2025 GHG Structure and Overview

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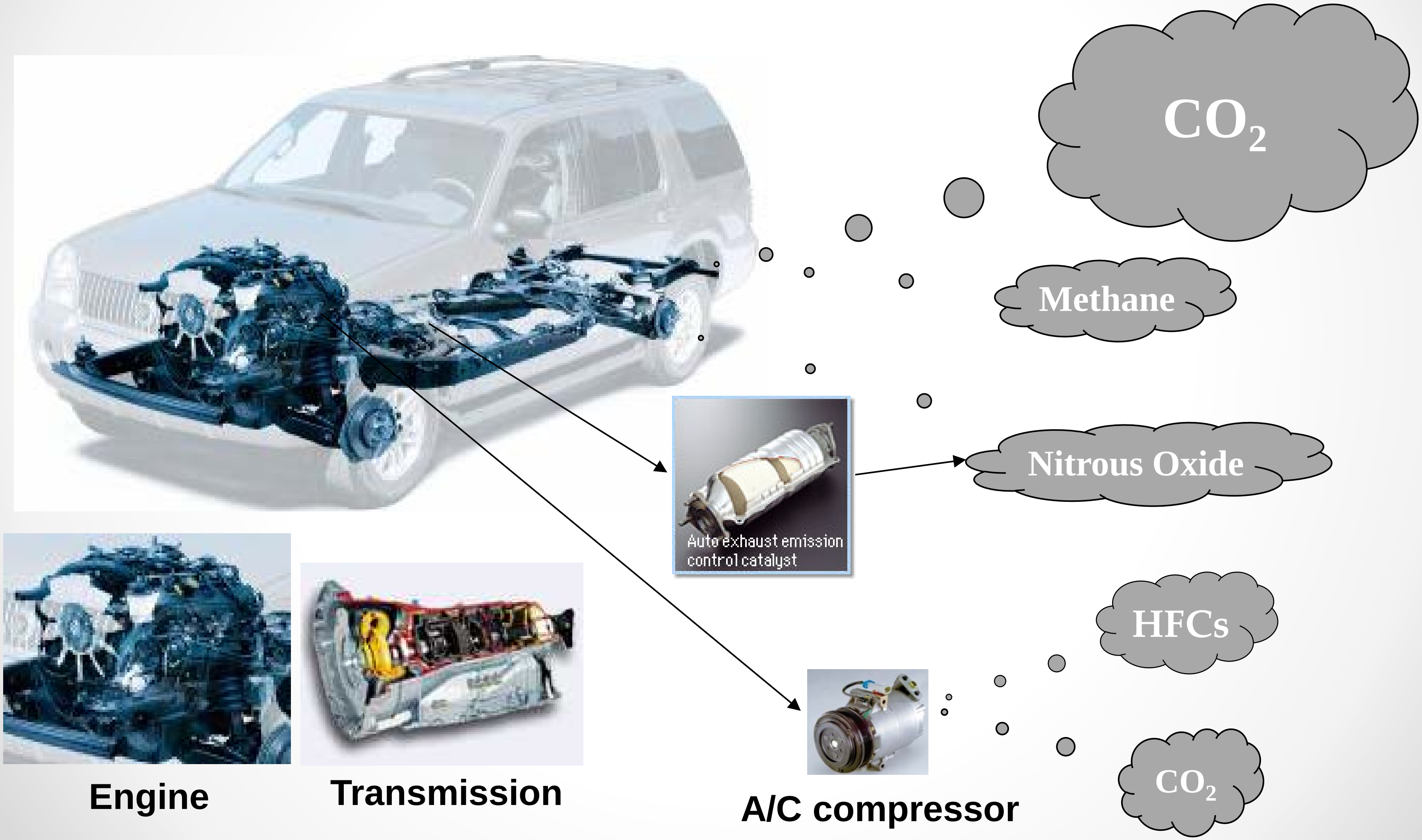
Mexico City

2025 GHG Structure and Overview (Vehicle Categories)

- Passenger Cars/2wd SUVs
- Light-duty Trucks
  - o LDT1, LDT2 and MDPVs

2025 GHG Structure and Overview (Vehicle GHG Sources)



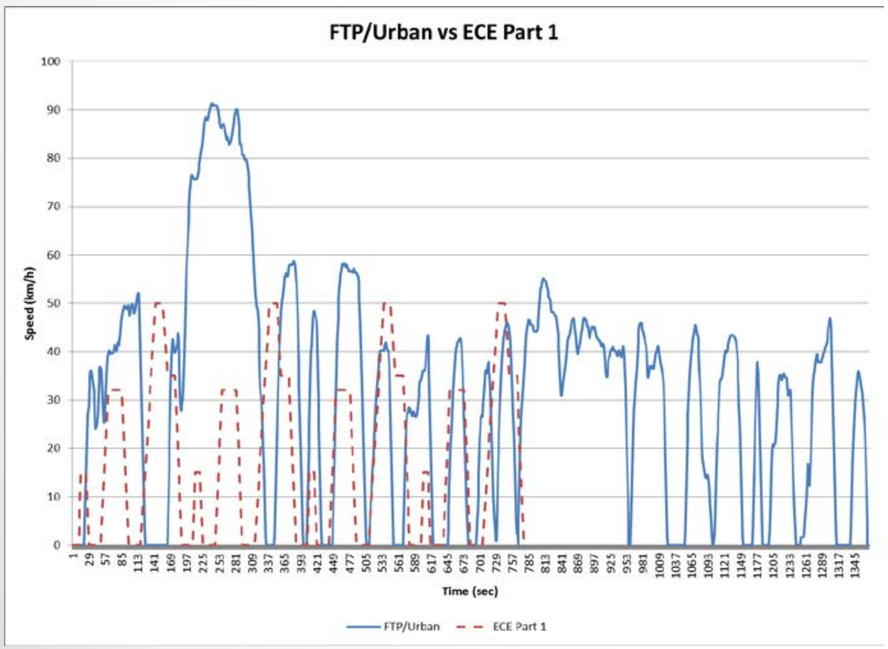
2025 GHG Structure and Overview (GHG Pollutants Regulated)

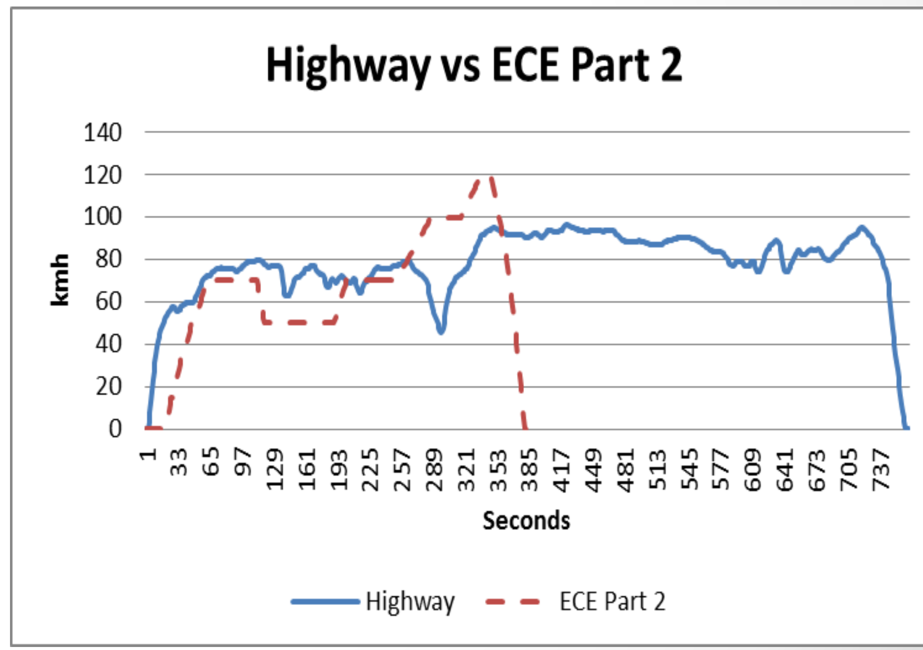
- Carbon Dioxide (CO_2)
  - Emissions from fuel consumed to provide vehicle propulsion and drive accessory loads
- Methane (CH_4)
  - By product of fuel combustion
- Nitrous Oxide (N_2O)
  - Incomplete reduction of engine out nitrogen oxide (NO) emissions
  - Primarily emitted during catalyst warm-up
- Hydroflourocarbons (HFC)
  - Air Conditioning refrigerants

Climate Pollutants	Lifetime (years)	Global Warming Potential 100 years
CO_2	~150	1
CH_4	12	25
N_2O	114	298
HFC134a	14	1300

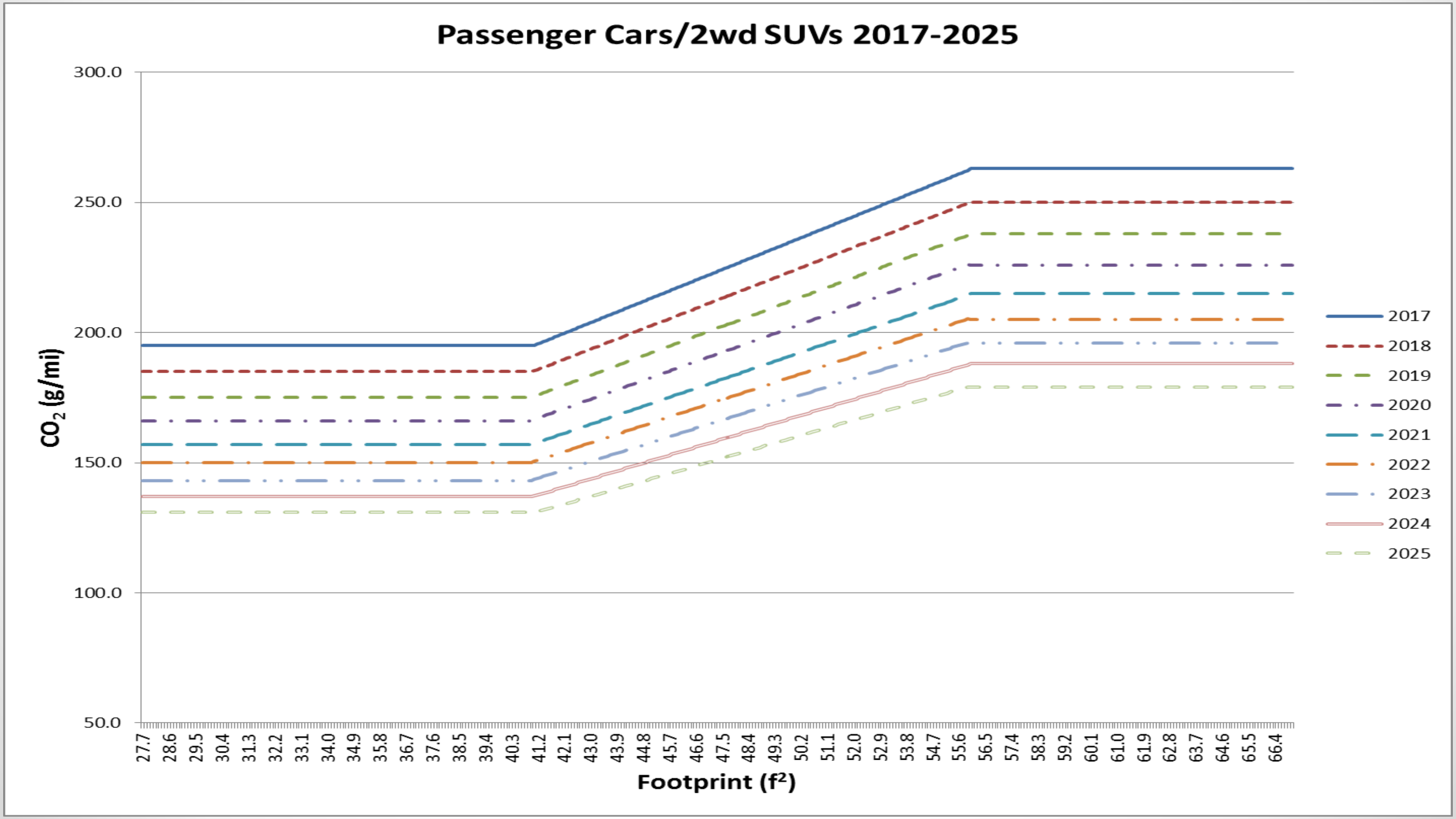
2025 GHG Structure and Overview (Test Cycles)

- Compliance based on composite FTP and Highway test cycles
  - 0.45 x FTP plus 0.55 x highway

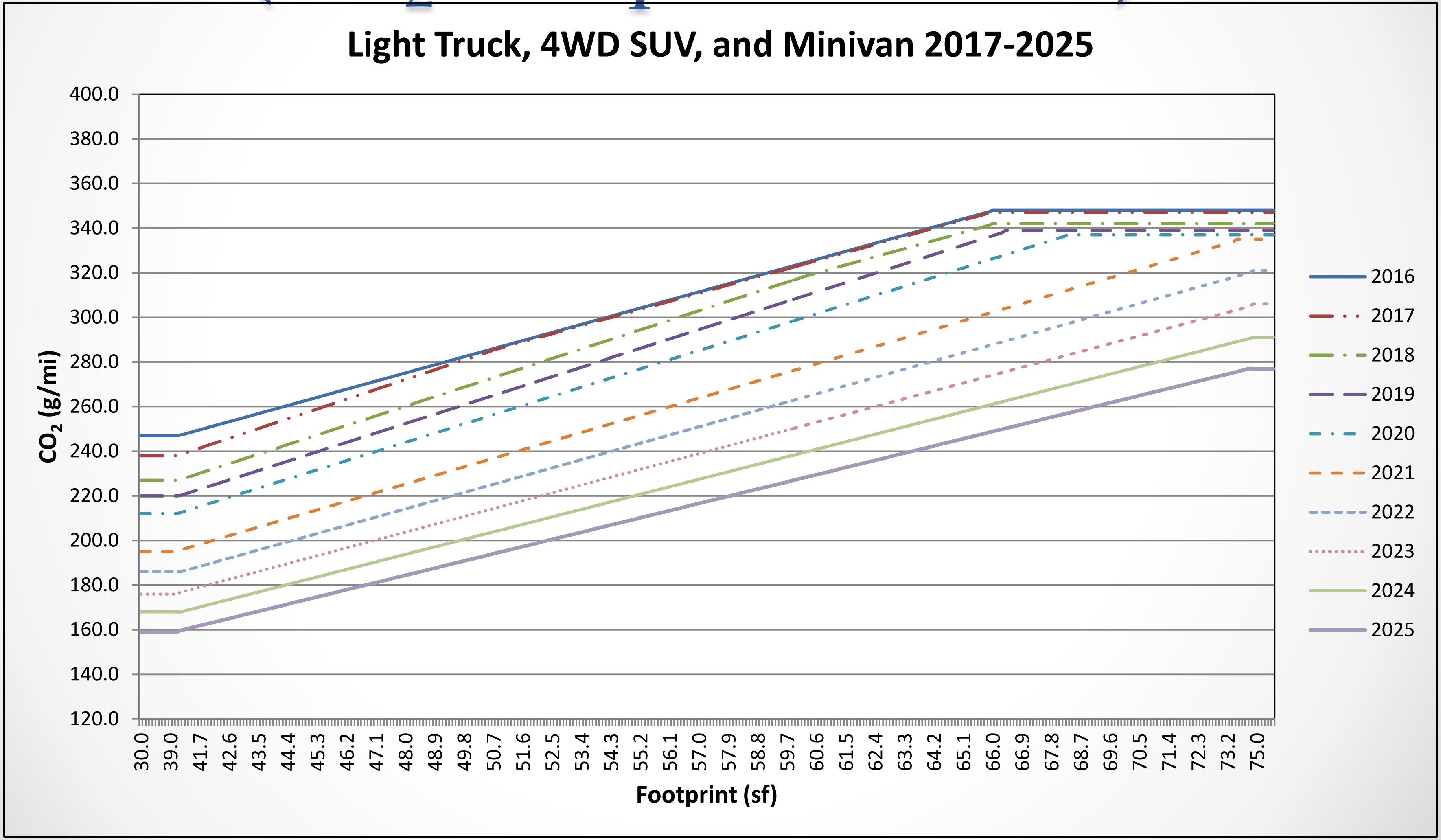




2025 GHG Structure and Overview (CO_2 Footprint Curves)



2025 GHG Structure and Overview (CO_2 Footprint Curves)



2025 GHG Structure and Overview (CO_2 Footprint Curves)

Passenger Car CO_2 Footprint Curves									
Coeff.	2017	2018	2019	2020	2021	2022	2023	2024	2025
a	4.53	4.35	4.17	4.01	3.84	3.69	3.54	3.4	3.26
b	8.9	6.5	4.2	1.9	-0.4	-1.1	-1.8	-2.5	-3.2
c	195.0	185.0	175.0	166.0	157.0	150.0	143.0	137.0	131.0
d	263.0	250.0	238.0	226.0	215.0	205.0	196.0	188.0	179.0

Light-Duty Truck CO_2 Footprint Curves									
Coeff.	2017	2018	2019	2020	2021	2022	2023	2024	2025
a	4.87	4.76	4.68	4.57	4.28	4.09	3.91	3.74	3.58
b	38.3	31.6	27.7	24.6	19.8	17.8	16	14.2	12.5
c	238.0	227.0	220.0	212.0	195.0	186.0	176.0	168.0	159.0
d	347.0	342.0	339.0	337.0	335.0	321.0	306.0	291.0	277.0

Target gCO_2/mile = (a x f) + b

Where: f is vehicle footprint in ft^2 and coefficients a and b are selected from table. Coefficients c and d are lower and upper CO_2 values representing the flat portions of the footprint curves.

a =slope (CO_2 g/mi per square foot)
b = intercept (CO_2 g/mi)
c = lower limit (CO_2 g/mi)
d = upper limit (CO_2 g/mi)

2025 GHG Structure and Overview (Fleet Averaging)

- GHG emissions (CO_2, CH_4 and N_2O) for each vehicle model calculated from composite FTP and highway emission values
  - 0.45 x FTP + 0.55 x highway
- Each vehicle model assigned target CO_2 emissions based on its footprint
  - Footprint defined as wheelbase times average of front and rear track width
- Each manufacturer has a “target” fleet average CO_2 emission standard based on the sales weighted footprint of their vehicle fleet
  - Separate target fleet average CO_2 standard for passenger car and light-truck fleets
- Compliance with CO_2 standards based on sales weighted fleet average measured CO_2 emissions

2025 GHG Structure and Overview (Credits/Debits)

- Credits are earned when a manufacturers' sales weighted fleet average measured CO_2 emissions are lower than their target fleet average CO_2 standard
- Credits can be carried forward five years and carried back three years
- Credits may be banked for future use or traded or sold to another manufacturer
- Credits earned in one category may be used to offset debits accrued in another category
  - i.e., credits earned by passenger cars may offset debits accrued by light-trucks
- Debits are accrued when a manufacturers' sales weighted fleet average CO_2 emissions exceed their target fleet average CO_2 emission standard

2025 GHG Structure and Overview (Fleet Averaging)

Manufacturer A 2017 Model Year Passenger Car Fleet Average CO_2 Emissions				
Vehicle Model	Sales	Footprint (ft^2)	Model Target CO_2 (g/mi)	Measured CO_2 (g/mi)
A	3,500	42.0	199	201
B	2,000	44.5	210	209
C	5,300	46.0	217	219
D	4,200	48.2	227	225
	Total	Sale Weighted Footprint	Sales Weighted Target Fleet CO_2 Emissions	Sales Weighted Measured Fleet CO_2 Emissions
	15,000	45.5	215	215

Manufacturer A 2017 Model Year Light-Truck Fleet Average CO_2 Emissions				
Vehicle Model	Sales	Footprint (ft^2)	Model Target CO_2 (g/mi)	Measured CO_2 (g/mi)
A	3,200	42.6	246	239
B	2,300	49.8	281	287
C	6,000	57.0	311	308
D	4,100	64.2	340	349
	Total	Sale Weighted Footprint	Sales Weighted Target Fleet CO_2 Emissions	Sales Weighted Measured Fleet CO_2 Emissions
	15,600	54.9	302	302

In this case, manufacturer A meets its fleet target CO_2 emissions for both its Passenger Car and Light-Truck fleets because vehicle models that exceed their target CO_2 are offset by vehicle models with lower CO_2 emissions than their target.

2025 GHG Structure and Overview (Fleet Averaging)

Manufacturer A 2017 Model Year Passenger Car Fleet Average CO_2 Emissions				
Vehicle Model	Sales	Footprint (ft^2)	Model Target CO_2 (g/mi)	Measured CO_2 (g/mi)
A	3,500	42.0	199	201
B	2,000	44.5	210	209
C	5,300	46.0	217	219
D	4,200	48.2	227	225
	Total	Sale Weighted Footprint	Sales Weighted Target Fleet CO_2 Emissions	Sales Weighted Measured Fleet CO_2 Emissions
	15,000	45.5	215	215

Manufacturer A 2017 Model Year Light-Truck Fleet Average CO_2 Emissions				
Vehicle Model	Sales	Footprint (ft^2)	Model Target CO_2 (g/mi)	Measured CO_2 (g/mi)
A	3,200	42.6	246	252
B	2,300	49.8	281	287
C	6,000	57.0	311	318
D	4,100	64.2	340	361
	Total	Sale Weighted Footprint	Sales Weighted Target Fleet CO_2 Emissions	Sales Weighted Measured Fleet CO_2 Emissions
	15,600	54.9	302	311

In this case, manufacturer A earns no credits for its passenger car fleet but accrues debits equal to 143,400 g/mi CO_2 for its light-truck fleet. Therefore, the manufacturer would be subject to penalties for 475 (143,400/302) non-compliant vehicles if debits not offset within three years.

Fleet average emissions calculation:
[(Model A CO_2 x Model A sales)+(Model B CO_2 x Model B sales)+(Model C CO_2 x Model C sales)+(Model D CO2 x Model D sales)]/Total Vehicles

Credit/Debit calculation:
(Fleet average requirement – Manufacturer fleet average emissions) x Total vehicles

2025 GHG Structure and Overview (Methane and Nitrous Oxide Standards)

- Separate CH_4 and N_2O standards
  - CH_4 standard 30 mg/mi
  - N_2O standard 10/mg/mi
- CH_4 and N_2O fleet averaging program
  - Manufacturer may choose to include adjusted CH_4 and/or N_2O emissions with their fleet average CO_2 emissions
    - Emissions adjusted by their GWP (CH_4 – 25, N_2O – 298)
    - This option provided for vehicles failing to meet CH_4 or N_2O standards

2025 GHG Structure and Overview (Methane and Nitrous Oxide Standards)

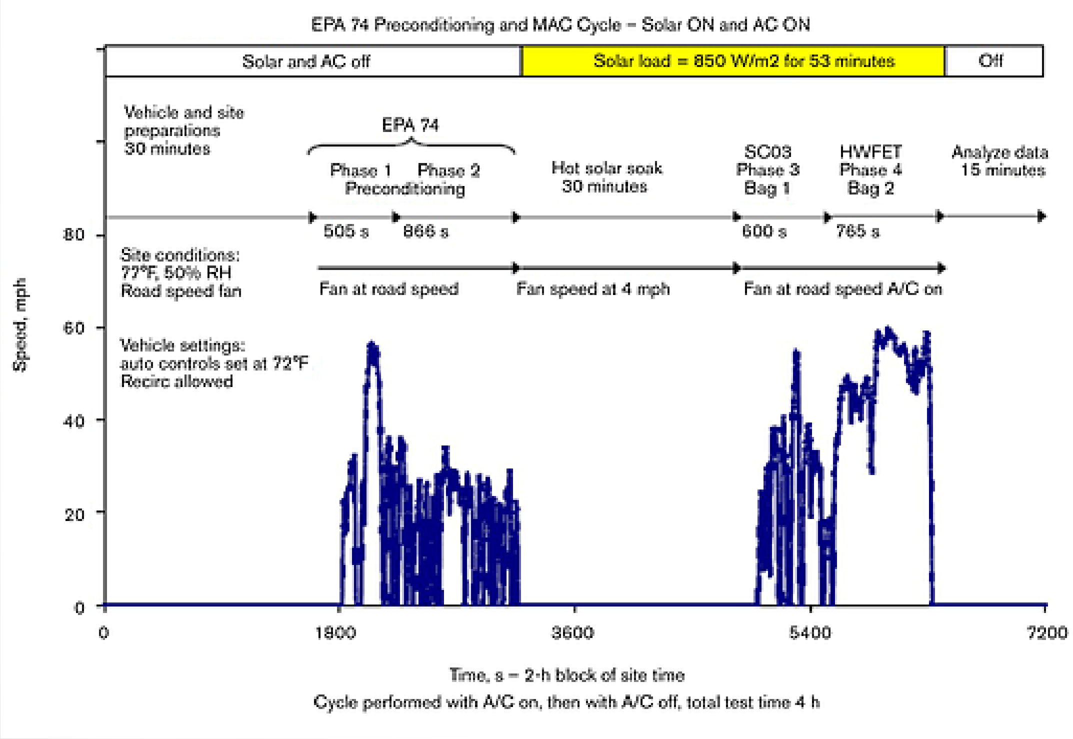
- Credits available for several technologies that are not measured over the GHG and fuel economy test cycles
  - Improved air conditioning systems
    - Low leak systems
    - More efficient systems
    - Low GWP refrigerant use
  - Thermal control technologies
  - Off-cycle technologies
  - Hybrid trucks

2025 GHG Structure and Overview (GHG Air Conditioning Credits)

The total credit value for an air conditioning system may not be greater than 5.0 grams per mile for any passenger car or 7.2 grams per mile for any light-duty truck or medium-duty passenger vehicle. Can be used until model year 2020.

Air Conditioning Technology	***Passenger Cars (g/mi)***	***Light-Duty Trucks and MDPV (g/mi)***
Reduced reheat, with externally-controlled, variable-displacement compressor (*e.g.* a compressor that controls displacement based on temperature setpoint and/or cooling demand of the air conditioning system control settings inside the passenger compartment).	1.5	2.2
Reduced reheat, with externally-controlled, fixed-displacement or pneumatic variable displacement compressor (*e.g.* a compressor that controls displacement based on conditions within, or internal to, the air conditioning system, such as head pressure, suction pressure, or evaporator outlet temperature).	1.0	1.4
Default to recirculated air with closed-loop control of the air supply (sensor feedback to control interior air quality) whenever the ambient temperature is 75 °F or higher: Air conditioning systems that operated with closed-loop control of the air supply at different temperatures may receive credits by submitting an engineering analysis to the Administrator for approval.	1.5	2.2
Default to recirculated air with open-loop control air supply (no sensor feedback) whenever the ambient temperature is 75 °F or higher. Air conditioning systems that operate with open-loop control of the air supply at different temperatures may receive credits by submitting an engineering analysis to the Administrator for approval.	1.0	1.4
Blower motor controls which limit wasted electrical energy (*e.g.* pulse width modulated power controller).	0.8	1.1
Internal heat exchanger (*e.g.* a device that transfers heat from the high-pressure, liquid-phase refrigerant entering the evaporator to the low-pressure, gas-phase refrigerant exiting the evaporator).	1.0	1.4
Improved condensers and/or evaporators with system analysis on the component(s) indicating a coefficient of performance improvement for the system of greater than 10% when compared to previous industry standard designs).	1.0	1.4
Oil separator. The manufacturer must submit an engineering analysis demonstrating the increased improvement of the system relative to the baseline design, where the baseline component for comparison is the version which a manufacturer most recently had in production on the same vehicle design or in a similar or related vehicle model. The characteristics of the baseline component shall be compared to the new component to demonstrate the improvement.	0.5	0.7

2025 GHG Structure and Overview (GHG Air Conditioning Credits)

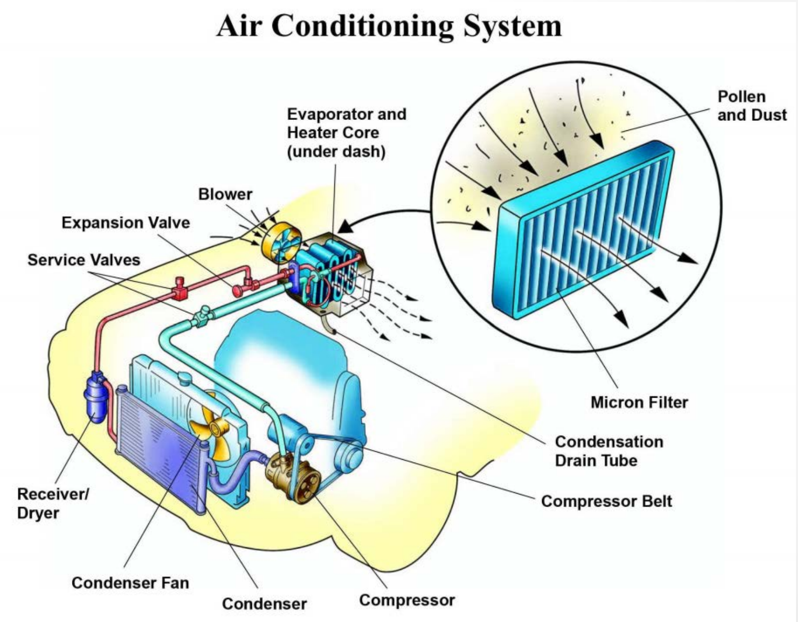


AC17, a new drive cycle for A/C fuel consumption, required from 2017-2025. The AC17 regulation prescribes a lengthy test as of 2017 for improved AC efficiency, although some engineering analysis is permitted in lieu of baseline test data. For 2020-2025, AC17 test data must be used to demonstrate reduced CO_2 emissions in order to receive AC efficiency credits. by performing baseline and improved vehicle tests.

2025 GHG Structure and Overview (GHG Air Conditioning Credits)

Low global warming potential refrigerant replacement (GWP) – replaces conventional refrigerant HFC-134a with lower global warming potential refrigerants such as HFO-1234yf, CO_2, HFC-152a. Technologies are provided a system of credits, up to approximately 14-17 gCO_2e/mile for cars and trucks.

Refrigerant	*GWP*
HFC–134a	1,430
HFC–152a	124
HFO–1234yf	4
CO_2	1



2025 GHG Structure and Overview (Thermal Control Credits)

The maximum credit allowed for thermal control technologies is limited to 3.0 g/mi for passenger cars and to 4.3 g/mi for light-duty trucks and medium-duty passenger vehicles. The maximum credit allowed for glass or glazing is limited to 2.9 g/mi for passenger cars and to 3.9 g/mi for light-duty trucks and medium-duty passenger vehicles.

Thermal Control Technology	Credit value: Passenger Cars (g/mi)	Credit Value: Light-Duty Trucks and Medium-Duty Passenger Vehicles (g/mi)
Glass or glazing	≤2.9	≤3.9
Active seat ventilation	1.0	1.3
Solar reflective paint	0.4	0.5
Passive cabin ventilation	1.7	2.3
Active cabin ventilation	2.1	2.8

2025 GHG Structure and Overview (Off-Cycle Credits)

A manufacturer may generate a CO_2 gram/mile credit for certain technologies as specified in the table, provided that each technology is applied to the minimum percentage of the manufacturer's total U.S. production of passenger cars, light-duty trucks, and medium-duty passenger vehicles specified in the table in each model year for which credit is claimed. A manufacturer may earn up to 10 g/mi CO_2 credit for any passenger car or light-duty truck.

Off-Cycle Technology	**Passenger Cars (g/mi)**	**Light-Duty Trucks and Medium-Duty Passenger Vehicles (g/mi)**	**Minimum percent of U.S. production**
Active aerodynamics	0.6	1.0	10
High efficiency exterior lighting	1.1	1.1	10
Engine heat recovery	0.7 per 100W of capacity	0.7 per 100W of capacity	10
Engine start-stop (idle-off)	2.9	4.5	10
Active transmission warm-up	1.8	1.8	10
Active engine warm-up	1.8	1.8	10
Electric heater circulation pump	1.0	1.5	n/a
Solar roof panels	3.0	3.0	n/a
Thermal control	≤3.0	≤4.3	n/a

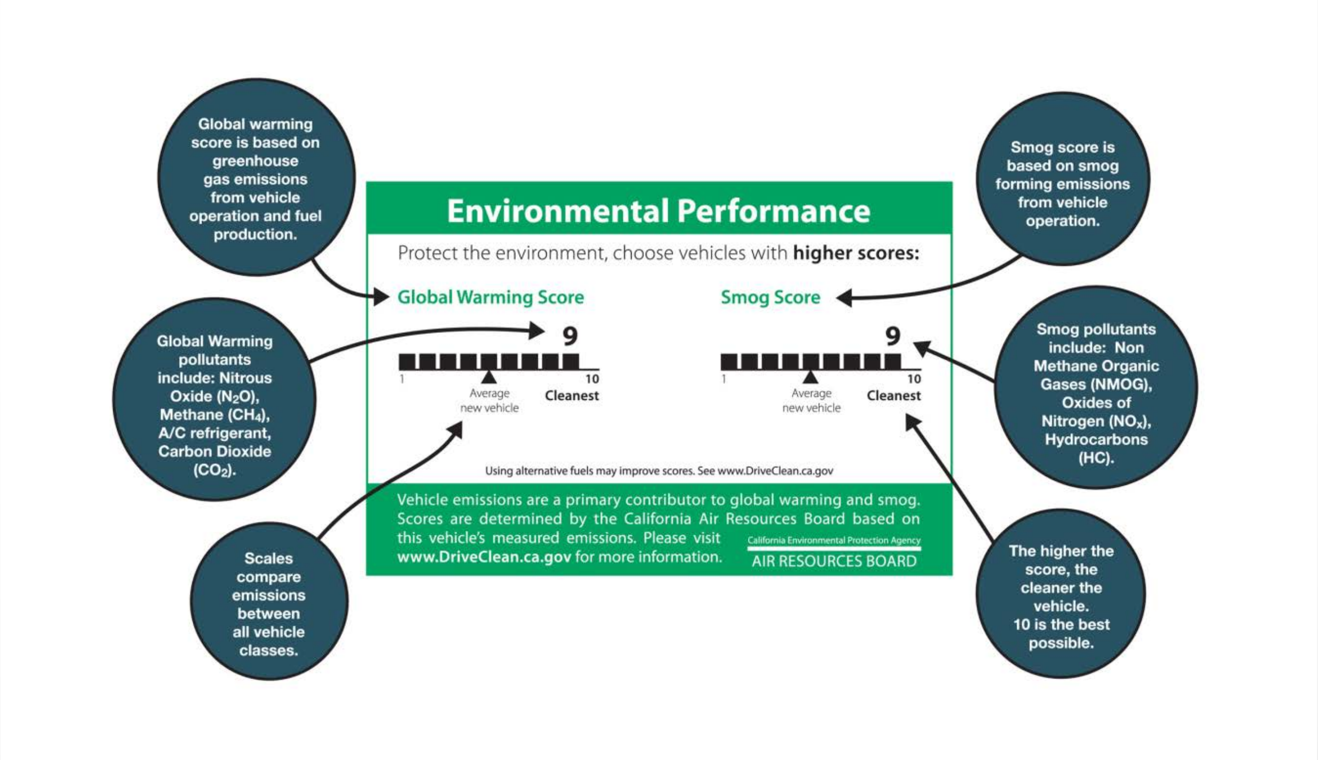
2025 GHG Structure and Overview (Hybrid Truck Credits)

Full-size pickup trucks that are mild hybrid gasoline-electric vehicles and that are produced in the 2017 through 2021 model years are eligible for a credit of 10 grams/mile. To receive this credit, the manufacturer must produce a quantity of mild hybrid full-size pickup trucks such that the proportion of production of such vehicles, when compared to the manufacturer's total production of full-size pickup trucks, is not less than the amount specified in the table for each model year.

Model year	Required minimum percent of full-size pickup trucks
2017	30%
2018	40%
2019	55%
2020	70%
2021	80%

2025 GHG Structure and Overview (Vehicle Labeling)

- California has its own vehicle GHG and smog label, but allows use of the federal GHG and fuel economy label



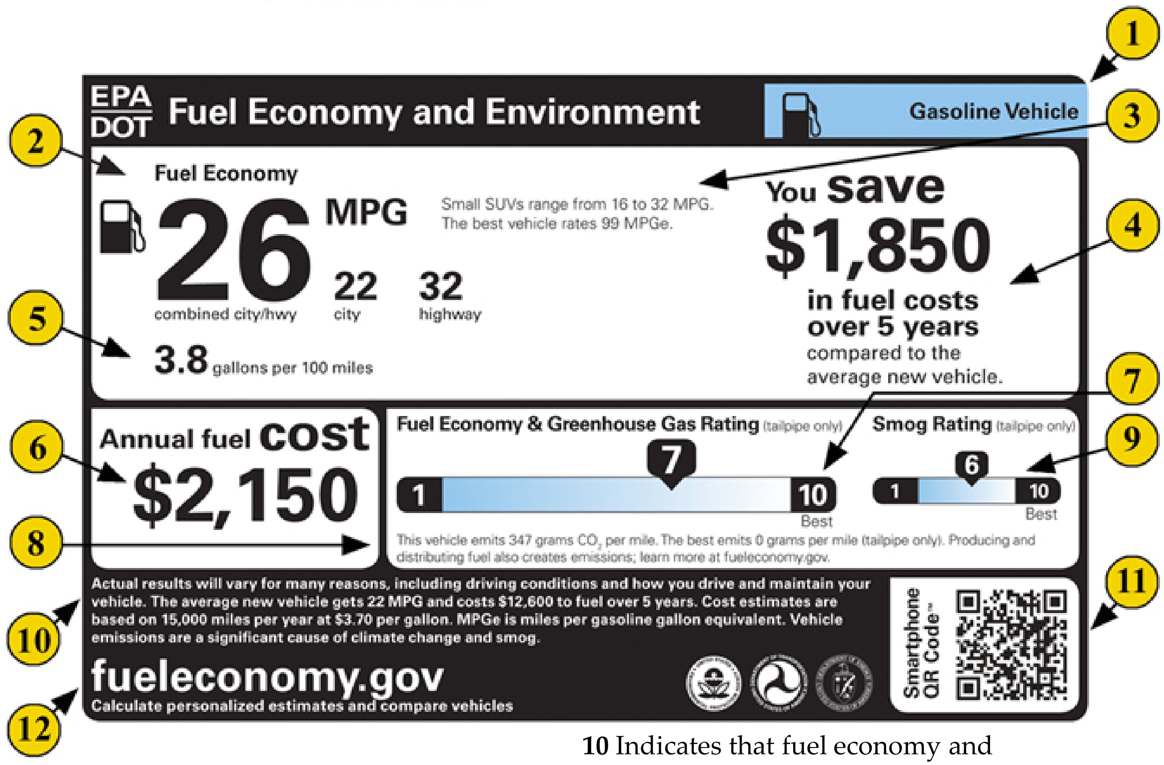
2025 GHG Structure and Overview (Vehicle Labeling)

- California vehicle environmental label ratings

Grams per mile CO_2-equivalent combined	Global Warming Score
Less than 200	10
200-239	9
240-279	8
280-319	7
320-359	6
360-399	5
400-439	4
440-479	3
480-519	2
520 and up	1

California Emissions Category– Federal Bins	NMOG + NOx (g/mile)	Smog Score
ZEV – Bin 1	0.0	10
PZEV	0.030	9
SULEV – Bin 2	0.030	8
Bin 3	0.085	7
Bin 4	0.110	6
ULEV	0.125	5
LEV – Bin 5	0.160	4
[LEV (option 1) – Bin 6] and [SULEV (MDPV)]	0.190 – 0.200	3
Bin 7	0.240	2
ULEV (MDPV) – Bin 8a	0.325	1

2025 GHG Structure and Overview (Vehicle Labeling)



1 Vehicle Technology & Fuel

2. Fuel Economy

3 Indicates the category of the vehicle (e.g., Small SUV, Station Wagon, Pickup Truck, etc.) and the best and worst fuel economy within that category for the given model year. There are nine car categories, six truck categories, and a "special purpose vehicle"

4 shows the estimated fuel cost over a five-year period for the vehicle compared to the average new vehicle

5 Fuel consumption rate

6 The annual fuel cost is based on two assumptions: an annual mileage of 15,000 miles and a projected gasoline price.

7 The new label assigns each vehicle a rating from 1 (worst) to 10 (best) for fuel economy and greenhouse gas (GHG) emissions (i.e., how much carbon dioxide the vehicle's tailpipe emits each mile), as shown below. There are two ratings that apply to each vehicle—one for fuel economy and one for greenhouse gas emissions—but gasoline vehicles will display only one rating. This is because carbon dioxide emissions are directly related to the amount of fuel consumed. This relationship varies from fuel to fuel, but both rating systems are based on gasoline vehicles, meaning that gasoline vehicles get the same rating for fuel economy and for greenhouse gas emissions.

8 <u>Combined city/highway CO_2 tailpipe emissions</u>
The labeled vehicle's CO_2 tailpipe emissions are based on tested tailpipe CO_2 emission rates. The rate of CO_2 emissions is displayed in grams per mile.
<u>Vehicle with lowest CO_2 emissions</u>
The label identifies the lowest tailpipe CO_2 emissions of available vehicles. If there are electric or fuel cell vehicles on the market, which by definition have zero tailpipe emissions, this value will be zero grams per mile.

9 Rating for vehicle tailpipe emissions of those pollutants that cause smog and other local air pollution. Displayed using a slider bar with a scale of 1 (worst) to 10 (best). The scale is based on the U.S. vehicle criteria emissions standards. For those vehicles that run on electricity, the tailpipe emissions are zero.

10 Indicates that fuel economy and emissions may be different due to how a vehicle is driven and maintained, air conditioning use and other factors.

11 A scan able **Q**R Code® link to helpful tools and additional information about the vehicle

12 The label directs you to the fueleconomy.gov web site, where you can compare vehicles and enter personalized information (e.g., local gas prices and individual driving habits) to get the best possible cost and energy-use estimates.

2025 GHG Structure and Overview (Vehicle Labeling)

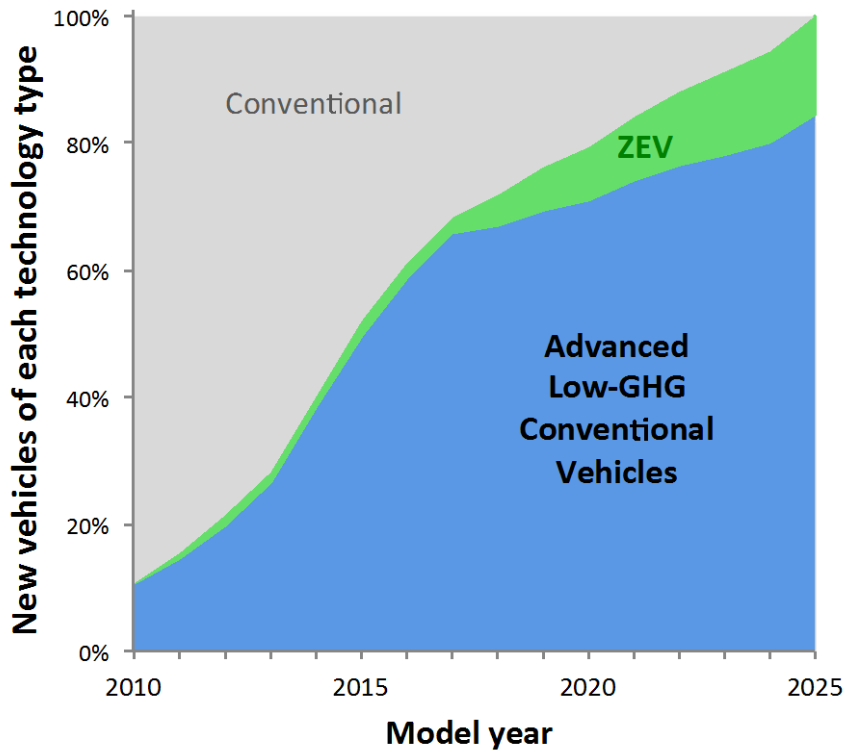
- Federal vehicle fuel economy and environmental label ratings

Grams per mile CO_2-equivalent combined	Fuel Economy (mpg)	Global Warming Score
Less than 200	45	10
200-243	37-44	9
244-291	31-36	8
292-335	27-30	7
336-378	24-26	6
379-456	20-23	5
457-539	17-19	4
540-613	15-16	3
614-658	14	2
659 and up	≤13	1

California Emissions Category–Federal Bins	NMOG + NOx (g/mile)	Smog Score
ZEV – Bin 1	0.0	10
PZEV	0.030	9
SULEV – Bin 2	0.030	8
Bin 3	0.085	7
Bin 4	0.110	6
ULEV	0.125	5
LEV – Bin 5	0.160	4
[LEV (option 1) – Bin 6] and [SULEV (MDPV)]	0.190 – 0.200	3
Bin 7	0.240	2
ULEV (MDPV) – Bin 8a	0.325	1

2025 GHG Structure and Overview (Vehicle GHG Technologies)

- Off-the-shelf low-GHG technology becomes commonplace



Engine
- Variable valve control
- Direct injection
- Turbocharging
- Cylinder deactivation
- Cooled exhaust gas recirculation
- Optimized controls

Driveline
- 8-speed transmission
- Continuously variable
- Dual clutch transmission

Vehicle
- Engine stop-start
- Hybrid power assist
- Aerodynamics
- Low rolling resistance tires
- Advanced lightweight materials
- Low-GWP refrigerant
- Electric accessories

2025 GHG Structure and Overview (Vehicle GHG Technologies)

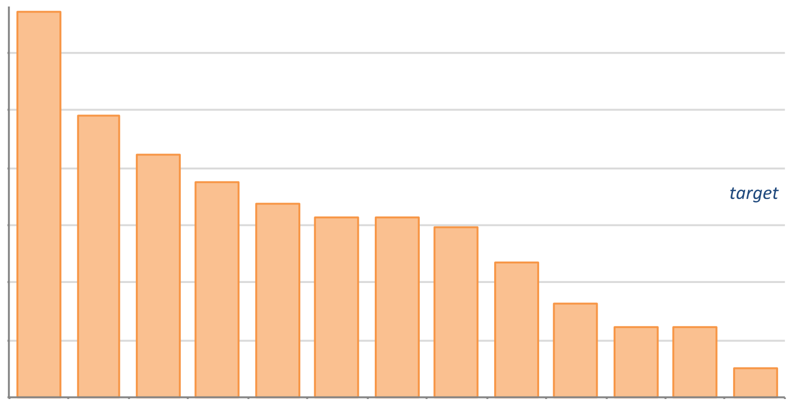
CO_2 Reduction from Individual Technologies from 2008 Reference					
Area	Technology	Small car	Mid-size car	Small light-duty truck	Large light-duty truck
Engine Technologies	Engine friction reduction	3.5%	4.5%	3.4%	4.2%
	Cylinder deactivation	-	6.1%	4.7%	5.7%
	Discrete cam phasing (DCP)	4.1%	5.2%	4.1%	4.9%
	Discrete variable valve lift (DVVL)	4.1%	5.2%	4.0%	4.9%
	sGDI (18-bar, 33% downsize)	12.2%	14.2%	12.1%	13.6%
	sGDI+DCP+DVVL (18-bar, 33% TDS)	14.9%	17.5%	14.8%	16.8%
	cEGR sGDI+DCP+DVVL (27-bar, 56% TDS)	21.4%	24.3%	21.2%	23.5%
	Compression-ignition DCP diesel	19.8%	21.3%	19.1%	21.3%
Transmission Technologies	Torque convertor lock-up	0.4%	0.5%	0.5%	0.5%
	Aggressive shift logic	2.0%	2.5%	1.9%	2.4%
	High efficiency gearbox	3.3%	3.9%	3.8%	4.3%
	Optimized shifting	5.2%	6.6%	5.1%	6.2%
	6-speed automatic	1.8%	2.2%	1.7%	2.1%
	8-speed automatic	6.5%	7.8%	6.8%	7.8%
	Wet dual clutch 8-speed	9.7%	11.5%	10.5%	11.9%
	Dry dual clutch 8-speed	10.3%	12.2%	11.1%	12.6%
	Continuously variable	11.0%	6.3%	6.0%	-

2025 GHG Structure and Overview (Vehicle GHG Technologies)

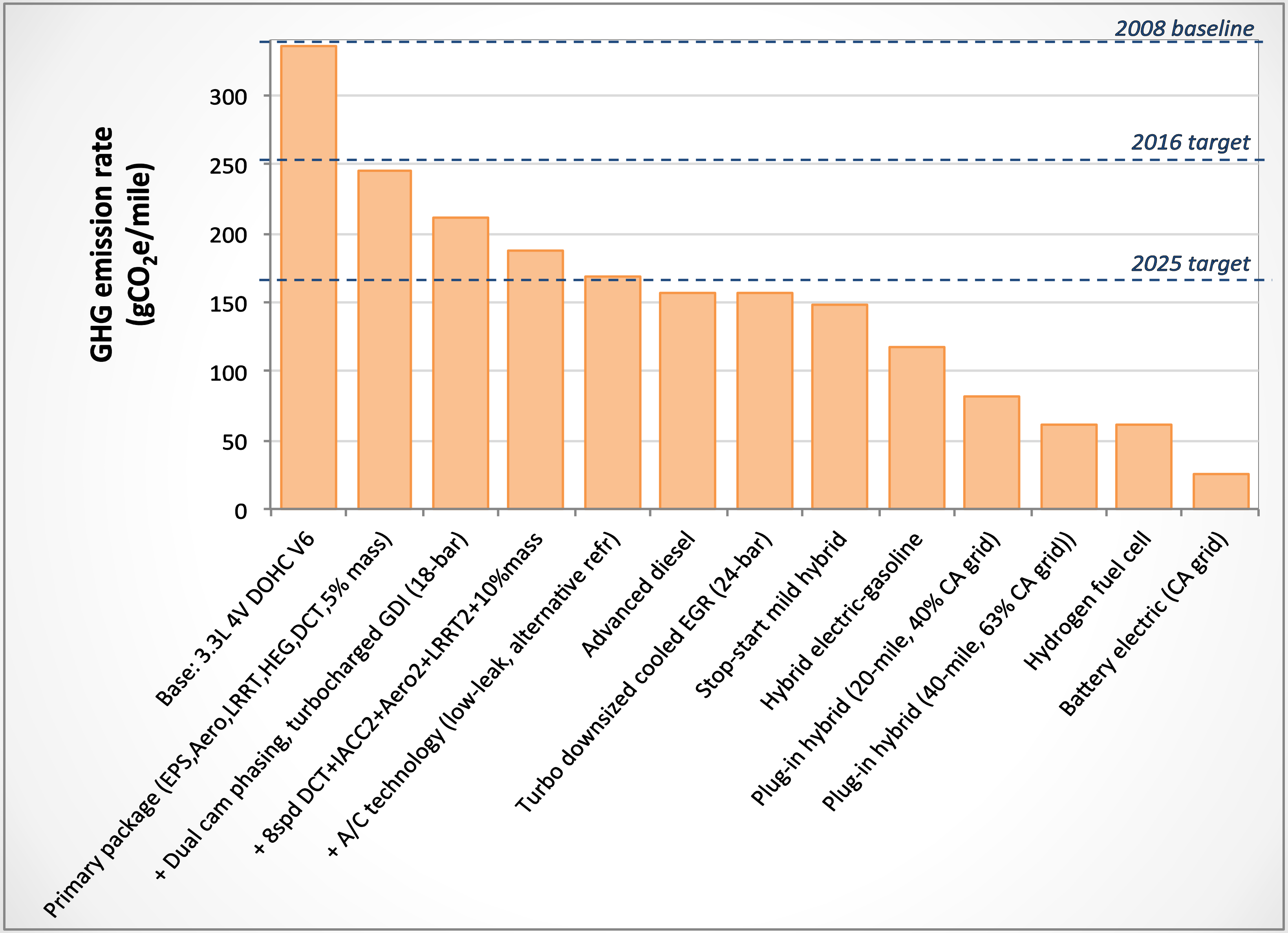
CO_2 Reduction from Individual Technologies from 2008 Reference					
Area	Technology	Small car	Mid-size car	Small light-duty truck	Large light-duty truck
Vehicle Load and Accessory Technologies	Low drag brakes	0.8%	0.8%	0.8%	0.8%
	Secondary axle disconnect	1.2%	1.4%	1.4%	1.6%
	Electric power steering	1.5%	1.3%	1.2%	0.8%
	Improved accessory efficiency	3.3%	3.0%	2.6%	3.5%
	Mass reduction (-10% curb mass)	5.1%	5.1%	5.1%	5.1%
	Mass reduction (-20% curb mass)	10.4%	10.4%	10.4%	10.4%
	Tire low rolling resistance (-10% C_{rr})	1.9%	1.9%	1.9%	1.9%
	Tire low rolling resistance (-20% C_{rr})	3.9%	3.9%	3.9%	3.9%
	Aerodynamics (-10% C_dA)	2.3%	2.3%	2.3%	2.3%
	Aerodynamics (-20% C_dA)	4.7%	4.7%	4.7%	4.7%
Hybrid system Technologies	12V stop-start	6.1%	6.8%	5.6%	6.5%
	High-voltage belt-alternator system	7.4%	7.6%	6.8%	8.0%
	Parallel hybrid (23-40 kW)	34.3%	34.6%	32.8%	31.9%
Reference Vehicle Characteristics	Test weight (lb)	2625	3625	4000	6000
	Rated power (hp)	106	158	169	300
	Rated torque (ft-lb)	103	161	161	365

2025 GHG Structure and Overview (Vehicle GHG Technologies)

Technology packages for GHG emission reduction from mid-size car (each successive package moving right includes applicable previous technologies)



Larger (more readable) version



2025 GHG Structure and Overview (Vehicle GHG Technology Costs)

Incremental Vehicle Price Increase in Year 2012 for CO_2-reduction Technologies ($)					
Area	Technology	Small car	Mid-size car	Small light-duty truck	Large light-duty truck
Engine Technologies	Engine friction reduction (EFR)	124	182	182	240
	Cylinder deactivation	-	214	214	241
	Discrete cam phasing (DCP)	104	104	224	224
	Discrete variable valve lift (DVVL)	178	259	259	369
	sGDI (18-bar, 33% downsize)	305	305	305	459
	sGDI+DCP+DVVL (18-bar, 33% TDS*)	578	578	578	974
	cEGR+sGDI+DCP+DVVL (27-bar, 56% TDS*)	1445	1445	1445	2435
	Compression-ignition diesel (with aftertreatment)	3261	3994	3268	4569
Transmission Technologies	Torque convertor lock-up	33	33	33	33
	Aggressive shift logic (ASL)	36	36	36	36
	High efficiency gearbox (HEG)	282	282	282	282
	Optimized shifting	38	38	38	38
	6-speed automatic	-11	-11	-11	-11
	8-speed automatic	77	77	77	77
	Wet dual clutch 8-speed	52	52	52	52
	Dry dual clutch 8-speed (8sp DCT)	-20	-20	-20	-20
	Continuously variable	243	284	284	-

*Turbo charged and downsized

2025 GHG Structure and Overview (Vehicle GHG Technology Costs)

Incremental Vehicle Price Increase in Year 2012 for CO_2-reduction Technologies ($)					
Area	Technology	Small car	Mid-size car	Small light-duty truck	Large light-duty truck
Vehicle Load and Accessory Technologies	Low drag brakes (LDB)	73	73	73	73
	Secondary axle disconnect (SAX)	0	0	0	108
	Electric power steering (EPS)	121	121	121	121
	Improved accessories (IAAC)	158	158	158	158
	Mass reduction (-10% curb mass)	94	109	125	171
	Mass reduction (-20% curb mass)	417	482	552	756
	Tire low rolling resistance (-10% C_{rr}) (LRRT1)	7	7	7	7
	Tire low rolling resistance (-20% C_{rr}) (LRRT2)	72	72	72	72
	Aerodynamics (-10% C_dA) (Aero1)	54	54	54	54
	Aerodynamics (-20% C_dA) (Aero2)	234	234	234	234
Hybrid System Technologies	12V stop-start	573	650	650	713
	High-voltage belt-alternator	2,358	2,497	2,497	2,774
	Parallel hybrid (23-40 kW electric motor size)	4,408	4,997	4,824	5,174
Reference Vehicle Characteristics	Test weight (lb)	2,625	3,625	4,000	6,000
	Rated power (hp)	106	158	169	300
	Rated torque (ft-lb)	103	161	161	365

Note: All potential incremental prices are in 2009 dollars and are from 2008 US baseline technology and include indirect cost multipliers for warranty, overhead, research and development, profit, etc; prices are for year 2012, and therefore time- and volume-based learning reduced incremental prices from 2012 through 2025 are not included.

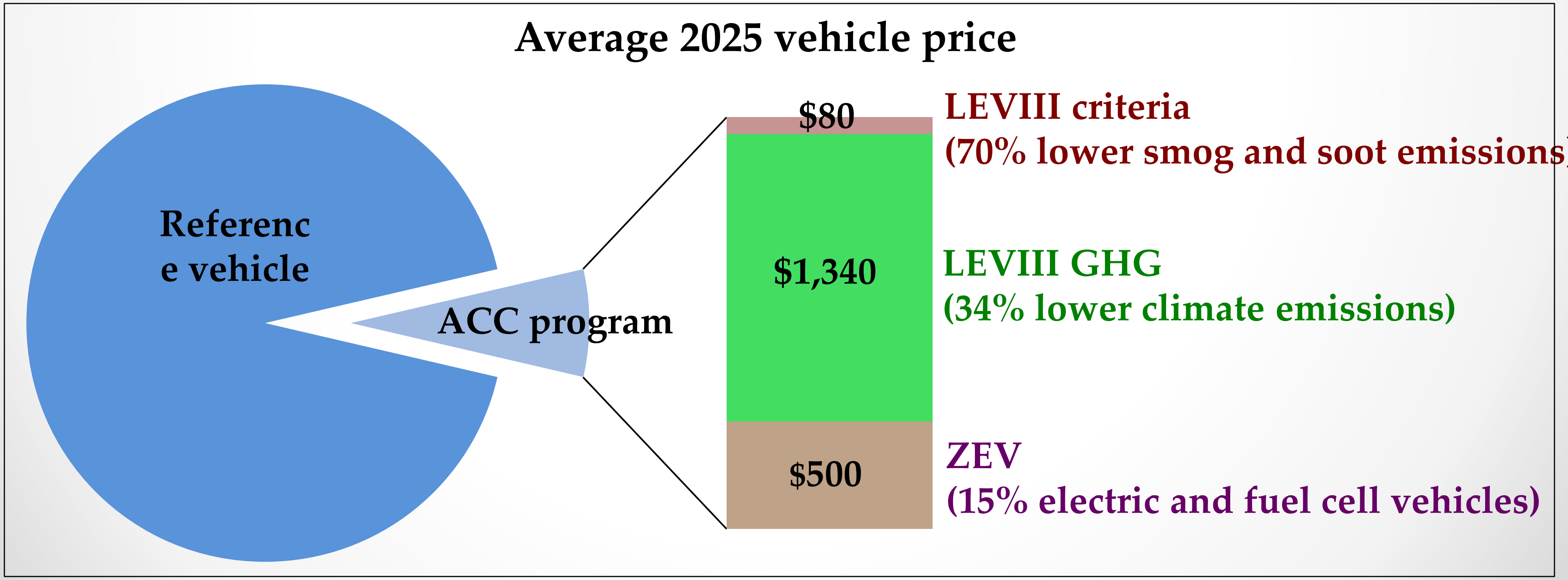
2025 GHG Structure and Overview (Vehicle GHG Technology Costs)

Summary sample technology package effectiveness, price, lifetime savings, payback period for mid-size vehicle versus 2008 baseline technology							
Technology package	GHG reduction from baseline	Incremental price in 2012	Incremental price in 2020	Incremental price in 2025	Lifetime consumer fuel savings	Benefit/ cost	Consumer payback period (years)
Base: 3.3L 4V DOHC V6, 4sp AT	0.0%	$0	$0	$0	$0	-	0
4V DOHC V6, EFR2, LDB, ASL2, IACC, EPS, Aero1, LRRT1, HEG, 6sp DCT, 5% mass	27.3%	$782	$676	$627	$7,263	11.6	1
4V DOHC I4, EFR2, LDB, ASL2, IACC, EPS, Aero1, LRRT1, HEG, DCP, GDI, TDS18, 6sp DCT, 5% mass	37.4%	$1,365	$1,101	$1,039	$9,953	9.6	1
4V DOHC I4, EFR2, LDB, ASL2, IACC, EPS, Aero1, LRRT1, HEG, DCP, GDI, TDS18, 8sp DCT, 5% mass	39.4%	$1,519	$1,234	$1,153	$10,479	9.1	1
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, GDI, TDS18, 8sp DCT, 5% mass	42.6%	$1,825	$1,491	$1,367	$11,341	8.3	1
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, GDI, TDS18, 8sp DCT, 10% mass	44.2%	$1,915	$1,562	$1,431	$11,761	8.2	1
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, GDI, TDS18, 8sp DCT, 15% mass	45.8%	$2,094	$1,717	$1,556	$12,187	7.8	1
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, GDI, SAX, TDS18, 8sp DCT, 15% mass	46.1%	$2,202	$1,804	$1,636	$12,277	7.5	1
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, DVVL, GDI, SAX, TDS18, 8sp DCT, 15% mass	46.6%	$2,381	$1,946	$1,767	$12,393	7.0	2
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, GDI, TDS24, EGR, 8sp DCT, 10% mass	48.0%	$2,540	$2,140	$1,891	$12,770	6.8	2
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, GDI, TDS24, EGR, 8sp DCT, 15% mass	49.5%	$2,719	$2,295	$2,015	$13,166	6.5	2
4V DOHC I4, EFR2, LDB, ASL2, IACC2, EPS, Aero2, LRRT2, HEG, DCP, GDI, SAX, TDS24, EGR, 8sp DCT, 15% mass	49.8%	$2,827	$2,382	$2,096	$13,250	6.3	2

Notes: 6sp = 6sp transmission (DCT-wet for vehicle type 3); 8sp = 8 speed DCT-wet; Aero = aerodynamic treatments; ASL = aggressive shift logic; AT = auto trans; DCP = dual cam phasing; DCT = dual clutch trans; DOHC = dual overhead cam; EFR = engine friction reduction; EGR = exhaust gas recirculation; EPS = electric power steering; GDI = stoich gasoline direct injection; HEG = high efficiency gearbox; IACC = improved accessories; LDB = low drag brakes; LRRT = lower rolling resistance tires; SAX = secondary axle disconnect; TDS18/24/27 = turbocharged & downsized 18 bar BMEP/24 bar BMEP/27 bar BMEP. ''1'' and ''2'' suffixes to certain technologies indicate the first level versus the second level of the technology.

2025 GHG Structure and Overview (Vehicle GHG Technology Costs)

- Regulations impose increasing costs from 2016 to 2025
  - o Incremental 2025 price increase to consumers: $1,900/vehicle
  - o At $1,900/vehicle , vehicle prices would increase by about 8%
  - o Fuel savings are 3 times greater than cost; payback period is within 3 years



2025 GHG Structure and Overview (California Consumer Impact)

- Average 2025 vehicle consumer impact:
  - Consumer savings greatly outweigh the cost (by 3-to-1 margin)
  - "Off the lot" savings from the first month
  - Overall payback within first vehicle purchaser

Lifetime effect per vehicle	Incremental technology price	$1,900
	Lifetime savings	$5,900
	Net lifetime savings	$4,000
	Payback period	3 years
Monthly effects for financed vehicle purchase	Increased monthly payment	$35
	Monthly fuel savings	$48
	Net monthly savings	$12

Note: values may not match due to rounding

2025 GHG Structure and Overview

(California Economic Impact)

- The regulations impact the economy in several ways
  - Increased vehicle prices, reduced fuel expenditures
  - Fuel savings spent throughout other sectors of the economy
- Projected impacts in year 2030
  - Positive effect on overall California economy

	Economic benefits from Advanced Clean Car program	Improvement from baseline California economic activity
Overall economic output	$14 billion	0.3%
Personal income	$6 billion	0.2%
Employment	37,000	0.2%

LEV III Criteria and GHG Program

- Good for public health and environment
  - Reduces GHG and smog forming emissions
- Good for consumers
  - Preserves consumer choice
  - Net savings
- Good for California economy
  - Increases jobs and personal income