a baseline scenario where EVs account for only ~45% of the fleet. While increased electrification results in job losses in ICE vehicle manufacturing, the net impact on total vehicle manufacturing jobs remains positive. Additionally, the study highlights that job creation in the energy value chain including charging infrastructure, grid reinforcement, electricity generation, and battery manufacturing could more than offset job losses in the EU auto manufacturing, further expanding employment opportunities in electromobility.

In the US, it is estimated that growth of charging infrastructure could create over 160,000 jobs by 2032 across various sectors,

¹³ Wang, S., Zhao, F., Liu, Z., & Hao, H. (2018). Impacts of a super credit policy on electric vehicle penetration and compliance with China's Corporate Average Fuel Consumption regulation. *Energy*, 155, 746–762.

¹⁴ Yang, Z., & Bandivedekar, A. (2017). *Light-duty vehicle greenhouse gas and fuel economy standards*. International Council on Clean Transportation; Khan, T., Jimenez, C., Pineda, L., Yang, Z., Miller, J., & Sen, A. (2025). *CO₂ emission standards to achieve Mexico's 2030 electrification target for light-duty vehicles*. International Council on Clean Transportation. <https://theicct.org/publication/co2-emission-standards-to-achieve-mexicos-2030-electrification-target-for-ldvs-jan25/>

¹⁵ Sykes, M., & Axsen, J. (2017). No free ride to zero-emissions: Simulating a region's need to implement its own zero-emissions vehicle (ZEV) mandate to achieve 2050 GHG targets. *Energy Policy*, 110, 447–460

¹⁶ Tamba, M., Krause, J., Weitzel, M., Ioan, R., Duboz, L., Grosso, M., & Vandyck, T. (2022). Economy-wide impacts of road transport electrification in the EU. *Technological Forecasting and Social Change*, 182, 121803.

including electrical installation, maintenance, software repair, planning and design, charger assembly, construction, administration, and legal services (Bui et al., 2024)¹⁷. In California, the ZEV mandate has driven automakers to scale up EV production. The state leads the U.S. in ZEV manufacturing jobs, with 55 ZEV-related manufacturers¹⁸.

Strong Fuel Economy or CO₂ Standards can Dis-incentivize Market Shifts to Larger, Less Efficient Vehicles

Several emerging EV markets in the global south are witnessing a rapid increase in large ICE SUV sales, contributing to reduced vehicle efficiency. According to Cazzola et al. (2023)¹⁹, the shift towards larger, heavier vehicles has slowed improvements in energy efficiency, as fuel consumption per kilometer could have declined 30% faster between 2010 and 2022 without the dominance of SUVs. However, this negative impact can be mitigated through electrification, as EVs have significantly lower specific energy consumption compared to conventional ICE SUVs (Cazzola et al., 2023). By implementing regulations that promote electrification, these markets can counterbalance the emissions and fuel demand increases caused by the growing SUV trend, ensuring that transport sector decarbonization targets are achieved despite evolving consumer preferences.

Axsen et al. (2022)²⁰ suggest that higher costs associated with SSRs can encourage consumers

to opt for smaller, more efficient vehicles. Analysis of the US automobile market indicates that automaker compliance costs rise from USD 1,600 per vehicle under GHG emissions standards alone to USD 2,000 per vehicle when combined with a ZEV mandate (Jenn et al., 2018²¹), reinforcing the impact of stringent regulations on consumer vehicle choices.

Policy Implications for Mexico

Adopting or strengthening SSRs is a critical action for Mexico to meet its climate commitments, reduce air pollution, and ensure the competitiveness of the Mexican auto industry. In line with the NDC 2.0 proposal, the Mexican government developed the draft National Electric Mobility Strategy in 2023. The strategy sets targets for BEVs and PHEVs of 50% and 100% of new vehicle sales across all vehicle segments by 2030 and 2040, respectively, with 100% transition to BEVs by 2050. Mexico currently has CO₂ emission and fuel economy standards for light duty vehicles, but not for medium and heavy-duty trucks or two wheelers. We recommend the following:

Strengthen the current Phase 2 CO₂ emission standards for light duty vehicles that covers model years 2025-2027 and sets targets of 89 g CO₂/km for passenger cars and 131 g CO₂/km for light commercial vehicles by 2027²⁰. These standards will need to be substantially strengthened to align with targets of 50% BEVs and PHEVs by 2030. It is estimated that to meet

¹⁷ Bui, A., Pierce, L., Ragon, P., Sen, A., Slowik, P., & Waites, T. (2024). Charging up America: The growth of United States electric vehicle charging infrastructure jobs – International Council on Clean Transportation. <https://theicct.org/publication/us-ev-charging-infrastructure-jobs-jan24/>

¹⁸ <https://www.gov.ca.gov/2023/04/21/california-surpasses-1-5-million-zevs-goal-two-years-ahead-of-schedule/>

¹⁹ Cazzola, P., Paoli, L., & Teter, J. (2023). Trends in the Global Vehicle Fleet 2023: Managing the SUV Shift and the EV Transition. Global Fuel Economy Initiative. <https://www.globalfuelconomy.org/data-and-research/publications/trends-in-the-global-vehicle-fleet-2023>

²⁰ Axsen, J., Hardman, S., & Jenn, A. (2022). What do we know about zero-emission vehicle mandates? *Environmental Science & Technology*, 56(12), 7553–7563.

²¹ Jenn, A., Hardman, S., Carley, S., Ziropiannis, N., Duncan, D., & Graham, J. D. (2018). Cost implications for automaker compliance of zero emissions vehicle requirements. *Environmental Science & Technology*, 53(2), 564–574

its 50% EV sales target by 2030 while improving ICE vehicle efficiency by 3% annually, Mexico would need to achieve a 56% reduction in fleet-wide average emissions for passenger cars and a 61% reduction for light commercial vehicles (LCV) relative to 2016 levels (Khan et al., 2025).

Extend the next phase of LDV standards to 2035. To create greater market certainty for investments in EV production and infrastructure and to retain its automotive industry competitiveness, Mexico should set long-term standards that ideally extend to at least model year 2035, consistent with California, Canada and the EU standards. Setting long-term, strong standards will increase the fiscal efficiency of manufacturing and consumer incentives by ensuring public funds for incentives leverage greater amounts of private capital consistent with rising sales targets. Longer term targets also increase the ability of stakeholders to make necessary investment decisions in a timely manner across the value chain including critical minerals, electricity infrastructure upgrades, and R&D for new battery technology.

Consider adoption of a market-based ZEV sales requirement. A ZEV program can provide even greater regulatory certainty for EV investments and can be especially effective when combined with a CO₂ or fuel economy standard as with programs in California, China, the United Kingdom, and Canada. The main reason is that the ZEV mandate is directly focused on the ZEV sales goal, while providing a range of strategies to comply including credit trading, cross-price subsidies, increased vehicle model variety, and increased charging availability.

Reduce compliance flexibilities in current CO₂ standards that weaken incentive to sell EVs. Mexico's Phase 2 CO₂ emission standards for LDVs allow manufactures to generate additional

compliance credits by using off-cycle and air conditioning credits and by selling advanced technology vehicles (Khan et al., 2025). These credits increase compliance flexibility but undermine the necessity for manufacturers to invest in a growing EV market.

In particular, the current standards allow very generous credit multipliers for BEVs (13.5x), PHEVs (8.3x), and hybrid electric vehicle (HEVs) (5x). These multipliers are significantly higher than those in leading markets such as the U.S., EU, and China. Other countries have already phased out or are in the process of eliminating such flexibilities (ibid). Further, while BEVs and PHEVs can be given suitable credit multipliers, all other ICE vehicles including conventional hybrids should not be given any flexibility mechanisms.

Adopt CO₂, fuel economy or ZEV regulations for medium and heavy-duty vehicles (MHDV).

MHDVs are the second largest source of GHGs for Mexico's transportation sector and are a major source of PM and NO_x pollution. Heavy duty trucks alone accounted for roughly 27% of the transportation sector's emissions in 2015 (Ruiz et al 2023²²). Mexico has adopted criteria emission standards for heavy duty trucks but does not have CO₂ or fuel economy standards. Fortunately, cost-effective technologies exist to improve fuel economy and truck technology is rapidly advancing and already are cost competitive on a total cost of ownership basis in some segments. Eight jurisdictions have adopted MHDV SSRs (either CO₂ standards, fuel economy standards, or ZEV sales requirements) including California, EU, UK, Japan, Canada, US, China and India. Mexico should adopt strong, long-term CO₂, fuel economy, or ZEV standards (or possibly a combination) for new MHDVs. In addition, given the large volume of Mexican trucks operating in cross-border freight,

²² Ruiz, A., et al. (2023). A pathway for a green transition of the transportation sector in Mexico [Issue brief]. WRI Mexico.

especially with California, harmonizing MHDV regulations to accelerate zero emission trucks in Mexico's fleet can ensure that they remain compliant and competitive to operate under California regulations that are requiring an

increasing share of ZETs to operate in ports and along heavy freight corridors, regardless of registration and origin.