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BEHIND THE WHEEL:
THE HIDDEN HANDS DRIVING THE EV MANDATE

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EXECUTIVE SUMMARY

In 2023, the Texas Public Policy Foundation (TPPF) published *Overcharged Expectations: Unmasking the True Costs of Electric Vehicles* (Bennett and Isaac, 2023), which attempted to compare the holistic lifecycle costs of model year (MY) 2021 electric vehicle (EV) and internal combustion engine vehicle (ICEV) ownership. Prior to this report, most studies analyzing the total cost of EV ownership only focused on out-of-pocket expenses of EV ownership and direct subsidies for EV purchases. However, the true cost of EV ownership is hidden through a web of subsidies, rebates, and credits — costs that are ultimately borne by taxpayers, ICEV buyers, and utility ratepayers. Of particular importance are the ways in which federal and state governments have tightened emission standards and illegally created and manipulated credit programs to create hidden subsidy schemes for EVs that dwarf the $7,500 federal tax credit that is most often discussed in public forums.

This report is a holistic examination of the subsidies EVs receive and appraises the total costs, which remain largely hidden from the public and policymakers, by design. Over a 10-year period, each MY2023 EV costs society between $94,121 and $152,695 — excluding the cost of purchasing the vehicle itself. This figure includes the actual expenses shouldered by automakers to comply with federal mandates and the losses incurred in EV production. Contrary to claims that electricity is cheaper than gasoline, when factoring in infrastructure costs, charging losses, and commercial rates, the effective cost of "fueling" an EV is equivalent to paying $25.96 to $41.24 per gallon of gasoline.

This represents a significant increase over TPPF's 2023 study, which appraised refueling costs for EVs sold in 2021 at $17.33 per gallon. The rise is fueled by stricter Corporate Average Fuel Economy (CAFE) standards and heightened civil penalties under the Biden administration, pressuring automakers into costly EV production commitments. In Q3 2024 alone, Tesla disclosed receipt of $739 million from regulatory credit sales (Tesla, 2024), reflecting real costs that distort market dynamics and place a heavier burden on the broader economy.

Most analyses overlook these hidden costs and focus only on EV owners' residential electricity cost, which accounts for less than 4% of the true cost of EV ownership.

Table 1: EV Costs Socialized to Gasoline Vehicle Owners, Taxpayers, and Utility Ratepayers

	Total Cost of EV Ownership	Lifetime Cost Paid by EV Owners	Percentage Paid	Cost Socialized to Non-EV Owners	Percentage Paid
Low Subsidy Cost	$186,626	$96,295	52%	$90,331	48%
High Subsidy Cost	$245,199	$96,295	39%	$148,904	61%

Note: *The cost-share of lifetime EV ownership shows that an EV owner will pay between **$96,295** for the total cost of ownership. However, **48–61%** of the total cost is covered by external sources, including automakers, gasoline and diesel vehicle owners, and utility ratepayers. This results in **$90,331** to **$148,904** in costs being socialized to non-EV owners, depending on the subsidy level (American Energy Institute calculations).*

Despite billions in subsidies and aggressive marketing, most consumers remain reluctant to adopt EVs. A June 2024 McKinsey survey reported that 40% of U.S. EV owners experienced buyer's remorse, with many planning to return to ICEVs upon trade-in (McKinsey & Co., 2024). This lack of consumer demand has even led some dealers to refuse delivery of EV inventory (King, 2023). Nonetheless, federal regulators continue to pursue EV mandates with unwavering commitment, aiming for 67% of all new vehicle sales to be electric by 2032. Automakers now face a costly choice: absorb billions in production losses underpinned by taxpayer subsidies or confront steep regulatory compliance penalties.

KEY POINTS

1. **Hidden Costs, Subsidies, and Regulatory Manipulation Driving the EV Mandate**

   Federal regulators have distorted fuel economy and emission standards to create a **de-facto EV mandate**—without Congressional approval. This includes an **illegal 6.7x credit multiplier for EVs**, granting them credit for non-existent fuel economy and forcing automakers into costly compliance measures. ICE manufacturers must either **purchase credits from EV makers, face steep financial penalties, or produce EVs at a loss** to meet increasingly stringent Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) tailpipe emissions standards.

   At the same time, automakers benefit from **federally backed accounting practices** that obscure the true costs of EVs. These hidden subsidies, combined with regulatory credit systems, impose **billions of dollars in costs on taxpayers, utility ratepayers, and ICEV buyers**. Over 10 years, each MY2023 EV benefits from **$94,121 to $152,695 in hidden subsidies**—equivalent to paying **$25.96 to $41.24 per gallon of gasoline** over its lifetime.

   These manipulated regulatory credit systems, including **EPA's GHG credits and National Highway Transportation Safety Administration's (NHTSA) CAFE standards**, provide EV manufacturers with **up to $114,991 in subsidies per vehicle**, creating an **opaque compliance system that distorts markets** and places heavy financial burdens on the broader economy.

2. **Burdens on ICE Vehicle Manufacturers**

   NHTSA's compliance subsidies for EVs are not funded by taxpayers directly but are paid by internal combustion engine (ICE) manufacturers and their customers. ICE manufacturers face steep penalties or must purchase costly credits to meet tightening fuel economy standards.

3. **Inflated Consumer Incentives for EV Adoption**

   Federal, state, and utility programs provide up to $18,194 in rebates and tax credits per EV, while utilities pass infrastructure costs onto ratepayers, driving up electricity rates. EV owners also avoid an estimated $2,506 in fuel taxes and registration fees, shifting these costs to gasoline and diesel drivers.

INTRODUCTION

On January 20, 2021, President Joe Biden recommitted the United States to the Paris Climate Accords (Department of State, 2021). As part of America's pledge to the agreement, the Biden Administration outlined several areas in which transportation policy could facilitate the national transition toward net-zero, including "tailpipe emissions and efficiency standards; incentives for zero emission personal vehicles; and funding for charging infrastructure to support multi-unit dwellings, public charging, and long-distance travel" (UNFCC, 2021). Thus far, the Biden Administration has made good on the promises it laid out in its climate pledge, much to the detriment of the American automotive industry, buyers of ICEVs, taxpayers, and utility ratepayers.

The National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA) have introduced stringent tailpipe emission standards, aligning the U.S. fuel economy and vehicle emission standards with those of the European Union's EV mandate. The Biden-backed 2021 Bipartisan Infrastructure Law (BIL) appropriated over $5 billion in National Electric Vehicle Infrastructure planning funding to build charging stations along the interstate system (H.R. 3684, 2021, Sec. 6701). The Inflation Reduction Act of 2022 (IRA 2022) also provided generous tax credits for EVs and EV supply chain industries to encourage Americans to switch from ICEVs to EVs (H.R. 5376, 2022, Sec._50142 and Sec. 13403). On top of the flotilla of federal subsidies, states, and public utilities help encourage the federal government's transition by showering EV buyers (and lessees) with a panoply of subsidies and rebates.

Tabulating all of the government-granted assistance the EV industry receives is a herculean task made all the more complicated by the fact Department of Transportation (DOT) and EPA do not disclose the value of the regulatory credits that EV manufacturers receive. Similarly, the State of California does not disclose to the public the cost of the compliance credits to meet the EV

sales mandates adopted by it and more than a dozen other blue states. The lack of transparency in these credit markets has caused a significant cost factor to go unnoticed by nearly every EV cost-benefit analysis, news report, and Wall Street analyst. For example, Burnham et al. (2021) appraised the average operating and maintenance cost of owning an EV over 10 years at $8,047. However, this study only considered private costs accrued to the EV buyer, the cost of a level 2 charger, and the cost of fueling the vehicle with electricity.

When most (though not all) of the hidden subsidies for EVs are combined, each MY2023 EV is projected to receive between $94,121 and $152,695 over a 10-year period. These costs do not include the cost to purchase the vehicle. In gasoline-equivalent terms, the true cost of fueling and operating an EV ranges from $25.96 to $41.24 per gallon — a fact that bureaucrats, with the backing of automakers, have gone to great lengths to conceal from the public.

Regulatory credits, which endow EVs with $56,417 up to $114,992 worth of subsidies, account for nearly 80% of the cost of EV ownership. And unlike conventional subsidies which are paid for by taxpayers, these regulatory credits are paid for directly by automakers and ICEV consumers. The Inflation Reduction Act's EV tax credits and rebates offered by state governments and public utilities add another $18,194. Finally, socialized infrastructure costs add $10,515. Avoided fuel taxes and registration fees add an additional $2,506.

The DOT and EPA under the Biden Administration have promulgated stringent fuel economy and emissions regulations designed to force a transition to EVs. The tightening of these standards is the primary driver behind the Biden Administration's goal to require 67% of new light-duty vehicles sold in the U.S. to be EVs by 2032 (The White House, 2023).

By mandating the most expensive technology for reducing greenhouse gas emissions and actually generate a substantial increase in ambient particulate matter (Emission Analytics, 2022), the federal government is running roughshod over sound public policies that would improve fuel economy and reduce emissions at substantially lower costs. Were the focus of the policy on reducing

emissions reductions as quickly and as cheaply as possible, the government would have designed policies that recognize the cost-effectiveness in hybrid vehicles. Hybrid vehicles offer significantly reduced emissions compared at similar prices to ICEV counterparts (Woodley et al., 2024). They use much smaller batteries, offer excellent driving range and performance, and do not burden ratepayers with costly upgrades to the grid.

SECTION 1: REGULATORY CREDITS

EV manufacturers receive their largest source of financial support from regulatory credits, a type of currency created by unelected bureaucrats. With no explicit authorization from Congress, regulators at DOT and EPA have warped existing federal standards to support a de-facto EV mandate. By implementing an illegal 6.7 times credit multiplier for EVs (i.e., giving them credit for non-existent fuel economy) and tightening fuel-economy and tailpipe emission standards, regulators have put ICEV manufacturers in a situation where they are forced to purchase or barter with EV manufacturers for credits or build an EV production line of their own to offset increasing regulatory compliance standards. These standards are the NHSTA's CAFE standards and the EPA's greenhouse gas (GHG) tailpipe emissions standards.

The CAFE standards are the more longstanding of the two standards. These regulatory measures require automakers to improve the average fleetwide **fuel efficiency** of the vehicles they manufacture each model year. Established by the NHTSA, CAFE standards aim to reduce fuel consumption and enhance energy independence by setting **fleet-wide fuel economy targets** for manufacturers. Automakers must meet specific miles-per-gallon (MPG) averages across the range of vehicles they sell, including cars, and light trucks.

The increasing fines automakers face will trigger several reactions. First, automakers will be forced to sink money on unprofitable EV lines to offset fines accrued to their larger vehicles. Second, ICEVs will need to shrink in size, compromising on comfort and safety features, to achieve these standards. Third, manufacturers will make larger trucks to achieve a class with a more generous CAFE standard. While these are games manufacturers can try to play, purchasing credits from EV makers is the path of least resistance — and NHTSA's preferred outcome — for non-compliant ICEV makers. These credits are traded between automakers with no public accounting of the costs. The automakers even can trade the credits for parts, services, or other commercial agreements (e.g., sharing/licensing of intellectual property).

While trading of CAFE credits is authorized under federal statute, an egregious abuse of this program, supported by automakers, has been a regulation to grant EVs nearly 7 times their fuel economy achieved in the real world. There is no law that authorizes this abuse, and even environmental groups petitioned the federal government to end this charade in 2023 (DOE, 2021, p. 73992; DOE, 2023, p. 21525; IER, 2023). These illegal fuel economy credits are worth billions to manufacturers of EVs and have served as the single-greatest financing mechanism of the EV industry, with nary a mention among the media or policymakers seeking to uncover the billions of dollars in costs this policy has imposed on buyers of gasoline vehicles.

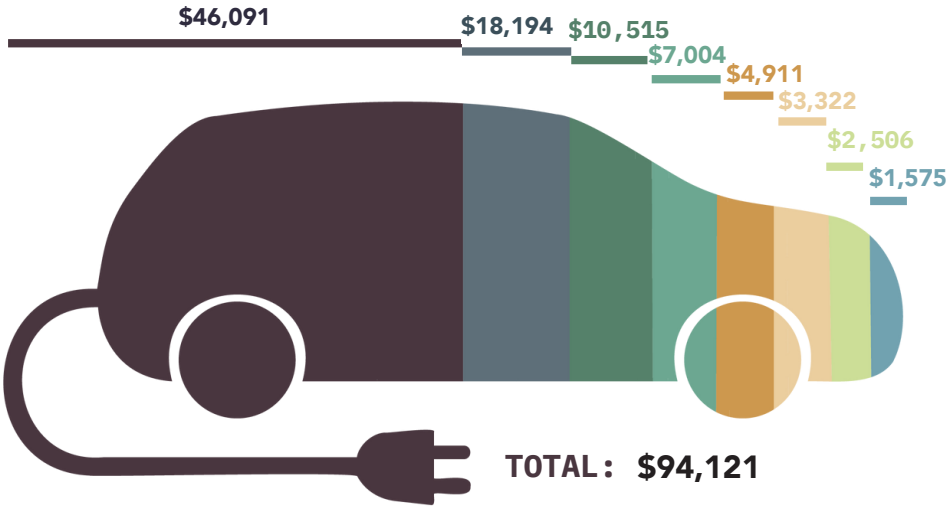
The **EPA's Greenhouse Gas (GHG) credit program** focuses primarily on **reducing tailpipe emissions** of carbon dioxide (CO_2) and other greenhouse gases. Automakers earn **credits** by producing vehicles that emit lower levels of CO_2 and by incorporating technologies like electric drivetrains, start-stop systems, or advanced aerodynamics that reduce emissions. Similar to CAFE credits, these credits can be traded between manufacturers for cash, parts, services or as part of other commercial

agreements, with no public accounting. Moreover, unlike CAFE, which was adopted by Congress in the 1970s with an authorized credit trading program, Congress never authorized fleetwide GHG emission standards or credit trading; i.e., the program is beyond EPA's statutory authority under the Clean Air Act. The EPA's GHG and NHSTA's CAFE standard combined furnish EV manufacturers with $46,091 – $104,665 in subsidies, or $12.02 – $27.30 per gallon equivalent.

In addition to the federal programs, the California Air Resources Board (CARB) has created an interstate credit market for so-called "Zero-Emission Vehicles" (ZEVs), which itself is a misnomer because EV supply chains and power generation generate tremendous amounts of emissions. Furthermore, on-road operation of EVs actually produces a significant increase in ambient particulate matter from rapid tire wear, and the production of road dust from the heavy weight and high torque of EVs when compared to ICEVs (whose tailpipe emissions of criteria pollutants are now close to zero) (Emission Analytics, 2022).

Established in 1990, CARB's ZEV program set the first ZEV mandate, requiring 10% of all vehicles sold in 2003 to have zero emissions. The policy "intended to be 'technology forcing'— that is, to spur innovation in the emerging electrification technologies and to increase the scale of battery production in order to lower costs" (McConnell and Leard 2017, p. 170). Despite federal laws specifically prohibiting the consideration of electric vehicles in setting fuel economy standards, the technology-forcing aspect of CARB has inspired activist regulators at the Federal level to implement stringent standards to force the adoption of EVs. CARB credits add an estimated additional $7,004 in hidden costs per electric vehicle, or $1.83 gallons equivalent, all at the expense of buyers of gasoline and diesel vehicles that unknowingly pay higher prices to allow the industry to absorb the price of those credits.

Hidden Costs and Subsidies for Electric Vehicles 2023



- Unlawful Bonus EV CAFE Credits
- Federal and State EV Tax Credits and Rebates
- Incremental Generation Transmission and Distribution Costs
- California and Other State EV Mandates and Credits
- Private Infrastructure and Distribution Costs
- EPA GHG Multiplier Credits
- Avoided Gas Taxes and Registration Fees
- Avoided Charging Infrastructure Costs

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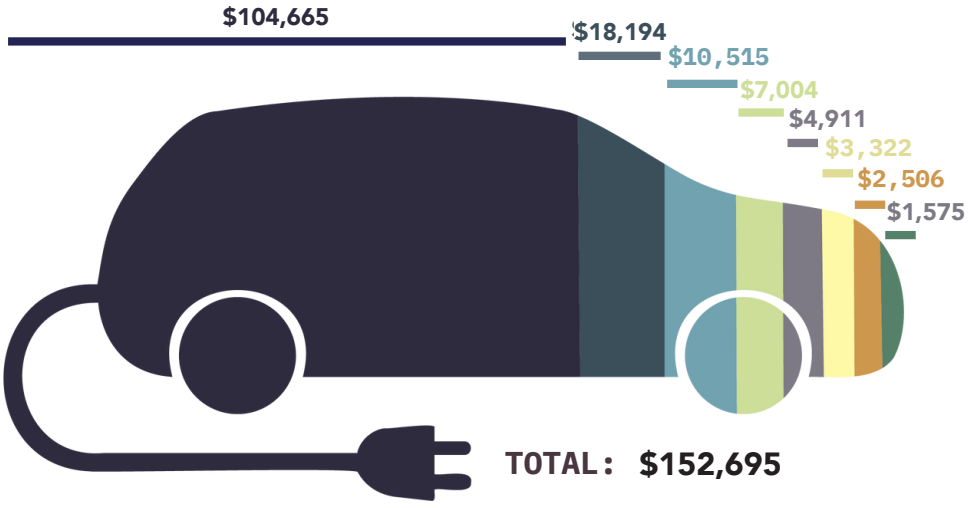
Hidden Costs and Subsidies for Electric Vehicles (Deep State Target)



- Additional Regulatory Value of Unlawful Bonus EV CAFE Credits
- Federal and State EV Buyer Tax Credits
- Incremental Generation Transmission and Distribution Costs
- California and Other State EV Mandates and Credits
- Private Infrastructure and Distribution Costs
- EPA GHG Multiplier Credits
- Avoided Gas Taxes and Registration Fees
- Avoided Charging Infrastructure Costs

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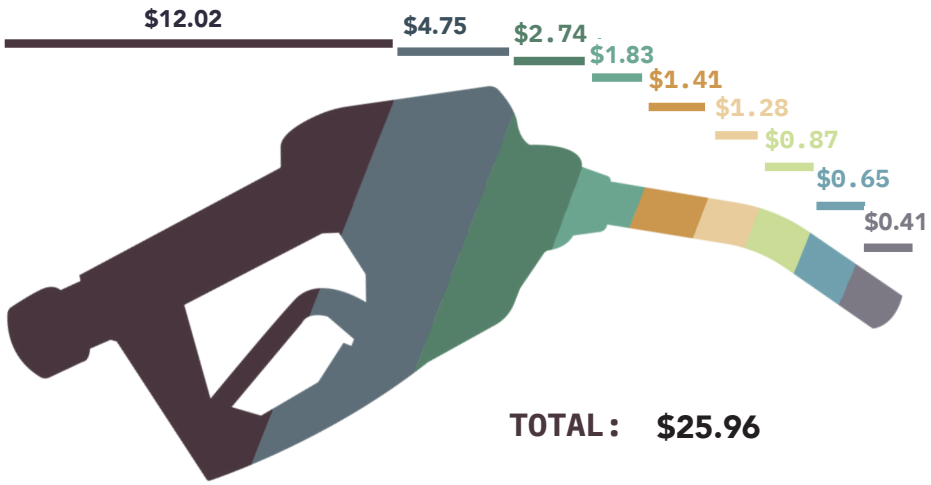
True Costs of Fueling an EV



- Corporate Average Fuel Economy Credits (CAFE)
- Federal and State EV Buyer Tax Credits
- Incremental Generation Transmission and Distribution Costs
- California and Other State EV Mandates and Credits
- Cost of Fueling an EV
- Additional Costs to EV Owner From Charging
- EPA GHG Multiplier Credits
- Avoided Gas Taxes and Registration Fees
- Avoided Charging Infrastructure Costs

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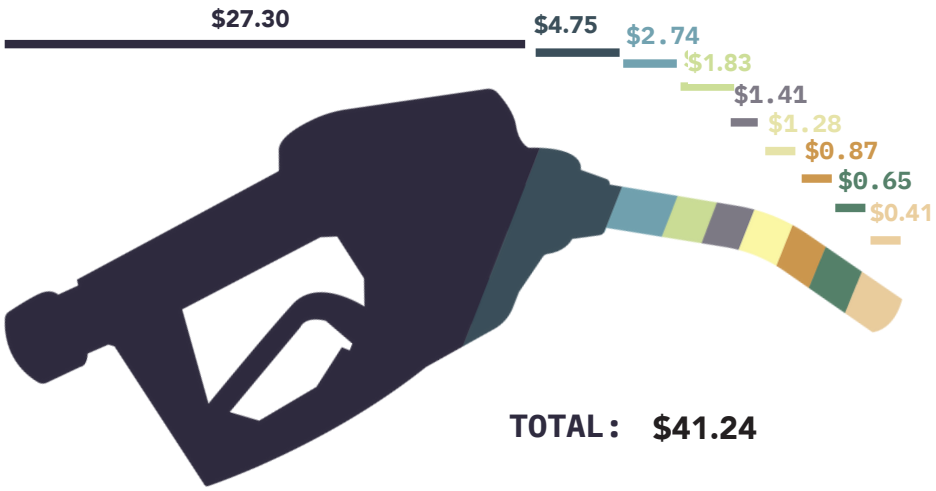
True Costs of Fueling an EV (Deep State Target)



- Corporate Average Fuel Economy Credits (CAFE)
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- California and Other State EV Mandates and Credits
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Adding up all of the illegal federal and state regulatory credit schemes, each EV receives between $56,417 and $114,991 in regulatory credits, or $14.72 and $29.99 per equivalent gallon. And these costs do not include the cost of the lawful portion of CAFE credit trading, only the unlawful CAFE EV multiplier credits for non-existent fuel economy.

HISTORY OF THE CAFE STANDARDS

The road to CAFE standards began in 1957 when the Independent Petroleum Association of America (IPAA) lobbied for oil import quotas. These quotas insulated America's domestic oil market from oil produced abroad by the American oil giants (Kohn, 1970). The quotas eventually harmed American consumers when U.S. oil production from domestic fields began declining in 1970 (EIAa, 2024). Then, the Arab oil embargo of 1973 cut America off from the largest source of foreign supply, which propelled oil prices to new heights. The political machinations that made oil artificially scare lent credence to the now debunked peak oil theory. Responding to the geopolitical and the perceived peak oil threat, Congress established the first CAFE standard in 1975 (S.B. 622, 1975, Secs. 501 & 502).

Congress' anticipated oil supply-side-induced energy crisis never materialized, but the CAFE program remained, giving federal regulators the powers to reshape America's vehicle fleet. In 2009, acting under order from President Obama, NHTSA announced a plan to raise the fleetwide CAFE standard to 35.5 mpg by 2016 (NHTSA, 2009), and in 2012 President Obama and NHTSA set fleetwide CAFE standards to achieve 54.5 mpg by 2025. The increase in fuel economy standards would purportedly "sav[e] consumers money… reduc[e] dependency on foreign oil… [and] motor vehicle tailpipe emissions of carbon dioxide" (NHTSA, 2009).

In setting the new standard, regulators forced automakers to prioritize fuel economy over other features highly valued by consumers like safety, vehicle size, performance, cargo space, towing capacity and others. In addition to requiring improvements in fuel economy, CAFE standards encourage preferential treatment within federal regulations for alternative fuel vehicles, such as ethanol, natural gas, and hydrogen. EVs are just the latest vehicle to directly benefit from the CAFE standards, however, the law explicitly prohibits NHTSA from considering EVs when setting the standards. This restriction was ignored by both the Obama and Biden Administrations.

In June 2024, NHTSA finalized its most recent ruling for CAFE standards. Passenger cars will need to achieve a fuel economy standard up to 66.4 for passenger cars and 54.4 for light trucks by MY2032 (NHTSA, 2024). These changes followed just two years after NHSTA raised the civil penalty for manufacturers whose fleets were below the CAFE standard:

Table 2: Civil Penalties Schedule

Civil Penalty	
MY2024	$17.00
MY2023	$16.00
MY2022	$15.00
MY2019 - 2021	$14.00
MY2018 and Prior	$5.50

Note: *Civil Penalties Schedule tracks NHTSA's increase in the civil penalty Automakers are required to pay per one tenth (0.1) mile per gallon below the CAFE Standard (NHSTA, 2022, p. 18994).*

Prior to this increase, the civil penalty had been set at $5.50 per 0.1 MPG shortfall for decades (Civil Penalties, 2016, p. 43529). NHTSA's attempt to raise the civil penalty for MY2016 to $14 was blocked by a lawsuit. According to the automakers themselves, the increase in civil penalties is projected to cost three large automakers — Ford, General Motors, and Stellantis — over $14 billion by 2023 (Reuters, 2023).

CAFE Credits:

CAFE credits are awarded to manufacturers whose vehicle fleets exceed CAFE's fuel economy standards in a given year. These credits are traded between automakers in a private market authorized by NHTSA. Transfers of all CAFE credits have occurred outside of the public eye, and there is no automaker that reports the costs (or benefits) of these transactions, by vehicle, or model year, to the public or to even shareholders despite it being material to company financial performance.

Currently, the CAFE credit market fails every criterion for promoting competition and savings to consumers. Leard and McConnell (2017) observed: "A well-functioning market for trading credits between companies requires transparency about the prices of trades that have occurred." In May 2024, Florida Senator Rick Scott and four other U.S. senators wrote a letter to Government Accountability Office Comptroller General Gene Dodaro (appointed by President Obama) requesting information on the market value of CAFE standards, inflation-adjusted civil penalties paid by automakers, the total volume of MPG credits EVs received since DOE established the PEF using the illegal multiplier, the cost of EPA and California regulatory credits, and other data points that would help bring aspects of this opaque market to light (Scott, 2024). However, as of October 25, 2024, the Comptroller has not provided any publicly available update to the Senators' request.

Without access to credit transaction data for multiple overlapping programs, we can never know the true combined cost of these credits. However, using civil penalties and cost estimates for improving fuel economy, as well as automakers' willingness to incur losses on EV investments in order to avoid purchasing compliance credits, we can infer a credit price.

EVs benefit from DOE's misapplication of a multiplier created by a series of laws passed by Congress to use the CAFE Standard to promote alternative fuel vehicles. In 1988, the Alternative Motor Fuels Act

applied a bonus multiplier of 6.67 — or 667% — to the fuel economy of alternatively fueled vehicles. The act defined alternative fuel vehicles as vehicles powered by ethanol, methanol, and natural gas. The Energy Policy Act (H.R. 776, 1992, Sec. 403) expanded the legal definition of "alternative fuels" to include hydrogen, liquified coal, other non-alcohol biofuels, and electricity; however, a July 1994 transportation law explicitly clarified that the multiplier would only apply to "*liquid* alternative fuel" (H.R. 1758, 1994, Sec. 32905).

The law's exclusion of electric vehicles failed to deter the Clinton-era DOE from establishing a petroleum equivalency factor (PEF) for EVs using the 6.67 multiplier in June 2000, which remains in effect to this day and was recently extended to the end of the decade (DOE, 2024, p. 22053). Every EV receives 6.67 MPG of credits for every 1 MPG of the vehicle's actual fuel economy rating. To make matters worse, EPA regulations adopt a fuel economy test procedure for EVs that is decidedly different than the procedures for gasoline vehicles (EPA, 2024) and results in exaggerated fuel economy ratings for EVs, which are then magnified by 6.7x. As a result, EVs receive more than 7x the fuel economy credits they deserve if the standards were written and implemented as the law requires.

ICEV manufacturers whose fleet MPG falls below the CAFE standard have three choices. Manufacturers can invest in technologies that improve their fleet's fuel economy, purchase CAFE credits (or trade parts, services or other things of value) from other automakers, or pay the civil penalty. This analysis assumes that automakers will consider all three and opt for the cheapest option.

Assuming the marginal cost of increasing the fuel economy of a vehicle by 1% is $48 (Leard et al., 2019, p. 32), an ICEV manufacturer whose (real-world) MY2023 fleet averages about 30.7 MPG (EIA 2022) would spend $48/0.307 MPG = $156.35 to improve fuel economy by 1 MPG. Given the fleetwide CAFE standard for MY2023 was 43.15 MPG, a MY2023 EV rated at 114.22 MPG could earn roughly (114.22 MPG*6.67) – 43.15 MPG

= 718 MPG worth of credits. It is important to note that the illegal 6.67x multiplier accounts for 90% of the total credits. Using the credit value of $156.35 per MPG, these EV CAFE credits could be worth ($48/0.307 MPG)*(114.22 MPG * 6.67) = $119,116 per EV. **Table 2** shows how the value of these credits has fluctuated from MY2019 – MY2024.

Alternatively, CAFE regulations allow automakers to pay a fixed penalty per 0.1 MPG for each vehicle that is short of the standard. The standard sets a cap on the amount an automaker is willing to invest in fuel economy improvements and a corresponding limit on the value of the regulatory credits. For vehicles made in 2023, the penalty was $16.00 per 0.1 MPG shortfall. Taking this civil penalty value, the value of the credits are $16.00 / 0.1 MPG = $160 per MPG. An EV manufacturer whose MY2023 vehicles averaged 114.22 MPG/e would earn ($160/ 1 MPG)*[(114.22 MPG*6.67) – 43.15 MPG] = $114,991 worth of excess compliance credits. More than 90% of those excess credits ($103,620) would be awarded due to the unlawful multiplier regulation.

Subtracting out cross-subsidies from EPA GHG standards and Section 177 credits (covered in the next two sections), every EV receives an illegal subsidy up to $104,665 subsidy CAFE standards. Assuming an EV is driven 120,000 miles over a lifetime of 10 years, that unlawful subsidy equates to $27.30 per equivalent gallon of gasoline an ICEV would consume over its 10 year life.[1]

EV makers will only receive the full $104,665 if CAFE credits are trading at the civil penalty rate. Unfortunately, CAFE credits are traded in a

1 The formula to convert total cost to cost per gallon-equivalent is $112,162 / (120000 miles / 31.3 MPG) = $7.21/gallon-equivalent, where 31.3 MPG is the average rated efficiency for new on-road vehicles in 2023 (EIA, 2023). This same conversion factor will be used throughout the paper. Note, however, that the average U.S. light-duty vehicle is driven 11,467 miles per year (EERE, 2020), which is probably well above the typical EV, making the estimate of 12,000 miles per year quite generous. Therefore, if the average EV does not last for 120,000 miles, then the costs of these credits are greater per EV mile driven. Also, the fleetwide fuel economy average of 36.32 MPG will increase over time, thereby increasing the cost per gallon equivalent obtained using this conversion factor. The bottom line is that this conversion factor is generous toward EVs in almost every aspect imaginable.

clandestine market without public accountability. Nobody outside of automakers boardrooms or NHTSA conference rooms knows the true market price for a CAFE credit. However, we can infer a credit price using manufacturers' EV investment patterns and loss tolerance on EV lines.

Ford and GM are willing to incur billions in nominal losses each year on their EV lines. When examining losses per vehicle, each EV appears to lose over $72,000. However, selling cars is not the point of most automakers' EV lines. Ford and GM have designed their EV lines to generate CAFE credits which they can use to offset their regulatory burden. Hence, the cost a company is willing to pay to generate these credits is (Total EV Losses)/Number of credits received = implied credit price. In 2023, Ford and GM lost $4.5 billion and $2.5 billion, respectively on their EV lines (Isidore, 2024, Duke, 2024). This implies GM and Ford paid $2.5 billion/531,383,783 credits = $4.70 and $4.5 billion/360,463,196 credits = $12.48, respectively. These costs of producing credits reflect Ford and GM's willingness to accept for these credits. The price at which credits are likely to trade reflects the industry total's cost of producing the credits. The weighted average of these EV credits is calculated as $7 billion/891,846,979 credits = $7.85 per credit.

The weighted average cost of these credits implies that the market clearing price for MY2023 credits is $7.85. Using this credit price, the average EV earns ($7.85/ 0.1 MPG)*[(114.22 MPG*6.67) – 43.15 MPG] = $56,417. Deducting ZEV and GHG credits, EVs likely earn $46,091 in CAFE credits. When priced at the observed market rate, CAFE credits add $12.02 per gallon equivalent to an EVs fueling costs. This estimate is similar to a result obtained by RBN energy when DOE's 6.67 multiplier is applied: $6,600*6.67 = $44,022 per electric vehicle (Auers, 2024).

CAFE standards have become the largest source of financial support for EV manufacturers. Initially designed to conserve gasoline by improving efficiency, regulators at NHTSA have since contorted the standard into a program for supporting the Biden Administration's EV mandate.

Billion-Dollar EV Technology Shift Fails to Have a Meaningful Impact

Since 2009, regulators at NHTSA have adopted CARB's approach to transportation emissions and warped the CAFE standards into a technology-forcing policy. Subjecting automakers to stringent, increasing fines for failing to meet fuel-economy standards is negative feedback which in theory will compel them to invest in technologies that improve fuel economy. Engine efficiency and hybridization are the traditional technologies manufacturers would try to implement. However, the standards are no longer designed with ICEVs and hybrids in mind. Functionally, the only technology capable of meeting these standards are EVs, despite the law prohibiting NHTSA from considering EVs when setting the standards.

EVs' highly exaggerated fuel economy ratings mean that if manufacturers are willing to pad their fleet with EVs, they can artificially boost their calculated fuel economy. The equation below demonstrates how a manufacturer will calculate their fleet's fuel economy standard under CAFE. All vehicles made in a model year are divided by the sum of each vehicle model divided by their respective fuel economy rating.

$$\frac{\textit{Total Production Volume}}{\frac{\textit{VehicleA}}{\textit{FuelEconomyA}} + \frac{\textit{VehicleB}}{\textit{FuelEconomyB}} + \ldots + \frac{\textit{VehicleE}}{\textit{FuelEconomyE}}} = \text{Average}$$

Ford attempted to bolster its fleet's fuel economy with EVs, but the results were disappointing. In 2023, Ford made 65,000 electric vehicles with an average EPA fuel economy rating of 85.5 MPG/e (Ford, 2023, DOE, 2024). Yet, these EVs failed to make a significant impact on the fuel economy of Ford's 1.75 million 2023 vehicle fleet. EVs increased Ford's fuel economy by a modest 0.45 mpg/e, from 24.727 to 25.183 mpg/e. Even with this modest increase, Ford's fleet is still well below the CAFE standard for light trucks of 35.8 mpg/e.

In 2023, 3,555,900 million EVs were registered (EERE), which were among the 287 million total on-road vehicles with an average fuel economy of 30.7 MPG/e (EIA, 2022, 2023). Assuming that EPA's EV fuel economy test was accurate (and it is not) and that all of these EVs achieved the EIA's purported MPG estimate of 114.22 MPG/e (EIA 2023), new EVs sold in 2023 raised the real-world fuel economy of the entire U.S. fleet by only 1.18 MPG [i.e., (114.22 MPG/e – 30.7 MPG/e) * (3,555,900 EVs) / (250,055,200 vehicles) = 1.18 MPG/e]. While automakers can improve an arbitrary fuel economy by simply building more EVs, achieving this modest increase of 1.18 MPG/e has come at an immense cost.

The total subsidy EVs receive from NHTSA's CAFE program varies widely depending on the price of credit prices. If credit prices reflect the ICEV manufacturer's loss tolerance, then the average EV receives $46,091. While this is well below the maximum possible credit price of $104,665, the recent increase in CAFE standards will increasingly force automakers to comply with the Biden Administration's 2035 EV mandate by purchasing credits or building more EVs to offset their increasingly non-compliant ICEVs.

EPA GHG credits:

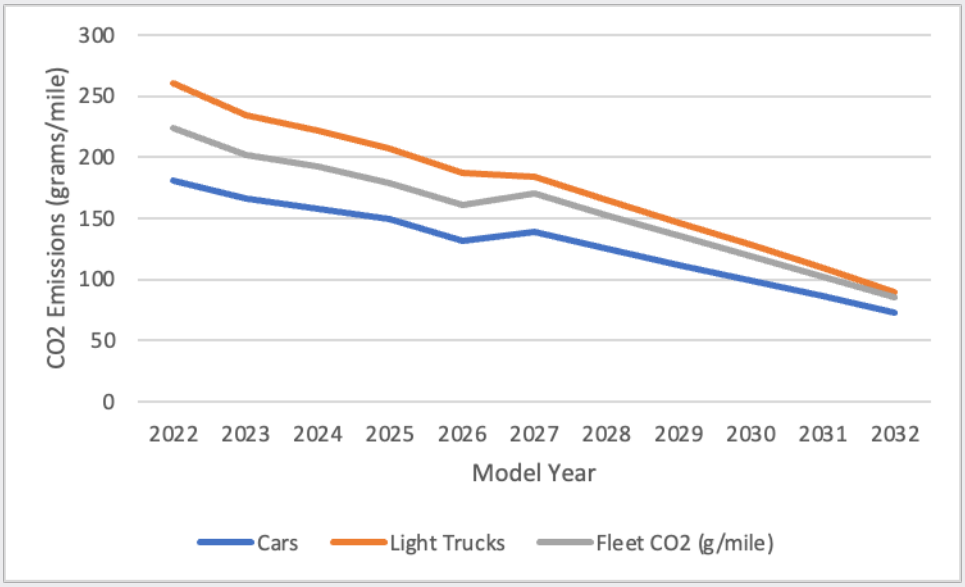
EPA emission standards are the second source of hidden regulatory credit revenue forcing autos into compliance with the EV mandate. EV manufacturers receive bonus credits under the EPA's banking system for exceeding tailpipe GHG emission standards, despite no statute that authorizes the EPA to adopt fleetwide average emission standards or allow trading and banking of EPA-created credits (i.e., regulatory cross-subsidies). Just like CAFE standards, these credits are traded outside of the public eye. Despite the immense costs incurred to the American people by these credits, neither automakers nor the market's creator — EPA — are required to disclose the cost of these credits. These costs are clearly material to investors and, therefore, should be required to be disclosed under federal law, but no automaker discloses the total cost or any breakdown by vehicle model, by units of emissions, by model year, or by the amount of credits banked, to their shareholders.

The GHG emission standards award credits based on each vehicle's average per-mile-driven tailpipe CO_2 emissions. If an automaker's vehicle fleet is comprised of two vehicles in MY20XX — Model A that emits 300 grams of CO_2 per mile driven and Model B emitting 200 grams of CO_2 per mile — and an equal number of these vehicles are made, then the manufacturer's MY performance would be 250 grams of CO_2/mile.

EPA's Harmonizes Standards with Foreign EV Mandates

On January 20, 2021, President Biden's promulgated Executive Order 13990 (2021), which directed EPA to revise tailpipe emission standards set by "The Safer Affordable Fuel-efficient (SAFE) vehicles rule for MY2021-2026. Acting under the order, EPA tightened tailpipe emission standards for passenger cars and light trucks.

EPA's Promulgated Tail-pipe Emission Standard



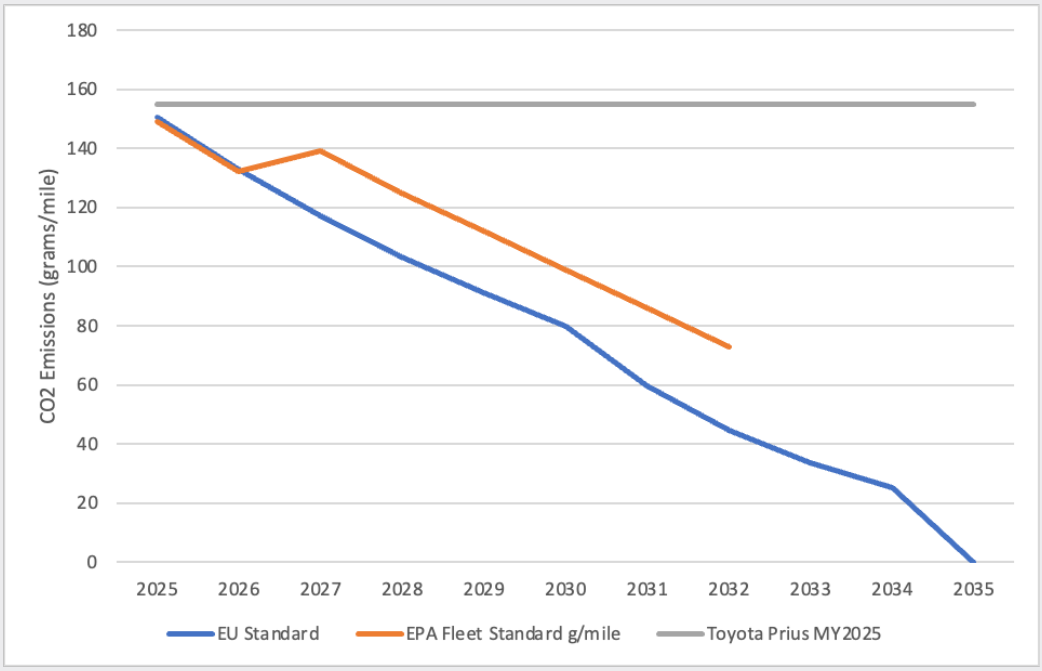
Note: *EPA's promulgated tail-pipe emission standard plots EPA's final tailpipe emission standards for MY 2026 – 2031 (EPA, 2024, p. 27824).*

In 2024, EPA promulgated the final rule for the MY2026 – 2031 tailpipe emission standards (EPA, 2024, p. 27824). These new standards require automakers to decrease fleetwide CO_2 emissions 62.1% over the 6-year period. The agency's tailpipe emission standards have effectively imposed a ban on ICEVs and a mandate for EV purchases, especially in California and other Section 177 states. Even if a consumer chooses a new gasoline vehicle, they are indirectly subsidizing someone else's EV. Through these policies, bureaucrats have orchestrated one of the largest wealth transfer schemes in U.S. history—shifting resources from red states to blue states, all while keeping the public largely unaware and denying its impact.

Continued

EPA's MY2026 – 2031 standards align the U.S. emission standards with the European Union's fleet-wide CO_2 emission targets (European Environmental Agency, 2024), which have functionally established an EV mandate on the continent by 2035. Europe's stringent tailpipe emissions have significantly contributed to the 40% rise in European car-makers manufacturing costs (Reuters, 2024).

EPA Fleet-wide Emissions Standards



Note: *EPA fleet standards compares Biden's EPA emission target with the Europe's 2035 EV mandate. For scale, the grams CO_2 emissions per mile of the MY2024 Toyota Prius, one of the most fuel efficient and lowest-emission vehicles on sale is included for scale. (EPA, 2024, p. 27824, European Environmental Agency, 2024, & Kooverjee, 2023).*

By instating these standards, EPA has prioritized the goals of the UN Paris Climate Accords, an agreement that has never been sent to the U.S. Senate for their advice and consent as required by law, as well as countries like China that dominate the EV supply chain, instead of the financial well-being, vehicle performance needs, and lifestyle preferences of American citizens, and the continued growth of the U.S. economy.

Excess compliance credits are awarded to automakers whose fleets are below the standards. Continuing from the example above, if the standard were set at 300 grams of CO_2 per mile, then the manufacturer with a fleet average of 250 grams of CO_2 would receive 50 grams of credits. These credits can be traded (for cash, parts, services, or other commercial terms) to automakers whose MY fleet is above the 300-gram standard or banked to apply against future model years.

EPA created this market out of whole cloth without any explicit statutory authority from the Clean Air Act to invent marketable emission credits that are costing auto manufacturers, gasoline and diesel vehicle buyers, and the economy billions of dollars (EPA, 2024). The obscurity of the EPA GHG credit market means that we must extrapolate credit values from limited public information and academic research to appraise their value. In 2023, TPPF used an estimate provided in Leard and McConnell 2017 of $36 to $63 per metric ton for the GHG credits. Each EV receives approximately 41 – 82 tons worth of credits per vehicle (EPA, 2021, p. 49344), despite real-world EV supply chain GHG emissions that largely offset these credits. Monetizing these credits yields a per-EV value between $1,476.19 - $5,166.68. Taking the midpoint of this range gives average estimated value an EV receives from these credits of $3,322, which equates to approximately $0.87 per equivalent gallon of gasoline.[2]

California ZEV Regulations and Other State Mandates:

In 1990, the California Air Resources Board (CARB) set the Golden State's first zero-emission vehicle mandate. By 2003, 10 percent of new vehicles purchased needed to be zero-emission (CARB, 2024). The goal of the CARB ZEV market was "to be 'technology forcing'— that is, to spur innovation in the emerging electrification technologies and to increase the scale of battery production in order to lower costs" (McConnell and Leard 2017, p. 170).

2 Because the EPA GHG standards are now so stringent, even more so than CAFE, it is likely that the values are increasing significantly but, again, there is zero public information provided by automakers or EPA about the value of these transactions, so the best we can do is very conservatively estimate their value.

Battery and other zero-emission technologies ultimately failed to develop in time to achieve CARB's target year of 2003 (CARB, 2024; McConnell and Leard, 2021). As EVs improved throughout the 2010s, CARB not only introduced increasingly aggressive zero-emission vehicle standards, it also began exporting its EV mandate program to other states.

California's "Advanced Clean Cars" program violates Section 209 of the Clean Air Act (42 U.S.C 7543), which prohibits states from adopting and enforcing emissions standards on new vehicles that are stricter than those set by federal agencies. However, the Obama-era and Biden EPA granted California a waiver (Barczewski, Lattanzio, & Peterson, 2024), allowing California to create and implement the Advanced Clean Cars program. Under California's latest iteration of this program, 100% of all new MY2035 light-duty vehicles will need to be ZEVs. Section 177 (42 U.S.C 7507) of the Clean Air Act allows states to adopt California motor vehicle standards for which EPA has issued a waiver. Sixteen states and the District of Columbia have adopted California's zero emission vehicle (ZEV) mandates and/or greenhouse gas emission standards and are collectively referred to as "Section 177 states."

When Section 177 states enroll in California's Advanced Clean Cars program, they enter into a ZEV credit market. Automakers selling vehicles in this state are required to meet the emission reduction standards set by the program, or purchase credits from manufacturers in compliance with the state standards.

McConnel, Leard, and Krados (2019) estimated the value of ZEV credits using Tesla's ZEV credit revenues disclosed in their quarterly shareholder letters. Unfortunately, Tesla stopped disclosing ZEV credit revenues in 2018. Revenue from ZEV credit sales are now combined with some other portion of ill-defined automotive regulatory credit sales, without any information regarding their vintage, value per vehicle, per model, per model year, the value of any banked credits, or whether any of the credits were traded for parts, services or other commercial agreements. However,

assuming that ZEV credits comprise a modest 5% of Tesla's total revenue share, ZEV credits value ranges between $2,490 - $8,112 from MY2019 – 2021 (Tesla, 2022; Tesla, 2020; McConnell, Leard, and Krados 2019).

Table 3: Total ZEV Credits Transferred from Tesla

Section 177 States	2021	2020	2019	2018	2017	2016	2015
California	10,938	19,957	6,000	0	88,214	51,776	80,227
Connecticut	-	-	-	-	-	2,236	264
Maine	0	156	50	0	0	54	111
Maryland	-	-	-	-	-	2862	360
Massachusetts	1468	2971	1650	1650	7498.32	4684	375
New Jersey	3586	9537	1080	0	8512.04	8036	2550
New York	9482	2850	0	0	8854	10287	850
Oregon	-	-	-	-	6239	2434	215
Rhode Island	275	40	200	0	216	85	88
Vermont	60	158	50	490	224	130	58
Total	**25,809**	**35,669**	**9,030**	**2,140**	**119,757**	**82,584**	**85,098**

Note: *Total ZEV Credits transferred from Tesla shows the credits transferred from Tesla to other Automakers in 11 of the 17 Section 177 states. The omitted Section 177 have not established a framework or published a report detailing credit transfers yet (CARBc, Maine DEP, MADEP, McConnell, Leard, and Krados 2019, NJDEP, NYDEC, ODEQ, RIDEM, & VDEC).*

Table 4: Estimated ZEV Credit Values

Year	ZEV Credits Sold (TSLA)	Credit Revenue (TSLA)	Value Per Credit
2021	25,809	$89,500,000	$3,468
2020	35,669	$88,800,000	$2,490
2019	9,030	$73,250,000	$8,112

Note: *Estimated ZEV Credit Values estimates ZEV credit values using the number of ZEV credits sold by Tesla and assuming ZEV credits make up 5 percent of Tesla's total automotive credit revenues (Tesla, 2022 & Tesla, 2021). The methodology was based on McConnell, Leard, and Krados (2019), which assumed 75 percent of Tesla's credit sales occurred in California.*

Note: These findings comport with Joshua Linn's (2022), a professor at the University of Maryland, estimate ZEV credit price of $3,236 (p. 37). While Linn assumed each EV received two and a half credits under California's program, CARB's data for MY2022 ZEV credits indicated that nearly every BEV sold obtained the maximum of four credits.

Table 5: ZEV Credits Awarded to MY2022 EVs

Total BEVs Sold CA	Total BEV Credits	Credits Per Vehicle
227,404	899,481	3.95

Note: *ZEV Credits Awarded to MY2022 EVs shows the total number of BEVs sold in California for MY 2022, the total BEV credits generated in MY 2022, and the weighted average credits received per vehicle. Virtually all battery electric vehicles receive 4 ZEV credits, adding $12,944 per EV sold (CARB, 2024; Linn, 2022; American Energy Institute's calculations)*

Multiplying $3,236 by four gives a total credit value of $12,944 per EV sold in Section 177 states. However, since not all EVs are sold in Section 177 states, that credit value per vehicle needs to be spread out among all the EVs sold in the U.S. in 2023. Of the 857,202 EVs sold nationally, 602,600 were registered in Section 177 states. Multiplying the total state credit cost of $12,944 per EV sold in ZEV states by the percentage of registered EVs in Section 177 states results in state credits worth $7,004 per EV sold in the U.S., or $1.83 per gallon equivalent.

What Did Regulatory Credits Cost Ford in 2023?

Regulatory credits have become a billion-dollar industry. In 2023, Tesla reported receiving $1.79 billion for selling CAFE, ZEV, EPA GHG, and other regulatory credits (Tesla, 2023). While these numbers are less per vehicle sold than what we claim non-compliant automakers pay under the program, most of the credits that EVs earn are not traded publicly; i.e., neither Tesla nor any other automaker report whether any of these credits are being traded for in-kind services, parts, access to charging networks, licensed used of patented technology, etc., or whether they have been banked for future compliance use. Regulators tightened CAFE and GHG standards and non-compliance penalties in hopes that the increased costs would force ICEV manufacturers to finally invest in their own EV production lines. The automakers themselves publicly commented that an increase in civil penalties is projected to cost the three large automakers — Ford, General Motors, and Stellantis — over $14 billion by 2023 (Kalmowitz, 2023).

In lieu of paying higher fines or purchasing credits, American automakers are now willing to lose billions of dollars manufacturing EVs each year while embracing federal taxpayer-funded subsidies that provide them billions of dollars. Under the government's EV mandate, EV production lines have several ostensible benefits: allowing ICEV manufacturers to offset regulatory compliance costs through the sale of the final vehicle, even if sold at a loss; incorporating EVs into an ICEV fleet boosts calculated fuel economy and GHG emissions performance; and the illegal fuel economy credit multiplier can generate credit surpluses that offset deficits from non-compliant vehicles.

Following this logic, Ford's response to increasing regulatory compliance costs was to spend billions into making its own EV production line (Model E) (Ford, 2022). In 2022, Model E lost $2.2 billion (Rosevear, 2023). In 2023, the EV unit's losses doubled, recording a $4.7 billion loss (Ford, 2024), and halfway into 2024, Ford indicated the EV unit had lost another $2.7 billion (Root, 2024).

In 2023, Ford lost a nominal $72,000 per EV that rolled off its assembly line. However, these losses were offset by the illegal credits accruing to each EV. We can infer from Ford's Q4 2023 sales data that the company received approximately 360.5 million CAFE credits from manufacturing 65,000 electric vehicles (Ford, 2023). In addition to receiving CAFE credits, Ford also received EPA credits valued at an estimated $215 million and

Continued

an estimated $138 million worth of ZEV credits (CARB, 2022), all from their EV line. The estimated value of the additional EPA GHG and California ZEV credits reduce (on-paper) total losses to $4.345 billion. Distributing those EV losses over the 360.5 million CAFE credits, Ford's EV line paid $12.05 per 0.1 MPG credit in 2023. This implies that the value of the illegal credits received per EV totals $86,603 per EV.

While $12.05 per credit is below the civil penalty, this is a very conservative estimate. If Ford's capital expenditure on EV production plants and the actual cost of manufacturing the EVs were included in these losses, the amount Ford paid to obtain each credit would be much closer to the MY2023 civil penalty of $16. Furthermore, Ford's per EV losses continue to increase. In April 2024, Car and Driver reported that Ford's losses increased to $130,000 per EV in Q1 2024 (Fink, 2024).

Ford must recuperate the losses of these EVs (and any credit purchases) by raising the cost of their ICEVs. However, the full $4.7 billion loss will not be passed onto drivers. The 360.5 million credits completely offset a deficit of 228 million credits accrued from failing to meet the light-truck CAFE standard for MY2023 of 35.8 mpg/e. Assuming each credit is priced at the civil penalty, Ford will only need to pass on a remaining $2.98 billion loss onto its customers. Spread over 1.75 million ICE vehicles sold per year, Ford will need to raise gasoline and diesel ICE costs by $1,704 per vehicle. Indeed, Ford's MY2024 lineup of F150 pickup trucks saw price increases at every model level ranging from $1,205 – $10,200 (Tucker, 2023).

Ford's decision to invest capital in an EV line also negatively impacted shareholders. To justify the capital investment in an EV production line and associated losses, Ford would have needed to derive $36 per each 0.1 MPG improvement in fleet fuel economy from all regulatory credits received. However, assuming credits are valued at the NHSTA civil penalty of $16 per 0.1 MPG, and adding the value received from GHG and Section 177 (ZEV) credits, Ford only received $13.00 per credit. Ford's investors would have been $2.2 billion better off had the automaker simply bought $2.5 billion in EV compliance credits from another manufacturer. Unfortunately, investors lack access to CAFE, GHG, and ZEV credit trade prices. Without this data, investors are unable to make informed decisions on shareholder resolutions and other business decisions.

SECTION 2: FEDERAL, STATE, AND UTILITY INCENTIVES FOR EV BUYERS

In 2022 and 2023, respectively, 987,900 and 1,113,600 EVs hit the road. In 2022, these vehicles received an estimated $1.5 billion in federal and state-sponsored tax credits and rebates, and 2023 saw total direct rebates and subsidies from the federal government, state agencies, and public utilities balloon to $7.4 billion. The average EV in 2023 received $18,194 in tax credits, rebates, and subsidies, or $4.75 per gallon equivalent.

Federal Tax Rebate for EV Buyers:

The Energy Improvement and Extension Act (2008, Sec. 205) created the 30D clean vehicle tax credit for light-duty EVs. Filers who purchased an EV could claim up to $7,500, but the program was capped at 250,000 vehicles. The American Recovery and Reinvestment Act (2009, Sec. 1141), removed the sunset date and capped the credit at 200,000 vehicles per manufacturer. Several minor changes were made to the Act until 2022 when IRA introduced new tax credits and completely overhauled the eligibility criterion for the credits (H.R. 5376, 2022, Sec. 13403).

To receive the full $7,500 value of the credit, the statute requires an electric vehicle to meet stringent sourcing requirements and prohibits the inclusion of battery components and critical minerals from foreign entities of concern like China. Final assembly also must be completed in America, and the vehicle's battery pack must contain 50% components from the U.S. or other free trade agreement countries. This requirement will increase 10% per year until reaching 100% in 2029, and certain critical minerals used in the batteries and electronics must be mined and processed in the U.S. or in a country with a free-trade agreement with the U.S. (H.R. 5376, 2022, Sec. 13401). Vehicles that meet some but not all of these requirements are eligible for a minimum tax credit of $3,750. The IRA also introduced a $4,000 tax credit for pre-owned electric vehicles effective January 1, 2024 (IRS, 2023).

Despite these statutory restrictions, the Biden-Harris IRS has issued regulations interpreting this statute that creates massive loopholes to allow automakers to claim these full credits despite sourcing much of the value of EVs and EV batteries from foreign entities of concern (IRS, 2022, 2023). The IRS has also interpreted the IRA tax credit restrictions as not applying to any leased vehicles, which comprise roughly half of the EVs on the road. Despite these unreasonable and unlawful interpretations (including disparaging remarks to the IRS from the Senator that drafted the language in the statute), no entity has yet challenged the IRS interpretations in court, and the subsidies are flowing freely to EV makers.

Before the IRA, claiming the 30D clean vehicle tax credit was a challenge. 30D credits were non-refundable and written down against other tax deductions (IRS, 2022). Consequently, few filers were able to claim the full $7,500 benefit. To maximize the effectiveness of the tax credit, IRA streamlined the convoluted process for claiming these tax credits. The IRA allows eligible EV purchasers to transfer the full $7,500 to auto-dealers registered with the government. The tax credit functions as an instant rebate taken off the vehicle's sticker price (Department of Treasury, 2023, p. 23370) and the value deposited in the bank of the dealer.[3] On June 12, 2024, the Department of the Treasury and IRS announced over $1 billion in 30D credits had been distributed to registered dealers since January 1, 2024 (Department of Treasury, 2024).

Not included in the cost of the aforementioned 30D credits, these rebates apply to all leased electric vehicles through a separate 45W credit. Over half of all electric vehicles are leased (Tucker, 2024). The IRA's 45W credit also grants businesses purchasing commercial electric vehicles weight-based tax credits. Commercial electric vehicles under 14,000 pounds can claim $7,500, while vehicles with weight exceeding 14,000 pounds can claim $40,000 (Sec. 13403).

3 Tesla does not have dealers, so the credits are booked directly to the company.

The battery electric semi-truck models that qualify for this tax credit have unladen tractor weights of 23,000 lbs or more, which is 35+ percent heavier than link-in-kind unladen class 8 diesel-powered tractors (Salter, 2024, DOE, 2010). While the number of electric semis on the road is currently negligible, interest is growing. PepsiCo ordered 100 electric semitrucks from Tesla to carry air-filled bags of Lays chips and Doritos. PepsiCo has only received 36 trucks from its initial order (DiNapoli, 2024). Timing worked in PepsiCo's favor as the remaining 64 trucks will qualify for the full 45W $40,000 tax credit (Richard, 2022).

In addition to the $7,500 tax credit, over 20 states offer incentives for EV buyers, ranging from $1,000 up to 7,500 per vehicle (Threewitt, 2024; EERE, 2024). Some of these programs offer an even higher rebate to qualifying low-income households. Plus, 12 states offer pre-owned EVs additional rebates ranging from $1,000 up to $4,250 per vehicle. Given nearly half of all new EVs are leased, these pre-owned subsidies significantly increase the government-support an EV receives over their life (Tucker, 2024). Public utilities also offer EV adopters rebates generally ranging between $300 up to $500. However, some utilities in California, which accounts for a third of all new EVs registered each year, offer rebates up to $4,000.

California, again home to the majority of EV drivers, also has illegally adopted electricity rates for commercial EV charging that eliminate demand charges needed to pay for electric distribution infrastructure (CPUC, 2024), effectively transferring those costs to other electric ratepayers in violation of federal and state laws prohibiting discriminatory electric rate structures. Despite being in place for over 10 years, no entity has challenged these illegal rate structures in any court. Because it is not currently possible to calculate the savings accrued by EV owners from this policy, this paper does not add this significant subsidy to the total estimates of EV subsidies.

Since 2020, the total subsidies EVs received from states and public utilities have ballooned. To help drive sales and force the transition to EVs, many states, especially Section 177 participants, raised and introduced new rebates for electric vehicles. In 2022, the number of states offering rebates for pre-owned EVs increased significantly. These new pre-owned rebate raise the amount of tax-payer supported subsidy EVs receive over their lifetime. We restricted the application of these state-level pre-owned rebates to vehicles sold in 2023 to produce a more conservative estimate.

The number of new EV registrations saw a slight increase from 987,900 in 2022 to 1,113,600 in 2023 (EFEE, 2023). In 2023 alone, these EVs benefited from $7.4 billion in subsidies. On average, each EV will receive $6,694 per year in state and utility transfers. Adding the federal tax credit for new vehicles, each EV receives approximately $18,194 in rebates, or $4.75 per gallon equivalent.

Table 6: State Rebates for EVs

Year	Total Subsidies	Number of EVs	Per Vehicle Subsidies
2023	$7,455,395,041	1,113,600	$6,694
2022	$1,518,514,453	987,900	$1,537
2021	$646,007,846	435,500	$1,483
2020	$353,214,639	235,300	$1,501

Note: *State Rebates for EVs shows the average amount the average EV receives in state sponsored subsidies, state tax credits, and rebates from local utilities over the lifetime of the vehicle.(EFFE, Xnel, American Energy Institute calculations)*

The Influence of Institutional Investors and Net-Zero Commitments on Automakers

A significant driving force behind the acceleration of EV mandates within major automakers like Ford, GM, and Stellantis is the influence of powerful institutional investors who have pledged to align their asset management practices with net-zero emissions goals by 2050. Many of these investors are members of alliances (or have been) like the Glasgow Financial Alliance for New Zero (GFANZ), Net Zero Asset Managers Initiative (NZAMI), Climate Action 100+ (CA100+), and the UN Principles for Responsible Investment (UNPRI). These investors collectively manage trillions of dollars in assets and prioritize environmental targets over traditional financial metrics.

The Environmental, Social, & Governance (ESG) commitments of these institutional investors come with expectations that their portfolio companies adopt policies that support this agenda. This influence can pressure automakers to pursue ambitious EV programs, even when doing so places considerable strain on profitability and requires costly, large-scale shifts in manufacturing and supply chains. While EV mandates and investments may align with global climate objectives, they can be at odds with consumer demand, operational sustainability, and the financial interests of automakers' shareholders who seek returns rather than policy-driven losses. As a result, these investors play an outsized role in steering automakers toward a path that may prioritize a political agenda over bottom-line resilience, leaving traditional stakeholders and consumers to bear the costs.

Table 7: Pro-ESG Fund Ownership of America's Largest Automotive Brands

Institutional Investor	Ford Ownership (%)	GM Ownership (%)
BlackRock	7.20%	2.17%
State Street	4.46%	4.67%
Vanguard	8.71%	8.65%

Note: *Pro-ESG fund Ownership of America's Largest Automotive Brands shows the ownership stake held by BlackRock, State Street, and Vanguard. These ESG funds use their ownership stakes to back CEOs and initiatives aligned with the Biden Administration's and the Paris Climate Accords' EV mandates (Yahoo Finance, "Ford" & "GM", 2024).*

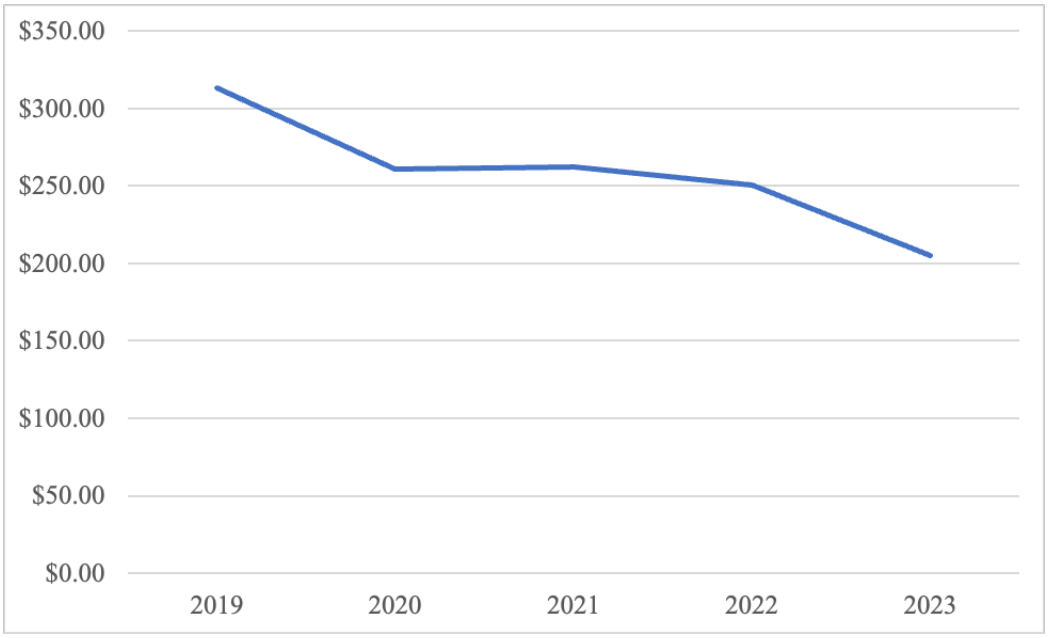
AVOIDED FEDERAL AND STATE GASOLINE TAXES AND FEES

Gasoline and diesel drivers pay significant liquid fuel taxes to fund the construction and on-going maintenance of federal and state road, highway, bridge and even bicycle lanes. Federal gasoline taxes are $0.184/gallon and federal diesel taxes are $0.244/gallon (EIA, 2024). Diesel is taxed at a higher rate to offset the additional wear and tear heavier trucks and semis place on public roads. The American Petroleum Institute (2022) estimates the average state taxes/fees on gasoline are $0.3869/gallon and $0.4024/gallon for diesel. Therefore, combined federal/state taxes and fees on gasoline average $0.5709/gallon and on diesel average $0.6464/gallon, typically comprising more than 20% of the total cost of gasoline and diesel

Of course, EVs are not subject to fuel taxes that fund road construction and maintenance, which is ironic given that, as heavier vehicles, they often inflict more wear and tear than their ICEV counterparts. This increased wear has led privately owned parking garages, as well as condo boards in cities like Los Angeles, Baltimore, Manhattan, and Miami, to ban EVs from their structures to prevent higher maintenance costs from being passed onto non-EV-owning residents (Kaplow, 2024).

To partially recoup lost fuel tax revenue, 37 states have added fees to EVs to help cover the costs of road maintenance (Igleheart, 2023, EEFE). These include special registration fees or annual fees for EVs to offset the revenue gap created by avoided fuel taxes. However, many states have found that these fees fall short of fully compensating for the lost tax revenue. States like Colorado, California, Georgia, Indiana, and Mississippi index their fees to account for inflation, but even with these adjustments, the fees fail to recover the full amount lost from fuel taxes.

Annual Avoided Gas Taxes and Fees per EVs



Note: *Annual Avoided Gas Taxes and Fees shows the annual amount each EV avoids in gas taxes and registration fees. This additional burden is recovered from ICEV owners through higher fuel taxes. Note: since 2019, the total amount avoided by EVs has declined as more states have imposed EV registration fees (American Energy Institute calculations, EEFE).*

A volume-weighted average of gasoline and diesel taxes for light-duty vehicles comes out to approximately $0.59/gallon, comprising roughly 20% of the cost of fuel. For a light-duty vehicle that gets 30.7 MPG over 120,000 miles, $0.59/gallon adds up to $2,506 of federal and state fuel and road taxes, which an equivalent EV avoids paying entirely. Many states also impose differing registration fees on gasoline vehicles and EVs. These fuel taxes and registration fees need to be compared to the taxes EV owners pay on electricity. Since 2019, the average avoided fuel cost of an EV has declined from $300 in 2019 to just over $200 in 2023. The cost of avoided gas and diesel taxes and the avoided registration fees adds $2,506 and $0.65 per gallon equivalent to the lifetime costs of owning the EV.

SECTION 3: INDIRECT SUBSIDIES AND SOCIALIZED INFRASTRUCTURE COSTS

Socialized infrastructure costs add $11,833 per EV to the cost of ownership (Bennett and Isaac, 2023, p. 6). In addition, each EV owner will accrue $4,569 in private costs for installation of residential and private charging equipment, behind the meter electricity losses, and billing/ overhead (Bennett and Isaac, 2023, p. 6). Copper and aluminum prices coupled with rising labor costs have pushed up utilities cost of upgrading transmission and distribution. Adjusting TPPF's estimate by the recorded 7.5% increase in the producer price index for residential electricity distribution raises the costs up to $4,912 per EV (FRED, 2024). Put in terms of gallon equivalent, these internalized costs totaled $1.28 per gallon of gasoline-equivalent.

Brent and Isaac (2023) found non-EV owners bear $1,318 per EV due to publicly subsidized charging stations. Excluded from the $1,318 were billions of dollars in subsidies appropriated for public and private EV charging infrastructure in the BIL and the IRA. In addition to federal financial support, some state governments and scores of public utilities began subsidizing residential charging stations through tax credits and direct rebates. Most of these subsidies are paid for by taxpayers and utility ratepayers, adding an additional $442 cost to society per EV.

Few state governments offer direct subsidies or tax credits for in-home and commercial charging stations, but many subsidies are now flowing form the federal government. In 2021, BIL awarded $5 billion (Federal Highway Administration, 2021) in electric vehicle infrastructure funds. States have received over $4 billion of these funds to begin working on projects that benefit their EV drivers. As of May 30, 2024, only 8 charging stations have been built using the allotted NEVI funds (Lancaster, 2024).

In 2022, the IRA offers individuals a $1,000 tax credit to offset installation costs of an in-home level 2 charging port (IRS, 2024). We assume that individuals will receive all $1,000 for installing chargers. Businesses can

receive a tax credit of 30% of the installation cost up to $100,000 for installing charging infrastructure. For this analysis, we assume that all DC fast charging ports installed received the $100,000 value of the federal tax credit. However, as of this writing the IRS has interpreted the statute as allowing multiple $100,000 credits per EV charging stations and, if this loophole is finalized, the costs of these subsidies could balloon substantially.

EV charging infrastructure is mostly supported by public utilities, and utilities in 40 states offer rebates for in-home level 2 chargers. These rebates typically range from $250 up to $500, with the average being $457. Utilities in 27 states offer additional commercial rebates averaging $3,187 for publicly accessible level 2 chargers. Utilities in 22 states offer an $56,895 on average for businesses installing DC fast charging ports. Of course, utilities have a vested financial incentive to lobby in favor of subsidies to build as much EV infrastructure as possible. Private and public charging infrastructure and significant upgrades to the power distribution systems needed to serve this new load is eligible for inclusion in setting higher utility rates (Allen, 2017).

For example, assume an EV owner installs a level 2 charger on a street of 10 people. The Local Electric Company awards the EV adopter with a $500 rebate. The utility logs the $500 rebate as investment in fixed capital investment and heads to the public utilities commission to seek approval for raising the base-rate. The public utility commission set regulated rate of return for capital investment for electric utilities is 9% (Lowrey, 2024). When the commission approves higher base rate — which they will invariably do for any green infrastructure — they allow Local Electric to recover the $500 plus an additional $45 in interest. Divided among the 10 residents of the block, each household sees rates rise by $54.50 to cover the cost of one neighbor accepting a level 2 charger rebate.

EV charger rebates offer utilities lucrative returns, which are especially tantalizing after two decades of flat electricity demand (EIA, 2024). The

rebates for EV infrastructure are driving up base-rates nationwide. In 2021, state utility commissions approved nearly $7 billion in base rate increases, $5.3 billion in 2022, and a record $9.7 billion in 2023 (EIA, 2024). These increase in base rates do not solely reflect the cost of in-home and public EV charging infrastructure, however, both are often included in public utilities base rate cases (SB19-077, 2019, Gokee, 2022, EIA, 2024).

Assuming that each EV resulted in the installation of one in-home or commercial charger, the 1,113,600 EVs registered in 2023 received $827,340,386 in residential charging tax credits and rebates. All 3,555,600 registered EVs received $6.528 billion in commercial infrastructure benefits. Included in this $6.528 billion was the federal government's $5 billion NEVI funding, and $528 million charging stations built in 2023 received from the Federal commercial infrastructure tax credit, state grant programs, and public utilities commercial rebates paid.

Over the 10-year lifespan of an EV, residential and commercial infrastructure rebates and taxpayer subsidies for EVs will add up to $74.29 and $183.58 per year, respectively. These rebates are paid for by society through higher electricity rates and with taxpayer dollars. They increase the cost of avoided infrastructure up to $1,575 per EV per year, or $0.41 per gallon equivalent.

SECTION 4: ITEMS OMITTED FROM THIS STUDY

Despite this paper finding lifetime ownership cost of an EV increased 94 – 214 percent from Bennett and Isaac's more conservative estimate (2023), our estimate still omits major costs and subsidies associated with EV ownership. Among these omitted costs are federal and state taxpayer-funded supply chain subsidies, battery replacement and recycling costs, and dozens of other incentives to push automakers to make more EVs and consumers to buy them. And while this study aimed to appraise the

shadow cost of EV ownership, it did not examine the cost burden that accrues to each income percentile.

The IRA appropriated billions in grants, subsidies, and loans for domestic battery manufacturing (2022, Sec. 13502). The advanced manufacturing production tax credit (45X) offers battery manufacturers $35 per kilowatt-hour of capacity for battery cells made in America with American components (Buffie, 2024; McGuireWoods, 2024). These fully refundable tax credits will award billions of taxpayer dollars every year to battery manufacturers. For example, Tesla's Gigafactory near Reno, NV manufactures 37 gigawatt-hours of batteries each year (The Tesla Team, 2023), potentially earning up to $1.7 billion annually in 45X credits. Assuming the average EV battery has a capacity of 80 kWh, this subsidy amounts to $3,600 per battery.

In addition to federal grants and subsidies, states have offered billions in subsidies and tax breaks to battery manufacturers. The state of Nevada offered Tesla $1.3 billion to construct its gigafactory (Whaley, 2014). Ford's prospective battery production facility in south-central Michigan was slated to receive $1 billion in state support. However, losses accrued to Ford's EV Model E unit promoted a scaling back of the battery plant, and the state of Michigan reduced its support to $384 – $409 million (Noble, 2024). The state of Kentucky offered Ford a $250 million loan to construct another battery plant in the state (Associated Press, 2023). In 2023, Georgia awarded $358 million in tax breaks, grants, and subsidies to a Norwegian battery manufacturer (Hansen, 2023). Should the EV transition fail to materialize as projected, taxpayers in these states will need to foot the bill for the battery boom that never was.

Battery replacement and recycling is another multi-billion-dollar cost omitted from this study. EV batteries are warranted for 8 years (Fischer, 2022), but reality is showing that the batteries often fail earlier than that, especially for vehicles located in extremely hot or cold climates (Bartlett, 2024). Replacing

an EV battery can cost up to $20,000 (Recurrent, 2023). Given an EV's anticipated lifespan of 10 years, its likely each EV will require at least one new battery. However, most EVs are located in regions susceptible to extreme heat and cold (Fitzpatrick and Beheraj, 2023). Ergo, many of these EVs will likely require a second battery replacement.

Disposing of EV batteries presents a suite of costly challenges. Considered hazardous waste, EV batteries require supply chains and facilities for safe disposal. Recycling these batteries is physically, chemically and logistically challenging (Moseman and Olivetti, 2023). Differing battery sizes between battery manufacturers complicates the sorting stage and will require bespoke processes and equipment capable of disassembling each battery type. Separating the battery and base metals will then need to be done through incinerating or acid leaching (Moseman and Olivetti, 2023). However, the biggest problem EV battery recycling faces is storage. With the battery recycling industry still in its infancy, batteries are piling up outside of woefully unprepared processing facilities. When exposed to the elements, the highly volatile compounds in batteries are at risk of combusting.

A single EV fire releases over 100 carcinogenic compounds into the air and surrounding environment, which include heavy metals and hydrogen cyanide (Gaige, 2024). An uncontainable fire at an EV battery recycling facility can multiply the potential environmental and human health damage by a thousand times. Following the Fredericktown, Missouri battery recycling plant fire, residents claimed there were thousands of dead fish in a creek near the plant fire (Vasan, 2024). EPA's monitoring indicated an increase in PM 2.5 and PM 10, but officials claimed the increase was "non-site" related (Martinez, 2024). The Scottish EPA recently suspended the license of a battery recycling plant following a fire in Kilwinning (Smulian, 2024). As the battery waste from EVs increases, the chances of fire and detrimental effects to human health also increases.

These adverse health impacts must be accounted for in air emission studies and benefit-cost analysis of EVs.

Other issues excluded from this analysis include:

- Billions of dollars in taxpayer-funded subsidies for electric buses, trucks, and truck stops, plus the addition of charging infrastructure at public facilities such as airports and ports.
- Tacit subsidies to EV drivers provided through state low-carbon fuel standards.
- The increased cost on public and private highways, roads, bridges and parking infrastructure imposed by EVs that are much heavier than comparable ICEVs.
- Disproportionately high EV recalls compared to ICE vehicles, part of which is socialized to ICE vehicle buyers from the company initiating the recall.
- The interest accrued on public utilities' capital expenditures on EV infrastructure.
- Unaccounted cost of the additional emissions and electricity generated by power plants.
- Environmental damage caused by the EV supply chain.

Finally, this paper did not examine the disproportionate impact of the socialized cost of EV ownership on the poor, who will be paying higher prices for used and new ICE vehicles, higher gas-taxes to offset road damage done by EVs, and increased monthly electric bills stemming from EV rebates and infrastructure subsidies given by utilities. Future versions of this study may quantify the social cost of EV ownership and examine its burden across income deciles.

CONCLUSION

The federal drive toward electric vehicles (EVs) has introduced extensive regulatory measures and corporate welfare that have imposed a costly burden on ICEV consumers, traditional automakers, and American taxpayers. Mandates and complex regulatory credit schemes imposed by agencies such as the EPA and NHTSA force automakers to prioritize EV production at an enormous financial loss, masked only by billions in subsidies. These costs are ultimately passed down to ICEV buyers, taxpayers, and utility ratepayers, resulting in higher prices and an artificially manipulated market that sidelines actual consumer demand.

The true cost of EV ownership — when factoring in hidden subsidies, infrastructure expenses, and indirect costs — remains largely hidden from the public. By focusing narrowly on EV owners' out-of-pocket costs, most analyses fail to capture the significant impact on American consumers at large. Over a 10-year period, each 2023 EV is expected to cost society between $94,121 and $152,695, or as much as $41.24 per gasoline-equivalent gallon — undermining the claim that EVs provide a more affordable transportation alternative.

Despite the aggressive financial backing and promotion of EVs, the majority of consumers continue to prefer the flexibility and variety offered by traditional vehicles. A notable portion of EV buyers report dissatisfaction and a desire to return to ICEVs, further indicating a disconnect between government mandates and consumer choice. Rather than relying on regulatory credits and subsidies that distort the market, automakers should be free to build vehicles that consumers want — whether that means small, fuel-efficient cars or large, family-sized SUVs.

As we look ahead, it's clear that a consumer-driven market, free from regulatory distortions, would better align with the diverse needs of American drivers, support a healthy economy, and restore transparency to the automotive industry.■

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