Impacts of Weakening the Existing EPA Phase 2 GHG Standards

April 2018

Overview

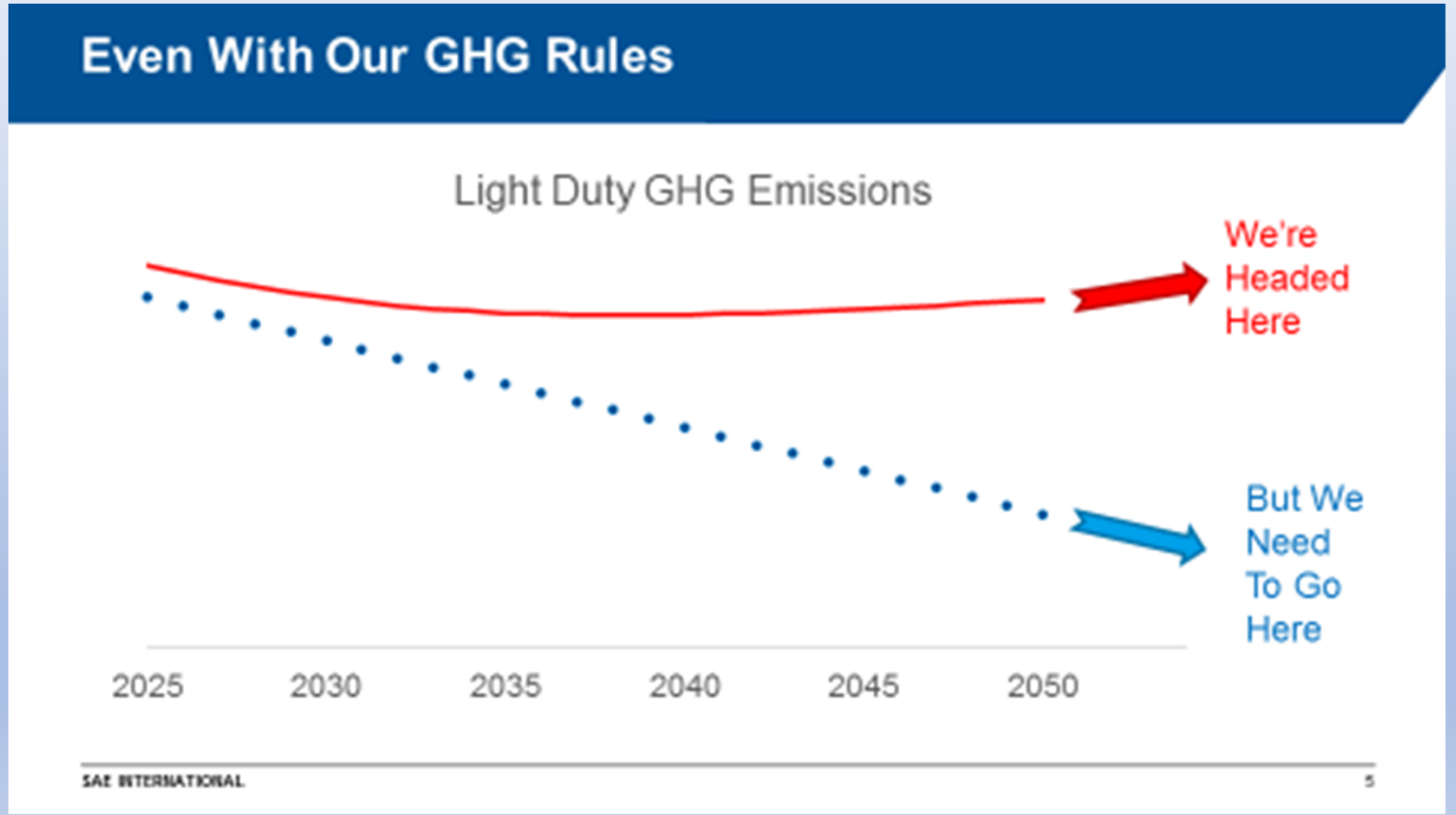
- Background on Joint EPA/NHTSA Phase 2 greenhouse gas (GHG)/fuel economy standards
- Impacts of weakening the existing Phase 2 standards
- Current technological and cost developments on Clean Cars

Phase 2 Greenhouse Gas and Fuel Economy Standards

GHG/Fuel Economy Standards for Light-Duty Vehicles

- EPA and NHTSA finalized joint rules in April 2010 and in August 2012, which created “one national program” and aligned the Federal program with California requirements
- By 2025, average fleet-wide CO_2 emission levels projected to be 163 grams per mile (g/mi), which is equivalent to 54.5 mpg
- Average price increase for 2025 vehicle projected to be about $1,800; net lifetime savings due to better fuel efficiency estimated at $5000 per vehicle
- Combined program reduces CO_2 emissions by 6 billion metric tons and reduces our oil dependence by 2 million barrels per day in 2025

Existing Light-Duty GHG Standards are Insufficient



From EPA

Status of Midterm Evaluation of MY2022-2025 Standards

- In January 2017, EPA made a Final Determination that the MY2022-2025 standards remain appropriate based on the fact that automakers are developing and deploying fuel efficient technologies more quickly and at lower costs than initially forecasted.
- California also completed a separate, corresponding midterm evaluation (MTE) and determined, on March 24, 2017, that the MY2022-2025 standards remain appropriate
- On March 22, 2017, EPA published its intention to reconsider the Final Determination, and on August 23, 2017, EPA issued a notice requesting comment on its reconsideration of the Final Determination and along with the MY2021 standards.
- **It is widely anticipated that EPA and NHTSA will issue joint NPRM that will substantially relax the GHG and fuel economy standards.**

What's at Stake if Phase 2 Standards are Relaxed as Anticipated

CO2 Losses

Fuel Saving Losses

Criteria Emission Impacts

Scenarios Evaluated

- The MY2022-2025 augural standards that NHTSA presented in the Phase 2 final rule were used as the reference case, which reflect fleet-wide annual fuel economy increases of about 4.7 to 4.9% between MY2022 and 2025

- Four likely weakening scenarios evaluated based on reports NHTSA is considering CAFE standards of 35.7 mpg in 2026 (~0.5% annual improvement):
  - MY2022-2025 standards improve at 0.5% year-over-year
  - MY2022-2025 passenger car standards improve at 1% year-over-year and light truck standards improve at 2% year-over-year
  - MY2021-2025 standards improve at .5% year-over-year
  - MY2021-2025 passenger car standards improve at 1% year-over-year and light truck standards improve at 2% year-over-year

- NHTSA's Volpe modeling tool used to assess impacts

Lost Annual Fuel Savings and CO_2 Impacts Associated with a Weakening of Cars Standards

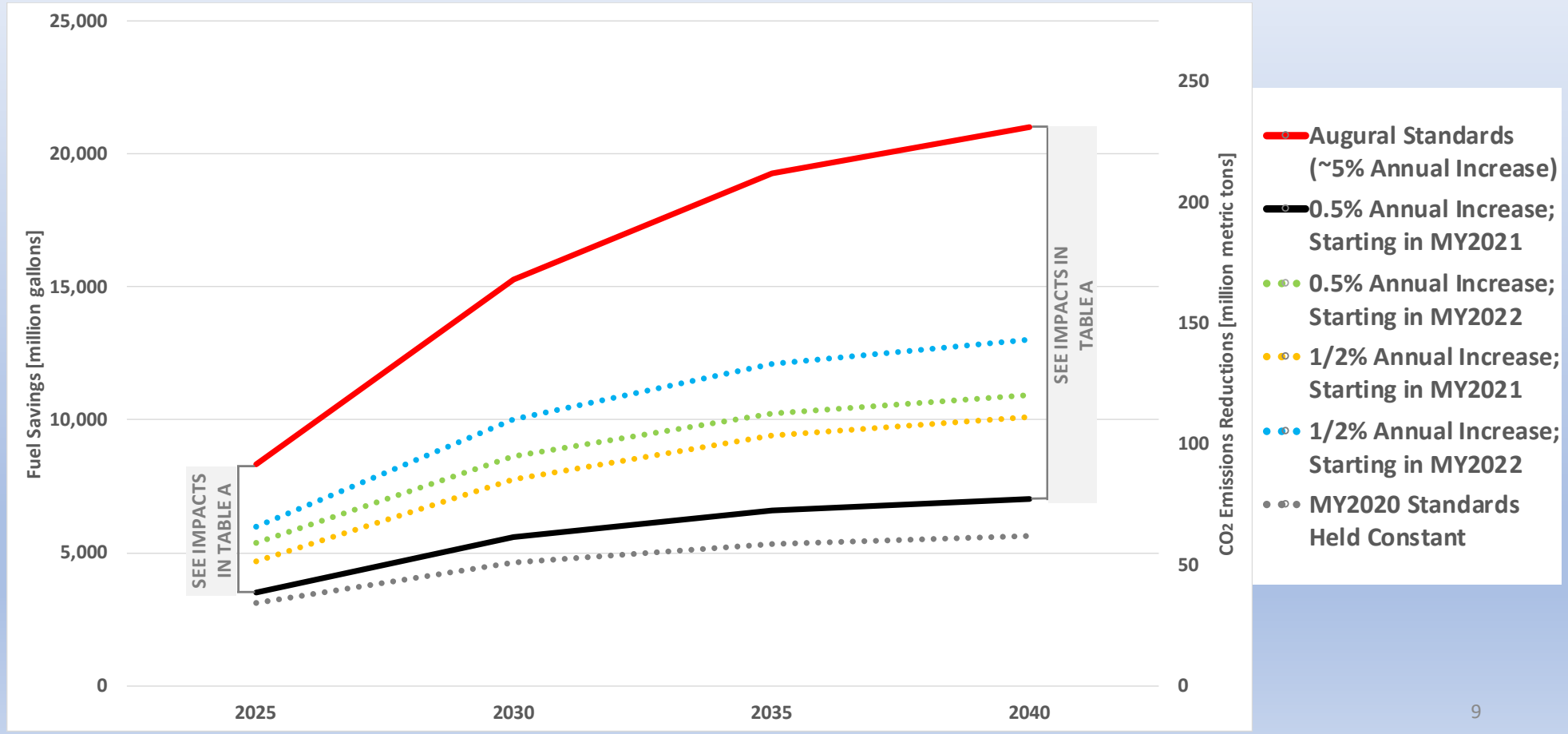
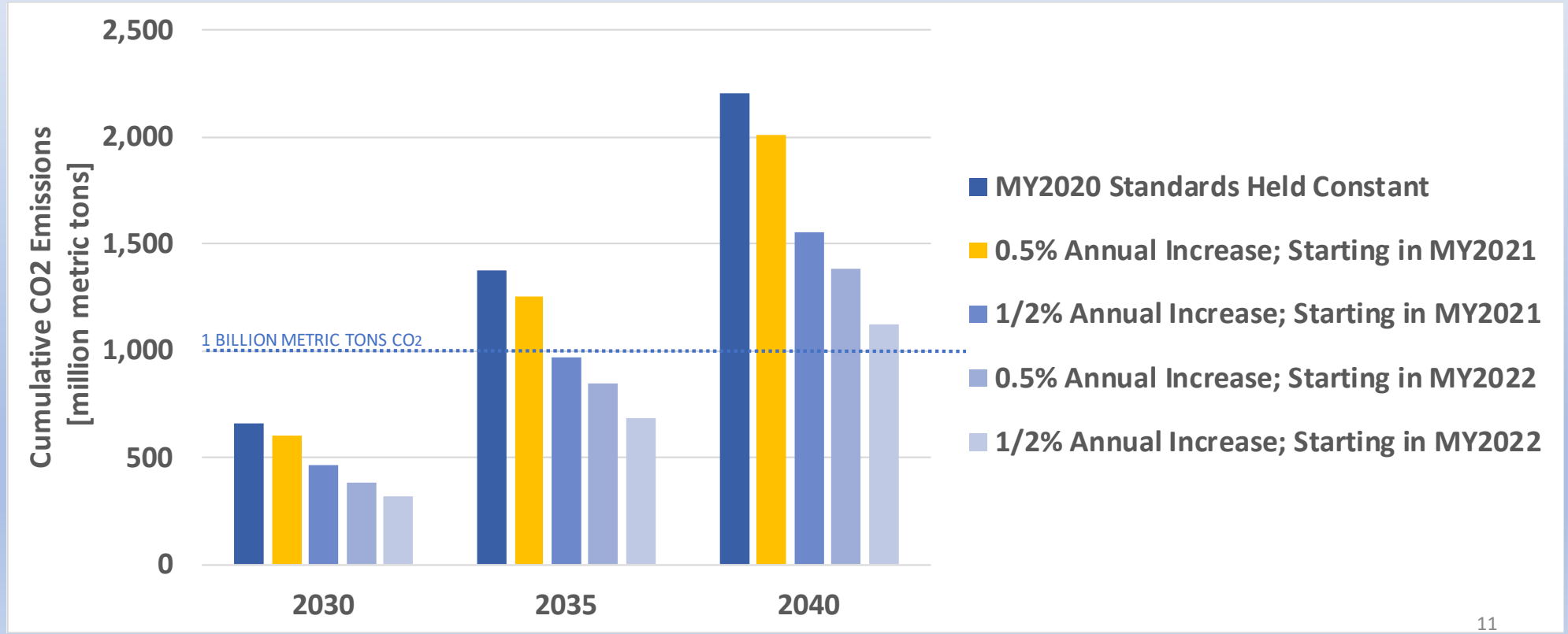


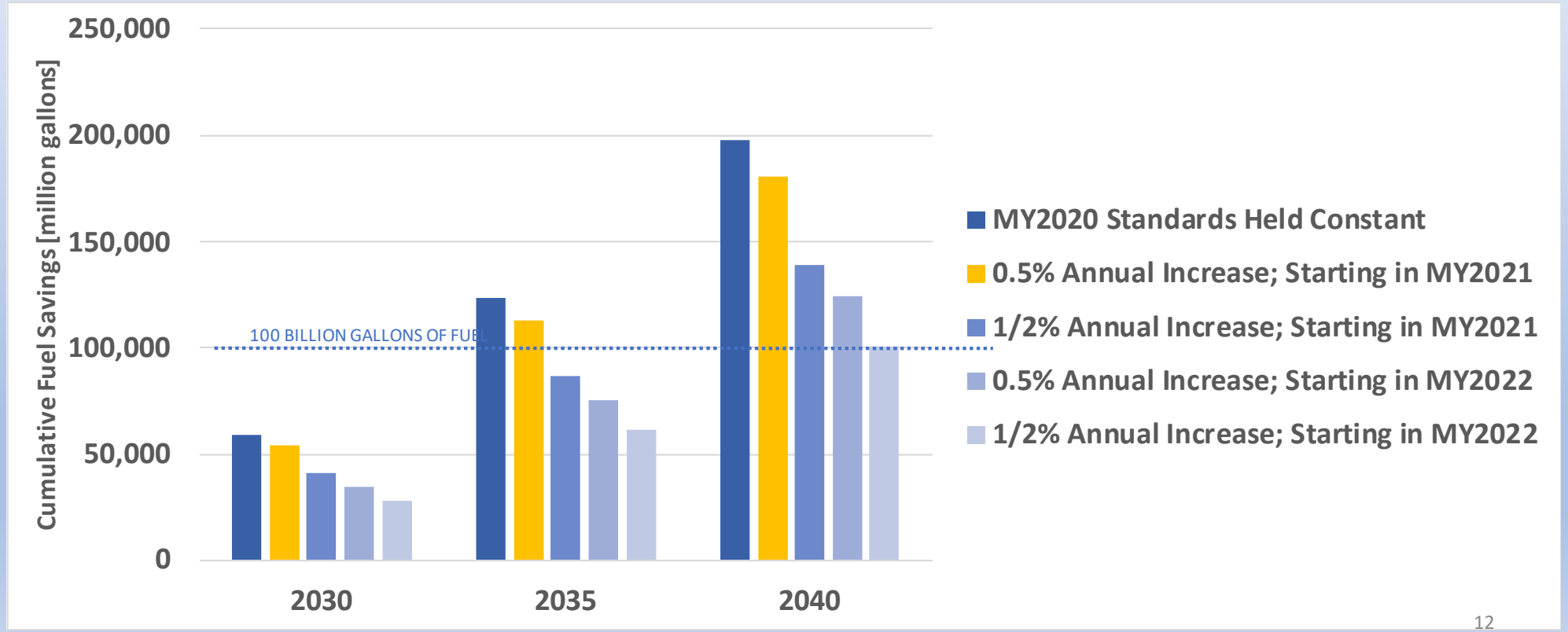
TABLE A: Impacts of 0.5% Weakening Scenario in 2025 and 2040

IMPACTS	2025	2040
0.5% weakening scenario would allow additional CO_2 emissions of:	53 MILLION METRIC TONS	156 MILLION METRIC TONS
0.5% weakening scenario would erode the original standards' benefits by:	57%	67%
These lost CO_2 emissions reductions are equivalent to:	MORE THAN 13 COAL-FIRED POWER PLANTS	MORE THAN 38 COAL-FIRED POWER PLANTS
0.5% weakening scenario would result in lost fuel savings of:	4.8 BILLION GALLONS	14 BILLION GALLONS
These lost fuel savings are equivalent to:	$12.5 BILLION	$36 BILLION

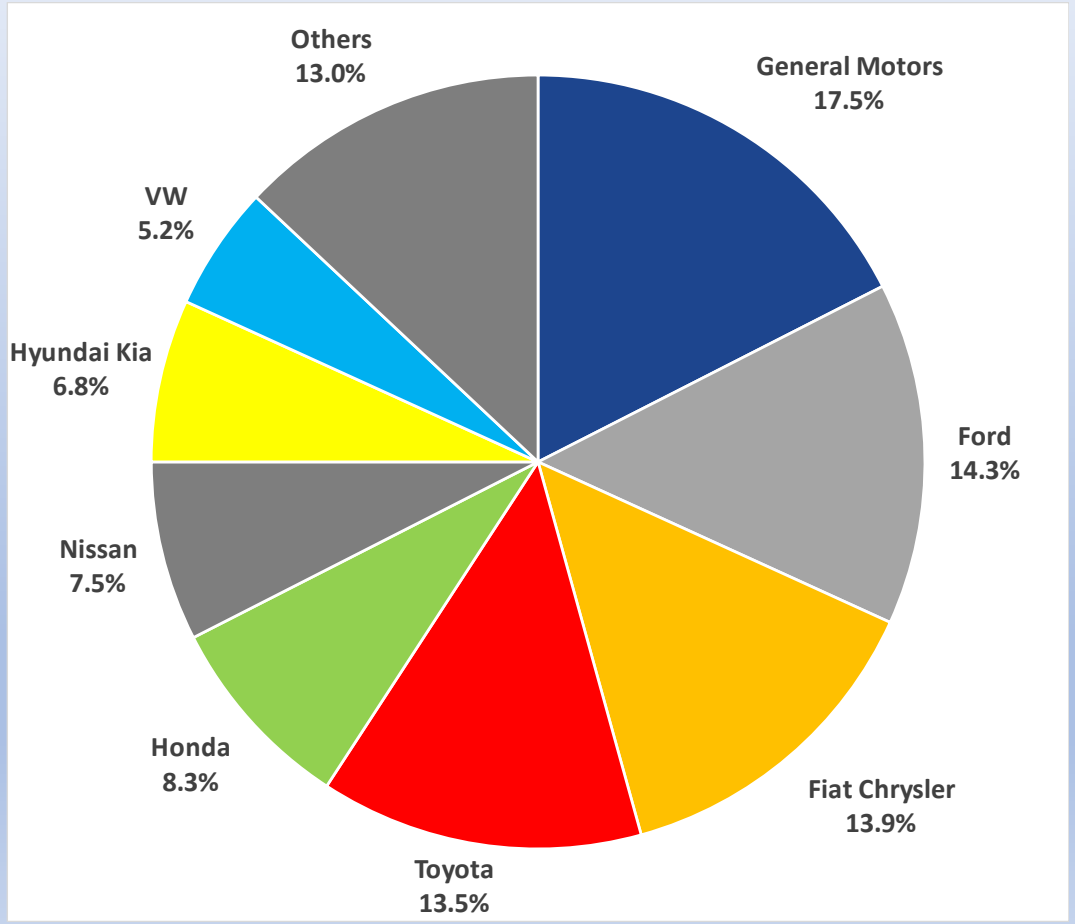
Cumulative CO_2 Losses Associated with a Weakening of Cars Standards Starting in MY 2021, Relative to the Augural Standards



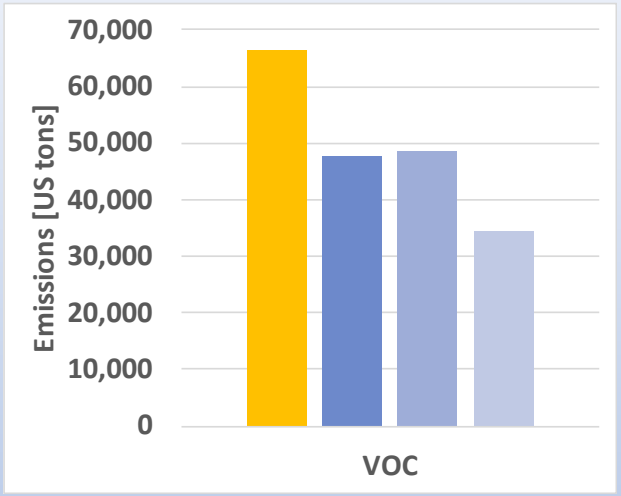
Cumulative Fuel Savings Losses Associated with a Weakening of Cars Standards Starting in MY 2021, Relative to the Augural Standards

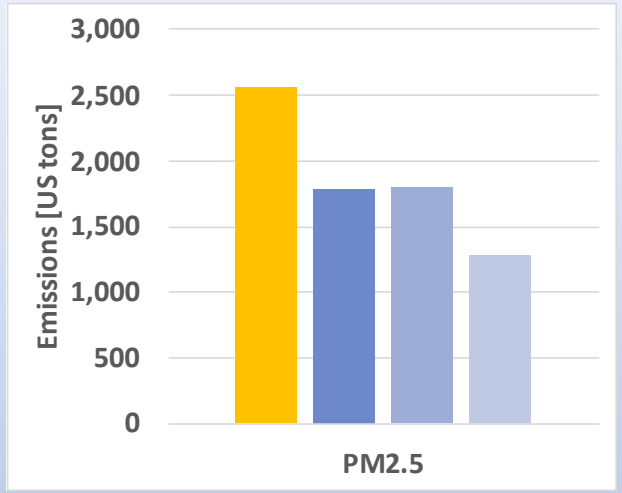


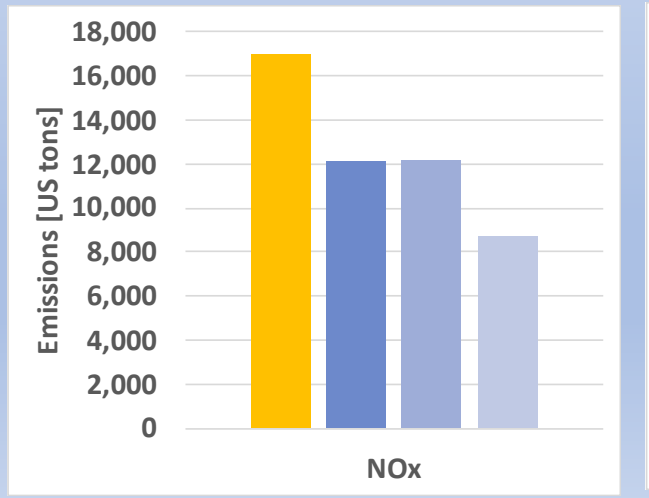
Manufacturers' Contribution to Excess CO2 Emissions and Lost Fuel Savings

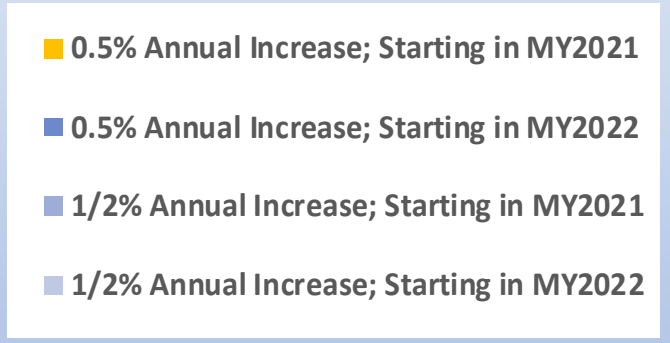


Criteria Pollutant Annual Impact in 2030

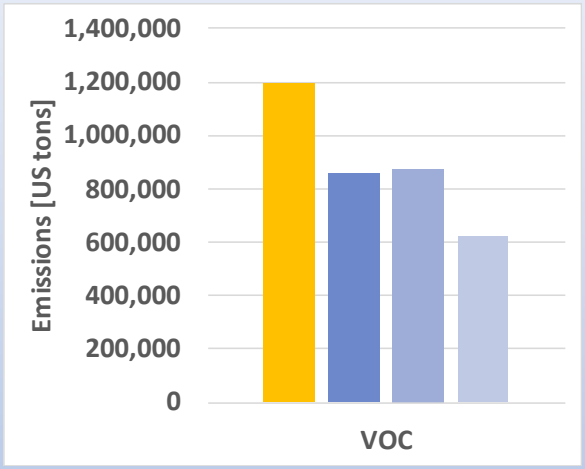


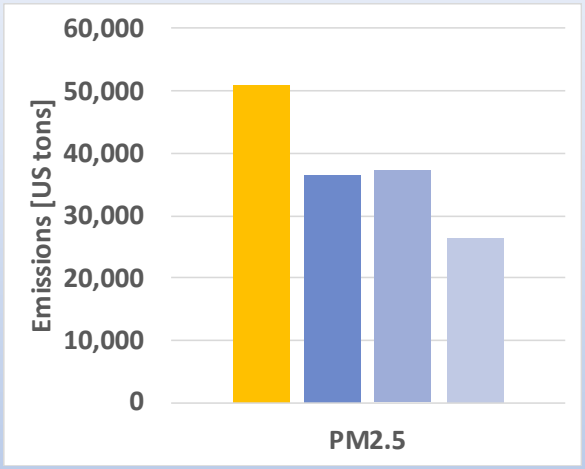


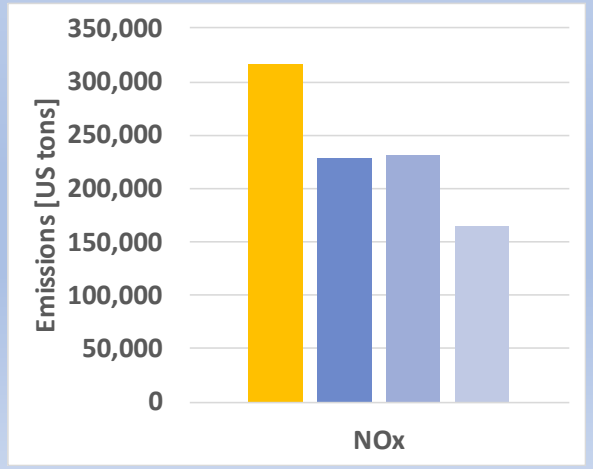


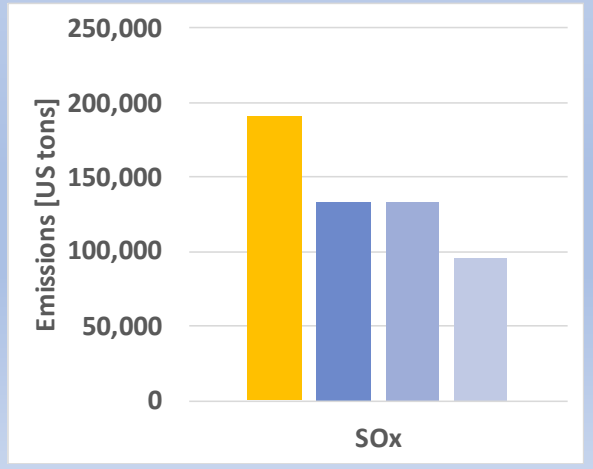


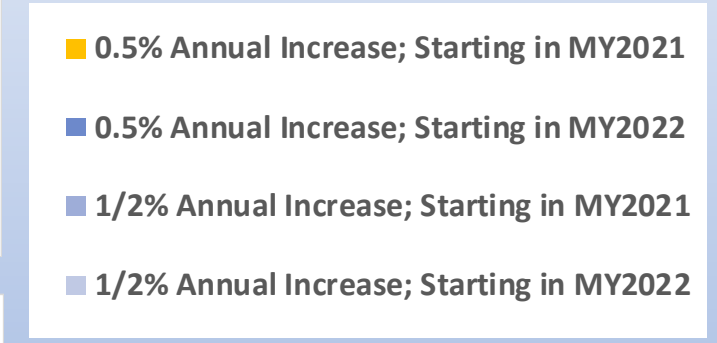
Lifetime Vehicle Criteria Pollutant Impacts for MY 2021 to MY 2032











Current Clean Car Developments

Technologies are Developing Rapidly

- Advanced gasoline vehicle technologies will continue to be main compliance pathway through 2025; very low levels of plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) are needed to comply with current GHG standards
- Automakers are developing and deploying fuel efficient technologies at a faster rate than forecasted in 2012 final rule
- A number of emerging technologies offer the potential to lower costs and achieve greater reductions in the future
- The cost of lithium ion batteries is declining rapidly
- The availability of cost competitive zero emission vehicle (ZEV) technologies opens a technological pathway for all OEMs to achieve very large CO_2 emission reductions

Automaker Investments in Electric Vehicle Development

- **Ford** will invest $4.5 billion in electrified vehicles by 2020: including a 300 mile range fully electric SUV and a F-150 hybrid
- **GM** recently laid out a bold vision for a "zero crashes, zero emissions, and zero congestion" future, announced plans for 20 new electric vehicles by 2023 – including two by 2019, and rolled out the acclaimed Chevy Bolt across the U.S.
- **Toyota** committed to having at least 10 new models of all-electric vehicles by the early 2020's
- **Daimler AG** announced a billion dollar investment to build electric vehicles in the U.S. with production starting in the early 2020's
- **BMW** reached 100,000 in global electric vehicle sales while promising a dozen new models of electric vehicles by 2025
- **Fiat-Chrysler** to electrify portfolio (Wards Auto, July 2017)
- **Volvo** announced that "all the models it introduces starting in 2019 will be either hybrids or powered solely by batteries" (New York Times, July 2017)

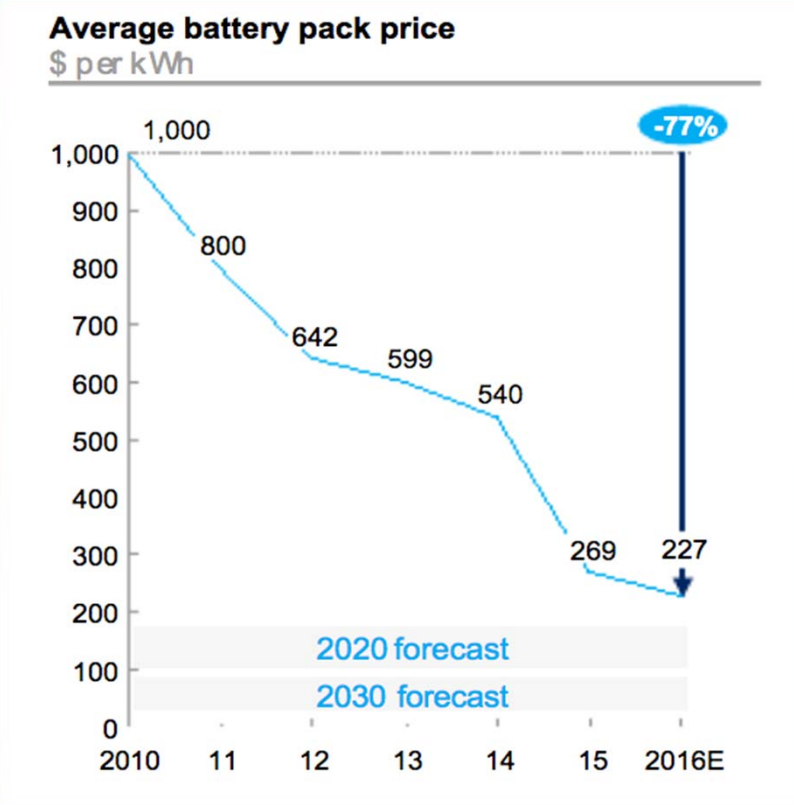
Trends in Electric Vehicle Penetration

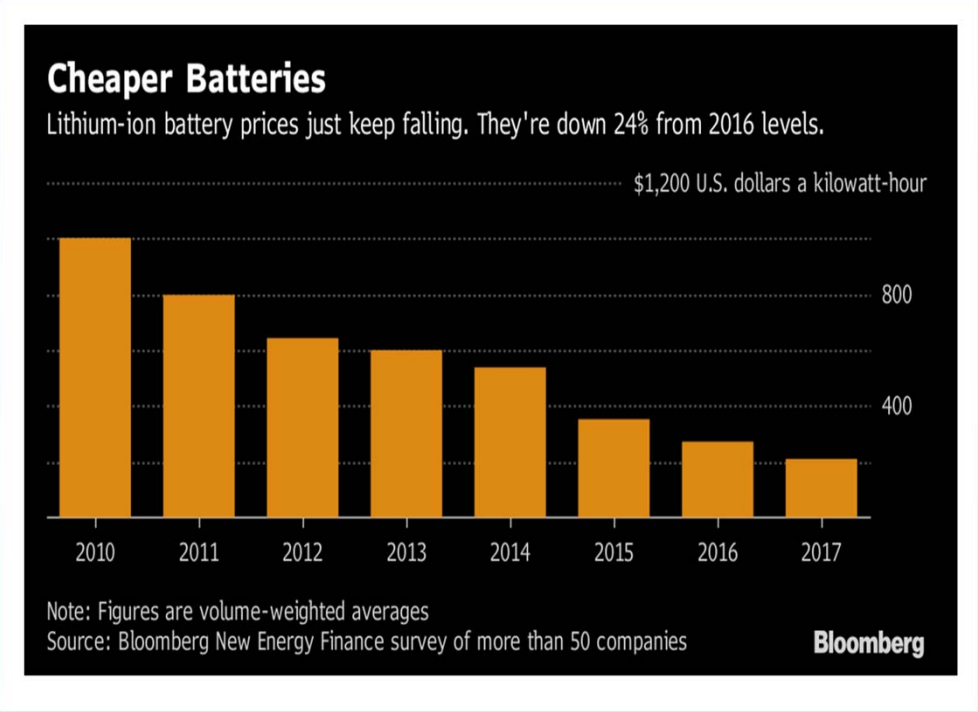
- From January through August 2017, sales of 8 fully electric cars grew 47% in the **US**; Sales of 6 plug-in hybrid cars were up 30%. (Clean Technica, September 2017)
- **France** set target to end sale of gasoline and diesel cars by 2040 (New York Times, July 2017)
- **India** has announced goal of ending sale of petrol and diesel-powered cars by 2030 (NDTV, June 2017)
- **China** has called for one out of every five cars sold to run on alternative fuel by 2025, and has said it will eventually ban sale of all gas-powered cars (New York Times, October 2017)
- **Britain** announced that it will ban the sale of all diesel and gas-powered cars after 2040 (New York Times, July 2017)
- **Norway** aims to ban sale of fossil fuel-powered cars by 2025 (Independent, June 2016)

Vehicle Compliance Cost Projections Continue to Decline Since EPA's 1/17 Final Determination

- ICCT's recent (3/17) technology and cost assessment concludes:
  - "previous costs of compliance have been greatly overestimated"
  - ICCT estimates that MY 2025 vehicle compliance costs relative to MY2021 at $551 compared to EPA's FD estimate of $875
- The cost of lithium ion batteries is declining rapidly
  - Battery prices have fallen about 80% from 2010 to 2016
  - Bloomberg projects battery costs will fall below $100 per kW-hr
- 100 mile BEV could be cost competitive with a conventional technology vehicle by 2030

Figure 1: Lithium-Ion Batteries Costs are Falling Faster than Anticipated (From McKinsey & Co. – January 2017)





From McKinsey & Co. January 2017

Conclusions

- The .5% annual increase alternatives will result in the loss of most to essentially all of the CO2 benefits and fuel savings expected from NHTSA's augural standards – 60 to 90% of the benefits are lost
- The 1% (cars) and 2% (trucks) annual increase alternatives will erode the benefits of the augural standards by 50 to 70 %
- All of the alternatives will substantially reduce the criteria emission benefits anticipated from the existing EPA MY 2021-2025 standards
  - The .5% starting in MY2021 scenario increases emissions for all pollutants compared to 2021 baseline levels
  - For the other scenarios, lost emission reductions range from 64 to 89%
- Efforts to weaken the standards are inconsistent with trends in technology development and cost and manufacturers own statements underscoring their investment in clean vehicles.

Appendix

Table 1: Projected Fleet-Wide CO2 Compliance Targets – From 10/12 Final Rule (in gram/mile)

	2017	2018	2019	2020	2021	2022	2023	2024	2025
Passenger Cars	212	203	193	183	173	164	157	150	143
Light Trucks	295	287	278	270	250	238	226	214	204
Combined Cars and Trucks	243	234	223	214	200	190	181	172	163

Table 2: Projected Fleet-Wide Fuel Economy Compliance Targets – From 10/12 Final Rule (in mpg)

	2017	2018	2019	2020	2021	2022*	2023*	2024*	2025*
Passenger Cars	40.1	41.6	43.1	44.8	46.8	49.0	51.2	53.6	56.2
Light Trucks	29.4	30.0	30.6	31.2	33.3	34.9	36.6	38.5	40.3
Combined Cars and Trucks	35.4	36.5	37.7	38.9	41.0	43.0	45.1	47.4	49.7

* The MY2022-2025 standards were considered augural since NHTSA determined that they could not finalize these standards due to statutory constraints.

Table 3: Projected Fleet-wide CO2 and Fuel Economy Compliance Targets – From Draft TAR

		Annual Energy Outlook (AEO) Fuel Price Case		
	2012 Final Rule	AEO Low	AEO Reference	AEO High
Car/Truck Mix (%)	67/33	48/52	52/48	62/38
CAFE (mpg)	48.7	45.7	46.3	47.7
CO2 (g/mi)/mpg equivalent	163/54.5	178/50.0	175/50.8	169/52.6

Table 4: Year-Over-Year Improvement in CO2 Standards (in %)

	2017	2018	2019	2020	2021	2022	2023	2024	2025
Passenger Cars	5.3	4.7	4.9	5.4	5.5	4.6	4.3	4.5	4.7
Light Trucks	1.0	2.7	3.1	3.0	7.4	4.8	5.1	5.3	4.7
Combined Cars and Trucks	2.8	3.7	4.3	4.0	6.6	4.5	5.3	5.0	4.7

Table 5: CO2 Annual Reduction for Each Scenario – Relative to a 2016 Baseline (in million metric tons)

Scenario	2025	2030	2035	2040
Augural Standards	93	170	215	234
.5% Annual Increase; Starting in MY2021	39	62	73	78
.5% Annual Increase; Starting in MY2022	60	96	114	122
1/2% Annual Increase; Starting in MY2021	52	87	105	113
1/2% Annual Increase; Starting in MY2022	66	110	133	143
MY2020 Standards Held Constant	34	51	59	63

Table 6: Lost CO2 Annual Benefit for Each Scenario Relative to the Augural Standards (in million metric tons)

Scenario	2025	2030	2035	2040
Augural Standards	---	---	---	---
.5% Annual Increase; Starting in MY2021	53	108	141	156
.5% Annual Increase; Starting in MY2022	33	74	101	113
1/2% Annual Increase; Starting in MY2021	41	84	110	121
1/2% Annual Increase; Starting in MY2022	27	60	81	91
MY2020 Standards Held Constant	58	119	155	172

Table 7: Fuel Savings for Each Scenario – Relative to 2016 Baseline (in million gallons)

Scenario	2025	2030	2035	2040
Augural Standards	8,318	15,283	19,266	21,034
.5% Annual Increase; Starting in MY2021	3,515	5,580	6,589	7,018
.5% Annual Increase; Starting in MY2022	5,384	8,649	10,236	10,914
1/2% Annual Increase; Starting in MY2021	4,680	7,774	9,424	10,128
1/2% Annual Increase; Starting in MY2022	5,902	9,913	11,974	12,280
MY2020 Standards Held Constant	3,096	4,611	5,320	5,619

Table 8: Lost Fuel Savings for Each Scenario Relative to the Augural Standards (in million gallons)

Scenario	2025	2030	2035	2040
Augural Standards	---	---	---	---
.5% Annual Increase; Starting in MY2021	4,803	9703	12,677	14,017
.5% Annual Increase; Starting in MY2022	2,934	6,634	9,030	10,121
1/2% Annual Increase; Starting in MY2021	3,679	7509	9,842	10,907
1/2% Annual Increase; Starting in MY2022	2,417	5,370	7,292	8,174
MY2020 Standards Held Constant	5,223	10,671	13,946	15,416

Table 9: Lost Annual CO2 Benefit compared to the Augural Standards – Relative to a 2016 Baseline (in %)

Scenario	2025	2030	2035	2040
Augural Standards	---	---	---	---
.5% Annual Increase; Starting in MY2021	58	63	66	67
.5% Annual Increase; Starting in MY2022	35	43	47	48
1/2% Annual Increase; Starting in MY2021	44	49	51	52
1/2% Annual Increase; Starting in MY2022	29	35	38	39
MY2020 Standards Held Constant	38	70	72	73

Note: This table would also apply to lost annual fuel savings as a percentage of the benefit of the CAFE augural standards relative to a 2016 baseline.

Table 10: Lost Annual CO2 Benefit as a % of the Incremental Benefit of the Augural Standards Relative to Holding MY2020 Standards Constant

Scenario	2025	2030	2035	2040
.5% Annual Increase; Starting in MY2021	91	91	91	91
.5% Annual Increase; Starting in MY2022	54	62	65	66
1/2% Annual Increase; Starting in MY2021	70	70	71	71
1/2% Annual Increase; Starting in MY2022	44	50	52	53

Note: This table would also apply to lost annual fuel savings as a percentage of the incremental benefit of the CAFE augural standards relative to holding the MY2020 standards constant into the future.

Table 11: Cumulative CO2 Losses Starting in 2021 – Relative to the Augural Standards (in million metric tons)

Scenario	2030	2035	2040
Augural Standards	---	---	---
.5% Annual Increase; Starting in MY2021	604	1253	2009
.5% Annual Increase; Starting in MY2022	385	842	1385
1/2% Annual Increase; Starting in MY2021	461	965	1552
1/2% Annual Increase; Starting in MY2022	315	684	1123
MY2020 Standards Held Constant	659	1373	2204

Table 12: Cumulative Lost Fuel Savings Starting in 2021 – Relative to the Augural Standards (in million gallons)

Scenario	2030	2035	2040
Augural Standards	---	---	---
.5% Annual Increase; Starting in MY2021	54,300	112,575	180,438
.5% Annual Increase; Starting in MY2022	34,588	75,606	124,395
1/2% Annual Increase; Starting in MY2021	41,413	86,630	139,383
1/2% Annual Increase; Starting in MY2022	28,249	61,393	100,791
MY2020 Standards Held Constant	59,231	123,348	197,986

Table 13: Manufacturers' Contribution to Excess CO2 Emissions and Lost Fuel Savings

Manufacturer	Projected MY2025 Sales	% Contribution
General Motors	2,636,880	17.5
Ford	2,225,337	14.3
FCA	2,091,735	13.9
Toyota	2,235,706	13.5
Honda	1,529,932	8.3
Nissan	1,351,830	7.5
Hyundai Kia	1,316,828	6.8
VWA	817,315	5.2
Subaru	647,152	3.6
BMW	444,231	3.0
Daimler	386,354	2.6
Others	750,693	3.8
Total	16,433,993	100.0

Table 14: Criteria Emission Annual Impact in 2030– Relative to EPA's MY2021 Standards (in US tons)

Scenario	VOC	NOx	PM2.5	SOx
Existing EPA Standards	(53,575)	(13,625)	(2,012)	(8,317)
.5% Annual Increase; Starting in MY2021	12,740 (+24%)*	3,388 (+25%)	546 (+27)	2,210 (+27%)
.5% Annual Increase; Starting in MY2022	(5,956) (-89%)	(1,520) (-89%)	(224) (-89%)	(925) (-89%)
1/2% Annual Increase; Starting in MY2021	(5,139) (-90%)	(1,442) (-89%)	(209) (-90%)	(841) (-90%)
1/2% Annual Increase; Starting in MY2022	(19,073) (-64%)	(4,919) (-64%)	(728) (-64%)	(2,996) (-64%)

* Represents the the percentage increase (+) or decrease (-) in emission reductions relative to those expected from the existing EPA MY 2021-2025 standards (row 1 of table).

Table 15: Lifetime Vehicle Criteria Emissions Impacts for MY 2021 through MY2032- Relative to EPA's MY2021 Standards (in US tons)

Scenario	VOC	NOx	PM2.5	SOx
Existing EPA Standards	(961,406)	(236,735)	(35,842)	(150,667)
.5% Annual Increase; Starting in MY2021	235,757	79,971	15,193	40,415
.5% Annual Increase; Starting in MY2022	(101,861)	(8,788)	671	(16,588)
1/2% Annual Increase; Starting in MY2021	(88,348)	(6,036)	1,283	(16,588)
1/2% Annual Increase; Starting in MY2022	(340,206)	(72,316)	(9,558)	(54,470)