ORAL ARGUMENT NOT YET SCHEDULED
No. 18-1114 (consolidated with 18-1118, 18-1139, 18-1162)

United States Court of Appeals for the District of Columbia Circuit

STATE OF CALIFORNIA, et al.,
Petitioners,
v.
ENVIRONMENTAL PROTECTION AGENCY, et al.,
Respondents.

ALLIANCE OF AUTOMOBILE MANUFACTURERS; ASSOCIATION OF GLOBAL AUTOMAKERS, INC.,
Intervenors for Respondent.

On Petition for Review of Agency Action by the United States Environmental Protection Agency, No. EPA-83FR16077

SEPARATE ADDENDUM OF PETITIONERS NATIONAL COALITION FOR ADVANCED TRANSPORTATION, CONSOLIDATED EDISON COMPANY OF NEW YORK, INC., NATIONAL GRID USA, NEW YORK POWER AUTHORITY, AND THE CITY OF SEATTLE, BY AND THROUGH ITS CITY LIGHT DEPARTMENT

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February 7, 2019

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IN THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

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DECLARATION OF CAROLINE CHOI

I, Caroline Choi, do hereby declare that the following statements made by me under oath are true and accurate to the best of my knowledge, information, and belief:

1. I am Senior Vice President, Regulatory Affairs for Southern California Edison ("SCE"). I am responsible for SCE's regulatory strategy and policy at the national and state levels, including regulatory affairs, regulatory operations and environmental affairs.

2. SCE is a subsidiary of Edison International, and is headquartered in Rosemead, California. SCE is one of the nation's largest electric utilities in the United States, serving more than 15 million people in a 50,000-square-mile area of southern California.

3. Edison International is a member of the National Coalition for Advanced Transportation ("NCAT").

4. SCE is committed to leading the transformation of the electric power industry toward a clean energy future. This electric-led strategy includes utility investment in programs to build and support the expansion of transportation electrification.

5. SCE supports strong vehicle greenhouse gas ("GHG") emissions standards and believes that the existing United States Environmental Protection Agency ("EPA") standards for model year ("MY") 2022-2025 light-duty vehicles are appropriate and readily achievable. SCE believes that the standards are critical to achieving air quality and climate goals, and, as described below, SCE is actively investing in infrastructure and other programs that support customer adoption of zero-emission vehicles and successful implementation of the standards.

6. SCE has developed a comprehensive and long-term business strategy in which SCE will play a leadership role in the electrification of the transportation sector, in order to achieve significant reductions in GHG and criteria pollutant

emissions. This strategy is described in SCE's vision for "Transportation Electrification: Reducing Emissions, Driving Innovation"[1] and "The Clean Power and Electrification Pathway."[2]

7. SCE's strategy involves substantial development of electrical infrastructure to support and enable the attainment of state and federal air quality and state climate change goals. These programs also stimulate technology innovation and market competition, enable consumer choice in charging equipment and services, attract private capital investments, and create high quality jobs for the public and our customers.

8. For example, in June of 2018 SCE filed an application with the California Public Utilities Commission seeking approval for a $760 million program in electric vehicle ("EV") fueling infrastructure—supporting up to 48,000 charge ports in SCE's service area—and market education and outreach.[3] To-date, SCE has funded approximately $18 million in infrastructure and programs to support 1,042 charge ports at 69 customer sites through its "Charge Ready" program. SCE also

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[1] White Paper (Jan. 2017), https://www.edison.com/content/dam/eix/documents/our-perspective/201701-transportation-electrification-reducing-emissions-driving%20-innovation.pdf.

[2] White Paper (Nov. 2017), https://www.edison.com/content/dam/eix/documents/our-perspective/g17-pathway-to-2030-white-paper.pdf.

[3] Application of SCE for Approval of its Charge Ready 2 Infrastructure and Market Education Programs (June 26, 2018), http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/2393DAED8E6B077F882582B800734ED4/$FILE/A1806XXX-%20SCE%20Charge%20Ready%202%20Application.pdf.

has approval from the California Public Utilities Commission for $360 million in transportation electrification infrastructure and programs to support medium-and-heavy-duty electric vehicles, $4 million in infrastructure and programs supporting direct-current fast charging ports, and $4 million in infrastructure to support electrification of port equipment at the Port of Long Beach.

9. In order to successfully plan, develop, obtain approval, and execute programs like these, SCE must rely on consistent implementation of regulatory programs.

10. SCE's parent company, Edison International, participated in EPA's mid-term evaluation process to assess the appropriateness of maintaining the existing light-duty vehicle GHG standards for vehicle MY 2022–2025, submitting comments to the agency through NCAT.[4]

11. EPA's mid-term evaluation final determination issued in April 2018[5] ("Revised Final Determination") has created substantial uncertainty by finding that the current standards are not appropriate, and by including inaccurate and erroneous

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[4] NCAT, Comments on EPA's Request for Comment on Reconsideration of the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles; Request for Comment on Model Year 2021 Greenhouse Gas Emissions Standards, EPA Docket No. EPA–HQ–OAR–2015–0827–9101 (Oct. 5, 2017).

[5] EPA, *Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles*, 83 Fed. Reg. 16,077 (Apr. 13, 2018).

findings on topics such as EV adoption and consumer acceptance. (83 Fed. Reg. at 16,080-81 & Fig. 1[6]).

12. Regulatory uncertainty and inconsistent and inaccurate analysis and findings related to key factors, such as EV demand and emission reduction needs, leads to unnecessary transaction and planning costs by causing confusion and producing distorted data regarding the market.

13. SCE supports strong vehicle GHG emissions standards and believes that the existing standards for MY 2022-2025 light-duty vehicles are appropriate and readily achievable. SCE believes that the standards are critical to achieving air quality and climate goals. SCE is actively developing infrastructure and other programs that support customer adoption of the zero-emission vehicles and successful implementation of the standards.

14. SCE believes that clear, consistent, and factually supported regulatory programs controlling emissions from mobile sources are critical to achieving vital air quality and climate goals, and ensuring that SCE can effectively plan and

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6 EPA's inclusion of an out-of-date figure which suggests EV sales continued to decline in 2016, coupled with the assertions that "consumer adoption remains very low," (83 Fed. Reg. at 16,081) and "EV Sales have decreased" (*id.* at 16,083) are examples of unsupported and invalid findings in the Revised Final Determination that can adversely impact SCE by, among other things, increasing transaction and planning costs to respond to, and account for, the EPA findings and decision in the Revised Final Determination. As explained in NCAT's Comments (at 17): "2016 sales of EVs jumped by 37 percent year over year—to over 159,000 vehicles—and the number of offerings increasing to 30 different models."

implement infrastructure programs to support these goals and our customers. The EPA's findings in the Revised Final Determination impair these efforts.

I declare under penalty of perjury pursuant to 28 U.S.C. § 1746 that the foregoing is true and correct. Executed on August 28, 2018.

Caroline Choi

<u>ORAL ARGUMENT NOT YET SCHEDULED</u>

**IN THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

NATIONAL COALITION FOR ADVANCED TRANSPORTATION, Petitioner, v. ENVIRONMENTAL PROTECTION AGENCY, Respondent.	Case No. 18-1118 Consolidated with case nos. 18-1114, 18-1139, 18-1162

DECLARATION OF PAUL LAU

I, Paul Lau, do hereby declare that the following statements made by me under oath are true and accurate to the best of my knowledge, information and belief:

1. I am the Chief Grid Strategy and Operations Officer at the Sacramento Municipal Utility District ("SMUD"). I am responsible for operation of SMUD's power markets, transmission, and distribution grids, including the Balancing Authority of Northern California (BANC), the development of a holistic smart grid strategy, and overseeing our utility's research & development programs.

2. Created by voters in 1923, SMUD is the nation's sixth-largest community-owned electric service provider, serving 624,770 customer accounts and a population of approximately 1.4 million in Sacramento, California.

3. SMUD is a member of the National Coalition for Advanced Transportation ("NCAT").

4. SMUD supports the United States Environmental Protection Agency's ("EPA") existing light-duty vehicle greenhouse gas ("GHG") emissions standards. EPA's existing model year ("MY") 2022-2025 standards provide important long-term incentives for manufacturing and deployment of electric vehicle technologies and supporting infrastructure. SMUD's interest in opposing a reduction in the stringency of EPA's existing light-duty vehicle standards stems primarily from SMUD's direct financial investments in infrastructure and in special electricity rates to foster electric vehicle ("EV") growth.

5. The regulatory certainty of EPA's existing standards has allowed SMUD to model projected EV penetration in SMUD's service territory, budget for needed infrastructure investments, and offer incentives to encourage EV adoption that will scale SMUD's investments. Between 2010 and 2017, SMUD spent over $27 million on its internal EV research and development program, and is on track to spend an additional $7.3 million by 2021. In addition since 2000, SMUD has spent $10.5 million to support EV charging infrastructure, outreach and education,

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and incentives for electric vehicles. SMUD has relied on EPA's existing MY 2022-2025 light-duty vehicle GHG standards in planning for these programs.

6. SMUD participated in EPA's Mid-Term Evaluation process to assess the appropriateness of maintaining the existing light-duty vehicle GHG standards for vehicle model years 2022 through 2025, submitting comments to the agency through NCAT.[1]

7. In April 2018, EPA issued its revised mid-term evaluation final determination ("Revised Final Determination") finding that the MY 2022-2025 standards are not appropriate, and must be revised.[2] EPA's Revised Final Determination also withdrew its prior January 2017 final determination in which the agency had found the MY 2022-2025 standards were appropriate.[3] In the Revised Final Determination, EPA relied on incomplete and inaccurate findings related to electric vehicle technology adoption and consumer acceptance.[4]

8. EPA's Revised Final Determination has created substantial uncertainty by determining that the existing MY 2022-2025 standards must be

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[1] NCAT, Comments on EPA's Request for Comment on Reconsideration of the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles; Request for Comment on Model Year 2021 Greenhouse Gas Emissions Standards, EPA Docket No. EPA–HQ–OAR–2015–0827–9101 (Oct. 5, 2017).

[2] EPA, *Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles*, 83 Fed. Reg. 16,077 (Apr. 13, 2018).

[3] *Id.* at 16,077.

[4] *Id.* at 16,079-81.

revised, and that the levels of EV deployment the agency previously projected are not feasible. By requiring revision of the standards, EPA's Revised Final Determination has undermined confidence in and/or altered the market projections that SMUD uses to determine the appropriate level of investment in EV infrastructure and the value of the rates it has offered to EV customers. EPA's action accordingly has required SMUD to bear new and additional planning and analysis costs related to these market projections.

9. SMUD estimates that relaxing the current standards could slow or reverse EV adoption trends and result in 2 to 3 times lower return on SMUD's investments out to 2030. This would, in turn, cause SMUD to reevaluate its rates and incentives for EV owners, and face choices of taking further financial losses to encourage enough EV adoption to make SMUD's investments scale, increasing rates for EV owners to recoup some losses, or abandoning the EV program after 25 years of investment. In any case, SMUD will need to spend further time and expense modeling, rolling out, and negotiating updated rates.

I declare under penalty of perjury pursuant to 28 U.S.C. § 1746 that the foregoing is true and correct. Executed on August 28, 2018.

Paul Lau

ORAL ARGUMENT NOT YET SCHEDULED

IN THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

NATIONAL COALITION FOR ADVANCED TRANSPORTATION, Petitioner, v. ENVIRONMENTAL PROTECTION AGENCY, Respondent.	Case No. 18-1118 Consolidated with case nos. 18-1114, 18-1139, 18-1162

DECLARATION OF JOSEPH MENDELSON, III

I, Joseph Mendelson, III, do hereby declare that the following statements made by me under oath are true and accurate to the best of my knowledge, information, and belief:

1. I am Senior Counsel, Policy and Business Development at Tesla, Inc. ("Tesla"). I am responsible for Tesla's relations with government agencies at the federal level related to the Environmental Protection Agency's ("EPA") light-duty vehicle greenhouse gas ("GHG") vehicle emissions standards and National Highway Traffic Safety Administration ("NHTSA") corporate average fuel economy ("CAFE") standards. These responsibilities have included facilitating Tesla's

participation, including the drafting and submission of written comments, in the Mid-Term Evaluation process.

2. Tesla is a member of the National Coalition for Advanced Transportation ("NCAT").

3. Tesla is a publicly traded corporation, incorporated in the State of Delaware on July 1, 2003, with headquarters located at 3500 Deer Creek Road, Palo Alto, CA 94304.

4. Tesla's mission is to accelerate the world's transition to sustainable energy. Moreover, Tesla believes the world will not be able to solve the climate change crisis without directly reducing air pollutant emissions—including carbon dioxide and other greenhouse gases—from the transportation and power sectors.

5. To accomplish its mission, Tesla designs, develops, manufactures and sells high-performance fully electric vehicles, and energy generation and storage systems, and also installs and maintains such systems and sells solar electricity. Tesla currently produces and sells three fully electric vehicles: the Model S sedan, the Model X sport utility vehicle, and the Model 3 sedan. A little over a year after its first delivery to customers, the Tesla Model 3 is now one of the top ten best selling cars in America and the Tesla Model S is the best-selling vehicle in its class.

6. Tesla has established, and continues to grow, a large network of retail stores, vehicle service centers, and electric vehicle charging stations to accelerate and support the widespread adoption of its products.

7. In the United States, Tesla conducts vehicle manufacturing and assembly operations at its facilities in Fremont, California and Sparks, Nevada. As an automobile manufacturer, Tesla is subject to regulation under the EPA light-duty vehicle GHG emissions standards and NHTSA CAFE standards.[1]

8. Tesla supports strong EPA GHG and NHTSA CAFE standards for light-duty vehicles. Regulatory certainty in the existing standards has contributed to billions of dollars in investments by Tesla.

9. Tesla has expanded direct investment in its cutting-edge auto manufacturing, to develop innovative new sustainable energy technologies and products, and to invest in new electric vehicle charging and support infrastructure throughout the United States. In 2013, Tesla had 8 Supercharger (DC fast charging) stations in North America. As of July 2018, Tesla's North American network has grown to include over 600 Supercharger Stations with nearly 5,500 individual chargers. It also includes a network of more than 3500 Destination Charging

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[1] EPA & NHTSA, 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 77 Fed. Reg. 62,624 (Oct. 15, 2012).

locations that replicate the convenience of home charging by providing hotels, resorts, and restaurants with Tesla Wall Connectors.[2]

10. Tesla participated in EPA's Mid-Term Evaluation process to assess the appropriateness of maintaining the existing light-duty vehicle GHG standards for vehicle model years ("MY") 2022 through 2025, submitting comments to the agency separately and through NCAT.[3]

11. In April 2018, EPA completed the Mid-Term Evaluation process, issuing a final determination that its existing light-duty vehicle GHG standards for MY 2022–2025 are no longer appropriate under Section 202(a) of the Clean Air Act—a reversal of the agency's January 2017 final determination that these standards were appropriate. EPA's decision, entitled "Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles," was published in the Federal Register at 83 Fed. Reg. 16,077 on April 13, 2018 (the "Revised Final Determination").

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[2] *See* Tesla, On the Road, https://www.tesla.com/supercharger (last visited Aug. 22, 2018).

[3] Tesla, Comments, EPA Docket No. EPA–HQ–OAR–2015–0827–9201 (Oct. 5, 2017); NCAT, Comments on EPA's Request for Comment on Reconsideration of the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light-Duty Vehicles; Request for Comment on Model Year 2021 Greenhouse Gas Emissions Standards, EPA Docket No. EPA–HQ–OAR–2015–0827–9101 (Oct. 5, 2017).

12. The EPA's Revised Final Determination that the existing light-duty vehicle MY 2022-2025 standards were no longer technologically achievable harms Tesla's ability to fulfill its corporate mission of transitioning the world's car fleet to electric vehicles and threatens to negatively influence consumers' confidence in the environmental and technical performance of Tesla's vehicles.

13. EPA's regulations for the Mid-Term Evaluation process require the agency to explain to the public in detail the basis for its final determination, including the agency's assessment of factors specifically listed in the regulation.[4] EPA's failure to provide this information in support of its Revised Final Determination adversely affects Tesla as a participant in the public regulatory process and as an entity regulated by the light-duty vehicle GHG standards. As an electric vehicle manufacturer Tesla has an interest in understanding EPA's justification for its reversal in position on the availability and effectiveness of electric vehicle technology in the agency's feasibility analysis.

14. Tesla's business interests in marketing electric vehicles are adversely affected by EPA's unsubstantiated, inadequately supported, and/or incorrect statements in the Revised Final Determination that reflect negatively on the performance, cost, and consumer acceptance of electric vehicles. EPA's statements in the Revised Final Determination represent a sharp, arbitrary and unsupported

[4] *See* 40 C.F.R. § 86.1818-12(h).

reversal of course in comparison with more favorable statements in its prior January 2017 final determination.

15. EPA's Revised Final Determination creates needless investment uncertainty. This harms Tesla's business by increasing current transaction costs associated with evaluating, planning, and making potential investments in its charging infrastructure and manufacturing expansion.

I declare under penalty of perjury pursuant to 28 U.S.C. § 1746 that the foregoing is true and correct. Executed this 28th day of August.

Joseph Mendelson, III

IN THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

STATE OF CALIFORNIA, et al., *Petitioners,* v. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, et al., *Respondents.*	No. 18-1114 (consolidated with Nos. 18-1118, 18-1139 and 18-1162)

Declaration of Terence Sobolewski

1. I am Senior Vice President and Chief Customer Officer with National Grid USA ("National Grid") and am responsible for the company's activities related to brand, new products, emerging technologies, sales of gas conversion and energy efficiency programs, and customer analytics.

2. National Grid is one of the largest investor-owned utilities in the world and, through its subsidiary companies, delivers electricity and natural gas to

millions of customers in the Northeastern states of Massachusetts, New York, and Rhode Island.

3. The states in which we operate have adopted ambitious plans to address climate change and reduce emissions of greenhouse gases. National Grid considers itself a partner in those efforts and puts environmental sustainability at the core of its mission to deliver affordable, reliable and increasingly clean energy to its customers.

4. National Grid is committed to supporting clean, efficient transportation options for our customers. The company is investing in clean transportation by adding electric vehicles ("EVs") to our fleet and through the buildout of an EV charging infrastructure. To date, National Grid has supported EV adoption by installing and managing more than 150 publicly accessible EV charging stations in Massachusetts, Rhode Island, and New York, with the goal of demonstrating the next generation of faster-charging stations, and by implementing a "Voluntary Time-of-Use Rate" (SC-1 VTOU), offering customers a reduced rate to charge their EVs during off-peak hours (11 pm to 7 am).

5. National Grid has also submitted a three-year EV pilot to the state of Massachusetts that will increase the number of charging ports in our service areas, boost EV adoption rates through various awareness campaigns and pay close attention to how the new load impacts the distribution network. National Grid is

taking these efforts because of the significant environmental and economic benefits EVs can provide to both its customers and the grid.

6. Along with other electric utilities and power providers, National Grid USA has challenged the final action of the United States Environmental Protection Agency ("EPA") entitled "Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022-2025 Light-Duty Vehicles" ("Action"), in which EPA withdrew its "Final Determination" that its greenhouse gas emissions standards for light-duty vehicles for model years 2022-2025 are appropriate and also announced a "Revised Final Determination" that the standards are not appropriate and should be revised because they are based on outdated information and more recent information indicates they are too stringent.

7. National Grid, along with other companies, submitted comments to EPA on its reconsideration of the Final Determination, urging EPA to maintain the standards because they provide the regulatory certainty needed to send long-term investment signals to promote low-carbon, low-emitting transportation.

8. By withdrawing its determination that its emissions standards are appropriate and finding instead that the standards are not appropriate and should be revised to be less stringent, EPA's Action has created substantial uncertainty with respect to whether and when EVs will be deployed by automakers and

adopted by consumers in the numbers needed to realize the economic and environmental benefits of the company's investments in EV infrastructure.

I declare under penalty of perjury pursuant to 28 U.S.C. § 1746 that the foregoing is true and correct. Executed on August 29, 2018.

Terence Sobolewski

Greenhouse Gas Emission Standards for Light-Duty Vehicles

Manufacturer Performance Report for the 2016 Model Year

Aston Martin
Lotus
McLaren
Tesla
Kia
BYD Motors
Toyota
Honda
Mazda
Ford
Subaru
General Motors
Mitsubishi
Nissan
Volkswagen
BMW
Fiat Chrysler
Volvo
Mercedes-Benz
Suzuki
Jaguar
Land Rover
Ferrari
Hyundai
Coda
Fisker
Porsche
Aston Martin
Lotus
McLaren
Tesla
Kia
BYD Motors
Toyota
Honda
Mazda
Ford
Subaru
General Motors
Mitsubishi
Nissan
Volkswagen
BMW
Fiat Chrysler
Volvo
Mercedes-Benz

EPA United States Environmental Protection Agency
EPA-420-R-18-002 January 2018

Greenhouse Gas Emission Standards for Light-Duty Vehicles

Manufacturer Performance Report for the 2016 Model Year

NOTICE:

This technical report does not necessarily represent final EPA decisions or positions. It is intended to present technical analysis of issues using data that are currently available. The purpose in the release of such reports is to facilitate the exchange of technical information and to inform the public of technical developments.

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EXECUTIVE SUMMARY

Background

On May 7, 2010, the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) issued a joint Final Rule to establish the first phase of a National Program with new standards for 2012 to 2016 model year light-duty vehicles that reduce greenhouse gas (GHG) emissions and improve fuel economy. These standards apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles. Subsequently, on October 15, 2012, EPA and NHTSA issued standards for GHG emissions and fuel economy of light-duty vehicles for model years 2017–2025, building on the first phase of the joint National Program.

EPA is releasing this report as part of our continuing commitment to provide the public with transparent and timely information about manufacturers' compliance with the GHG program.[1] This report supersedes previous reports and details manufacturers' performance towards meeting GHG standards in the 2016 model year, the fifth and final year of the first phase of the EPA GHG standards. This report includes data through the end of the 2016 model year. Some values from previous model years may have changed based on changes or corrections to the historical data.[2]

The following figure illustrates the process and the inputs that determine a manufacturer's compliance with the light-duty vehicle GHG emission standards. Every manufacturer starts at the same place: by measuring the CO_2 tailpipe emissions performance of their vehicles using EPA's City and Highway test procedures (referred to as the "2-cycle" tests). Then they may choose to apply a variety of optional technology-based credits to further reduce their fleet GHG emissions compliance value. The 2-cycle tailpipe CO_2 value, when reduced by the net grams per mile equivalent of the optional credits, determines a manufacturer's model year performance and whether credits or deficits are generated by a manufacturer's model year fleet.

It is important to note that the Department of Justice, on behalf of EPA, alleged violations of the Clean Air Act by Fiat Chrysler Automobiles based on the sale of certain 2014 through 2016 model year vehicles equipped with devices that defeat the vehicles' emission control systems. In addition, the Department of Justice and EPA have reached a settlement with Volkswagen over the use of defeat devices for certain 2009 through 2016 model year vehicles. In this report, EPA uses the CO_2 emissions and fuel economy data from the initial certification of these vehicles. Should the investigation and corrective actions yield different CO_2 and fuel economy data, any relevant changes will be used in future reports. For more

[1] Relevant information on the CAFE program can be found on the NHTSA website at NHTSA's CAFE Public Information Center: http://www.nhtsa.gov/CAFE_PIC/CAFE_PIC_Home.htm.

[2] This report summarizes data as it was reported to EPA by the manufacturers and does not necessarily represent final EPA decisions or positions regarding the data or the compliance status of manufacturers.

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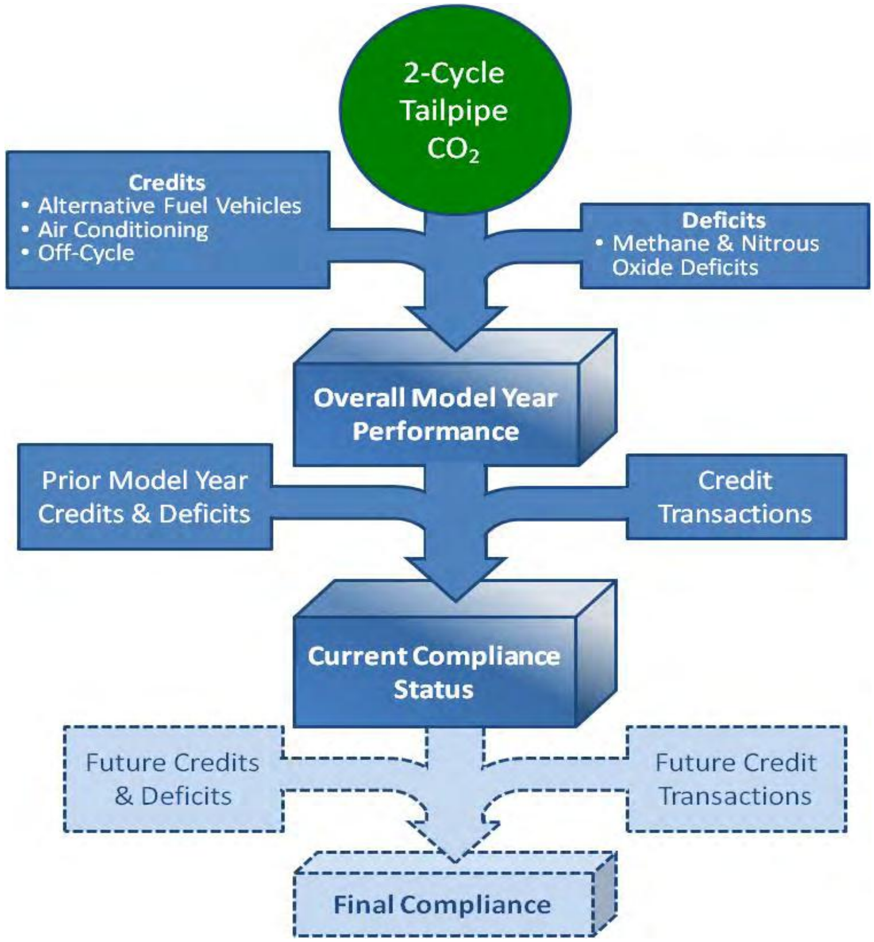
information on actions to resolve these alleged violations, see www.epa.gov/vw and www.epa.gov/fca.

Process for Determining a Manufacturer's Compliance Status



Individual model year performance, however, does not directly determine model year compliance or non-compliance. Manufacturers with deficits in a model year may use credits carried over from a previous model year to offset a deficit. They may also purchase credits from another manufacturer. Manufacturers with a deficit at the conclusion of a model year may also carry that deficit forward into the next model year. Manufacturers must, however, offset any deficit within three years after the model year in which it was generated to avoid enforcement action. After considering these additional credits and deficits, EPA determines a manufacturer's current compliance status. For example, a manufacturer with a deficit remaining from model year 2013 after the 2016 model year would be considered out of compliance with the 2013 model year standards. As this report will show, there are no manufacturers that ended 2016 in this position. No manufacturer is yet out of compliance with the GHG program in any of these first five model years; their performance in subsequent years, and whether deficits can be successfully offset using future credits (either generated or acquired) will ultimately determine final compliance.

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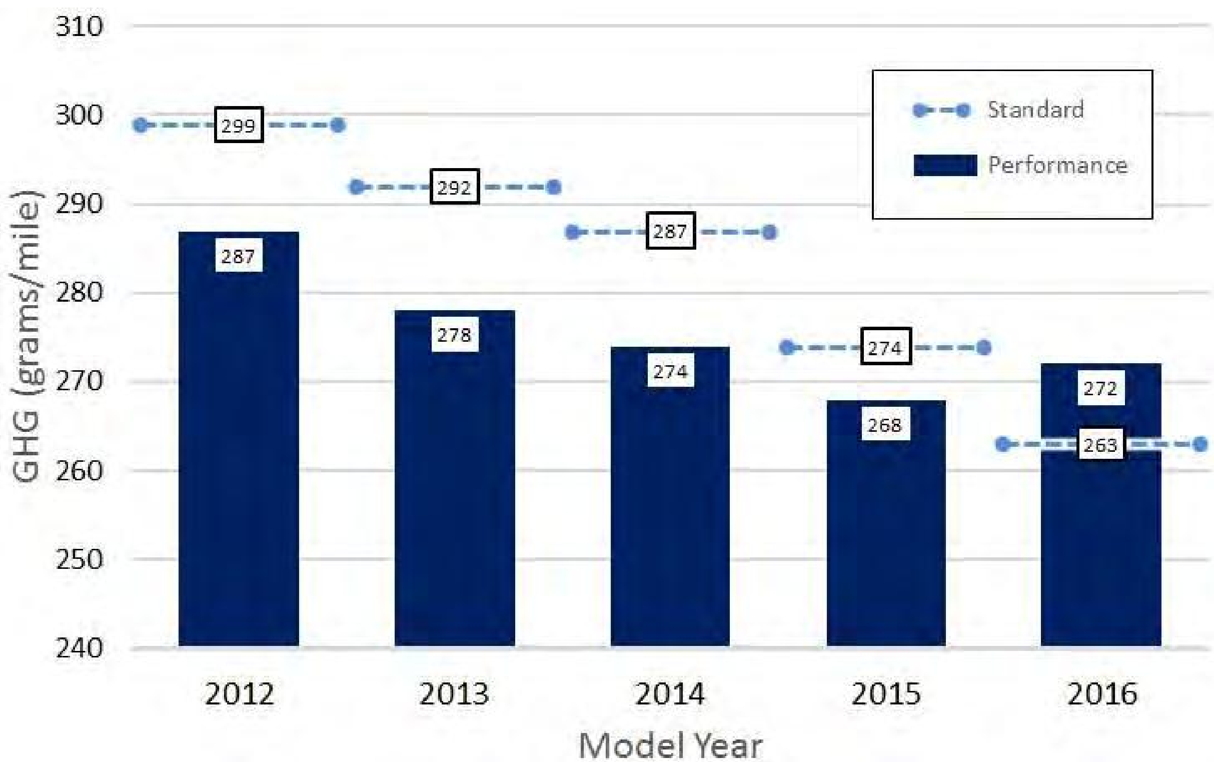
1 *The auto industry generated a GHG deficit in the 2016 model year, but all major manufacturers comply with the 2016 standards, with some companies using credits from prior years.*

Overall industry performance in model year 2016 was 9 grams/mile higher than required by the 2016 GHG emissions standard. This makes 2016 the first model year in which the industry generated a GHG emissions deficit, after generating credits in each of the first four years of EPA's program. The increases in stringency in the standards in the 2015 and 2016 model years were the largest increases in the first phase of EPA's GHG program; since the 2014 model year the standards have decreased by 24 grams/mile. The standards were intentionally structured with this progression of increasing stringency, as explained in the rulemaking. A contributing factor to the 9 gram/mile industry-wide gap between performance and the standard in the 2016 model year was the expiration of flexible fuel vehicle credits. Due to the credits accumulated in the previous four years and early credits generated by some manufacturers in the 2009-2011 model years, some of which were used to offset the 2016 deficit, the industry as a whole does not face any non-compliance issues in the 2016 model year. See Section 3 for more detail on these values.

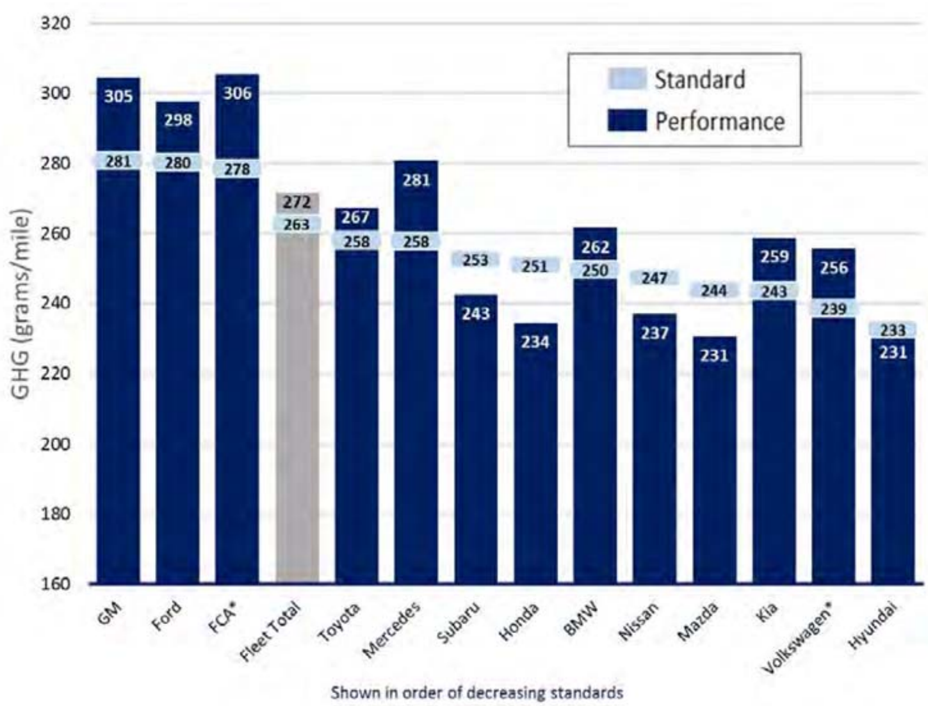
Figure ES-1. Industry Performance versus Standards, 2012-2016 Model Years



2 *Eight out of the thirteen largest manufacturers generated deficits relative to their 2016 model year standards, but used credits from previous model years to comply.*

Unlike the previous four years, in which generating credits was the norm, most large manufacturers (with sales greater than 150,000 vehicles) generated deficits in the 2016 model year. Five of the thirteen manufacturers reported beating their standard, with compliance margins ranging from 16 grams/mile (Honda) to 1 gram/mile (Hyundai). The remaining eight generated deficits against their standard due to fleet GHG emissions that were higher than the standard by amounts ranging from 10 grams/mile (Toyota) to 28 grams/mile (FCA). Note that the figure below does not include the impact of credit transfers reported from prior model years (within a company) or reported credit trades (transactions between companies), and thus does not portray whether or not a manufacturer has complied with the 2016 model year standards. In fact, the manufacturers that generated a 2016 model year GHG deficit have reported sufficient credits available from prior model years to be able to offset that deficit and thus achieve compliance with their respective 2016 model year standards. More detail about model year 2016 performance is provided in Section 3.

Figure ES-2. Manufacturer Performance and Standards in the 2016 Model Year



* FCA and Volkswagen are subjects of an ongoing investigation and/or corrective actions. These data are based on initial certification data provided to EPA, and are included in industry-wide, "Fleet Total", or "All" values. Should the investigation and corrective actions yield different CO_2 data, any relevant changes will be used in future reports.
Note: Rounding may result in differences between charts and tables and the values reported in the text.

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3 *All large manufacturers concluded Phase 1 of EPA's GHG standards meeting the standards and with substantial credits available to use through 2021.*

The majority of manufacturers, representing 99 percent of 2016 model year U.S. sales, have reported compliance with the standards for the 2012-2016 model years. In fact, 19 of 21 manufacturers are reporting a non-negative credit balance going into the 2017 model year, meaning that these manufacturers have met the standards in all of the 2012-2016 model years (credits cannot be carried forward if a deficit exists in a prior model year). Manufacturers are allowed to carry deficits forward for three model years. Thus, a manufacturer with a deficit from the 2016 model year (such as Volvo) must offset that deficit by the end of the 2019 model year, or be subject to possible enforcement action. All manufacturers that initially reported a deficit in the 2012-2013 model years have successfully offset that deficit, thus no manufacturer is in a position of non-compliance for any model year at the end of the 2016 model year. The makeup of these credit and deficit balances is tracked by model year "vintage" as explained in Section 5.

Table ES-1. Credit Balances After the 2016 Model Year (Mg)[3]
(including credit transfers & trades)[4]

Manufacturer	Credits Carried to 2017	Manufacturer	Credits Carried to 2017
Toyota	78,078,963	Mercedes	2,991,505
Honda	36,024,476	Mitsubishi	1,755,470
Nissan	26,682,834	Suzuki*	428,242
Ford	22,084,139	Karma Automotive*	58,852
Hyundai	20,583,544	BYD Motors*	4,824
GM	19,666,700	Tesla	576
Subaru	14,498,843	Volvo	(9,218)
Mazda	9,424,551	Jaguar Land Rover	(1,387,781)
Kia	6,011,615	*FCA†*	*19,217,792*
BMW	3,202,342	*Volkswagen†*	*2,438,608*
All Manufacturers			**261,759,183**

†FCA and Volkswagen are listed separately in this table due to an ongoing investigation and/or corrective actions. These data are based on initial certification data, and are included in industry-wide or "All" values. Should the investigation and corrective actions yield different CO_2 data, any relevant changes will be used in future reports.
*Although these companies produced no vehicles for the U.S. market in the most recent model year, the credits generated in previous model years continue to be available.

[3] The Megagram (Mg) is a unit of mass equal to 1000 kilograms. It is also referred to as the metric ton or tonne.
[4] This table does not include unused credits from the 2009 model year, which expired at the end of the 2014 model year. See Section 2 for more information.

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C. Credits Based on Alternative Fuel Vehicles

EPA's GHG program contains several credits and incentives for dedicated and dual fuel alternative fuel vehicles. Dedicated alternative fuel vehicles are vehicles that run exclusively on an alternative fuel (e.g., compressed natural gas, electricity). Dual fuel vehicles can run both on an alternative fuel and on a conventional fuel such as gasoline; the most common is the gasoline-ethanol flexible fuel vehicle, which is a dual fuel vehicle that can run on E85 (85 percent ethanol and 15 percent gasoline), or on conventional gasoline, or on a mixture of both E85 and gasoline in any proportion. Dual fuel vehicles also include vehicles that use compressed natural gas (CNG) and gasoline, or electricity and gasoline. This section separately describes three different and uniquely-treated categories of alternative fuel vehicles: advanced technology vehicles using electricity or hydrogen fuel cells; compressed natural gas vehicles; and gasoline-ethanol flexible fuel vehicles.

1. Advanced Technology Vehicles

EPA's GHG program contains incentives for advanced technology vehicles. For the 2012-2016 model years, the incentive program allows electric vehicles and fuel cell vehicles to use a zero grams per mile compliance value, and plug-in hybrid electric vehicles may use a zero grams per mile value for the portion of operation attributed to the use of grid electricity (i.e., only emissions from the portion of operation attributed to gasoline engine operation are "counted" for the compliance value). Use of the zero grams per mile option is limited to the first 200,000 qualified vehicles produced by a manufacturer in the 2012-2016 model years. Electric vehicles, fuel cell vehicles, and plug-in hybrid electric vehicles that were included in a manufacturer's calculations of early credits also count against the production limits. As noted in Section 2, both GM and Mercedes selected an option in the early credit provisions by which they could choose to set aside their relatively small 2011 model year advanced technology vehicle production for inclusion in a future model year yet to be determined.

All manufacturers of advanced technology vehicles in the 2012-2016 model years are well below the cumulative 200,000 vehicle limit for the 2012-2016 model years, thus all manufacturers remain eligible to continue to use zero grams per mile. If a manufacturer were to reach the cumulative production limit before the 2017 model year, then advanced technology vehicles produced beyond the limit must account for the net "upstream" emissions associated with their vehicles' use of grid electricity relative to vehicles powered by gasoline. Based on vehicle electricity consumption data (which includes vehicle charging losses) and assumptions regarding GHG emissions from today's national average electricity generation and grid transmission losses, a midsize electric vehicle might have upstream GHG emissions of about 180 g/mi, compared to the upstream GHG emissions of a typical midsize gasoline car of about 60 g/mi. Thus, the electric vehicle would have a net upstream

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emissions value of about 120 g/mi.[23] EPA regulations provide all the information necessary to calculate a unique net upstream value for each electric or plug-in hybrid electric vehicle.[24]

The nature of this incentive is such that it is reflected in the 2-cycle emissions values shown in Section 3.A. For example, the incentive allows Tesla to record zero grams per mile for their fleet (see Table 3-1) in the 2012-2016 model years. Without the incentive, however, the 2016 model year 2-cycle fleet average GHG emissions for Tesla would in fact be about 105 g/mi.[25] Use of the incentive in Tesla's case in the 2016 model year allowed them to generate almost 950,000 Mg of additional GHG credits relative to what they would generate by using the net upstream value of 105 g/mi. Nissan's passenger car fleet benefitted similarly from the ability of the electric Nissan Leaf to use zero grams per mile instead of the calculated net upstream value of 82 g/mi.[26] As a result, the overall impact on Nissan's passenger car fleet in the 2016 model year was an improvement of 1.1 g/mi, allowing them to generate about 210,000 Mg of credits more than if the incentive provisions were not in place. The net impact from Nissan and Tesla on the entire 2016 model year fleet of this incentive is thus about 1.1 million Mg of credits, or about 0.3 g/mi. While there are other electric vehicles and plug-in hybrid electric vehicles in the 2016 fleet, as shown in Table 3-4, Nissan and Tesla account for a substantial fraction of the 2016 model year volume of these vehicles. A few thousand of the remaining advanced technology vehicles are electric vehicles, but the majority of the remaining vehicles are plug-in hybrid electric vehicles, which will have a smaller overall impact than electric vehicles because of their use of gasoline in addition to electricity (the other companies with larger volumes of advanced technology vehicles – General Motors and Ford – produced far more plug-in hybrids than dedicated electric vehicles in the 2016 model year). Because it is unlikely that the total impact of this incentive exceeds 0.5 g/mi across the 2016 model year fleet, we have not carried out the analysis for all advanced technology vehicles. In the future, however, it may be more important, interesting, and useful to have a complete assessment of the impact of incentives for these vehicles. Table 3-4 shows the 2010-2016 production volumes of advanced technology vehicles that utilized the zero grams per mile incentive.

[23] Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, Final Rule, Federal Register 75 (7 May 2010): 25435.
[24] See 40 CFR 600.113-12(n).
[25] Using the calculations prescribed in the regulations, the sales-weighted upstream emissions for Tesla's 2016 passenger cars is 180 grams/mile and the upstream emissions associated with a comparable gasoline vehicle is 75 grams/mile. The difference, or the net upstream emissions of Tesla's 2016 passenger car fleet, is 105 grams/mile.
[26] The upstream GHG emission value for the 2016 Nissan Leaf is 144 grams/mile and the upstream emissions associated with a comparable gasoline vehicle is 62 grams/mile. The difference, or the net upstream emissions of the 2016 Leaf, is 82 grams/mile.

Table 3-4. Production Volumes of Advanced Technology Vehicles Using Zero Grams/Mile Incentive, by Model Year

	Model Year							
Manufacturer	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
BMW	-	-	-	-	9,895	11,386	11,755	33,036
BYD Motors	-	-	11	32	50	-	-	93
Coda	-	-	-	37	-	-	-	37
Ford	-	-	653	18,654	18,826	17,384	22,343	77,860
GM	-	4,370	18,355	27,484	25,847	14,847	12,447	103,350
Honda	-	-	-	471	1,635	-	-	2,106
Hyundai	-	-	-	-	-	72	1,432	1,504
Karma	-	-	1,415	-	-	-	-	1,415
Kia	-	-	-	-	-	926	2,788	3,714
Mercedes	-	546	25	880	3,610	3,125	2,365	10,551
Mitsubishi	-	-	1,435	-	219	-	130	1,784
Nissan	-	8,495	11,460	26,167	10,339	33,242	13,128	102,831
Tesla	599	269	2,952	17,813	17,791	24,322	46,058	109,804
Toyota	-	-	452	829	1,218	5,838	-	8,337
Volvo	-	-	-	-	-	-	2,183	2,183
FCA†	*-*	*-*	*-*	*2,353*	*3,404*	*7,825*	*4,639*	*18,221*
Volkswagen†	*-*	*-*	*-*	*-*	*755*	*4,869*	*12,776*	*18,400*
Total	**599**	**13,680**	**36,758**	**94,720**	**93,589**	**123,836**	**132,044**	**495,226**

†FCA and Volkswagen are listed separately in this table due to an ongoing investigation and/or corrective actions. These data are based on initial certification data, and are included in industry-wide "Total" or "All" values. Should the investigation and corrective actions yield different CO_2 data, any relevant changes will be used in future reports.

2. Compressed Natural Gas Vehicles

There were no compressed natural gas vehicles (CNG) subject to the GHG standards in the 2016 model year. The Honda Civic CNG was the only CNG vehicle produced for general purchase by consumers during the first phase of EPA's GHG program, and it was only available in the 2012-2014 model years, and is a dedicated alternative fuel vehicle. In the 2015 and 2016 model years, Quantum Technologies offered a dual fuel (CNG and gasoline) version of GM's Chevrolet Impala through an agreement with GM. Quantum Technologies is exempt from GHG standards under the small business provisions (although they could opt in if they chose), and as a result these vehicles were not subject to 2015-2016 model year GHG standards and thus won't be accounted for in this report.

3. Gasoline-Ethanol Flexible Fuel Vehicles

For the 2012 to 2015 model years, EPA provided GHG credits for flexible fuel vehicles (FFVs) that corresponded to the statutory fuel economy credits under CAFE. As with the CAFE program, the GHG program based FFV credits in these years on the assumption that FFVs operate 50% of the time on the alternative fuel and 50% of the time on conventional

4. Credit Transactions

Credits may be traded among manufacturers with a great deal of flexibility (with the exception of 2009 model year credits and credits generated by manufacturers using the TLAAS program, which are restricted to use only within a manufacturer's own fleets). There are only a few regulatory requirements that relate to credit transactions between manufacturers (other than the restrictions just noted), and these are generally designed to protect those involved in these transactions. While it may seem obvious, it is worth stating that a manufacturer may not trade credits that it does not have. Credits that are available for trade are only those available (1) at the conclusion of a model year when all the data is available with which to calculate the number of credits generated by a manufacturer, and not before; and (2) after a manufacturer has offset any deficits they might have. Credit transactions that result in a negative credit balance for the selling manufacturer are not allowed and can result in severe punitive actions. Although a third party may facilitate transactions, EPA's regulations allow only the automobile manufacturers to engage in credit transactions and hold credits.

Since the 1990's, many of EPA's vehicle emissions regulatory programs have included the flexibilities of averaging, banking, and trading (ABT). The incorporation of ABT provisions in EPA emissions regulations has been generally supported by a wide range of stakeholders: by manufacturers for the increased flexibility that ABT offers and by environmental groups because ABT enhances EPA's ability to introduce standards of greater stringency in an earlier time frame than might otherwise be achieved. Historically, manufacturers tended to make use of the ability to average emissions and bank emissions credits for use in subsequent years, but until recently there has been almost no credit trading activity between companies. The use of trading provisions in EPA's light-duty GHG program is a historic development, and one that EPA welcomes because we believe it will allow greater GHG reductions, lower compliance costs, and greater consumer choice.

The credit transactions reported by manufacturers through the 2016 model year are shown in Table 4-1. Note that manufacturers do not report transactions to EPA as they occur. Thus there may be additional credit transactions that have occurred that are not reported here, but because of the timing of those transactions (after the manufacturers submitted their 2014 model year data) those transactions will be reported in the 2015 model year reports of the manufacturers involved, and thus will be included in EPA's performance report regarding the 2015 model year. As of the close of the 2016 model year, more than 30 million Megagrams of CO_2 credits had changed hands. Credit distributions are shown as negative values, in that a disbursement represents a deduction of credits from the specified model year for the selling manufacturer. Credit acquisitions are indicated as positive values because acquiring credits represents an increase in credits for the purchasing manufacturer. The model year represents the "vintage" of the credits that were sold, i.e., the model year from which the credits originated. The vintage always travels with the credits, regardless of when a transaction takes place and in what model year the credits are ultimately used. A manufacturer with 2010 model year credits can hold them until 2021, meaning, for example, that a sale of 2010 credits could potentially be reported to EPA as late as the reporting deadline for the 2021 model year, and those 2010 credits traded in model year 2021 could be used by the buyer to offset deficits from the 2018-2021 model years. The overall impact of these credit transactions on the compliance position of each manufacturer is discussed in Section 5, which pulls together all the credits and deficits, including early credits, discussed in the preceding sections. Note that each value in the table is simply an indication of the quantity of credits from a given model year that has been acquired or disbursed by a manufacturer, and thus may represent multiple transactions with multiple buyers or sellers.

Table 4-1. Cumulative Reported Credit Sales and Purchases (Mg)

		Model Year "Vintage"							
	Manufacturer	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Credits Disbursed	Coda	-	-	5,524	1,727	-	-	-	7,251
	Honda	14,182,329	6,590,901	-	-	-	-	-	20,773,230
	Nissan	950,000	1,345,570	250,000	1,000,000	-	-	-	3,545,570
	Tesla	35,580	14,192	177,941	1,049,384	1,020,296	1,337,853	2,452,519	3,635,246
	Toyota	2,507,000	-	-	-	831,358	-	-	3,338,358
Credits Acquired	BMW	2,000,000	-	-	-	-	-	-	2,000,000
	Ferrari	265,000							265,000
	FCA	11,424,329	7,090,901	-	1,049,384	1,020,296	1,337,853	2,452,519	21,922,763
	GM	-	-	5,524	1,727	-	-	-	7,251
	Jaguar Land Rover	-	39,063	-	-	831,358	-	-	870,421
	McLaren		6,507						6,507
	Mercedes	3,985,580	814,192	427,941	1,000,000	-	-	-	6,227,713

RFF REPORT

New Markets for Credit Trading under US Automobile Greenhouse Gas and Fuel Economy Standards

Benjamin Leard and Virginia McConnell

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RESOURCES FOR THE FUTURE

New Markets for Credit Trading under US Automobile Greenhouse Gas and Fuel Economy Standards

Benjamin Leard and Virginia McConnell*

Abstract

Recent changes to the US Corporate Average Fuel Economy (CAFE) regulations that allow for credit banking and trading have created new opportunities for lowering the cost of meeting strict new standards. For the first time, automakers will be able to trade credits between their own car and truck fleets and across manufacturers, and they will be able to bank credits over longer time periods. The potential to lower the costs of the regulations could be large if well-functioning credit markets develop. A recent development is that new regulations starting in 2012 for greenhouse gas (GHG) emissions overlap with the CAFE standards, creating two separate regulations and two separate credit markets, one for fuel economy (regulated by the National Highway Traffic Safety Administration) and one for greenhouse gases (regulated by the Environmental Protection Agency). We find that although the two regulations are supposed to be harmonized, there are some important differences in how credits are defined and how they can be traded, creating added costs for manufacturers. We review evidence on how well the credit markets are working, including the extent of credit banking and the number and price of trades. We then assess the potential for the following to interfere with well-functioning markets: overlapping regulations, reductions that are not additional, thin markets, and use of monopoly power. We find that some features of robust trading are missing and discuss some possible ways to improve efficiency in these markets.

Key Words: credits, pollution markets, CAFE rules, GHG emissions reductions

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1. Introduction

In the absence of a US national cap-and-trade market for greenhouse gas (GHG) emissions, industry and regional market-based policies are becoming increasingly important for achieving cost-effective carbon reduction and energy efficiency improvements (Burtraw et al. 2014). In the transportation sector, such market-based mechanisms have not been easy to implement because of the large number of sources and the challenge of measuring energy use or emissions from individual vehicles. However, recent changes to the joint Corporate Average Fuel Economy (CAFE) regulations for light-duty vehicles present new opportunities for credit trading, which could lower the costs of meeting the more stringent standards.

US fuel economy standards were constant for many years. However, under the new rules, implemented jointly by the National Highway Traffic Safety Administration (NHTSA) and the US Environmental Protection Agency (EPA), manufacturers face increasingly strict limits are on both fuel use and GHG emissions of the vehicles they produce for model years 2012 through 2025 (EPA.2012). To lower the costs of meeting the new standards, the new rules allow manufacturers the flexibility to bank, borrow and trade credits.

Although the standards have been set jointly by the two agencies, in practice, there are differences in how the standards can be met, including different credit programs and rules on trading. As we see below, restrictions in one program are likely to affect compliance strategies in the other program and to decrease the efficiency of meeting the programs' common goals of reducing fuel use and emissions.

This article examines the design and efficiency of the credit trading programs established as part of the new CAFE and GHG rules. We evaluate the efficiency of different provisions of the credit trading programs by comparing the expected costs and benefits of the standards to the costs and benefits in an ideal setting, where manufacturers have perfect information and no market power, and the credit trading programs have no distortions.

We begin with a detailed description of the new CAFE and GHG credit regulations, including summarizing how credits are defined and traded in the two markets, and identifying key similarities and differences between them. We then examine available evidence about these markets during the early years of the programs from 2012 to 2015, including information on trends in banking, in credit prices, and the amount of credit trading over time, to give a sense of how well the markets are working. This is followed by an assessment of both credit programs and the emerging markets for trading credits between manufacturers. We discuss the major factors that may prevent these markets from improving the efficiency of the standards, drawing on lessons from the literature about previous pollution trading programs. We present conclusions and the outlook for the future in the final section.

2. Background and Overview of the New CAFE and GHG Credit Markets

Manufacturers must comply with both the NHTSA and EPA rules, with each rule having its own credit program and market. Although the two agencies intended to harmonize the stringency of the rules, they are not the same because the provisions of the two credit programs are different. Here we first show the standards and then describe some of the key differences in the credit programs.

2.1. The CAFE and GHG Standards

NHTSA sets CAFE standards requiring that each manufacturer's vehicle fleet achieve a minimum average miles per gallon (mpg). Cars and light trucks have separate standards,

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with trucks facing lower sales-weighted average fuel efficiency requirements than cars. In 2008, NHTSA was required under the Energy Independence and Security Act (EISA) to set annual standards for vehicle fuel efficiency at "maximum feasible" levels through 20301. At about the same time, EPA was given authority under the Clean Air Act (CAA) to regulate GHG emissions from vehicles as a pollutant.2 Because of the direct relationship between a vehicle's gasoline consumption and its CO2 tailpipe emissions,3 these two regulations are closely related.

Although NHTSA and EPA have collaborated in a joint rulemaking to reduce fuel and GHG emissions from the light duty fleet, the agencies have separate legal mandates that they are required to meet (i.e., under the EISA and CAA, respectively), and automakers must meet separate standards for fuel economy and GHG emissions.4 Figure 1 shows the changes over time in both the NHTSA CAFE standards (left axis) and the EPA GHG standards (right axis), with the new standards, beginning with model year 2012, shown as dashed lines. By the 2025 model year, fuel consumption and GHG emissions are projected to fall by about half as a result of the stricter CAFE and GHG standards, respectively.

2.2. Flexibility in the Credit Markets

For a program to be economically efficient, it must provide incentives for manufacturers to increase fuel economy and reduce GHG emissions in the least costly way—for each manufacturer and across manufacturers—and over time. Under both programs, manufacturers earn credits whenever they overcomply with the standard during a compliance period. In principle**,** both rules for the 2012–25 model years provide manufacturers with three options for flexibility to lower the costs of meeting the standards.

First, manufacturers can use credits from overcompliance in one fleet (e.g., cars) to achieve compliance in the other fleet (e.g., trucks). This is often referred to as averaging, and it is likely to lower costs, especially for manufacturers whose marginal costs differ across their car and truck fleets. Second, manufacturers can bank credits from overcompliance in one year to use for compliance in a future model year. These banked credits can be held and used for up to five years into the future, or used to cover shortfalls in the previous three years. These banking provisions help firms to smooth and therefore lower the cost of complying with increasingly strict regulations over time (Ellerman et al. 2005).

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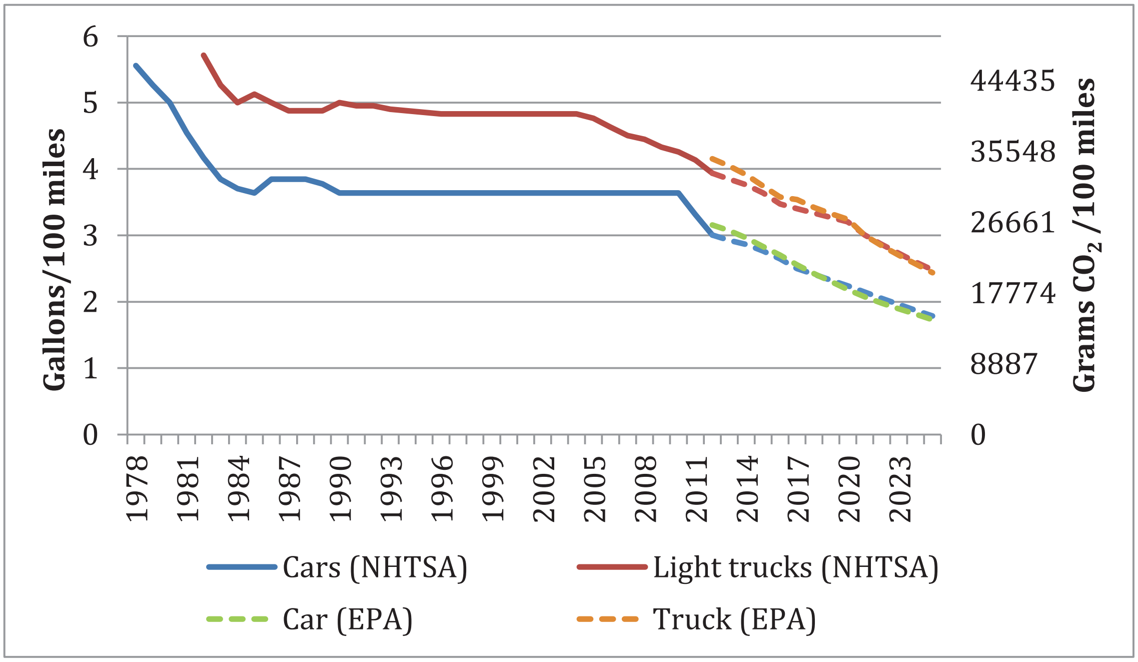
[1] See https://www.gpo.gov/fdsys/pkg/USCODE-2011-title49/pdf/USCODE-2011-title49-subtitleVI-partC-chap329-sec32902.pdf

[2] The US Supreme Court case was *Massachusetts v. Environmental Protection Agency*, 549 US 497 (2007).

[3] One gallon of gasoline contains 8.887 grams, or 0.008887 megagrams (Mg), of CO_2.

[4] 77 Fed. Reg. 62623 (Oct. 15, 2012).

FIGURE 1. CAFE AND GHG STANDARDS (GALLONS PER 100 MILES), AND EPA GHG STANDARDS (GRAMS CO_2 PER 100 MILES)



Notes: The NHTSA fuel economy standards are presented in gallons per mile for so they can be compared to the EPA GHG emission standards. The new joint standards started in 2012. Differences between the standards from 2012 to 2025 are due to differences in nontailpipe emissions, which EPA accounts for but NHTSA does not.
Sources: McConnell (2013); grams of CO_2 per mile forecasts from www.epa.gov/oms/climate/documents/420f12051.pdf

Third, for the first time, manufacturers can buy and sell credits among one another. This will lower the overall costs of reducing emissions and fuel use because it will encourage manufacturers with low costs to exceed the standards and sell earned credits to manufacturers that are below the standard (Montgomery 1972). The potential for savings depends on the heterogeneity of costs across companies (Newell and Stavins 2003) and how well credit markets function (Stavins 1995). Analyses of the earlier CAFE standards found that the standards resulted in significant variation in the marginal costs of reducing fuel economy across manufacturers,[5] suggesting that credit trading across firms could achieve substantial cost savings.

2.3. Differences in how Credits are Defined

In both the NHTSA and EPA programs, credits are granted to manufacturers each year based on the extent to which their vehicles do

[5] For example, Jacobsen (2013) estimates that the marginal cost of increasing CAFE standards by one mile per gallon ranges from $0 (for unconstrained firms) to $438 per vehicle. Anderson and Sallee (2011) also find substantial variation in marginal costs of increasing the standards, although they find a much smaller variation.

better than the standards. Credit units are defined differently in the two programs.[6]

2.3.1. Definition of Credits in the NHTSA Program

Under NHTSA's CAFE program, a credit is earned for each one-tenth of a mile per gallon that each vehicle exceeds its miles per gallon standard. A manufacturer's total credits earned in a given period, therefore, are calculated as the product of 10 times the difference between the average fuel economy across its fleet and the fuel economy standard for its fleet.[7] Credit units are thus based on an emissions rate, and do not reflect how much fuel is actually saved given that vehicles are above the standard. Because vehicles are driven different miles over time, the amount of fuel reduced from the credits will differ depending on the mix of vehicles sold.

NHTSA makes the simplifying assumption that each car and each truck is driven the same number of miles over its lifetime (195,264 miles for cars and 225,000 miles for trucks). However, this assumption fails to account for differences in miles driven and the lifetime of vehicles within the car and truck category, which means the crediting system will tend to overcredit some vehicles and undercredit others. This is a potentially important source of inefficiency (Jacobsen et al. 2016).

In addition, because NHTSA credits are specified in rates (mpg), they cannot be traded one for one across car and truck fleets, either within a firm, or across firms. They must first be adjusted to account for the differences between car and truck miles driven. This way of designating credits seems to add unnecessarily complexity to potential markets for trading.

2.3.2. Definition of Credits in the EPA Program

The EPA program defines credits in terms of emissions reduced relative to the emissions allowed by the standard. To determine emissions, manufacturers much first convert emissions rates (in grams of CO_2 per mile) total emissions over the lifetime of their vehicles. They do this by using the same assumptions on total lifetime miles for cars and trucks as NHTSA (see above). Credits are then denoted in terms of the megagrams (Mg) of CO_2—i.e., the mass of CO_2—saved relative to the standard. As with the NHTSA rules, the simplifying assumption that all vehicles in a fleet are driven the same number of miles is a source of inefficiency.[8] But, because EPA credits are defined in terms of emissions saved, they have the advantage of being more directly tradable across car and truck fleets and between different manufacturers.

2.4. Differences in Banking Provisions

Although both programs allow banking, they impose different expiration dates on earned credits (see Table 1). In a setting where each manufacturer's compliance requirement is binding, these expiration dates lower the efficiency of the programs because expiration dates reduce manufacturers' incentives to

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[6] See Appendix A1 for an example of a representative manufacturer that earns credits under both programs during a compliance period.

[7] NHTSA requires manufacturers to use a sales-weighted harmonic average of their fleets to calculate the average mpg.

[8] A more efficient policy would give vehicle driver incentives to reduce fuel use and emissions whether by the type of car she drives, or the number of miles driven. This implies a different regulatory approach than CAFE, such as a gasoline or carbon tax.

smooth their abatement over time. As we discuss later, however, placing limits on how long credits last also protects the programs from the potential problem that the standards may not produce "additional" reductions for those manufacturers whose emissions or fuel use would have been less than the standards in any case. When banking is allowed for these firms' aggregate emissions and fuel use reductions from the rules will be lower than expected. Whether the banking expiration dates improve or reduce efficiency depends on the relative magnitudes of these two effects.

2.5. Differences in Emissions Averaging Between Car and Truck Fleets

The EPA rules provide more flexibility for manufacturers to average emissions between their car and truck fleets (see fourth row of Table 1), but there are differences in what the two agencies allow. EPA does not limit averaging within a manufacturer's own fleet, whereas the NHTSA rules limit how many credits can be transferred between a manufacturer's car and truck fleets. It is not clear why NHTSA limits these transfers, but the reduction in flexibility raises costs to the manufacturers of meeting the NHTSA standards if the car and truck standards are binding. And, the NHTSA limit on transfers also raises the costs of compliance with the more flexible EPA rules because manufacturers must comply with both rules.

2.6. Penalties for Noncompliance

Another key difference between the two programs is the penalty for noncompliance. Under NHTSA rules, manufacturers have always been allowed to pay penalties if they cannot meet the standard. If the rules turn out to be more expensive than anticipated or fall more heavily on some firms than others, the fine limits the cost of additional reductions. Under the EPA regulations, which are governed by the CAA, no fee in lieu of compliance is allowed. That is, if a manufacturer is found to be noncompliant, a decision about whether that manufacturer may sell vehicles and under what penalty would have to be negotiated on a case-by-case basis. If the noncompliance penalty under the EPA program exceeds the NHTSA fine, and the stringency of the standards is equivalent, then the NHTSA fine becomes irrelevant.[9] In a world with no uncertainty, removing any fines increases the efficiency of the programs, assuming firms can freely trade. But when demand and costs are uncertain, setting a fine or a bound on marginal costs can improve efficiency.[10] We discuss this issue in more detail below.

2.7. Credits for Alternative Fuel Vehicles

Another difference between the two programs concerns how credits are granted for alternative fuel vehicles, such as plug-in electric and all-electric vehicles. NHTSA grants no credits for these vehicles, whereas EPA has several provisions designed to increase the volume of electric vehicles. Manufacturers are allowed to count vehicles that run on electricity as having zero emissions of CO_2. However, actual CO_2 emissions from these vehicles depend on how the electricity that powers them is generated. Most studies of this issue have found that levels of CO_2 emissions vary significantly depending on where the power is generated (Holland et al 2015), but in most regions

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[9] We discuss the issue of overlapping regulations in more detail later. Appendix A2 which can be found here (link) presents a graphical illustration of this issue.

[10] Pizer (2002) presents this result using a general model of GHG abatement with uncertain benefits and costs.

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emissions are not zero under the current power infrastructure and regulatory requirements. Too many credits from electric vehicles are being generated, which reduces the stringency of the standards.

Another provision of the EPA rules is that beginning with the 2017 model year, a manufacturer is allowed to count each electric vehicle as being equivalent to more than one vehicle for the purposes of calculating its total credits. This so-called "credit multiplier" provides too many credits for electric vehicles and raises the cost of meeting the standards. It is also likely to increase emissions overall as the non-electric fleet will have to reduce less and the emissions of the electrics is counted as having zero emissions.

TABLE 1. COMPARISON OF CREDIT PROVISIONS UNDER NHTSA AND EPA PROGRAMS

Regulation	NHTSA CAFE program	EPA GHG program
Definition of a credit	1/10 mpg above manufacturer's required mpg standard for fleet	1 Mg of CO_2 below the manufacturer's required standard*
Credit banking (carry forward)	5-year banking period	From 2009 to 2011, companies banked credits through the Early Crediting Program; 5-year banking period, with the exception that credits earned between 2010 and 2016 can be carried forward through 2021
Credit borrowing (carry back)	3-year carry back period	3-year carry back period
Limits on manufacturers' credit transfers between car and truck fleets	Limits on credits that can be transferred between cars and trucks: MY 2011–2013, 1.0 mpg MY 2014–2017, 1.5 mpg MY 2018 on, 2.0 mpg	No limits on transfers between cars and trucks in each manufacturer's fleet
Monetary cost of noncompliance	Fee up until July, 2016 $5.50/tenth mile over standard, per vehicle; starting July, 2016, $14/tenth mile over standard	Unknown penalty, but could be as high as $37,500 per car for violation of the CAA
Provisions for alternative fuel vehicles	Credits for ethanol and methanol in fuels are being reduced. Electric, hybrid electric, or fuel cell vehicles are treated the same as conventional vehicles.	Allows manufacturers to count each alternative fuel vehicle as more than a single vehicle. Multipliers range from 2.0 to 1.3, depending on the extent of alternative fuel used and the MY. Emissions from battery electric vehicles assumed to be zero.
Exemptions	No exemptions for manufacturers with limited product lines; fines can be paid	Temporary Lead-time Allowance Alternative Standards (TLAAS) for manufacturers with limited product lines through 2015

*Vehicle and fleet average compliance for EPA's GHG program is based on a combination of CO_2, hydrocarbons, and carbon monoxide emissions which are the carbon containing exhaust constituents. These GHG emissions are referred to here as CO_2 emissions for shorthand.

EPA argues, however, that the overall long-run efficiency of the rules will be enhanced by the alternative vehicles policy. This is because the more rapid introduction of alternative fuel vehicles will result in knowledge spillovers and industry-wide cost reductions. This long-run effect remains to be seen, but in the short-run, the policy will grant too many credits for electrics, drive up the cost of meeting the regulations, and reduce the stringency of the standards.

2.8. Standards for Small Volume Producers

Yet another difference between the two programs is that to address distributional concerns, the EPA program provides less stringent standards for small-volume producers—known as Temporary Lead-time Allowance Alternative Standards—while the NHTSA does not (see bottom of Table 1). These lower standards may be efficient because they allow small-volume manufacturers with very limited and specialized product lines and high costs to continue producing, at least in the short term.

3. Empirical Evidence on Market Outcomes

The evidence to date suggests that automakers are using the new credit banking and trading mechanisms in the CAFE and EPA GHG programs to reduce their compliance costs under both rules. Although the available data do not allow us to determine the exact number of credits that have been transferred between car and truck fleets, we are able to conclude that such transfers have been occurring. In addition, we observe significant banking behavior, as companies are overcomplying with current standards, either because the standards are not binding on some manufacturers or because they anticipate using the banked credits in later years when standards become more stringent. Finally, over the last several years, through 2015, there has been some trading of credits between manufacturers, and the volume appears to be increasing over time.[11] We show evidence of these trades, discuss trends in trading over time, and provide some information about prices paid for credits in these trades.

3.1. Credit Transfers between Cars and Trucks

Table 2 shows net credits earned in the EPA GHG program, and total GHG emissions separately for cars and trucks across all manufacturers for each year. [12] Because net credits earned are positive in each year, the industry as a whole has been in compliance with the EPA standard, but by only a small amount: total industry-wide emissions were less than 1 percent lower than required between 2012 and 2014. Table 2 also shows that in the first several years of the EPA GHG program, manufacturers earned more credits from their passenger car fleets than from their light-duty truck fleets.

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[11] Because EPA makes more data publicly available than NHTSA, including actual credit trades, we report EPA compliance information. However, neither agency reports information on the price of trades.

[12] NHTSA does not report data on credits earned by manufacturer. Although it does report NHTSA credits held in any period, it is not always possible to infer how many were earned in a given year (see NHTSA (2014).

TABLE 2. EPA GHG NET CREDITS AND TOTAL EMISSIONS, BY MODEL YEAR

Model year	Passenger vehicles		Light trucks	
	Net credits (million Mg)	Total emissions (million Mg)	Net credits (million Mg)	Total emissions (million Mg)
2009*	57.91	1,600.69	40.16	1,247.43
2010*	50.54	1,716.27	45.16	1,666.98
2011*	8.29	1,676.92	28.73	1,934.53
2012	29.57	2,204.51	0.67	1,699.37
2013	37.80	2,402.95	0.99	1,888.27
2014	28.86	2,258.11	11.43	2,113.08

Notes: Net credits are defined as the sum of credits earned (i.e., overcompliance) minus deficits (i.e., undercompliance). Both credits earned and total emissions are calculated over the life of the vehicles produced in a given model year. * denotes an early crediting year.
Source: Author calculations based on EPA (2015b).

In 2012, overcompliance for cars was 29 million Mg of CO_2, which is several orders of magnitude more than the overcompliance for trucks—net credits for trucks were just 0.67 million Mg of CO_2. The general picture is the same for 2013. In the 2014 model year, net credits are still higher for cars, but there is also a significant increase for trucks. Although the banking and borrowing provisions prevent us from using these data to directly determine firm behavior, the data do suggest that in the 2012–14 perioed, it was easier to overcomply for passenger cars than for trucks.

3.2. Banking

Overall, the data show that manufacturers accumulated credits in the early years of the program. Between the 2009 and 2011 model years, both NHTSA and EPA allowed early banking of credits in advance of the tightening of the standards in 2012. NHTSA had allowed banking in the CAFE program leading up to the new rules, and EPA also wanted to provide flexibility to manufacturers to meet the standards because compliance is likely to be lumpy, due to the fact that vehicles are redesigned roughly every four to seven years (Blonigen et al. 2013). Manufacturers as a whole have continued to accumulate credits since the regulations took effect in 2012. Total EPA credit holdings at the end of 2011 were about 226 million Mg and they were 285 million Mg by the end of 2015. We estimate that the magnitude of these EPA credit holdings at the end of 2015 would be sufficient to cover about 8-9 percent of the total reductions required by the regulations through 2025.

A substantial amount of early banking is what we would expect with lower costs before the standards begin and increasingly strict standards in the future. Indeed, many automakers argue that the most costly and difficult standards to meet will be those for the 2022–25 model years. This strategy of overcomplying early and using banked credits later is also consistent with observed banking behavior in other emissions trading programs.[13] Although this banking behavior relaxes the effective stringency of future standards, the impact is dampened by the fact

[13] In a study of the US acid rain program, Ellerman and Montero (2007) find that capped firms spent the first five years of the program banking permits before starting to draw down their banked supply of permits for compliance in later years, when the standards were tightened.

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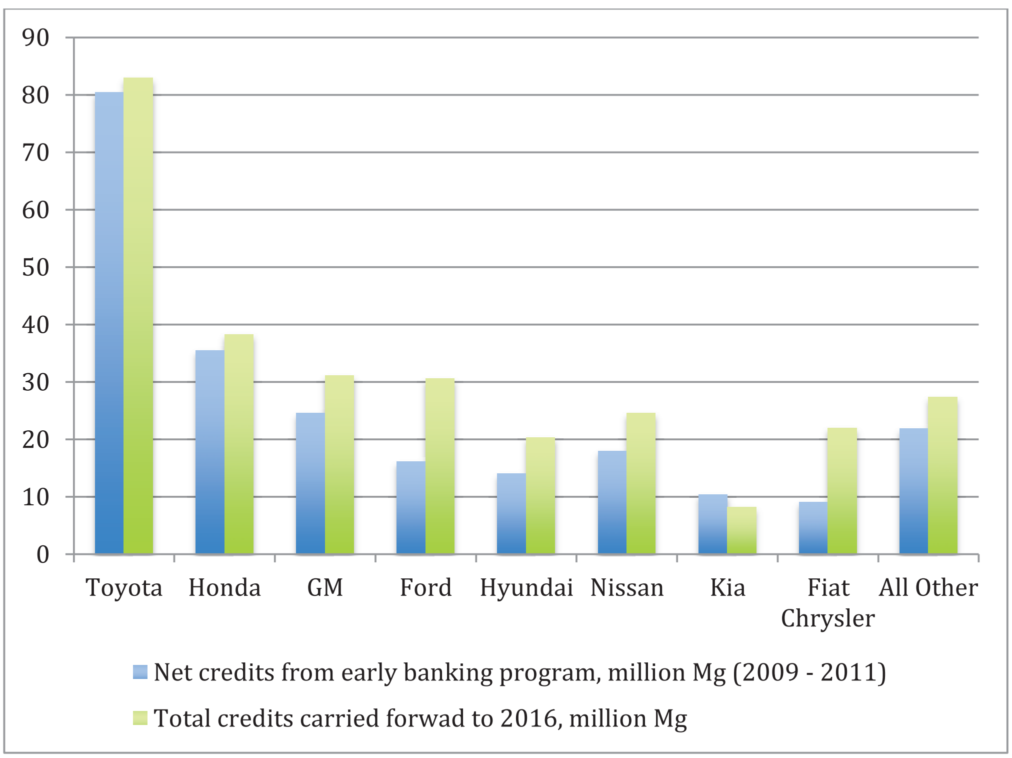
that credits can only be carried forward for five years (see Table 1).

The distribution of banked credits is different across individual automakers, however, with a small subset of manufacturers earning a majority of the credits. For example, between 2009 and 2011, Toyota and Honda banked about 56 percent of the total early GHG credits but sold only about 31 percent of passenger cars and light trucks. The big three US automakers, Ford, GM, and Chrysler, sold about 44 percent of all passenger cars and light trucks during this period but earned only about 23 percent of all GHG credits. The first bar in The first bar in Figure 2 shows credits earned between 2009 and 2011 for many of the manufacturers, and the second bar shows their credit holdings as of the start of 2016. Since 2011, most firms have increased their credit holdings, though for most, the majority of credit holdings were earned from 2009 to 2011, before the new standards came into effect.

3.3. Trading Across Manufacturers

Table 3 presents data on EPA GHG credit trades (shown as credit sales in Mg) that occurred from 2012 to 2015. The first column shows the year of the trade, and the second column shows the vintage of the traded credit. For example, in 2012 Nissan sold 500,000 of their credits earned in 2011 to Chrysler. Because credits expire, after 2021 in the EPA market, we expect credits earned in earlier years to be sold first. All of the credits sold through 2015 were earned between 2010 and 2012, except for those sold by Tesla which, because it sells only electric vehicles, has less incentive than other companies to bank credits for future compliance.

FIGURE 2. EARLY CREDITS AND CREDITS CARRIED FORWARD TO 2016, BY MANUFACTURER, DENOTED IN MILLION MG GHG EMISSIONS



Source: EPA (2016).

The total volume of trades as shown in Table 3 is about 20 million Mgs, which is roughly 7 percent of total credits holdings in 2015. But it is important to note that the market for trades in the first few years, from 2012 to 2013 was very thin: total trades were about 2.6 million Mg credits which was just over 1 percent of total credits earned by the end of 2013. However, the volume of trades was close to three times higher in 2014 than in the previous two years, at 7.2 million Mg. Then volume increased again in 2015 by about 4 million Mgs. Further, some of the largest companies, including Toyota and GM, have just recently made single trades for the first time.

Trading activity may increase in the future, both because banked credits will expire and both the car and truck standards will continue to increase in stringency, making it more difficult for some companies to rely solely on averaging their car and truck fleet credits or using banked credits to meet each standard. In summary, the volume of trades is growing and is likely to continue to do so as the standards tighten.

TABLE 3. EPA GHG CREDIT TRADES THROUGH 2015

Transaction Year	*Credit Vintage*	*Buyer*	*Seller*	*Credit Sales (Mg)*	*Sales Per Year (Mg)*
2012	2011	FCA/Chrysler	Nissan	500,000	1,067,713
2012	2010	Ferrari	Honda	90,000	
2012	2010	Mercedes-Benz	Tesla	35,580	
2012	2011	Mercedes-Benz	Tesla	14,192	
2012	2012	Mercedes-Benz	Tesla	177,941	
2012	2012	Mercedes-Benz	Nissan	250,000	
2013	2010	FCA/Chrysler	Honda	144,383	1,593,072
2013	2013	FCA/Chrysler	Tesla	1,048,689	
2013	2010	Mercedes-Benz	Nissan	200,000	
2013	2010	Mercedes-Benz	Honda	200,000	
2014	2011	Mercedes-Benz	Nissan	500,000	7,201,602
2014	2014	FCA/Chrysler	Tesla	1,019,602	
2014	2010	FCA/Chrysler	Toyota	2,507,000	
2014	2010	FCA/Chrysler	Honda	3,000,000	
2014	2010	Ferrari	Honda	175,000	
2015	2015	FCA/Chrysler	Tesla	1,337,853	11,215,577
2015	2014	FCA/Chrysler	Tesla	694	
2015	2013	FCA/Chrysler	Tesla	695	
2015	2010	FCA/Chrysler	Honda	5,680,851	
2015	2012	GM	Coda	5,524	
2015	2013	GM	Coda	1,727	
2015	2014	Jaguar Land Rover	Toyota	831,358	
2015	2011	Jaguar Land Rover	Nissan	39,063	
2015	2013	Mercedes-Benz	Nissan	1,000,000	
2015	2011	Mercedes-Benz	Nissan	314,192	
2015	2011	McLaren	Nissan	3,620	
2015	2010	BMW	Honda	2,000,000	

Sources: Author calculations based on the Greenhouse Gas Emission Standards for Light-Duty Vehicles 2012, 2013, 2014, and 2015 Reports.

3.4. Information on Credit Prices

Information about the prices paid for credits is important for several reasons. Price information helps potential market participants to make profit-maximizing decisions. If manufacturers cannot identify the typical market price for a GHG credit, it will be more costly for them to decide whether to hold or sell credits.[14] Credit prices also reveal information about marginal costs, which is useful for estimating the overall costs of the standards. In a competitive market for credits, the marginal credit price would equal the equilibrium marginal cost of meeting the standard. However, transaction prices may not reflect marginal costs if multiple regulations overlap, markets are thin, or other market distortions exist.

Neither NHTSA nor EPA requires manufacturers to report credit prices. [15] Thus, there is virtually no public information available about transactions prices. In order to shed light on these prices, we identify two approaches for calculating transaction prices based on the data that are currently publicly available. Because public data for calculating NHTSA prices are not available, we calculate prices in the EPA GHG credit market and then convert them into equivalent NHTSA credit prices.

3.4.1. Estimating Prices: Approach 1

Under the first approach, we estimate the credit price by merging trading quantities from EPA (2014a) with revenue data from Tesla Motors' 2013 SEC Filing Form 10-K to compute 2012 and 2013 EPA GHG credit prices. In 2013, Tesla sold \$64.6 million worth of EPA GHG credits, which is equal to \$63.7 million denominated in 2012\$ (see Table 4). By dividing revenue reported from GHG credit sales by the total sales of EPA GHG credits sold by Tesla, we find that Tesla sold each GHG credit for an average of about \$36 for 2012 and \$63 for 2013 as show in the 5th column of Table 4 (both in 2014\$).

3.4.2. Estimating Prices: Approach 2

For the second approach, we use public information from a settlement between two manufacturers and the federal government. More specifically, in November 2014, EPA and the US Department of Justice reached a settlement with Hyundai and Kia concerning violations of the CAA. The initial complaint was filed in response to the companies' sales of about 1.2 million model year 2012 and 2013 cars and SUVs that had labels that overstated the vehicles' fuel economy. The settlement required both companies to forgo 4.75 million EPA GHG credits in 2014, which EPA "estimated to be worth over \$200 million" (EPA 2014b). If we assume that these credits are worth exactly \$200 million in 2014\$, or \$193.97 million in 2012\$, and divide this by the number of credits (4.75 million), we get a credit price of \$40.84/Mg (see Table 4).

Based on assumptions about the CO_2 content of a gallon of gasoline, mileage for cars, and a baseline level of fuel economy, we convert the EPA GHG credit prices to equivalent NHTSA credit prices and obtain a 2012 NHTSA credit price of \$67.76 per mile per gallon per vehicle, and a 2013 price of \$115.67 (see Table 4). These values are higher than the NHTSA fine of \$55 per mile per gallon per vehicle during this time period, which implies that the EPA rules are more binding on manufacturers during this period than the NHTSA rules.

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[14] The costs of finding suitable trading partners are higher in thin markets, especially in the absence of a centralized trading system (Klier et al. 1997).

[15] Both agencies require manufacturers to report credit holdings and credit trades for compliance purposes only.

TABLE 4. CALCULATING CREDIT PRICES (2014$)

Year	Action	Value (million 2014$)	Quantity (million Mg)	EPA GHG price ($/Mg)	Equivalent NHTSA credit price ($/ mpg/vehicle)
2012	Tesla sales of EPA GHG credits	8.4	0.228	36	70
2013	Tesla sales of EPA GHG credits	65.7	1.049	63	119
2014	Hyundai and Kia CAA settlement	200	4.750	42	80

Notes: To convert the price of an EPA GHG credit to 10 NHTSA credits (1 NHTSA credit is 1/10 of an mpg), we assume that: increasing mpg by 1 from 30 to 31 is equivalent to reducing gallons per mile by 0.0011; each gallon of gasoline contains 0.008887 Mg of CO_2; and cars are driven 195,264 miles over their lifetime.
Sources: Tesla Motors' 2013 SEC Filing Form 10-K; EPA (2014a, table 4-1; 2015a, table 4-1;2014b).

4. Assessment of the Credit Trading Markets and Lessons From Other Pollution Regulations

Despite the opportunities for lower cost of compliance allowed by the new credit trading markets, there are several issues that may influence how effective these markets will be in practice. In this section we explore four areas that could prevent the credit markets from improving efficiency in achieving the goals of the EPA and NHTSA regulations: overlapping regulations, are emissions, reductions additional, lack of transparency and thin markets, and the effects of market power.

4.1. Overlapping Regulations

One area of increasing concern for the success of emissions trading programs is the issue of overlapping regulations (Burtraw and Shobe 2012; Goulder 2013).[16] The relationship among regulations, both across jurisdictions and over time, is complex and depends on the regulations' timing and design (Levinson 2012; Goulder and Stavins 2012). Because the joint NHTSA and EPA regulations are separate but effectively regulate the same thing (i.e., fuel use and the associated emissions of CO_2),[17] unless they are completely harmonized, they are likely to interact with each other, resulting in higher costs.

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[16] Another area of concern is changing regulations. For example, although the SO_2 allowance trading market was successful for a long period, it was later essentially gutted by changes in broader air pollution regulations and the ability of utilities to trade ton for ton across state lines (Schmalensee and Stavins 2013).

[17] The reason for the overlapping regulations of the two programs appears to be legal. Under early legislation, and more recently under the EISA, Congress authorized NHTSA to set fuel economy standards. However, EPA has been authorized under the CAA to set CO_2 standards starting in 2012. Thus, the agencies claim to have separate legal mandates.

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Given the differences between the regulations (see table 1), a key impact of their overlap is that navigating compliance under the two programs is more difficult than it would be under a single program. If the programs were fully harmonized but continued to overlap, then compliance under the two programs would be similar to achieving compliance under a single program; manufacturers would simply use the same compliance strategy for both programs. However, given the differences in how credits are defined and how they can be traded within and across manufacturers fleets means manufacturers must have separate compliance strategies for the two programs. This makes it more difficult to achieve an efficient allocation of both fuel economy improvements and GHG abatement.

The overlapping nature of the two programs will make credit trading especially challenging. Under a single trading program, prices reflect the marginal costs of compliance, which helps guide market participants in making efficient investment decisions. However, with multiple, overlapping programs, prices in one credit market may no longer reflect the marginal costs of compliance. For example, the marginal cost of compliance in one program may be close to or equal to zero for a manufacturer that is in compliance under the other program.[18] Rules that create overlapping regulations that are not well harmonized, such as these by EPA and NHTSA, reduce transparency and increase the costs of attaining the joint goals of the two standards.

4.2. Are Emissions Reductions from the Regulations Additional?

Some automakers have historically exceeded fuel economy standards (EPA, 2014a, 2016). This means that if these companies earn credits for exceeding the standards, these credits do not represent "additional" reductions because the companies would have achieved the reductions without the crediting program. When there are credit markets, the sale and use of credits earned from non-additional behavior effectively loosens the stringency of the standard, which lowers realized fuel economy improvements and GHG reductions.

The problem of additionality has been an issue in other emissions markets, including Phase 1 of the US Acid Rain Program.[19] Montero (1999) finds that many electricity generating units that opted into Phase 1 of the program had business-as-usual (BAU) emissions that were below their permit allocations. Thus they were able to sell the surplus permits to other capped firms, which actually resulted in higher overall emissions. Similar additionality issues have arisen more recently in cap-and-trade programs for CO_2 that have carbon offset programs (Bushnell 2012; Bento et al. 2015).[20]

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[18] Appendix A2 discusses this issue in more detail using a stylized model. Appendix A3 discusses how the overlap between the Zero Emission Vehicle (ZEV) regulation and the CAFE/EPA regulations influences credit prices and efficiency. These are now going to be online.

[19] The Acid Rain Program allowed large power plants in the middle and eastern parts of the Untied States to trade emissions for reduction of SO_2 under the Clean Air Act of 1990. During Phase 1 of the program, the regulation allowed a subset of unconstrained electricity generating units to voluntarily be regulated. Owners of these units were then able to earn and sell SO2 permits to other regulated power plants.

[20] Carbon offset programs allow owners of unregulated emissions sources, such as dairy farms, to earn carbon credits for reducing emissions below a specified baseline.

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4.2.1. Evidence of Additionality

We find some evidence that credits were given for BAU behavior in the early years of the new fuel economy and GHG standards for passenger cars and light trucks. Figures 3a and 3b, which indicate average fuel economy and the CAFE standards from 2000 to 2011 for cars and light trucks, respectively, reveal that passenger car standards remained flat until 2011, when they were changed under the new standards, while light truck standards were flat until 2005 and began to increase in 2006. As shown in Figure 3a, many of the large manufacturers appear to have overcomplied with their passenger car standard, independent of any change in the standard. Toyota, for example, increased its passenger car fleet fuel economy from slightly less than 30 miles per gallon in 1999 to 35 miles per gallon by 2005. Ford and GM also increased their passenger car fleet fuel economy, from slightly under the standard in 1999 to more than 2 miles per gallon over the standard by 2007. As shown in figure 3b, the trends for trucks are similar although not as strong.

One reason for overcompliance in the years leading up to the recent policy changes is the significant increase in real gasoline prices. Between 1999 and 2008, real gasoline prices nearly tripled, from approximately $1.17 to $3.24 (in 2015$). Numerous studies have shown that this gasoline price increase led to consumers demand more fuel efficient vehicles in new and used automobile markets (Li et al. 2009; Busse et al. 2013), which likely resulted in some manufacturers banking credits for BAU behavior. [21]

From 2009 to 2011, before the new standards took effect, most manufacturers continued to produce fleets that have fuel economy levels above the standards, as we can see from Figures 3a and 3b. This was a time when many credits were banked for future use (see section on banking above). To the extent these banked credits were not additional, then total fuel reductions from the standards will be lower than expected. However, the stringency of both standards is scheduled to increase to be far above the historic BAU fuel economies of even the most fuel-efficient fleets, reducing the likelihood that additionality issues will influence program outcomes in the long run. Separating whether banked credits are non-additional or whether they are an efficient investment in longer term compliance requires a detailed model of the new vehicle market and is thus a potential area of future empirical research.

[21] This is consistent with Montero (1999), who found that BAU emissions were falling prior to implementation of the Acid Rain Program because of declining low-sulfur coal prices.

FIGURE 3A. AVERAGE FUEL ECONOMY AND CAFE STANDARDS FOR PASSENGER CAR FLEETS, 1999–2011

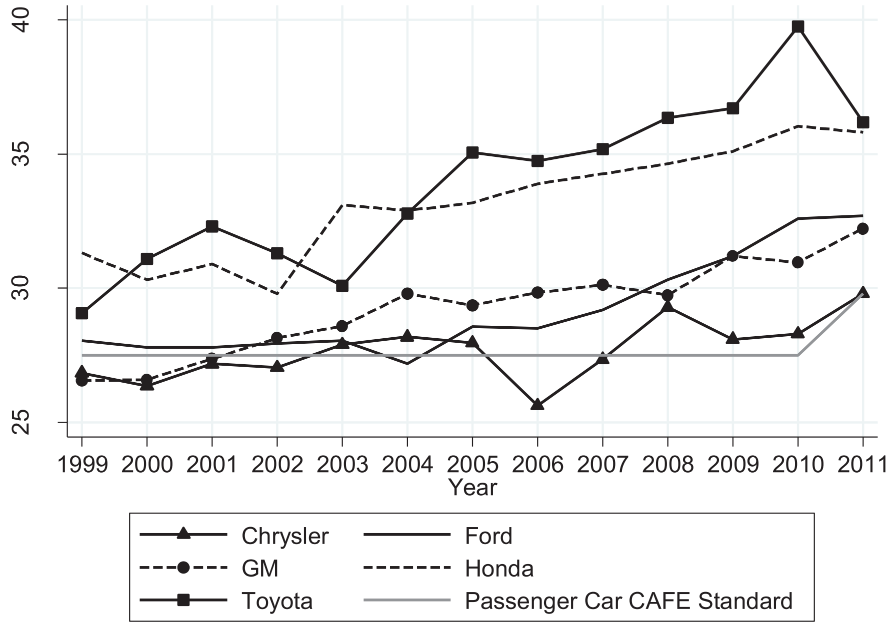
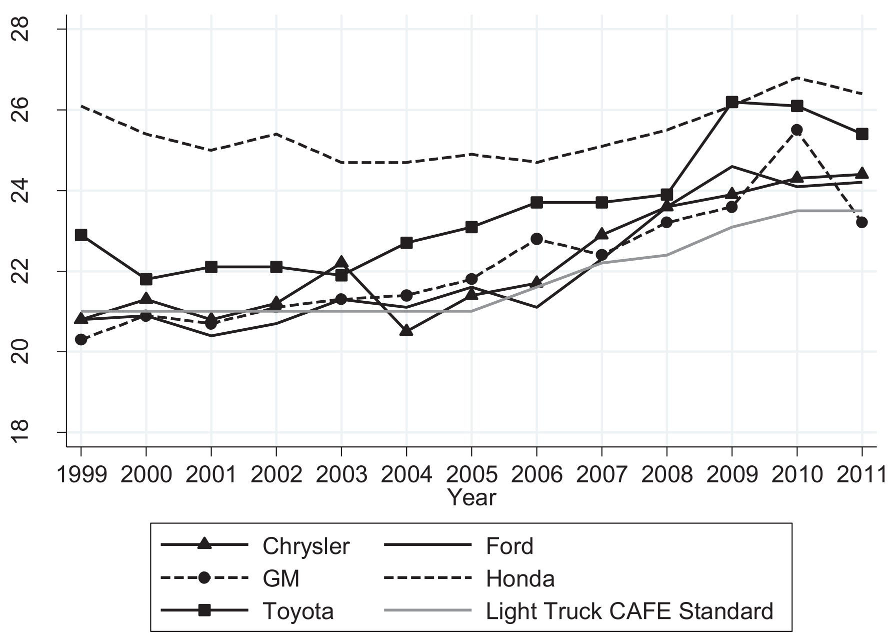


FIGURE 3B. AVERAGE FUEL ECONOMY AND CAFE STANDARDS FOR LIGHT TRUCK FLEETS, 1999–2011



Note: The gray lines indicate the CAFE standards. *Sources for 3a and 3b*: 1999 and 2000 fuel economy data: http://www.nhtsa.gov/cars/rules/CAFE/FuelEconUpdates/2000/index.html; 2001 and 2002 fuel economy data: http://www.nhtsa.gov/cars/rules/CAFE/FuelEconUpdates/2002/index.htm; 2003 and 2004 fuel economy data: http://www.nhtsa.gov/Laws+&+Regulations/CAFE++Fuel+Economy/2004+Automotive+Fuel+Economy+Program; 2005–2011 fuel economy data: http://www.nhtsa.gov/staticfiles/rulemaking/pdf/cafe/June_2014_Summary_Report.pdf.

4.3. Lack of Transparency and Thin Markets

A well-functioning market for trading credits between companies requires transparency about the prices of trades that have occurred and a way for potential traders to find each other without incurring high transaction costs (Stavins 1995). The history of credit trading under other vehicle programs such as the California Low-Emission Vehicle and Zero Emission Vehicle programs has been that buyers and sellers of credits find each other on an as-needed basis, and regulators report information on quantities traded but not on prices (CARB, 2016[22]).

The CAFE and EPA credit-trading programs are getting started in a similar way. The limited trading thus far has been done informally, with manufacturers contacting each other directly. EPA reports on quantities traded and who bought and sold credits for each vehicle model year, but not on the price of the trades. NHTSA does not report any information about the credit market. In most auction markets as well as in previous emissions trading programs, the trading price is published and then participants decide whether to buy or sell. Given that parties have to find each other and they do not have information about previous prices, it is not surprising that few trades have taken place.

In addition to the problems of potentially high transactions costs and no price transparency, credit markets have also been thin because of the agencies' midterm review of the standards that is to be finalized in 2018. Uncertainty about the outcome of this review in terms of the longer-term stringency of the standards is likely to make manufacturers reluctant to trade credits until these issues are resolved.

4.3.1. Bounding Credit Market Prices

One potential role for the agencies to encourage more trading is to reduce uncertainty for manufacturers by providing information about the range of possible credit prices. The NHTSA fine for non-compliance[23] already sets an effective price cap on the credit price,, which effectively establishes a "safety valve" on the costs of the regulations. The notion of a safety valve is attributed to Roberts and Spence (1976) and later applied to climate policy by Pizer (2002) and Murray et al. (2009). It involves trading off some confidence about the quantity of pollution reduction that will be attained for more certainty about the cost of the reductions. In this case, if the rules turn out to be more expensive than anticipated or fall more heavily on some firms than others, a fee imposed on the firm in lieu of reductions limits the additional cost and also provides information to manufacturers about the maximum price of a credit. EPA is prohibited from allowing manufacturers to pay a fine, as discussed above, but EPA could sell credits to buyers at a fixed price to set a ceiling on costs.

The agencies could also set a price floor on credits by offering to buy credits at a given price. The combination of the price floor and ceiling would provide certainty to manufacturers about the range of credit prices and would push the market toward greater efficiency. More information would be available to potential participants, and there would be less credit price fluctuation due to likely future shifts in supply and demand (e.g., the development of alternative fuel technologies and changes in gasoline prices).

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[22] Information on trades is available at https://www.arb.ca.gov/msprog/zevprog/zevprog.htm

[23] The current NHTSA fine is $140/mpg per vehicle under the manufacturer's standard.

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4.4. Effects of Market Power

In a tradable permits market with relatively few firms, as is the case for light-duty vehicles, one issue that arises is whether the market is susceptible to market power. The potential for market power in the CAFE and EPA GHG credit markets depends on the credit balances held by the largest manufacturers. We focus on the EPA GHG program again here because more recent data are available and the EPA and CAFE programs have a similar distribution of credits. Table 5, which ranks the concentration of EPA GHG credits among the six largest companies, suggests that market power may pose a threat to the allocative efficiency of these markets because these six manufacturers own about 80 percent of the credits.

In his analysis of the impact of market power on the efficiency of pollution markets, Hahn (1984) argues that if a few firms have a relatively large number of pollution permits, they will exercise monopoly power by selling relatively few permits, thereby lowering the efficiency gains from trading. The large number of EPA emissions credits held by a few firms as shown in Table 5, and the limited number of trades to date under the EPA program (less than 10 percent of credits have been traded), is consistent with a setting where some firms can act in ways that would restrict competition. However, there is no direct evidence of such strategic behavior and the firms with the largest number of credit holdings have sold some credits over the past few years. Moreover, there are other reasons that companies may be holding credits.

TABLE 5. CONCENTRATION OF EPA GHG CREDITS AT THE END OF THE 2015 COMPLIANCE YEAR

(Rank) manufacturer	Credit balance (million Mg)	Market share (%)	Cumulative market share (%)
(1) Toyota	80	29	29
(2) Honda	38	13	42
(3) Ford	31	11	53
(4) GM	31	11	64
(5) Hyundai	20	7	71
(6) Nissan	25	9	80
All other manufacturers	58	20	100
Total	286	100	—

Notes: Credit balances include the sum of car and light truck credits and are net of deficits, penalties, and trades between manufacturers. Manufacturers can use the 2010-15 vintages for compliance up to the 2021 standard.
Source: Author calculations based on EPA (2016).

For example, they may be uncertain about future compliance costs, or they may believe that there could be future changes in the standards. In addition, the trading market is relatively new, and companies are likely to need time to become familiar with the idea of trading credits.[24]

It is also important to note that Hahn's analysis assumes perfect competition in output markets, an assumption that is unlikely to hold in the US automobile market. Rubin et al. (2009) conduct numerical simulations of an imperfectly competitive automobile market to measure the cost savings from incorporating tradable fuel economy standards. They find that market power in the credit trading market between firms lowers the potential cost savings from trading, but only modestly. Overall, we do not find any suggestion that market power is being misused, but it will be important to reexamine this issue as the credit markets become more robust in the future.

5. Conclusions and Future Outlook

This article has looked at two overlapping regulations, one on vehicle fuel use by NHTSA and the other on GHG emissions by EPA, and at how increased flexibility for manufacturers that allows banking and trading can make these regulations more efficient. We focus here on the market for credit trading between auto manufacturing firms, which offers a way for vehicle manufacturers to reduce the costs of attaining increasingly strict standards through the 2025 model year. Our analysis of the credits and credits markets is likely to have implications for other countries that have recently implemented regulations for light-duty fuel consumption, since many of these are including flexible mechanisms for compliance that are similar to those in the United States. The market for credit trading between companies in the United States is at an early stage, and though so far there have been few trades, the number of trades has been increasing rapidly in the last few years. Most manufacturers are in compliance with the standards, and many have used banking provisions to accumulate varying amounts of credits to hold in reserve. It is not clear, at this stage, whether many of the banked reduction credits were additional to what firms would have done anyway, or whether they are needed for spreading the high costs of compliance over time by overcomplying early and undercomplying later. More analysis of this issue is important because the former suggests the standards may be too lax, and the latter suggests that the banking and credit market will be essential to reducing the costs of very stringent standards, especially in the 2022-2025 time period. The combination of these costly standards in the later years and large variation in the ease of compliance between manufacturers suggests an important role for credit trading in the future.

However, we have identified here a number of problems in the structure of the credit markets that may be leading to thin markets with few trades. There is too little information about prices of past trades, and the transactions cost of finding a trading partners can be high. There are ways government can facilitate the market. We suggest that reducing uncertainty about the price of credits, and about the stringency of future regulations will both be important.

Perhaps the greatest barrier to efficient credit trading markets for GHGs and fuel economy is that there are two separate but overlapping rules, with two separate credit markets, each with somewhat different rules about what counts as a credit and how they can be traded. This complicates compliance for the manufacturers and drives up the cost of meeting the joint goals of reducing oil use and GHG emissions. The two rules are governed by two different pieces of legislation, but ideally, they will be more fully harmonized with a single compliance system and credit market.

[24] This possible explanation is consistent with evidence on the efficiency of the first few years of allowance trading under Phase 1 of the Acid Rain Program (Carlson et al. 2000).

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Appendix

A1. Example of Representative Manufacturer Overcompliance

In this Appendix we illustrate how manufacturers comply with both the NHTSA gallons per mile standards and the EPA GHG standards., Table A1 presents an example of a representative manufacturer that overcomplies with both standards during a given model year. As shown in the left panel, which presents information on credits earned under NHTSA's CAFE program, the manufacturer overcomplies by 1.2 to 1.5 mpg among its car and truck fleets, respectively, earning 1,200,000 car credits and 1,350,000 truck credits. The right panel, which provides example data on the manufacturer's earned EPA credits, indicates that the manufacturer also overcomplies under the EPA program.

TABLE A1. CREDITS EARNED BY A REPRESENTATIVE MANUFACTURER DURING A GIVEN MODEL YEAR

CAFE program			EPA program		
	Car fleet	**Truck fleet**		**Car fleet**	**Truck fleet**
Vehicles sold	100,000	90,000	Vehicles sold	100,000	90,000
Fleet average (miles/gallon)	30.2	25	Average (grams of CO_2/mile)	294.3	355.5
CAFE requirement (average miles per gallon)	29	23.5	EPA GHG requirement (grams CO_2/mile)	306.4	378.2
Difference (average miles/gallon)	1.2	1.5	Difference	12.1	22.7
Credits earned (10* miles/gallon* no. of vehicles)	1,200,000	1,350,000	Credits earned over vehicle lifetime (Mg of CO_2)	236,270	461,440

Notes: Credits are in miles per gallon saved on average for the fleet, not total fuel saved over the vehicles' lifetimes. To convert car credits to truck credits, for example, NHTSA requires that these estimates first be converted to total fuel use and then traded. In other words, under the NHTSA crediting system, car and truck credits do not trade one for one. Cars and trucks are assumed to travel 195,264 miles and 225,865 miles, respectively, over their lifetimes. EPA credits are designated in terms of Mg saved over vehicle lifetimes. Therefore, credits can be traded between car and truck fleets. The EPA and NHTSA make the same assumptions about total miles traveled.

A2. Conceptual Framework for Analyzing the Effects of Overlapping NHTSA and EPA Rules

To illustrate the effects of the overlapping NHTSA and EPA rules on the credit markets, we present a simplified example of two representative manufacturers with different marginal costs of compliance.[25] Figure A1 presents these manufacturers and their costs of complying over the next few years. Each manufacturer is subject to two rules, one from NHTSA to increase the miles per gallon (mpg) of its fleet of vehicles, and one from EPA to reduce megagrams (Mg) of CO_2 (or metric tons of CO_2). If the requirements under the two rules are fully harmonized, we can show the marginal cost of the requirements in terms of either CO_2 reductions or improvements in mpg. One is a linear function of the other. We show the marginal costs in Figure A1 in terms of reduced Mg of CO_2, but we use the figure to talk about both rules.

Each manufacturer is subject to a different target or standard, depending on the fleet of vehicles it produces under the two regulations. Firm 1 represents a large-volume manufacturer that has midrange GHG emissions initially but has relatively low costs of reducing emissions from its fleet (MC_1). Firm 2 has smaller production volumes but higher average initial emissions from its fleet and higher costs of reducing emissions (MC_2), representing, for example, a European manufacturer.

Starting at point A and moving from left to right, the horizontal axis measures Mg of CO_2 reduced by Firm 1 over and above BAU reductions (at the left origin). Starting at point M and moving from right to left, the horizontal axis measures Mg of CO_2 reduced by Firm 2, where the origin (at point M) represents BAU reductions. Both vertical axes measure the marginal cost of reducing one Mg of CO_2 beyond BAU levels. The figure also shows the emissions reduction target that each firm must meet, indicated by the vertical black line representing reductions equal to Mg_T. This target or standard could be different for each firm, depending on the sizes and types of vehicles each firm sells.

Both Firms Complying under the NHTSA Rules that Allow Payment of the Fine

We start with the effect of the NHTSA requirements because they have been in place the longest, and firms have been able to pay a fine in lieu of compliance. To attain this NHTSA standard, the cost for Firm 1 is shown by AFD, and the cost for Firm 2 to attain its standard is MDH. The new NHTSA rules allow firms to trade credits, but they also allow payment of the fine. The NHTSA fine for an automaker is currently \$14.00 per 1/10 mpg, or \$140 per mpg per vehicle over the standard.[26] Since figure A1 is in terms of Mg of CO_2, we show the fine as f_N, which is either \$140/mpg or \$61/Mg of CO_2.[27] In this case, both firms would pay the fine rather than comply with the standard. Firm 1 would reduce to $Mg_{1,N}$ or to an average fleet mpg that is below the standard, with costs of ACB; Firm 2 would reduce to $Mg_{2,N}$, with costs of MKL, which is also below the standard. Firm 1 would pay BCED in fines to NHTSA, and Firm 2 would pay KDEL in fines. In this case, even when trading is allowed, no trading in the credit market would occur. Here the fine

[25] Our analysis abstracts from dynamic effects, such as the impact of the regulations on technological advances or on the future stringency of CAFE standards.

[26] The NHTSA fine had been \$5.50 per 1/10th mpg or \$55 per mpg for many years. It was changed by NHTSA to \$14 per 1/10th mpg in July of 2016.

[27] Conversion from mpg to Mg is explained in the notes to table 4.

represents a safety valve policy that prevents marginal costs from going above f_N.[28]

Result When Both Firms Must Comply with Both Regulations

What is the effect of the binding EPA regulation with credit trading on the NHTSA outcome? Firm 1 is more than complying under the EPA rules, so it has already paid for reductions up to Mg_E. Firm 1 could now sell credits in the NHTSA market ($Mg_E - Mg_T$ equivalent for NHTSA units), but the opportunity cost of these reductions is now zero. Firm 2 is reducing up to Mg_E under the EPA standard with trading, so it does not meet the NHTSA standard. It could pay the fine for the additional mpg needed to meet the standard, but firms like Firm 1 have already earned EPA credits and should be willing to sell at less than f_N, possibly at a price close to zero.

The result is that because the two regulations have effectively the same target, the sum of the credit prices should equal the marginal cost of reducing fuel use (or equivalent CO_2 emissions). Firms will not pay twice for essentially the same reductions. In the case where the EPA standards are binding and no fine is allowed, an EPA credit market with a price such as P_E per Mg is likely to develop, and the price should closely reflect marginal costs. No NHTSA fines would be paid, and the NHTSA credit price may be close to zero.[29]

A3. Effects of Other Regulations: Zero Emission Vehicle Regulations in California and Participating States

Other regulations may also have an effect on the CAFE credit markets. One such regulation is the Zero Emission Vehicle (ZEV) mandate in California and participating states.[30] The ZEV mandate requires that a certain percentage of vehicles sold in participating states be “zero emitting,” which currently includes only pure electric or fuel cell vehicles. The required percentage for the large-volume manufacturers is as high as 15 percent by 2025, which has important implications for the fleet of vehicles that these manufacturers will sell, because the participating states make up about 25 percent of the US market.

If firms that sell vehicles in California have to sell ZEV vehicles, then the costs of meeting the CAFE standards with the remaining vehicles in their fleets will be lower than they would be in the absence of the ZEV mandate. However, the companies’ costs of meeting the CAFE standards *overall* are higher because they are required to produce and sell more ZEV vehicles than they would choose to, in order to meet the standards at the lowest cost.

[28] It is possible that the fine is higher than Firm 1’s marginal costs at the target standard but still below the cost of complying for Firm 2. A limited NHTSA market for credits may develop if auto companies are willing to trade with each other at costs slightly lower than the fine. Under these circumstances Firm 2 would still pay some fines but would also purchase some credits from Firm 1.

[29] In the presence of other differences in credit allowances and limits to trading, the outcomes in the credit markets will be more complex than described here. For example, companies can earn credits in different ways (see table 1).

[30] For details on the ZEV mandate, see http://www.arb.ca.gov/msprog/zevprog/zevprog.htm.

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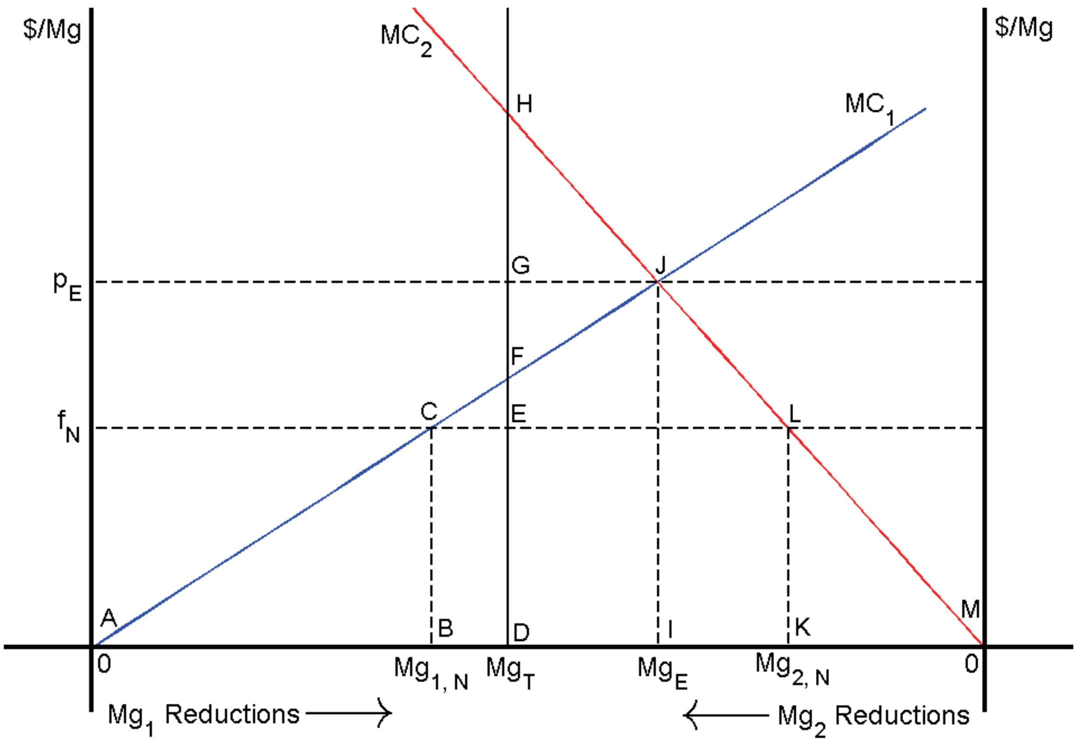
FIGURE A1. MANUFACTURERS FACING OVERLAPPING REGULATIONS FOR IMPROVING FUEL ECONOMY AND REDUCING CO_2 EMISSIONS



Note: Figure is shown in terms of marginal cost of reducing emissions of CO_2 (in Mg), but it could be shown instead in terms of cost of fuel economy improvements.

STATUTORY ADDENDUM

5 U.S.C. § 706

§ 706. Scope of review

To the extent necessary to decision and when presented, the reviewing court shall decide all relevant questions of law, interpret constitutional and statutory provisions, and determine the meaning or applicability of the terms of an agency action. The reviewing court shall—

(1) compel agency action unlawfully withheld or unreasonably delayed; and

(2) hold unlawful and set aside agency action, findings, and conclusions found to be—

(A) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;

(B) contrary to constitutional right, power, privilege, or immunity;

(C) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right;

(D) without observance of procedure required by law;

(E) unsupported by substantial evidence in a case subject to sections 556 and 557 of this title or otherwise reviewed on the record of an agency hearing provided by statute; or

(F) unwarranted by the facts to the extent that the facts are subject to trial de novo by the reviewing court.

In making the foregoing determinations, the court shall review the whole record or those parts of it cited by a party, and due account shall be taken of the rule of prejudicial error.

42 U.S.C. § 7607

§ 7607. Administrative proceedings and judicial review

* * *

(b) Judicial review

(1) A petition for review of action of the Administrator in promulgating any national primary or secondary ambient air quality standard, any emission standard or requirement under section 7412 of this title, any standard of performance or requirement under section 7411 of this title,, any standard under section 7521 of this title (other than a standard required to be prescribed under section 7521(b)(1) of this title), any determination under section 7521(b)(5) of this title, any control or prohibition under section 7545 of this title, any standard under section 7571 of this title, any rule issued under section 7413, 7419, or under section 7420 of this title, or any other nationally applicable regulations promulgated, or final action taken, by the Administrator under this chapter may be filed only in the United States Court of Appeals for the District of Columbia. A petition for review of the Administrator's action in approving or promulgating any implementation plan under section 7410 of this title or section 7411(d) of this title, any order under section 7411(j) of this title, under section 7412 of this title, under section 7419 of this title, or under section 7420 of this title, or his action under section 1857c-10(c)(2)(A), (B), or (C) of this title (as in effect before August 7, 1977) or under regulations thereunder, or revising regulations for enhanced monitoring and compliance certification programs under section 7414(a)(3) of this title, or any other final action of the Administrator under this chapter (including any denial or disapproval by the Administrator under subchapter I of this chapter) which is locally or regionally applicable may be filed only in the United States Court of Appeals for the appropriate circuit. Notwithstanding the preceding sentence a petition for review of any action referred to in such sentence may be filed only in the United States Court of Appeals for the District of Columbia if such action is based on a determination of nationwide scope or effect and if in taking such action the Administrator finds and publishes that such action is based on such a determination. Any petition for review under this subsection shall be filed within sixty days from the date notice of such promulgation, approval, or action appears in the Federal Register, except that if such petition is based solely on grounds arising after such sixtieth day, then any petition for review under this subsection shall be filed within sixty days after such grounds arise. The filing of a petition for reconsideration by the Administrator of any otherwise final rule or action shall not affect the finality of such rule or action for purposes of judicial review nor extend the time within which a petition for judicial review of

such rule or action under this section may be filed, and shall not postpone the effectiveness of such rule or action.

* * *

40 C.F.R. § 86.1818-12

§ 86.1818-12. Greenhouse gas emission standards for light-duty vehicles, light-duty trucks, and medium-duty passenger vehicles.

* * *

(h) *Mid-term evaluation of standards.* No later than April 1, 2018, the Administrator shall determine whether the standards established in paragraph (c) of this section for the 2022 through 2025 model years are appropriate under section 202(a) of the Clean Air Act, in light of the record then before the Administrator. An opportunity for public comment shall be provided before making such determination. If the Administrator determines they are not appropriate, the Administrator shall initiate a rulemaking to revise the standards, to be either more or less stringent as appropriate.

(1) In making the determination required by this paragraph (h), the Administrator shall consider the information available on the factors relevant to setting greenhouse gas emission standards under section 202(a) of the Clean Air Act for model years 2022 through 2025, including but not limited to:

(i) The availability and effectiveness of technology, and the appropriate lead time for introduction of technology;

(ii) The cost on the producers or purchasers of new motor vehicles or new motor vehicle engines;

(iii) The feasibility and practicability of the standards;

(iv) The impact of the standards on reduction of emissions, oil conservation, energy security, and fuel savings by consumers;

(v) The impact of the standards on the automobile industry;

(vi) The impacts of the standards on automobile safety;

(vii) The impact of the greenhouse gas emission standards on the Corporate Average Fuel Economy standards and a national harmonized program; and

(viii) The impact of the standards on other relevant factors.

(2) The Administrator shall make the determination required by this paragraph (h) based upon a record that includes the following:

(i) A draft Technical Assessment Report addressing issues relevant to the standard for the 2022 through 2025 model years;

(ii) Public comment on the draft Technical Assessment Report;

(iii) Public comment on whether the standards established for the 2022 through 2025 model years are appropriate under section 202(a) of the Clean Air Act; and

(iv) Such other materials the Administrator deems appropriate.

(3) No later than November 15, 2017, the Administrator shall issue a draft Technical Assessment Report addressing issues relevant to the standards for the 2022 through 2025 model years.

(4) The Administrator will set forth in detail the bases for the determination required by this paragraph (h), including the Administrator's assessment of each of the factors listed in paragraph (h)(1) of this section.

CERTIFICATE OF SERVICE

I, Robert A. Wyman, Jr., hereby certify that on February 7, 2019, the foregoing has been electronically filed with the Clerk of the Court for the United States Court of Appeals for the District of Columbia Circuit by using the CM/ECF system. I certify that all participants in this case are registered CM/ECF users and that service will be accomplished by the CM/ECF system.

/s/ Robert A. Wyman, Jr.
Robert A. Wyman, Jr.