DEPARTMENT OF CONSUMER AFFAIRS

Bureau of Automotive Repair

2024
Smog Check Performance Report

July 1, 2024

Introduction and Summary

Pursuant to the requirements of Assembly Bill (AB) 2289 (Eng, Chapter 258, Statutes of 2010), this report provides an update on the status of California's Smog Check Program (Smog Check or Program) and an assessment of the performance of those participating stations and technicians. AB 2289 directs the California Bureau of Automotive Repair (BAR) to implement both inspection-based performance standards for stations inspecting directed vehicles[1] and On-Board Diagnostics (OBD II) focused inspections for newer vehicles that are so equipped. This legislation also enhanced BAR's ability to identify and take corrective action against those stations and technicians performing improper inspections. This 2024 submission of the Smog Check Performance Report (SCPR) satisfies the statutory reporting requirement for calendar year (CY) 2023. It should be noted that AB 1263 (Berman, Chapter 681, Statutes of 2023) now directs BAR to complete the SCPR on a biennial basis rather than annually. As such, the next report is scheduled for July 1, 2026.

AB 2289 requires that BAR, in cooperation with the California Air Resources Board (CARB), perform certain analyses of Smog Check-related data and periodically report the results of these analyses to the public. Specific information required to be presented in this report include:

- The percentage of vehicles initially passing a Smog Check that subsequently fail a roadside inspection.
- The percentage of vehicles that initially fail (and later pass) Smog Check that fail a subsequent roadside inspection.
- An estimate of the excess emissions associated with these vehicles.
- A best-effort explanation of the reasons why these vehicles may have been inappropriately passed or failed within Smog Check.
- A comparison of current findings to those included in the 2009 report entitled "*Evaluation of the California Smog Check Program Using Random Roadside Data*" (the "2009 Report").

In addition to the above, AB 2289 requires BAR to offer recommendations for modifications to the existing program geared toward reducing "excess emissions" to a minimum and to consider those best practices implemented by other states and districts. The term "excess emissions" is traditionally used to describe levels of pollutants that are over and above those to which a vehicle has been certified, however in this report, the term is used to describe those additional benefits that might be realized if all vehicles subject to the program were inspected by "high performing" Smog Check stations.

[1] "Directed vehicles" include most 1976-1999 model year vehicles, and those newer vehicles identified as having the greatest likelihood of failing their next inspection. These vehicles are required (are "directed") to be certified by STAR-certified stations.

Summary of Findings

A summary of the test results for Model Year (MY) 2000 and newer vehicles inspected in CYs 2021-2022 and 2022-2023 are presented in Table 1 below. Separate results are shown for vehicles that initially failed Smog Check and subsequently received certification (FAIL), and those which initially passed Smog Check (PASS). Overall, vehicles failed roadside inspection at a statewide fleet-weighted average[2] of about 14%, which is comparable to the overall failure rate found in the CY 2021-2022 roadside sample. Sufficient data were not available to present separate results for pre-2000 MY, tailpipe tested vehicles for each of the analyses performed in this report. While diesel-powered vehicles are included in roadside inspection, the resulting dataset was also too small to draw meaningful conclusions.

Table 1
Roadside Failure Rates of Tested Gasoline-Powered Vehicles, MYs 2000-2023*

Initial Smog Check Results	Roadside Failure Rates Within One Year after Smog Check (CY 2021-2022)	Roadside Failure Rates Within One Year after Smog Check (CY 2022-2023)
FAIL	30% (345)	27% (225)
PASS	13% (6,167)	14% (10,220)
Overall	**14% (6,512)**	**14% (10,445)**

* Sample sizes are shown in parentheses beside the failure rate percentages.

Analyses of the CY 2022-2023 roadside test data, Smog Check inspection data, and related information presented, discussed, and/or cited in this report lead BAR to conclude the following:

1. Incremental improvements to the Smog Check Program are evidenced by:
   - A decline in the roadside failure rates;
   - A narrowing of the differences between roadside and Smog Check failure rates;
   - Ongoing enforcement actions against stations and technicians performing fraudulent inspections.

2. Vehicles certified by “high performing” Smog Check stations with higher Follow-up Pass (FPR) scores failed at a lower rate during roadside inspections compared to vehicles certified by “low performing” Smog Check stations with lower scores.

3. Vehicles certified by Smog Check stations in “Good Standing” failed at a lower rate during roadside inspections compared to vehicles certified by stations that had their licenses suspended or revoked.

4. BAR and CARB staff estimate that in CY 2023, Smog Check could have provided 48 additional tons per day (tpd) of exhaust and evaporative emission reductions of reactive organic gases (ROG) and oxides of nitrogen (NOx) from vehicles subject to the program if all participating stations operated as effectively as high-performing stations.

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[2] Roadside failure rate percentages are weighted by model year population to match the number of initial Smog Check tests performed in the State.

After a brief review of BAR's Roadside Inspection Program data collection efforts conducted in support of the 2024 SCPR, this report discusses the following:

- Key factors that affect the roadside emission fail rates (and by inference, in use emission rates) including relationships between vehicle age, level of performance of the prior certifying Smog Check station, technician performance and other factors;
- BAR's efforts to improve station and technician performance in Smog Check;
- An assesment of excess emissions associated with sub-optimal station performance;
- An update of those measures adopted in California and a summary of the efforts of other states and districts to reduce emissions through inspection and maintenance (I/M); and
- Specific recommendations for program improvement.

Background

California's Smog Check is a biennial program requiring the inspection of vehicles' emissions and/or engines and emissions control components and systems every other year. It is important to note that gasoline-powered vehicles eight years old and newer are currently exempt from biennial inspection. However, these vehicles, like others, are tested upon initial registration in California and upon change of ownership (COO).

The analyses included in this report are based upon data collected during CYs 2022 and 2023, representing the latest complete test cycle for the entire fleet. For purposes of these analyses, the fleet was subdivided into two broad groups; pre-2000 MY vehicles that receive an Acceleration Simulation Mode (ASM) or Two Speed Idle (TSI) exhaust emissions test, and those 2000 and newer MY vehicles equipped with OBD II that receive an OBD-focused Inspection using a BAR OBD Inspection System (OIS).

In a comprehensive program evaluation report[3] prepared for CARB and BAR ("2009 Report") by Austin, *et. al.,* differences between failure rates observed at roadside and the initial test results from the prior Smog Check were examined. The significantly higher failure rates observed during roadside inspections led the authors to conclude that: *"…many of the vehicles that initially failed during the previous Smog Check cycle were not actually repaired or were repaired only temporarily."*

Further investigation into prior Smog Check histories showed that many of the excess and premature failures seen at roadside were due to vehicles that had previously failed Smog Check that were subsequently certified, presumably having been repaired. The authors estimated that the Smog Check Program could have achieved an additional reduction of 70 tpd of excess emissions of hydrocarbon (HC) and NOx had these vehicles been properly inspected and properly repaired.

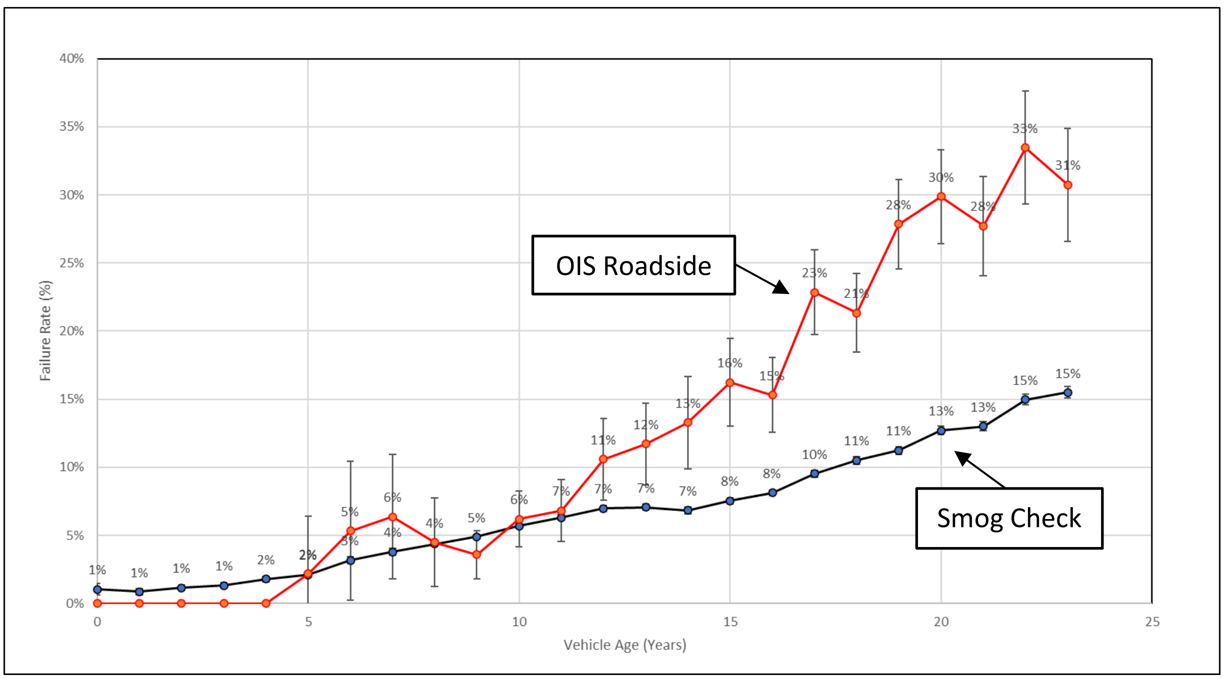
To address this issue, the authors suggested that BAR:

[3] Austin, T., McClement, D., and Roeschen, J.D., 2009, "Evaluation of the California Smog Check Program Using Random Roadside Data, Report No. SR09-03-01, March 12, 2009, Sierra Research, http://www.calautoteachers.com/PDF/FINAL_RoadsideReport_031209.pdf

- Further refine the station performance algorithm for increased enforcement;
- Create incentives for more stations to become high performing;
- Perform inspections of vehicles immediately following certification at Smog Check stations through either roadside or on-site testing; and
- Continue roadside inspections to provide data for Smog Check performance assessment and to target low performing stations for additional enforcement.

Figure 1 below presents the age specific initial failure rates for the CY 2022-2023 OIS Smog Check tested fleet compared to the results of the roadside inspections. As can be seen, the Smog Check failure rate (SCFR) increases by a factor of 4 from about 4% for 8-year-old vehicles, to 15% for 23-year-old vehicles (darker, bottom line in the figure). However, higher failure rates were observed in the corresponding roadside sample fleet (upper red line) where the roadside failure rate (RFR) increased from about 6% for vehicles age 8, to 31% for 23-year-old vehicles. For purposes of this report, vehicle age was determined by subtracting the vehicle's MY from the CY of inspection (Vehicle Age=CY-MY).

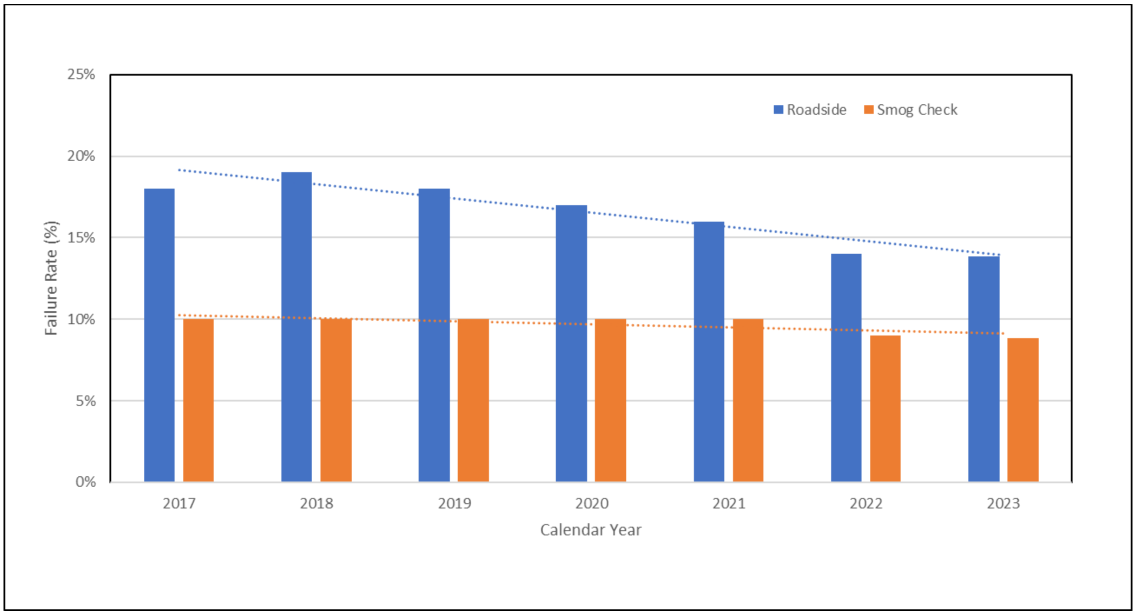
Figure 1
OIS Fail Rates by Vehicle Age using Smog Check and Roadside Testing Data
(CY 2022-2023, MY 2023 and Older Gasoline-Powered Vehicles) *



*Error bars reflect the 95% confidence levels. The greater the sample size, the smaller the variation around the mean.

Figure 2 presents the current and historic RFRs and SCFRs for CYs 2017 to 2023. While the SCFR has remained relatively constant, the RFR has declined steadily from a fleet adjusted high of 19% in 2018, to 14% in 2023. Perhaps of greater significance is the narrowing of the difference between the SCFR and RFR. The reduction in the RFR and the narrowing gap between the two failure rates are evidence of incremental program improvement.

Figure 2
Current and Historic Roadside and Smog Check Failure Rates by CY



Although several causes could contribute, it is clear from other evidence that at least a portion of the difference between roadside and smog check failure rates can be attributed to the fact that some Smog Check stations pass vehicles that should have failed if properly inspected. Additionally, it is expected that a portion of the difference is due to improper repairs that were not durable. If all Smog Check stations performed proper inspections and made effective and lasting repairs, the failure rates observed at roadside would more closely approximate those seen within the Program.

Roadside Inspection Program

BAR, with the assistance of the California Highway Patrol (CHP), continuously conducts roadside inspections in “enhanced areas” of the state, those urbanized areas experiencing serious, severe, or extreme air quality problems. The purpose of these inspections is to gather sufficient data to perform an independent assessment of the Smog Check Program.

Roadside inspections are completely voluntary for participants and the results do not affect the Smog Check pass/fail status of any of the vehicles tested. The inspections are performed after on-road vehicles are directed by a CHP officer to a roadside inspection area where they are tested by certified BAR technicians in a similar manner to what is required by Smog Check. The roadside test is abbreviated in order to minimize inconvenience to the public and increase participation. The voluntary nature of the roadside testing program and a shift in CHP priorities have resulted in fewer tests being performed in CY 2022 and 2023 compared to pre-pandemic years. Approximately 14,000 vehicles, roughly divided into 90% 2000 and newer MY OIS tested vehicles, and 10% 1999 and older tailpipe tested vehicles, were used in support of the findings in this report (See Table 2 below).

Table 2
Roadside Inspection Datasets - Vehicles Tested

Model Year Group	CY 2019	CY 2020	CY 2021	CY 2022	CY 2023
1976-1995	877	124	175	276	196
1996-1999	1,576	264	446	571	575
2000-2003	3,152	538	1,080	1,289	1,329
2004-2006	2,310	452	1,015	1,306	1,303
2007+	2,925	712	2,038	3,408	3,600
Total	**10,840**	**2,090**	**4,754**	**6,850**	**7,003**

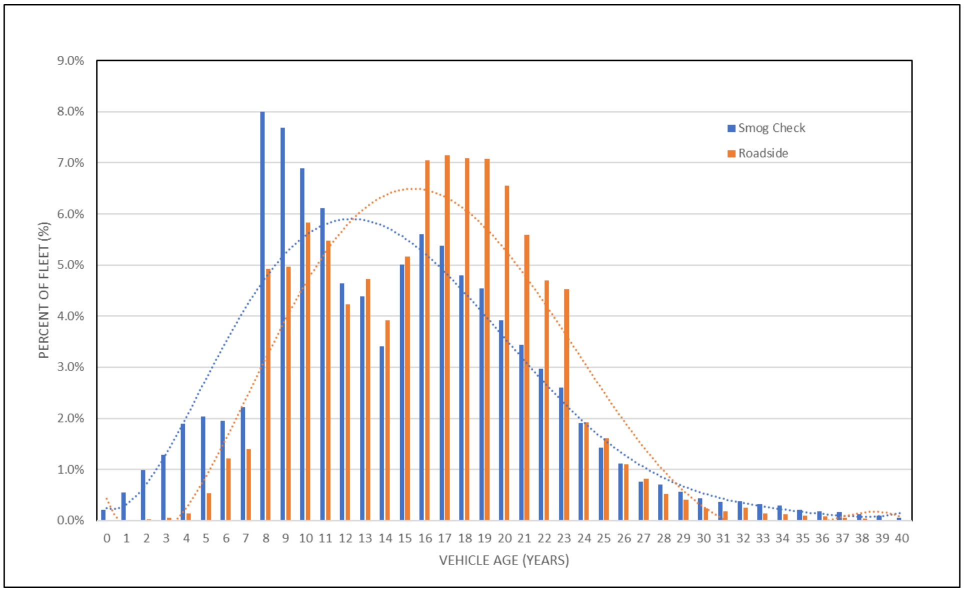
As can be seen in Figure 1, both the roadside and Smog Check datasets reflect the fact that as vehicles age and wear, their emission control components become less effective or fail outright. It is the objective of Smog Check to accurately identify these vehicles and incentivize their prompt and effective repair. As age is arguably one of the strongest indicators of the performance of a vehicle's emissions control system, it is important to assess the representativeness of the roadside dataset with respect to the distribution of vehicles by age.

Figure 3 (below) presents the MY distribution of the CY 2022-2023 roadside dataset, as well as the distribution of initial tests performed within Smog Check for the same period. Given that newer vehicles are generally exempt from inspection and understanding that older vehicles are more likely to develop problems with their emission control systems, older vehicles are purposefully oversampled at roadside compared to Smog Check. As illustrated in Figure 3, the resulting average age of the roadside dataset is two MYs older (16.3 yrs.) compared to the Smog Check dataset (14.6 yrs.). To correct for this difference, BAR weights the roadside sample results by the number of initial Smog Check tests (i.e., the number of unique vehicles of each MY or MY group in the overall California fleet subject to the program) prior to computing the statistics for the fleet.

During OIS inspections, the vehicles' OBD system may not be "ready" to communicate the information necessary to make a definitive pass/fail determination. That is, the relevant systems' monitors have not accrued enough time or mileage to accurately assess their status. Historically, all vehicles that were "not ready" were treated as Smog Check failures in the SCPR. However, for purposes of this analyses, it was assumed that vehicles with an OBD status of "not ready" that were under warranty at the time of inspection (less than 7 MYs old or 70,000 miles) would ultimately pass inspection. Otherwise, vehicles were considered to fail inspection. This methodological change is reflected in Figure 1 and in all subsequent pertinent analyses performed for this report. The impact on the assumed failure rate is limited to those newer, age exempted vehicles. Vehicles will not pass Smog Check if "not ready," regardless of their warranty status.

A detailed discussion about those issues that may impact the representativeness of the random roadside fleet and specific suggestions for future modifications to BAR's data collection efforts are included in Attachment D of this report.

Figure 3
Smog Check and Roadside Population Distributions by MY



Efforts to Improve Station Performance

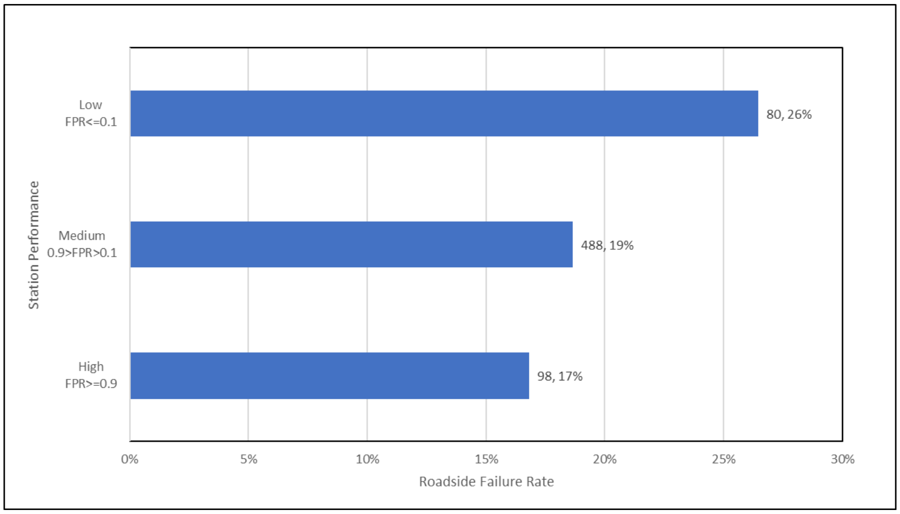
BAR has taken exhaustive measures to improve station and technician performance through more effective education, incentives, and administrative discipline. Individuals and entities licensed by BAR are subject to a process of progressive discipline beginning with reminders and warnings but, in the extreme case of fraudulent testing, will result in license suspension or revocation as required by state law.

One of BAR's most popular and effective incentive programs is the STAR program, which is a voluntary program established by BAR in 2013 for Smog Check stations seeking to test directed vehicles. Stations and technicians participating in the STAR program have their performance assessed against other stations and technicians within the Program. As an incentive for more stations to become high performing, BAR continually directs a portion of the enhanced area fleet, including vehicles designated as "gross polluters,"[4] to those stations that meet all STAR requirements.

The popularity of the STAR program is evidenced by the fact that in CY-2023, 48% of licensed stations were STAR certified and 83% of all Smog Check tests were performed by STAR stations. The effectiveness of the STAR program in reducing emissions is evidenced by the significantly lower RFRs of vehicles previously certified by high-performing stations (stations with an FPR greater than or equal to 0.9) compared to those vehicles certified by less than optimally performing stations. The reduced failure rates due to certification by higher performing stations are shown in Figure 4 (below).

[4] "Gross Polluters" pollute much more than typical vehicles that fail a Smog Check. The emission levels associated with Gross Polluters varies according to vehicle type and model year, however they typically exceed at least one or more of the gross polluter standards (twice the minimum emissions limit).

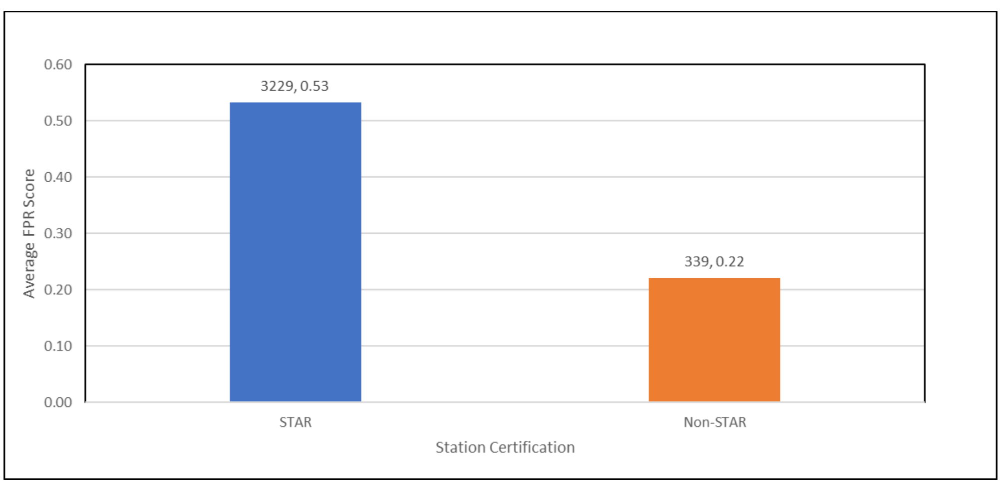
Figure 4
Performance of Certifying Smog Check Station vs. Roadside Failure Rates
CY 2022-2023 Roadside Data*



*The terms “Low”, “Medium”, and “High” refer to station performance based on FPR score. The numbers to the right of the bars reflect the number of stations included in the analysis and the roadside failure rate (# of stations, % fail).

Similar patterns have been reported in SCPRs dating back to 2015. Fewer follow-up failures directly benefit motorists by eliminating repeat testing and repairs, and the environment through a reduction in emissions of smog-forming pollutants. Figure 5 compares the average FPRs of STAR certified, and non-STAR certified stations. As can be seen in the figure, STAR certified stations tend to have higher FPRs which translates to fewer failures at roadside.

Figure 5
Mean FPR Score as a Function of Station Type Where Vehicle was Last Certified*



*The numbers above the bars reflect the number of stations included in the analysis and the average FPR score

While incentives like STAR are popular with most Smog Check stations, an effective Smog Program having thousands of decentralized (privately owned) stations, also requires a comprehensive enforcement mechanism employing a variety of tools including announced and unannounced station inspections, use of documented vehicles (vehicles configured with implanted defects) and other tools to identify improper and/or illegal behaviors and pursue corrective actions.

The most prevalent fraudulent practices in California impacting Smog Check include:

- Clean Piping (pre-2000 MY vehicles).
- Clean Gassing (pre-2000 MY vehicles).
- Clean Plugging (2000+ MY vehicles).
- Clean Tanking (pre-1996 MY vehicles).
- Registration-based fraud (all vehicles).

"Clean piping" involves fraudulently obtaining an emissions sample from a known passing vehicle and representing the results as having been taken from the vehicle being tested.

"Clean gassing" is a method by which a surrogate gas is introduced into an Emission Inspection System (EIS),[5] such that the EIS measures the surrogate gas or a mixture of surrogate gas and exhaust emissions and issues a passing test result based upon those readings rather than the actual emissions of the vehicle.

As emissions are not directly measured for MY 2000 and newer vehicles in Smog Check, the practice of "clean plugging" is the modern equivalent of clean piping in that OBD data reportedly collected from the vehicle being inspected is obtained from a known passing vehicle or from a device called a simulator, designed to generate passing readings.

"Clean Tanking" involves reporting fraudulent evaporative control system test results that are derived from a calibration tank or other surrogate tank rather than the fuel tank of the vehicle being tested.

Finally, registration-based fraud involves providing false information to the Department of Motor Vehicles (DMV) in order to obtain or renew registration without a required Smog Check. Some motorists falsely claim that their vehicles are registered in "attainment areas" of the state to avoid inspection, while others have reported to DMV that their vehicles have been converted and are no longer powered by gasoline or powered by diesel fuel.

In response to these and other highly improper and/or illegal acts, BAR has developed and continues to refine its ability to identify suspicious activities and to gather data and related evidence to support administrative and legal actions to combat and deter fraud and other illegal activities. Table 3 provides a summary of BAR's case filings with the California Office of the Attorney General (OAG), along with case outcomes for each year.[6] It should be noted that filings may take more than a year to resolve, therefore the number of outcomes may not match the number of case filings on a year-to-year basis. The data presented in Table 3 reflect case

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[5] The BAR 97 Emission Inspection System (EIS) inspects vehicles under simulated driving conditions to detect HC, CO, and NOx.

[6] Enforcement actions are published on BAR's website in a searchable format at Enforcement Actions - Bureau of Automotive Repair (ca.gov).

filings that were based on assessment of Smog Check data only and excludes other filings that were based on more traditional BAR investigations or those investigations and actions by the DMV[7] or the US Department of Justice.

Table 3
Summary by Year of BAR Smog Check Data-Only Case Filings and Outcomes
(Outcomes Still Pending on Some Filings as of this Writing)

Year	Case Filings to OAG	Outcome: Revocation	Outcome: Suspension	Outcome: Probation
2016	117	2	0	0
2017	555	39	0	3
2018	252	280	9	9
2019	63	342	30	48
2020	96	249	24	69
2021	99	124	36	47
2022	71	100	22	26
2023	91	62	12	17
Total	**1233**	**1198**	**133**	**219**

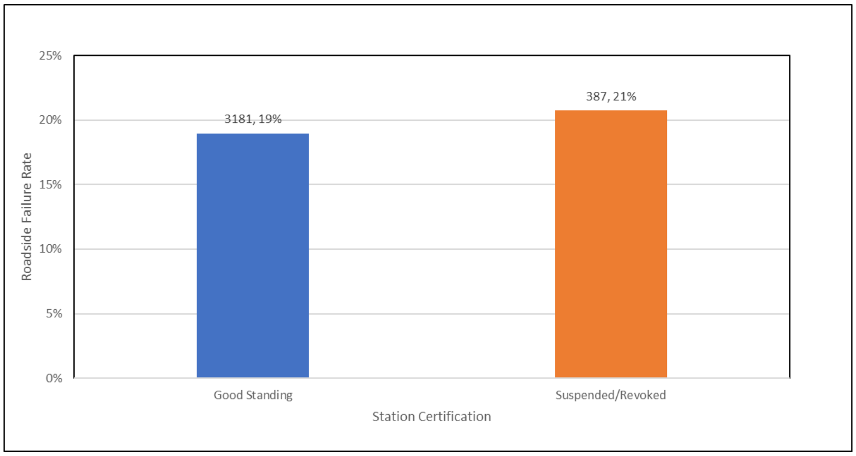
Figure 6 illustrates the superior performance of stations in good standing compared to those that have had their licenses suspended or revoked. As shown, vehicles certified by stations in good standing failed at a lower rate at roadside compared to those that had their licenses suspended and/or revoked in CY 2022-2023.

The DMV grants licensed business partners the ability to conduct certain transactions including registration renewals. In responding to questionable practices performed by some of these business partners, BAR and DMV developed an Application Programming Interface (API), a data exchange between the two agencies making it more difficult for motorists to (illegally) bypass the requirement to show proof of compliance with Smog Check. This action has resulted in a significant reduction in registration-based fraud.

In furthering efforts to improve the overall integrity of the program and to prevent fraud, the Office of Administrative Law (OAL) approved BAR's regulatory action requiring Smog Check technicians to use biometric palm scanners instead of a password to log in to test systems and perform OIS tests. This regulation took effect in October of 2022.

[7] "Traditional" investigations conducted by BAR include, but are not limited to, the use of undercover vehicles with implanted defects and station surveillance.

Figure 6
Roadside Failure Rate and Station License Status Where Vehicle was Last Certified*



*Numbers above the bars show how many stations are included in the analysis and the percent failing at roadside

As stated earlier, the process of bringing regulatory action against stations and technicians involved in fraudulent activities can be both complex and time consuming. For every case listed in Table 3, there may be dozens of cases in development that have not reached the point of filing with the OAG. The decline in case filings from the high of 555 in 2017 to the 91 cases filed in 2023 should not be misinterpreted as an indication of a decline fraudulent practices within the Program. As fraudulent methods become more sophisticated, additional time and resources are required to develop these cases and prosecute those engaged in illegal activity.

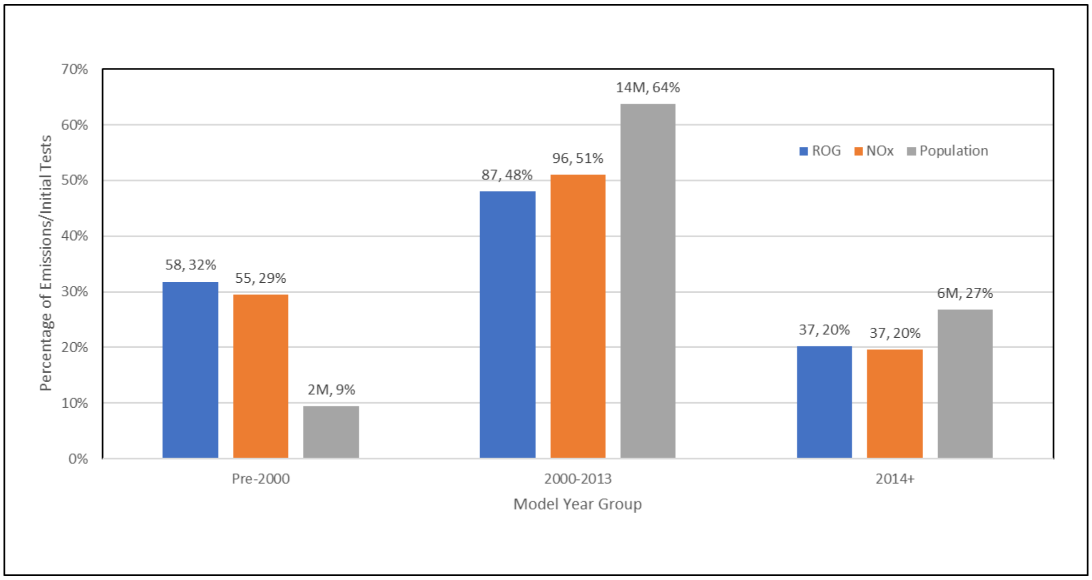
Estimate of Excess Emissions

The authors of the 2009 Report used roadside ASM emission test results to derive the estimate of an additional 70 tpd reduction of HC+NOx achievable through Smog Check program improvements. Because emissions are not measured for 2000 and newer MY vehicles within Smog Check (approximately 90% of the on-road fleet), differences in emission levels of vehicles certified by high and low performing stations could not be reliably estimated for this version of the report. Alternatively, CARB's official on-road motor vehicle emissions inventory model, EMFAC (**Em**ission **Fac**tor), along with Smog Check and roadside inspection data were used to estimate achievable additional reductions.

CARB developed, maintains, and routinely updates their EMFAC computer model, which is designed to estimate the emissions of California's on-road fleet. The latest official version of the model available at the time of this report, EMFAC2021 (v1.0.2), was used to estimate the excess emission associated with the Smog Check program. In this instance, excess emissions are defined as those additional benefits that might be obtained through improvements to the performance of participating stations.

According to EMFAC, gasoline-, and diesel-powered light-duty autos, light-, and medium-duty vehicles, and light-heavy-duty trucks with a gross vehicle weight rating (GVWR) of less than 14,001 pounds contributed a total of 367 tpd of ROG+NOx to the CY 2023 statewide emissions inventory. An accounting of the inventory by MY group and pollutant is shown in Figure 7 below along with the number of initial Smog Check tests performed over the CY 2022-2023 biennial inspection cycle.

Figure 7
ROG + NOx Emissions by MY Group & Smog Check Inspections Performed in CY 22-23*



*The numbers above the bars represent the emissions in tons per day or number of initial tests in millions (M) followed by the percentage of the total inventory or total number of initial tests performed.

The current version of EMFAC does not explicitly model the impact of Smog Check on the emissions inventory. Like roadside inspections, the benefits of the Program are assumed to be implicitly reflected within the baseline. Further, it is assumed within CARB's model that increases in fleet emissions are directly attributable to the degradation in the effectiveness, or complete failure of emission control components and systems.

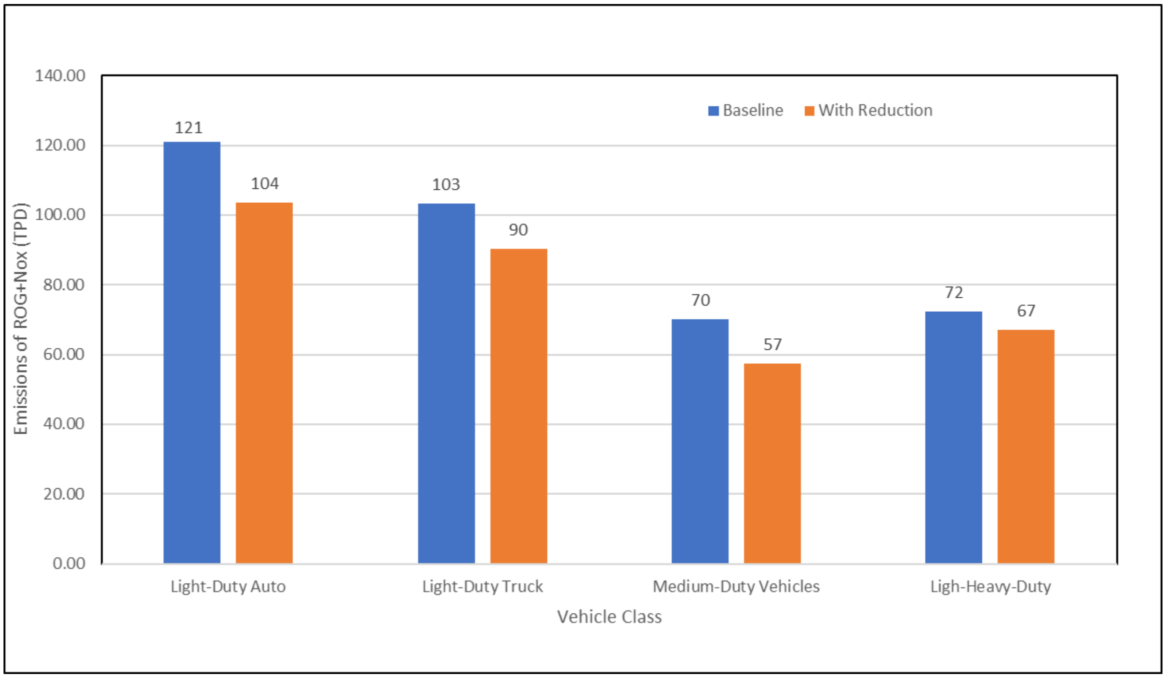
Under these assumptions, a one-to-one relationship can be established between the age specific failure rates observed during roadside and initial Smog Check inspection, with the age specific emissions rates estimated by EMFAC. For the purposes of this report, the potential additional benefits of the program were estimated by lowering the RFRs to a level equal to that of the initial SCFRs and calculating the related change in emissions.

Using this methodology, it is estimated that approximately 48 tpd of additional benefit (reduction in emissions of ROG+NOx) could be achieved if all Smog Check stations performed at the level of high performing stations (See Figure 8 below). That is, if RFRs were equivalent to the SCFRs, the resulting reduction in emissions would be equivalent to removing over 5 million gasoline-powered light-duty automobiles from daily operation.

As stated earlier, MY 2000 and newer vehicles are not routinely tested for emissions in either Smog Check or at roadside. Therefore, previous analyses of additional Smog Check related benefits carried the assumption that all observed failures impact both exhaust and evaporative emission rates. In a departure from previously used methodologies, stored diagnostic trouble codes (DTCs) recorded during OIS inspections were used to identify vehicles failing inspection for issues which impact exhaust emission only, evaporative emissions only, or both. This distinction is important in that exhaust failures result in higher ROG and NOx emissions, while evaporative control system failures result in an increase in ROG emissions only. This change in methodology along with the lower overall failure rate at roadside resulted in a lower estimate of potential benefits compared to previous versions of the SCPR.

A comprehensive explanation of the methodology used in estimating the potential additional benefits of the program are included in Attachment C of this report.

Figure 8
Potential Reductions of ROG + NOx by Vehicle Class for CY 2022-2023



Evaluation of Best Practices of Vehicle Inspection Programs prepared by University of California Riverside (CE-CERT)

The following is a summary of the current techniques, practices, and procedures utilized within I/M programs conducted in 30 states and the District of Columbia. Each of the programs evaluated here were found to utilize at least one, but more typically some combination of two or more of the test procedures described below.

OBD Tests

OBD tests are typically administered to 1996 and newer MY gasoline-powered vehicles and 1998 and newer MY diesel-powered vehicles equipped with OBD systems. The test is performed while the vehicle is stationary. After communication is established with the OBD system, the vehicle's on-board computer is queried to determine test readiness and collect any stored DTCs that are relevant to determining the functioning of components and systems that are critical for emissions control. For example, those DTCs observed in the CY 2022-2023 roadside OIS tested fleet are presented in Table 4.

Table 4
Observed DTCs by Category for Roadside OIS Inspected Vehicles*

DTC Category	Observations	% of Vehicles	DTC Description
P01	792	7.1%	Air Fuel Metering System
P02	15	0.1%	Fuel or Air Metering Injection System
P03	546	4.9%	Ignition System
P04	1,212	10.9%	Emissions System
P05	100	0.9%	Speed and Idle Control System
P06	34	0.3%	Computer Output Circuit
P07-P08	149	1.3%	Transmission-related

*Several vehicles were found to have multiple stored codes.

Loaded Mode Tests

Typically administered to 1995 and older MY (pre-OBD) vehicles weighing less than 14,001 lbs. GVWR, loaded mode tests require vehicles to be operated under load on a treadmill-like device called a dynamometer. Emissions are measured while the vehicle is in operation with the drive wheels on the dynamometer. Several different driving cycles (vehicle speed / time / load traces) are used throughout the states including the I/M 97, I/M 147, I/M 240, the ASM 25/25, and the ASM 50/15. (The number following "I/M" in the name of the test denotes the length of the test cycle in seconds. The numbers in the numerator and denominator that follow "ASM" in the name of the test denote the load on the vehicle expressed in percent, and the vehicle speed in miles per hour (mph), respectively).

Idle Tests

Although best practices dictate that a loaded mode test be performed, idle tests can be conducted without a dynamometer and are therefore less costly. Idle tests are typically administered to older vehicles (pre-catalyst equipped) or vehicles that cannot easily or safely be tested on a dynamometer (including most all-wheel drive vehicles (AWD), some vehicles with anti-lock braking systems (ABS), and vehicles weighing more than 14,000 lbs. GVWR). During an idle test, tailpipe emissions of HC and carbon monoxide (CO) are collected from a stationary vehicle operating at one or more engine speeds (low and/or high idle). NOx is not measured during idle tests as NOx emissions are not produced at idle.

Gas Cap/Evaporative System Tests

A properly sealing gas cap is essential in limiting evaporative emissions from escaping the fuel tanks of gasoline-powered vehicles. During the gas cap test, a technician may perform a visual examination to see that the cap fits tightly to the fuel filler neck. Alternatively, a functional check may be performed to ensure that the cap can hold pressure without leaking. Some states including California perform a test of the vehicle's evaporative emission control system. Using an adaptor in place of the gas cap and after temporarily sealing a vapor line, a small amount of nitrogen is injected to test the system for leaks.

Opacity Tests

Typically administered to diesel-powered vehicles, opacity tests are performed to determine the amount of light absorbed by the vehicle's exhaust as a proxy for emission levels of particulate matter (PM). The exhaust plume is evaluated while the vehicle's engine is in operation. Various test procedures are used to determine levels of opacity including:

- The **snap-idle** or **snap-acceleration** test which calls for the engine speed to be raised from idle to the maximum speed as rapidly as possible with the vehicle in park, followed by fully releasing the throttle allowing the engine to return to idle.
- The **Lug-Down** which is a loaded test performed either on-road or on a dynamometer. At wide open throttle (WOT) the engine is slowly loaded using the service brakes. Loading is applied linearly throughout an engine rpm (revolutions per minute) range from maximum to seventy percent in no less than seven seconds.
- The **Stall Test** Procedure is a full-load stationary test designed for vehicles equipped with automatic transmissions. With the vehicle's brakes applied, engine speed is increased until the transmission's stall speed is attained.[8] Stall speed is maintained for approximately five seconds to allow for stabilization.
- The **High Idle** Test Procedure is performed with the vehicle's transmission in neutral. The engine speed is slowly increased to the maximum governed no-load rpm and the plume is evaluated when the rpm stabilizes.

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[8] Stall speed is the maximum engine RPM achieved with the transmission in a forward operating gear without generating any driveshaft motion (i.e., the vehicle remains stationary).

Visual inspections

Technicians may perform a visual inspection of the vehicle to determine the presence and condition of the following components:

Visually Inspected Components

- Crankcase Emission Controls.
- Fuel Evaporative System.
- Exhaust Gas Recirculation (EGR).
- Fuel Metering System.
- Computers, Sensors, and Switches.
- Liquid Fuel Leaks.
- Thermostatic Air Cleaner (TAC).
- Exhaust Gas After Treatment System (Catalyst).
- Ignition Spark Controls.
- Air Injection System (AIS).
- Other Emission Related Components.
- Visible Smoke.

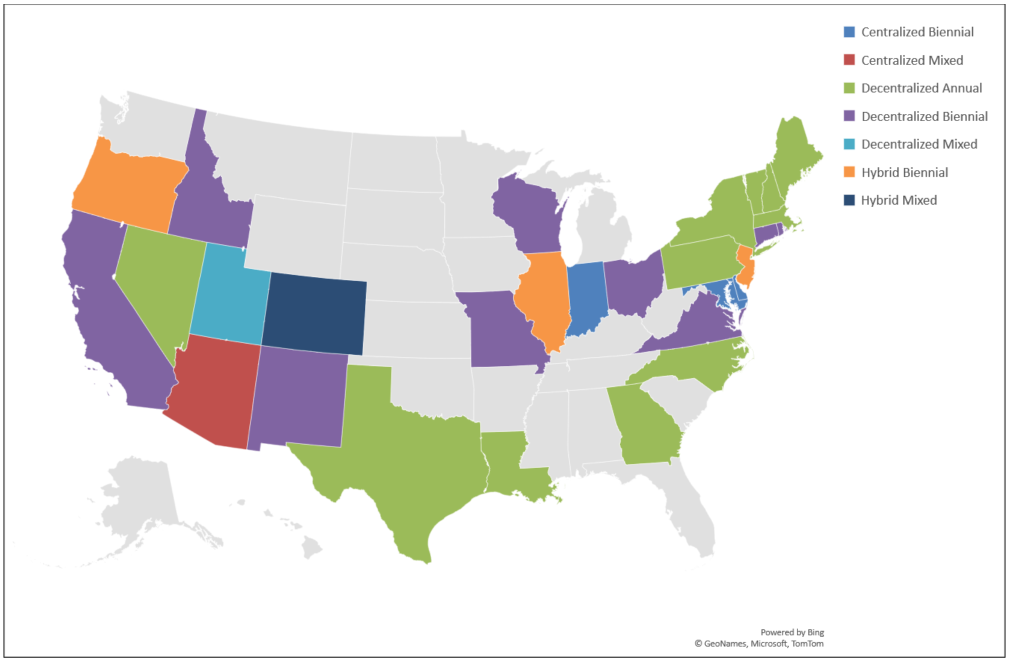
I/M Program Summary

The programs evaluated in this summary can be divided into broad categories by:

- **Program Administration** (i.e., who holds primarily responsibility for vehicle inspection)
  - Centralized (inspection performed by government or their contractor);
  - Decentralized (inspection performed by private entities licensed by the state); or
  - Hybrid, which is a mixture of both centralized and decentralized inspection.
- **Frequency of testing**
  - Annually – every year.
  - Biennially – every other year.

The largest fraction of states conducting I/M was found to operate decentralized programs with an annual inspection requirement (11 states). The second most frequent structure is a decentralized-biennial program, which is utilized in California and eight other states including Connecticut, Idaho, Missouri, New Mexico, Ohio, Rhode Island, Virginia, and Wisconsin. Three states, Delaware, Indiana, and Maryland, operate centralized-biennial programs as does the District of Columbia. Illinois, New Jersey, and Oregon operate a hybrid-biennial program. Utah conducts a decentralized-mixed program, and Colorado operates a hybrid-mixed program.

Figure 9
I/M Program Administration and Inspection Frequency by Area



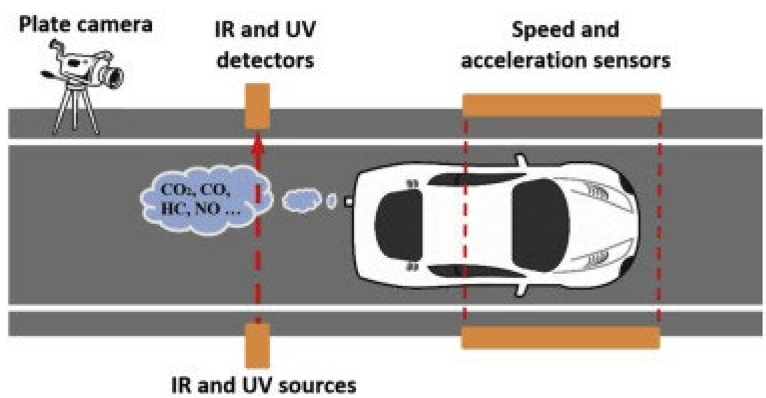
- The state of Tennessee suspended emissions inspections of light-duty vehicles in 2022.
- The California Legislature granted BAR the authority to establish a centralized/hybrid test network for 1995 and older MY vehicles requiring a BAR-97 inspection. If a centralized/hybrid network is implemented, use of the OIS test platform would be expanded to include 1996 to 1999 MY vehicles. BAR is in the process of soliciting input from the industry on both the design and implementation of such a program.
- There are currently five contractors supporting state I/M programs. Opus/Gordon Darby now administers I/M programs in 18 states and the District of Columbia. Applus+ Technologies supports four states, Worldwide Environmental Products (WEP) holds contracts in two states, Parsons Engineering Science operates in three states, and OnCore Consulting supports a single state program (California).
- Twelve states and the District of Columbia conduct periodic safety inspections in addition to emissions testing. These states tend to conduct inspections annually and require the acquisition and display of window stickers as proof of compliance. The remaining states tie compliance with periodic emissions testing directly to registration renewal. BAR is in the process of implementing a new Vehicle Safety System Inspection Program as required by AB 471 (Low, Chapter 372, Statutes of 2021).
- California, 10 other states, and the District of Columbia require vehicles to be tested upon change of ownership. Three states, North Carolina, Rhode Island, and Utah require testing upon change of ownership only when the vehicle is sold by a dealer.
- California's program is conducted statewide, as are the programs in eight other states and the District of Columbia (district-wide). The remaining states require testing only in those areas where air quality is adversely impacted by on-road motor vehicles. Statewide testing in California is only required for change of ownership and initial registration.

- The overall number of emissions test stations fell nationwide over the past year, presumably due to the lingering impacts of the pandemic, the cessation of testing in several states, and the steadily diminishing population of pre-OBD vehicles.
- California had 7,774 licensed stations in CY-2023, a decline of 230 compared to the previous year. The State of California operates the third largest inspection network in the U.S. surpassed only by New York with 10,000 stations, and Pennsylvania with 8,000 stations. Network sizes in other states range from as few as three stations in the District of Columbia, to as many as 5,200 in Texas. Delaware, Indiana, and Oregon each have less than 10 stations in their test networks.
- The average cost of inspection varies widely from state to state and by test type. The cost associated with annual inspection ranges from as little as $10.00 in Louisiana, to as much as $52.50 in Missouri. For those biennial programs that charge an inspection fee, costs range from a low of $14.00 in Maryland, to a high of over $58.00 in California. Delaware, Illinois, Indiana, Ohio, and Wisconsin do not charge inspection fees. Centralized tests in New Jersey are also performed at no charge to vehicle owners.
- All participating states and the District of Columbia, with the exception of Idaho, require periodic testing of hybrid-electric vehicles.
- Given the low failure rate amongst the newest vehicles in the fleet, most I/M programs, with the notable exception of Maine, New Hampshire, and Vermont, exempt vehicles less than two model-years old from testing. California exempts light-duty gasoline powered[9] autos that are eight MYs old and newer from inspection which is the longest period of exemption with the exception of Utah's Cache County where the age of first test is 11. California requires these otherwise exempted vehicles to be tested upon initial registration and upon change of ownership.

Supplemental Programmatic Elements

In addition to the programmatic features described above, several states have implemented supplemental test procedures designed to either better identify those vehicles most likely to benefit from inspection and/or provide greater convenience to vehicle owners.

- **Remote Sensing**



Remote Sensing Devices (RSD) are an integral part of the I/M programs in Colorado, Connecticut, Georgia, Ohio, Rhode Island, Texas, and Virginia. The use of RSD is also being evaluated in Arizona and Maryland. These devices estimate emissions by shining an infrared light source across a roadway and measuring the attenuation of the signal through the exhaust plume of

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9 Editor's footnote: California DMV requires Smog Check certification of diesel-powered vehicles weighing less than 14,001 lbs. GVWR in basic, enhanced areas of the state and upon initial registration or change of ownership.

passing vehicles. The advantage of RSD is that data on a large population of vehicles can be obtained quickly and relatively inexpensively. However, because only a "snapshot" of the vehicle's emissions is captured under either uncontrolled or loosely controlled conditions, the use of RSD is typically limited to making coarse determinations. In some areas RSD is used to identify low emitting vehicles for exclusion from periodic inspection, a practice referred to as "clean screening". Alternatively, the devices may be used to identify vehicles that have a high probability of failing an inspection, a practice referred to as "dirty screening". Because of the imprecise nature of the emissions measurements, vehicles are not typically failed based on RSD readings alone, rather suspect vehicles are required to undergo more comprehensive inspection within conventional programs.

- **Remote OBD**

In California, Nevada, and Oregon, portions of the light-duty fleet subject to periodic inspection are allowed to opt into a remote OBD monitoring program. Participating vehicles are fitted with devices that allow their on-board computers to be queried remotely and relevant data are retrieved through telematics. The advantage of this approach is the ability to continuously monitor vehicle emission control systems compared to testing once per year or once every other year. Although the overall cost and potential for fraud remains a concern, this approach has been shown to be convenient for subscribers and has the potential of achieving surplus emission reductions by minimizing the time between detection of failure and repair, as well as the detection of failure within the otherwise exempted fleet. Participation in California's remote OBD inspection program, the Continuous Test Program (CTP), is currently limited to light-duty vehicles operated by government fleets. CARB is in the process of implementing a remote OBD program for monitoring heavy-duty diesel vehicles operating in California.

- **OBD Kiosks**

Maryland, Ohio, Oregon, and the District of Columbia offer a self-testing option to owners of OBD-equipped vehicles. Motorists use an ATM-like touch-screen computer equipped with hardware designed to interface with and retrieve relevant information from the vehicles' on-board computer. OBD kiosks are conveniently located and are available 24 hours per day, seven days per week. Although this approach appears promising, concerns have been expressed regarding fraudulent use of surrogate vehicles or simulators to circumvent test requirements.

- **Mobile/On-Site OBD Testing**

Rather than have fleet operators bear the cost and inconvenience of bringing cars in one-by-one for testing at a licensed station, the states of Oregon, Georgia and Missouri offer on-site testing by appointment. The availability of Oregon's Mobile on-site testing units (MOST) saves participating vehicle owners both time and travel costs and eliminates travel related emissions. However, the same fraud-related concerns expressed with respect to OBD kiosks apply to mobile testing unless these inspections are conducted by the state or their designated contractor.

Summary of Best Practices of I/M Programs

The following are considered best practices for I/M programs in the U.S. A summary of the different testing practices by State is provided in Table 5.

Test Frequency

Those states and districts performing periodic emissions inspections are almost equally split between those requiring biennial and annual tests. It has been suggested that more frequent inspection (annual rather than biennial) might result in lessening the impact of fraud and increasing emission reductions. These potential benefits must be weighed against increased costs and public inconvenience.

OBD-equipped vehicles

Best practices call for:

- A scan of the vehicle's on-board computer to verify that monitors have run and whether DTCs are present.
- Clearance of permanent DTCs by running the vehicle's self-check rather than clearing codes with a scan tool or disconnecting the vehicle's battery.
- The development and incorporation of a comprehensive system for the detection of fraud in decentralized programs.

Non OBD-equipped vehicles

Best practices include several methods for the inspection of pre-OBD vehicles including:

- Performance of loaded-mode dynamometer emissions testing using established cycles such as the I/M 240, I/M 147, or ASM tests.
- Performance of a two-speed Idle emissions tests for vehicles that cannot safely or reliably be tested on a dynamometer.
- The use of RSD or similar method to make quick pass/fail determinations or as a screening tool for inclusion or exemption from further inspection.

Evaporative system checks

The main elements of evaporative system checks include the following, which are currently integrated into California's Smog Check program:

- Low-pressure evaporative system tests to check for leaks for pre-OBD vehicles.
- Separate leak check of the fuel cap.

Visual inspection of the emission control system

Inspection of the emission control systems should include:

- Performance of an inspection for the presence and outward appearance of the catalyst, EGR system, air injection, positive crankcase ventilation, etc.

Specific Suggestions for Program Improvement prepared by CE-CERT

Suggestions for overall system improvement include:

- **Tightening the Criteria for STAR Certification**
  - In CY2023, almost half of all participating stations were STAR certified and these stations conducted an overwhelming majority of initial Smog Check tests. As the fraction of STAR stations increases, the ability to discern high performing stations from those who may be engaged in illegal or fraudulent actions becomes more difficult. It is suggested that BAR consider establishing more stringent criteria for obtaining and maintaining STAR status to ensure that certification is synonymous with excellence.

- **Streamline the Process of Taking Enforcement Actions**
  - As a follow up to the previous suggestion, dozens, if not hundreds, of currently licensed stations are known or are suspected of committing illegal acts. Further, there is currently little or no deterrent for those in the process of having their licenses suspended or revoked from continuing to commit illegal acts. It is suggested that BAR work with OAL and OAG to standardize the process of compiling and filing Smog Check data only enforcement actions against those suspected stations and technicians and limit their ability to commit additional fraudulent acts while legal actions are pending.

- **Institute Automatic Test System Lock-Out**
  - BAR should consider addressing the issue of limiting fraudulent activity through the modification of OIS algorithms. A possible approach would involve warning the technician when a test result appears to be fraudulent (clean-plugging or tanking) and a system lock-out would be imposed if multiple suspected fraudulent entries go unaddressed. BAR should also consider taking a more aggressive stance in using their certification blocking authority to curtail the business of bad actors.

- **Coordinate with CHP on expanded use of Vehicle Code 27156**
  - VC 27156 states that ***"No person shall operate a vehicle after notice by a traffic officer that the vehicle is not equipped with the required certified motor vehicle pollution control device correctly installed in operating condition…"*** Under current Smog Check regulations, a vehicle owner may operate a non-complying vehicle for up to eight years. It is suggested that BAR consider working with CHP to cite those owners in operating vehicles in violation of VC 27156 and in doing so, minimize the time between identification of failure and repair. Alternatively, BAR might seek such authority for its enforcement staff.

- **Reassess Directed Vehicle Criteria**
  - Each year, BAR directs a number of vehicles with a high likelihood of failing Smog Check to be tested by STAR stations. BAR might consider the feasibility of refocusing their selection criteria to include vehicles known or suspected of being fraudulently certified during their last inspection cycle, vehicles that refused inspection at roadside, etc.

- **Expand CTP to Non-Governmental Fleets**
    - Remote OBD has proven to be a viable, US EPA approved, strategy for the automated inspection of fleet. Although BAR has administered the CTP as a pilot program for decades, BAR lags behind other states and agencies in fully embracing the potential of this advanced technology. Given that Nevada and Oregon have a successful history OBD3 (OBD2 with telematics), and that CARB is in the process of implementing remote OBD for the inspection of heavy-duty diesel vehicles operating in the state, BAR is encouraged to seriously consider expanding participation in the CTP to OEMs and trusted non-governmental fleets.

- **Allow official tests and pre-tests at OBD Kiosks**
    - A major reason that motorists either delay or avoid Smog Check is the assumption that compliance will be cost prohibitive, inconvenient, or both. California has the highest per vehicle inspection cost in the nation and it is anticipated that the competition will diminish as the number of licensed stations continues to decline. BAR is encouraged to consider allowing the installation of a number of self-check kiosks throughout the state affording vehicle owners a less costly and more convenient alternative to traditional Smog Check.

- **Coordination with CARB**

    - **Surveillance Programs**
        - CARB periodically conducts surveillance programs designed to gather emissions related data on a representative sample of on-road fleet. California motorists are offered incentives ranging from a free tank of gas, a rental car, and free repair in exchange for allowing CARB to perform extensive tests in their state-of-the-art laboratory. As the information gathered by CARB could be used to supplement BAR's roadside inspection data collection efforts, it is suggested that BAR consider coordinating with CARB on future surveillance programs.

    - **Estimations of Emissions and Benefits**
        - As emissions are not measured for the OIS tested fleet, it is suggested that BAR consider working with CARB staff to develop new methodologies for estimating vehicle emissions, perhaps by linking specific DTCs to tailpipe emissions levels, to better assess the impact of Smog Check on air quality.

    - **Modeling of Emissions and Benefits**
        - Following up on the previous suggestion, the current version of the EMFAC model lacks the capability to estimate the current and potential benefits of Smog Check. Although this feature was available in previous versions, it was removed from the model due to a lack of "non-I/M" emissions data needed to establish a baseline. As CARB and BAR are required by legislation (AB 2289) to estimate the potential benefits of the program, it is suggested that BAR consider working with CARB on future updates to EMFAC.

Table 5
I/M Testing Requirements by State

State/Area	Fuel	GVWR	Model Year(s)	Steady State	Loaded Mode	OBD	Gas Cap	Opacity	Visual
Arizona	Gas	<8501	1996 to age 5	-	-	X	X	-	X
Arizona	Gas	<8501	1967 to 1995	-	I/M 147	-	X	-	X
California	Gas	<14001	2000 to age 9	-	-	X	-	-	X
California	Gas	<2000	TSI	TSI	ASM25/25 ASM50/15	-	X	-	X
California	Diesel	<14001	1998 and newer	-	-	X	-	Snap Idle	X
Colorado	Gas	<8501	2007 to age 8	-	-	X	X	-	-
Colorado	Gas	<8501	1982 to 2006	-	I/M 240	-	X	-	-
Colorado	Gas	<8501	1967 to 1981	TSI	-	-	X	-	-
Colorado	Diesel	-	-	-	-	-	-	X	-
Connecticut	Gas	<8501	1996 to age 5	-	-	X	-	-	-
Connecticut	Gas	8501-10000	2008 to age 5	-	-	X	-	-	-
Connecticut	Gas	8501-10000	1998 to 2007	TSI			X		
Connecticut	Gas	8501-10000	1995 to 1997	-	ASM25/25	-	X	-	Catalyst
Connecticut	Diesel	<8501	1998 to age 5	-	-	X	-	X	-
Connecticut	Diesel	8501-10000	2007 to age 5	-	-	X	-	-	-
Connecticut	Diesel		1996 to 2006					X	
Delaware	Gas	<8501	1996 to age 8	-	-	X	-	-	Catalyst
Delaware	Gas	<8501	1981 to 1995	TSI	-	-	X	-	Catalyst
Delaware	Gas	<8501	1968 to 1990	Curbside	-	-	X	-	Catalyst
Delaware	Diesel	<8501	1997 to age 8	-	-	X	-	-	-
District of Columbia	Gas	<8501	1996+	-	-	X	-	-	-
District of Columbia	Gas	<8501	1984 to 1995	-	I/M 240	-	-	-	-

State/Area	Fuel	GVWR	Model Year(s)	Steady State	Loaded Mode	OBD	Gas Cap	Opacity	Visual
District of Columbia	Gas	<8501	1968 to 1983	TSI	-	-	-	-	-
District of Columbia	Gas	<8501	1975+	-	-	-	X	-	Catalyst
Georgia	Gas	<8501	Ages 4 to 24	-	-	X	X	-	Catalyst
Idaho	Gas	<14001	1996 to age 5	-	-	X	-	-	X
Idaho	Gas	<14001	1981 to 1995	TSI	-		X	-	X
Idaho	Diesel	-	1997 to age 5	-	-	X	-	-	-
Idaho	Diesel	-	1981 to 1997	-	-	-	-	Snap Idle	-
Illinois	Gas	<8501	1996 to age 4	-	-	X	X	-	-
Illinois	Gas	8501-14000	2007 to age 4	-	-	X	-	-	-
Indiana	Gas	<9001	1996 to age 4	-	-	X	X	-	-
Indiana	Gas	<9001	1981-1995	-	I/M 93	-	X	-	-
Indiana	Gas	<9001	1976-1980	SSI	-	-	X	-	-
Louisiana	Gas	<10001	1996 to age 3	-	-	X	-	-	Catalyst
Louisiana	Gas	<10001	1980 to 1995	-	-	-	X	-	X
Maine	Gas	-	1996+	-	-	X	X	-	Catalyst
Maine	Gas	-	1987 to 1995	-	-	-	X	-	Catalyst
Maine	Gas	-	1974 to 1986	-	-	-	X	-	-
Maine	Diesel	>18000	-	-	-	-	-	X	-
Maryland	Gas	<8501	1996 to age 4	-	-	X	-	-	Catalyst
Maryland	Diesel	8501-14000	2008 to age 4	-	-	X	-	-	Catalyst
Maryland	Diesel	>10000	2008 to age 4	SSI	-	-	X	-	-
Maryland	Diesel	8501-26000	1977 to 1995	SSI	-	-	X	-	Catalyst
Massachusetts	Gas	-	Ages 0 to 14	-	-	X	-	-	-
Massachusetts	Diesel	>10000	-	-	-	-	-	X	-
Missouri	Gas	<8501	1996 to age 2	-	-	X	-	-	--

State/Area	Fuel	GVWR	Model Year(s)	Steady State	Loaded Mode	OBD	Gas Cap	Opacity	Visual
Missouri	Diesel	-	1997 to age 2	-	-	X	-	-	-
Nevada	Gas	<14001	1996+	-	-	X	-	-	-
Nevada	Diesel	<14001	1968 to1995	TSI	-	-	-	X	-
New Hampshire	Gas	<8501	Ages 0 to 20	-	-	X	-	-	-
New Hampshire	Diesel	<8501	Ages 0 to 20	-	-	X	-	-	-
New Jersey	Gas	<8501	1996 to age 5	-	-	X	-	-	-
New Jersey	Gas	8501-14000	2008 to age 5	-	-	X	-	-	-
New Jersey	Gas	>14000	2014 to age 5	-	-	X	-	-	-
New Jersey	Diesel	<8501	1997 to age 5	-	-	X	-	-	-
New Mexico	Gas	<10001	1996+	-	-	X	X	Smoke	Catalyst
New Mexico	Gas	<10001	Age 35 to 1995	TSI	-		X	Smoke	Catalyst
New York	Gas	<8501	Ages 0 to 25	-	-	X	X	Smoke	X
New York	Gas	8501-18000	Ages 0 to 25	-	-	-	X	-	X
New York	Diesel	<8501	Ages 0 to 25	-	-	X	-	-	-
New York	Diesel	8501-18000	Ages 0 to 25	-	-	-	-	X	X
North Carolina	Gas	<8501	Ages 3 to 20	-	-	X	-	-	-
Ohio	Gas	<10001	Ages 3 to 25	-	-	X	-	-	-
Ohio	Diesel	<10001	Ages 3 to 25	-	-	X	-	-	-
Oregon	Gas	<8501	1996 to age 5	-	-	X	-	-	-
Oregon	Gas	<8501	1975 to 1995	SSI	-	-	-	-	-
Oregon	Diesel	<8501	1997 to age 5	-	-	X	-	-	-
Oregon	Diesel	<8501	1975 to 1996	SSI	_	-	X	-	-
Pennsylvania	Gas	<9001	1996 to age 2	-	-	X	X	-	-
Pennsylvania	Gas	<9001	1975 to 1995	SSI	X	-	X	-	Comp
Rhode Island	Gas	<8501	1996 to age 2	-	-	X	X	-	-

State/Area	Fuel	GVWR	Model Year(s)	Steady State	Loaded Mode	OBD	Gas Cap	Opacity	Visual
Rhode Island	Gas	<8501	<1996	-	-	-	X	-	X
Rhode Island	Diesel	<8501	1996 to age 2	-	-	X	X	-	-
Rhode Island	Diesel	<8501	<1996	-	-	-	X	-	X
Texas	Gas	-	Ages 2 to 24	-	-	X	X	-	-
Utah	Gas	All Weights	1968 to 1995	TSI	-	-	-	-	-
Utah	Gas	<8501	1996 to 2016	-	-	X	-	-	-
Utah	Gas	>8500	1996 to 2016	TSI	-	-	-	-	-
Utah	Gas	<14001	2008 to 2018	-	-	X	-	-	-
Utah	Gas	>14000	2008 to 2018	TSI	-	-	-	-	-
Utah	Diesel	<14001	1998 to 2006	-	-	-	-	-	X
Utah	Diesel	<14001	2007 to 2018	-	-	X	-	-	-
Vermont	Gas	<8501	Ages 0 to 16	-	-	X	Visual	-	Catalyst
Vermont	Diesel	<8501	Ages 0 to 16	-	-	X	-	-	-
Virginia	Gas	<10001	Ages 0 to 25	-	-	X	Visual	-	Catalyst
Virginia	Diesel	<8501	1997+	-	-	X	-	-	X
Wisconsin	Gas	<8501	1996 to 2006	-	-	X	-	-	-
Wisconsin	Gas	8501-14000	2007 to 2018	-	-	X	-	-	-
Wisconsin	Diesel	8501-14000	2007 to 2018	-	-	X	-	-	-

Attachments

Attachment A - Specific Comments from University of California, Riverside, Bourns College of Engineering – Center for Environmental Research and Technology (CE-CERT) “Review of the 2023 Smog Check Performance Report” and BAR Responses

Attachment B - List of Acronyms

Attachment C – Methodology and sample calculation of additional potential benefits of Smog Check

Attachment D - Issues Related to the Roadside Inspection Program Representativeness

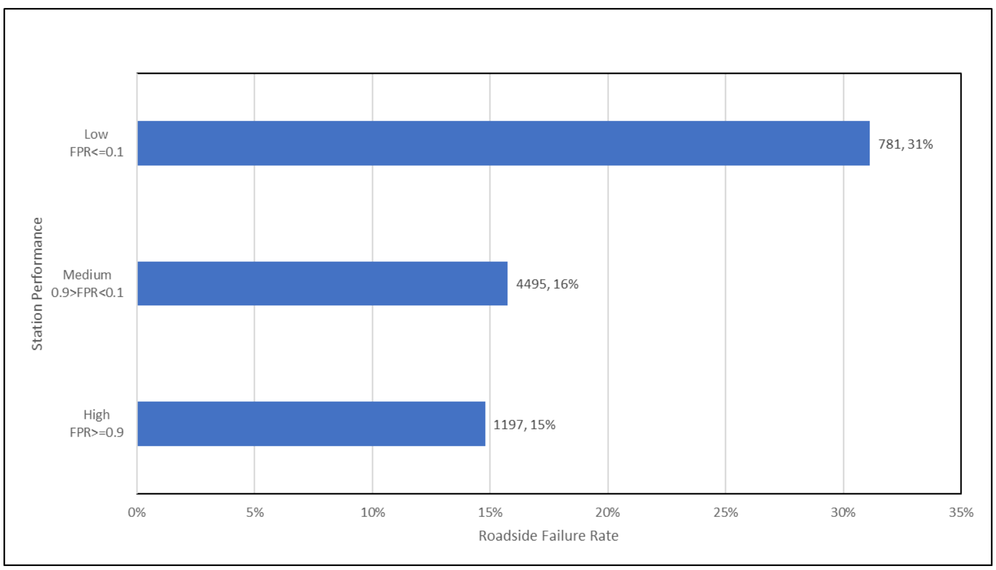
Attachment A
Specific Comments from CE-CERT "Review of the 2023 Smog Check Performance Report" and BAR Responses

This attachment contains specific comments from the _Review of the 2023 Smog Check Performance Report_ conducted by the University of California at Riverside's, Bourns College of Engineering - Center for Environmental Research and Technology, (CE-CERT), with annotations (*in italics*) by BAR. Comments by CE-CERT on specific statements, tables, and page numbers refer to BAR's 2023 SCPR.

CE-CERT: Page 6 – in reference to Figure 2

It would be interesting to see how these rates differ between pre-2000 and 2000+ vehicles, as shown in Figure 6.

Figure 2
Performance of Certifying Smog Check Station vs. Roadside Failure Rates
CY 2021-2022 Roadside Data*



*The terms "Low"," Medium," and "High" represent the station performance based on FPR score. The numbers to the right of the bars reflect the number of stations included in the analysis and the roadside failure rate (# of stations, % fail).

BAR Response:

The information displayed in Figure 2 reflects the results for the entire 2022-2023 Roadside test fleet. Unfortunately, not enough data exists to sub-divide these data into the six subsets (pre-, and post-2000 MY, High, Medium, and Low FPR) and derive meaningful conclusions.

CE-CERT: Page 13 – in reference to Table 4

Table 4
Summary by Year of BAR Smog Check Data-Only Case Filings and Outcomes
(Outcomes Still Pending on Some Filings as of this Writing)

Year	Case Filings to OAG	Outcome: Revocation	Outcome: Suspension	Outcome: Probation
2016	117	2	0	0
2017	555	39	0	3
2018	252	280	9	9
2019	63	342	30	48
2020	96	249	24	69
2021	99	124	36	47
2022	71	100	22	26
Total	**1253**	**1136**	**121**	**202**

It is assumed that the main reason for the decline in case filings over time is due to fewer inspections being identified as suspicious in more recent years, however, is it possible that stations are becoming more adept at hiding illegal actions?

BAR Response:

The referenced Table 4 (as well as the corresponding Table 3 in the 2024 SCPR) is neither intended nor should it be construed as a comprehensive listing of BAR Enforcement activities. Complex investigations and cases, especially those involving multiple law enforcement agencies, often require more time and resources to compile, file, and prosecute. An example of this may be found in a recent case filed by the US Department of Justice alleging a conspiracy and multiple fraudulent Smog Check activities in California.

On April 4, federal prosecutors unsealed an indictment charging 12 people with conspiracy to cheat California Smog Check inspections. Federal prosecutors reported the scheme involved the use of a cheating device—marketed as the “OBDNator”— to falsify Smog Check inspection results and pass vehicles that would have otherwise failed inspection. According to the indictment, the criminal ring developed and distributed the device which was then used at numerous Smog Check stations throughout the state between October 2015 and March 2024. The indictment is the result of a joint investigation by the U.S. Environmental Protection Agency, Criminal Investigation Division and the Federal Bureau of Investigation with assistance from BAR, the U.S. Department of Justice’s Environment and Natural Resources Division, and Homeland Security Investigations San Diego. For additional information, see the press release[10] issued by the United States Attorney’s Office, Eastern District of California.

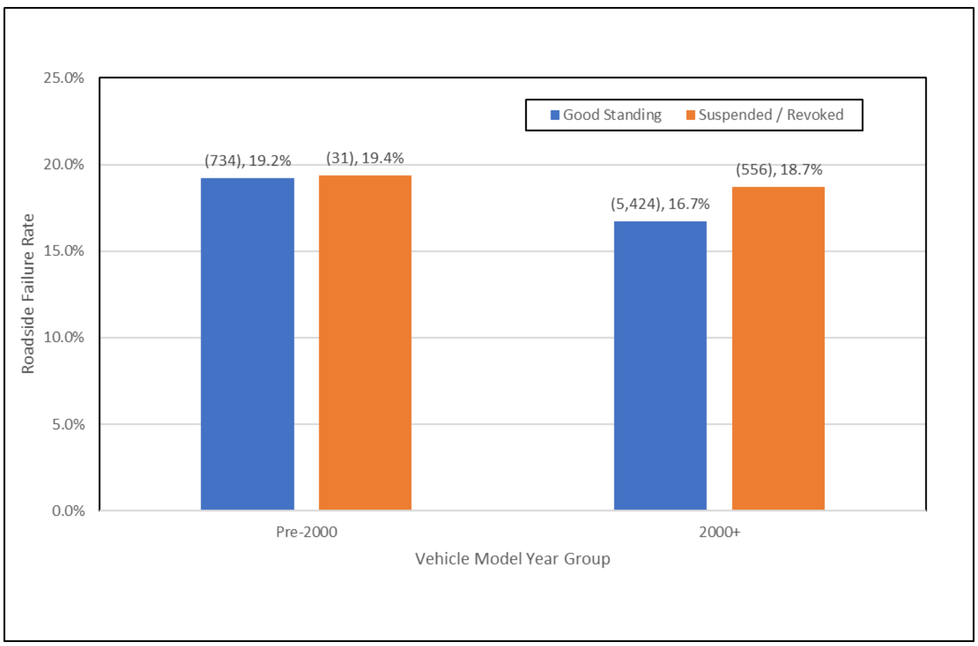
10 USDOJ press release: https://www.justice.gov/usao-edca/pr/12-members-smog-inspection-cheating-ring-indicted

While it is likely that a significant number of stations and technicians engaged in illegal acts have been deterred by BAR regulations and associated legal actions, individuals who are determined to commit fraud will continue to develop ever more sophisticated methods to do so. BAR, in response, continues to develop more comprehensive methods of vehicle inspection and fraud detection.

CE-CERT: Page 14 – in reference to Figure 6

The numbers of stations in “Good Standing” seem higher than the medium and high stations in Table 2. Is this because not all low performing stations get suspended?

Figure 6
Roadside Failure Rate by MY Group and Station License Status
Where Vehicle was Last Certified



BAR Response:

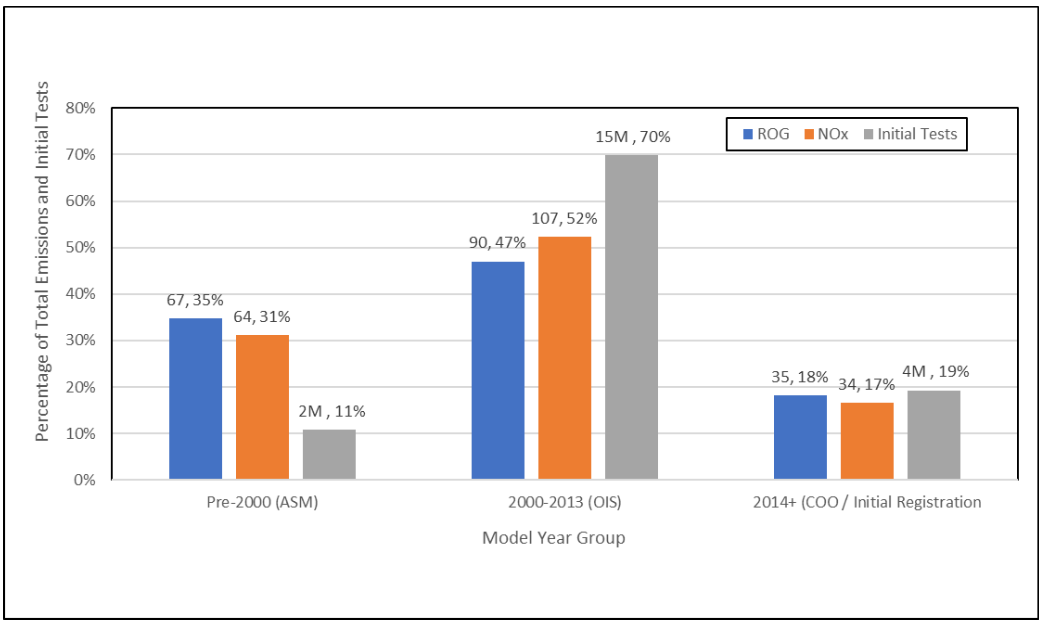
Yes, that is correct. Some stations may have been in the process of administrative action during CY 2022-2023, while others may have been implementing corrective actions on their own behalf to improve their FPR scores. It is also important to note that the comparison of stations according to their legal standing is further complicated by the relatively small number of stations under disciplinary action at any given time. In preparing this version of the SCPR, 587 stations were under suspension or had their licenses revoked compared over 6,000 stations in good standing.

CE-CERT: Page 15 – in reference to paragraph three under the heading "Current Estimate of Excess Emissions"

The numbers in Figure 7 disagree with the preceding paragraph showing 397 tpd of ROG = NOx for vehicles subject to Smog Check compared to 289 tpd in the text.

"According to EMFAC, gasoline-, and diesel-powered light-duty autos, light-, and medium-duty vehicles, and light-heavy-duty trucks with a gross vehicle weight rating (GVWR) of less than 14,001 pounds contributed a total of 289 tpd of ROG+NOx to the CY 2022 statewide emissions inventory. A breakdown of the inventory by MY group and pollutant is shown in Figure 7 below along with the number of initial Smog Check tests performed over the CY 2021-2022 biennial inspection cycle."

Figure 7
Exhaust ROG + NOx Emissions by Model Year Group
and Number of Smog Check Inspections Performed in CY 2021-2022*



*The numbers above the bars represent the emissions in tons per day or number of initial tests in millions (M) followed by the percentage of the total inventory or total number of initial tests performed.

BAR Response:

That is correct. The difference between the numbers in the preceding paragraph and Figure 7 is that the tpd estimates in the figure include 108 tons of evaporative emissions. The paragraph should read "According to EMFAC, gasoline-, and diesel-powered light-duty autos, light-, and medium-duty vehicles, and light-heavy-duty trucks with a gross vehicle weight rating (GVWR) of less than 14,001 pounds contributed a total of 289 tpd of ROG+NOx "**exhaust emissions**" to the CY 2022 statewide emissions inventory."

CE-CERT: Page 16 – in reference to paragraph two

"For purposes of this report, the potential additional benefits of the Program were determined by lowering the RFRs to a level equal to that of the initial SCFRs and calculating the related change in emissions."

In the second paragraph of the "Current Estimate of Excess Emissions" section, estimating additional benefits are described to be the equivalent to having all vehicles inspected at "high performing" Smog Check stations however for the actual calculation, it appears that the RFRs were reduced to just those from the initial SCFR, which presumably would include both high, medium, and low performing stations.

BAR Response:

That is correct. As outlined in Appendix C, the potential additional emissions benefit was estimated by lowering the RFRs to the level of the SCFRs on a model year specific basis. This methodology carries the assumption that the RFRs and SCFRs of high performing stations would be equivalent.

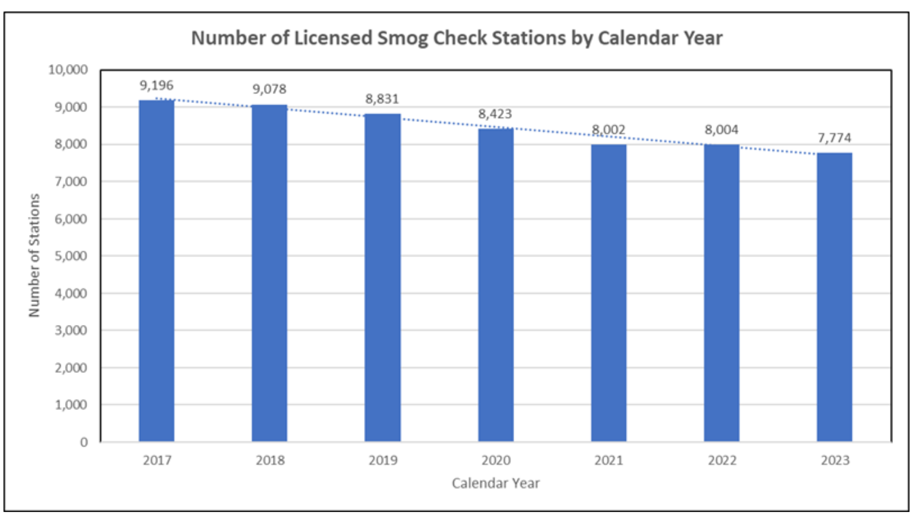
CE-CERT: Page 19 – 3rd bullet.

- The overall number of emissions testing stations fell nationwide over the past year, presumably due to the pandemic and the steadily diminishing population of pre-OBD vehicles. The number of licensed stations dropped by nearly 1,000 in California in 2022 compared to the previous year.

It would be interesting to see if this trend continues. It might give some insight into the underlying cause.

BAR Response:

The text is in error and should have read "The number of stations dropped by nearly 1,000 **"nationwide"** in 2022 compared to the previous year." The figure below presents the number of Smog Check Stations licensed in California from 2017 through 2023.



Attachment B
List of Acronyms

2009 Report, *Evaluation of the California Smog Check Program Using Random Roadside Data*

AB, Assembly Bill

ABS, Antilock Braking System

AIS, Air Injection System

API, Application Programming Interface

ASM, Acceleration Simulation Mode

ATM, Automated Teller Machine

AWD, All Wheel Drive

BAR, Bureau of Automotive Repair

BER, Basic Emission Rate

CARB, California Air Resources Board

CCR, California Code of Regulations

CE-CERT, College of Engineering-Center for Environmental Research and Technology (University of California, Riverside)

CHP, California Highway Patrol

CO, Carbon Monoxide

Comp, Comprehensive

COO, Change of Ownership

CTP, Continuous Test Program

CY, Calendar Year

DAD 2.0, Data Acquisition Device – Second Generation

Directed Vehicles, these vehicles can only receive Smog Check certification from STAR test only or STAR test and repair stations.

DTC, Diagnostic Trouble Code

DR, Deterioration Rate

DMV, California Department of Motor Vehicles

Eng, State Assemblyman Mike Eng

EGR, Exhaust Gas Recirculation

EIS, Emissions Inspection System

EMFAC, **Em**ission **Fac**tor – CARB's official on-road motor vehicle emissions inventory estimation model

ER, Emission Rate

FPR, Follow-up Pass Rate: The FPR is, in brief, "…a performance measure that evaluates whether vehicles previously certified by each station or technician are passing, in their current cycle, at higher-than-expected rates." CCR, Title 16, Division 33, Chapter 1, Article 5.5, §3340.1, "Follow-up Pass Rate."

gms, grams

gpm, grams per mile

Gross Polluter, a vehicle with tailpipe emissions exceeding the gross polluter exhaust emission standards prescribed in CCR Section 3340.42

GVWR, Gross Vehicle Weight Rating

HC, Hydrocarbon

Hp, horsepower

I/M, Inspection and Maintenance

Mi, mile

Mph, Miles per Hour

LDA, Light-Duty Auto

LDT, Light-Duty Truck

LHD, Light-Heavy-Duty

M, Million

MDV, Medium-Duty Vehicle

MOST, Mobile On-Site Testing

MY, Model Year

NOx, Oxides of Nitrogen

OAG, Office of the Attorney General

OAH, Office of Administrative Hearings

OAL, Office of Administrative Law

OBD II, On-Board Diagnostics, 2nd generation, generally required on 1996 and newer MY, gasoline-powered light-duty vehicles.

OBD3, On-Board Diagnostics, 3rd generation, referring to remote OBD or OBD II + telematics.

OIS, OBD II Inspection System for testing OBD-equipped vehicles including MY 2000 and newer gasoline-powered vehicles and 1998 and newer MY diesel-powered vehicles.

PC, Passenger Car

PM, Particulate Matter

Program, Smog Check

RFR, Roadside Failure Rate

RPM, Revolutions per Minute

ROG, Reactive Organic Gases, the portion of hydrocarbon emissions that are reactive in the atmosphere and participate in reactions that form ozone

RSD, Remote Sensing Device

SCFR, Smog Check Failure Rate

SCPR, Smog Check Performance Report

SSI, Single Speed Idle

STAR, Classification of Smog Check stations allowed to certify directed vehicles

TAC, Thermostatic Air Cleaner

tpd, Tons per day

TSI, Two-Speed Idle

U.S., United States

USEPA, United States Environmental Protection Agency

VC, Vehicle Code

VMT, Vehicle Miles of Travel

WEP, Worldwide Environmental Products

WOT, Wide Open Throttle

YR(s), Year / Years

Attachment C
Methodology for Estimating Potential Additional Emission Reductions and Example Calculations

The following presents a detailed explanation of how the estimate of excess emissions were derived for the 2024 SCPR.

Ideally, emission reductions associated with Smog Check are estimated by comparing the measured emissions of vehicles passing roadside inspection to those that fail. However, given that the pass/fail determination for 2000 and newer MY vehicles is based upon OBD status, emissions measurements are unavailable for the vast majority of the fleet.

CARB has developed a sophisticated mathematical model used to characterize the emissions of pollutants attributable to the operation of the on-road fleet. The EMFAC model, which is periodically reviewed and approved by the USEPA, is used to estimate the benefits of both proposed and adopted emission control strategies and related legislation. In this version of the SCPR, the EMFAC model was used to estimate the potential additional benefits associated with Smog Check.

In support of the development and maintenance of EMFAC, CARB conducts "surveillance" test programs. Under surveillance, vehicles are randomly selected from the on-road fleet in California for extensive testing in CARB's laboratory. Like BAR's roadside inspection program, it is assumed that the random sample procured by CARB is representative of the fleet at large and faithfully reflects the impact of various adopted emission reduction strategies including Smog Check.

Figure C-1 (below – shown earlier in this report as Figure 1) displays both the roadside inspection and initial Smog check failure rates as a function of vehicle age for OIS tested vehicles. As these data reflects the characteristics of the fleet in 2023, MY 2023 vehicles are represented in the graphic as having age zero and MY 2000 vehicles as being 23 years old. Note that 15% of MY 2000 vehicles would be expected to fail based on Smog Check initial tests, however 31% were found to fail at roadside. For purposes of this analysis, the differences between the roadside and the Smog Check failure rates were used to estimate excess emissions associated with the program.

Figure C-1
OIS Failure Rates by Vehicle Age for Smog Check and Roadside Test Data
(CY 2022-2023, Gasoline-Powered Vehicles)

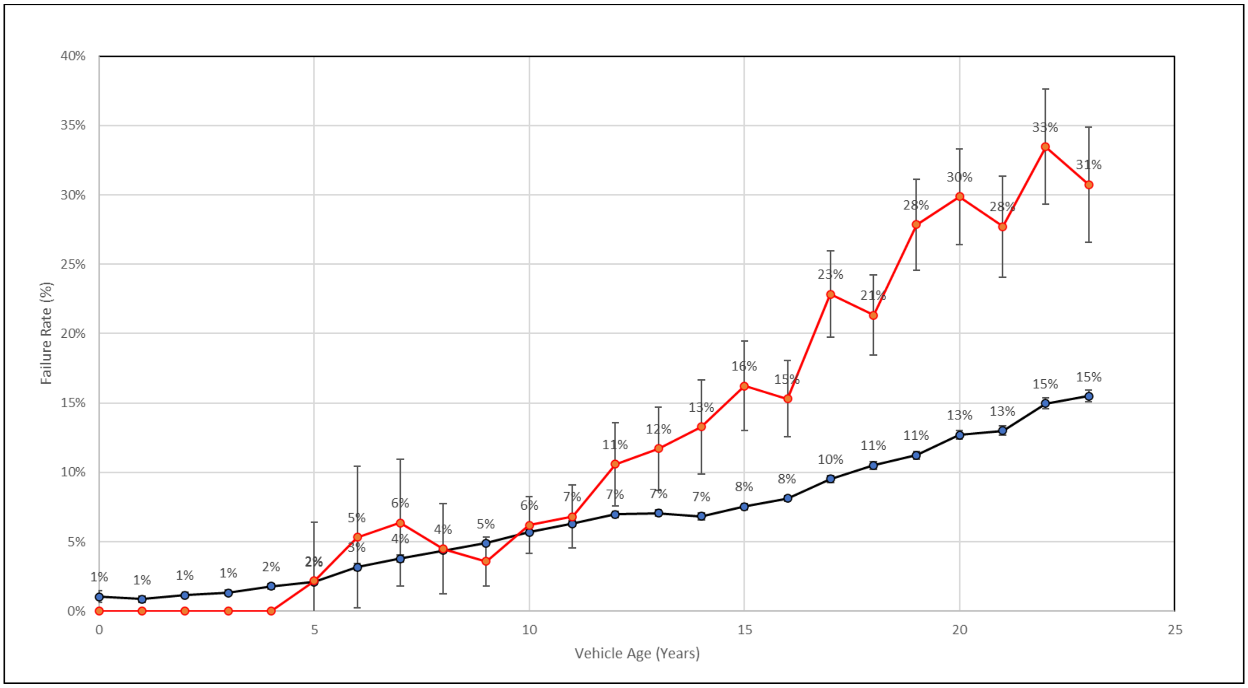
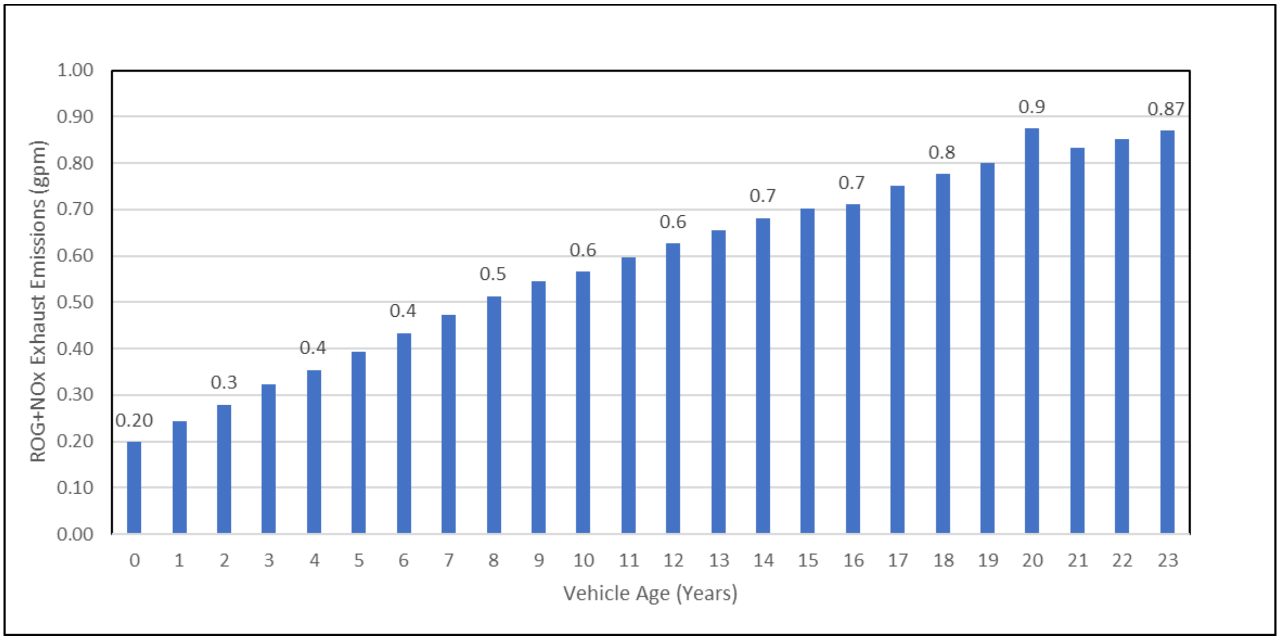


Figure C-2 (below) presents the age specific gram per mile (gpm) ROG+NOx exhaust emission rates for MY 2000 gasoline-powered LDAs as estimated by CARB's model EMFAC2021 (v1.0.2). The statewide, annual average, age-specific emissions rates were derived by dividing the CY and MY tpd estimates from the model by the corresponding vehicle miles of travel (VMT). For example, the basic exhaust emission rate (BER), the estimated emissions at zero miles is 0.2 gpm for MY 2000 vehicles, which increases to 0.87 gpm at age 23.

Equation 1:
Emissions (gpm) = (Emissions tpd)*(453.59 gms/lb. X 2000 lbs./ton) / VMT
BER MY 2000 (gpm) = (9.0 tpd X 907180 gms/ton) / 40,955,507 mi/day = 0.20 gpm

Equation 2:
Emissions (gpm) = (BER gpm X DR gpm/yr X Vehicle Age (yrs))
Emissions (gpm) = 0.20 gpm + .029 X 23 = 0.87 gpm
(Assuming linear deterioration)

Figure C-2
Grams/Mile Exhaust Emissions of ROG + NOx by Age
MY 2000 Gasoline-Powered LDAs
(EMFAC2021 Statewide/Annual)



The gpm emission rates presented in Figure C-2 can be broken down into two distinct components; 1) the BER, or intercept, and 2) the incremental increase in emissions as a function of vehicle age referred to as the deterioration rate (DR or slope). Assuming that any increase in emissions over and above the BER can be attributed to the loss of efficiency or failure of emission control components or systems, the amount of deterioration can be directly correlated to Smog Check failures in the fleet (See Figure C-3 below).

As such, the 0.87 gpm emission rate for 23-year-old vehicles as estimated by EMFAC can be assumed to reflect the impact of the 31% failure rate observed at roadside. Therefore, additional emission reductions for 23-year-old vehicles can be calculated by comparing the emission rate at a 31% RFR to the emissions associated with the 15% SCFR (See Figure C-4).

Equation 3:
Potential Benefit (tpd) =$\sum_{45}^{0}(\mathrm{ER} - \mathrm{BER})/\mathrm{RFR} * (\mathrm{RFR} - \mathrm{SCFR}) * \mathrm{VMT}/(\mathrm{gms./lb.} * \mathrm{lbs./ton})$

Example:
For MY 2000 LDA in CY 2023
=(0.87gpm-0.20gpm) / 31% X 100 X (31%-15%) X 100 X 40,997,769 mi/day /(453.59 gms/lb X 2000 lbs/ton)
= 0.67 gpm / 31 X 15 = (0.32 gpm X 281,2706 mi/day) / 907,180 gms/ton = 1 tpd

Figure C-3
Basic Emission Rate and Deterioration Rate
MY 2000 Gasoline-Powered LDAs (Exhaust ROG + NOx)

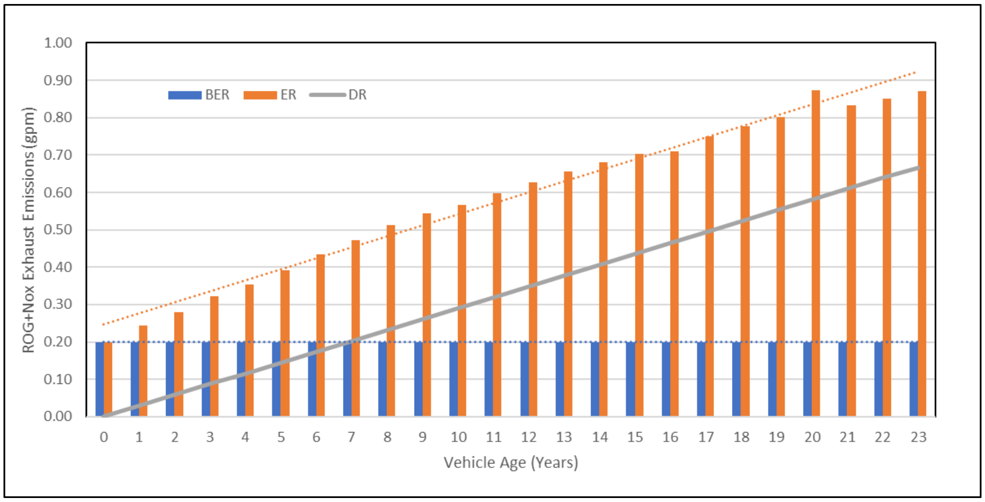
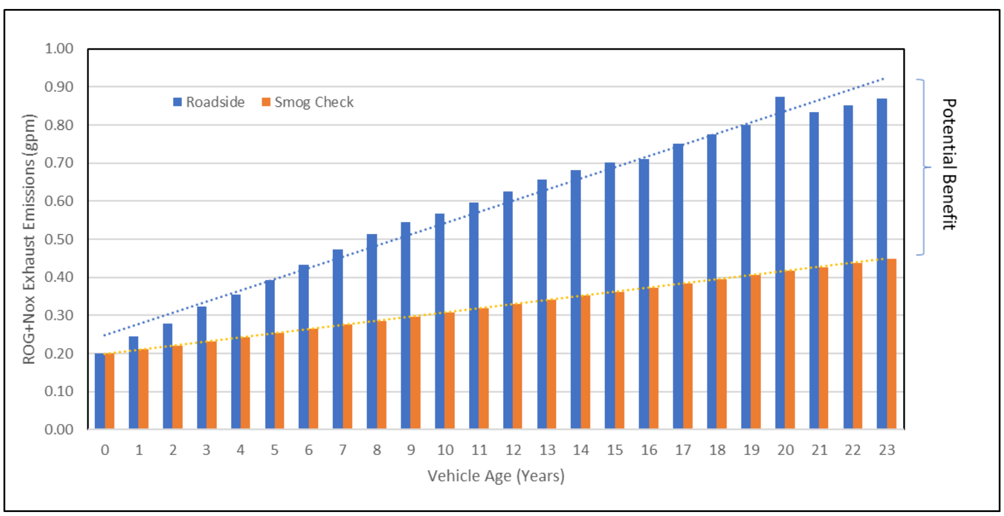


Figure C-4
Basic Emission Rate and Deterioration Rate
MY 2000 Gasoline-Powered LDAs (Exhaust ROG + NOx)



In a departure from previous versions of the SCPR, an effort was made through the analysis of stored DTCs, to separately identify failing vehicles with exhaust related issues from those vehicles failing due to evaporative emission control problems. This distinction was considered important to make given that exhaust emissions failures contribute to excess emission of both ROG and NOx, however vehicles with evaporative control issues would only contribute to excess ROG emissions (See Figure C-5). Table C-1 lists those evaporative emission related DTCs.

Figure C-5
Sources of Vehicular Emissions

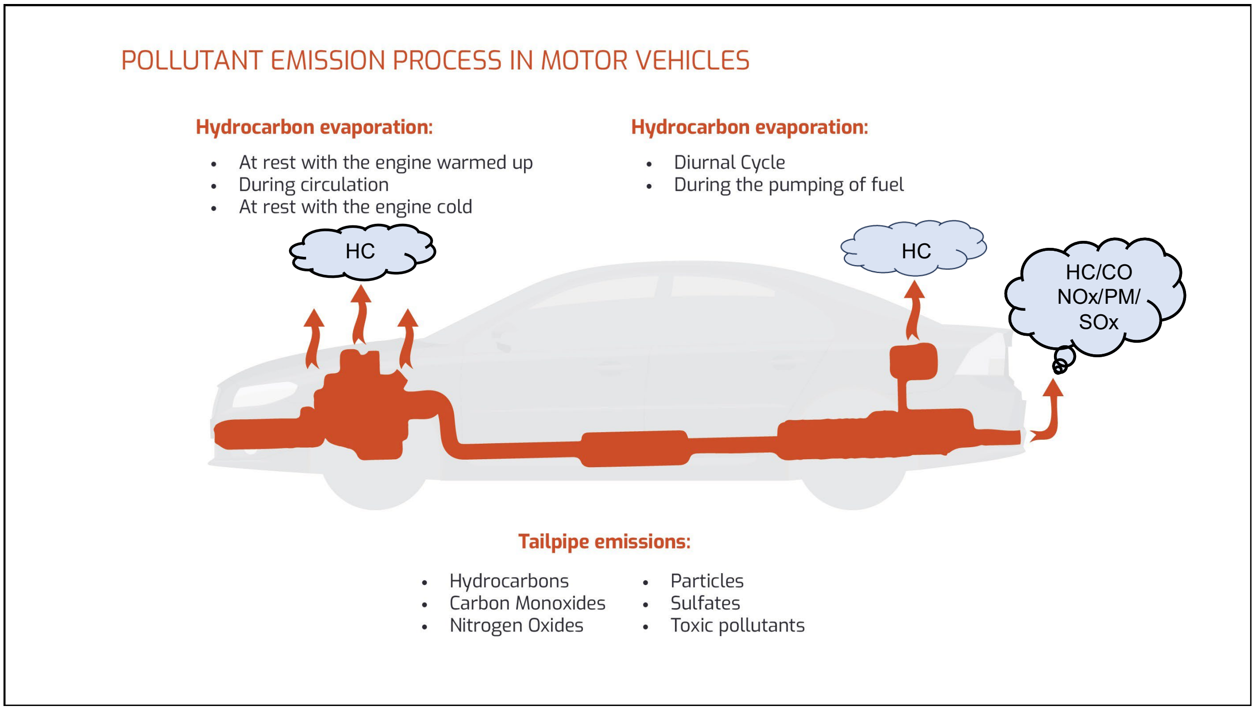


Table C-1
Evaporative Emission Control System Related DTCs

P0440	P0441	P0442	P0443	P0444	P0445
P0447	P0448	P0449	P0450	P0451	P0452
P0454	P0455	P0456	P0457	P0460	P0461
P0463	P0464	P0465	P0466	P0467	P0468
P0460	P0461	P0462	P0463	P0464	P0465
P0467	P0468	P0469	P0496	P0497	P0498

Figures C-6 and C-7 below present the RFR (red upper line) and SCFRs (dark lower line) for exhaust only, and evaporative emissions control only failures. For purposes of this analysis, vehicles with stored DTCs indicating both exhaust and evaporative emission control systems problems were included in both the exhaust and evaporative emission failure rates.

Figure C-6
OIS Failure Rates by Vehicle Age for
Smog Check and Roadside Test Data (Exhaust Only)

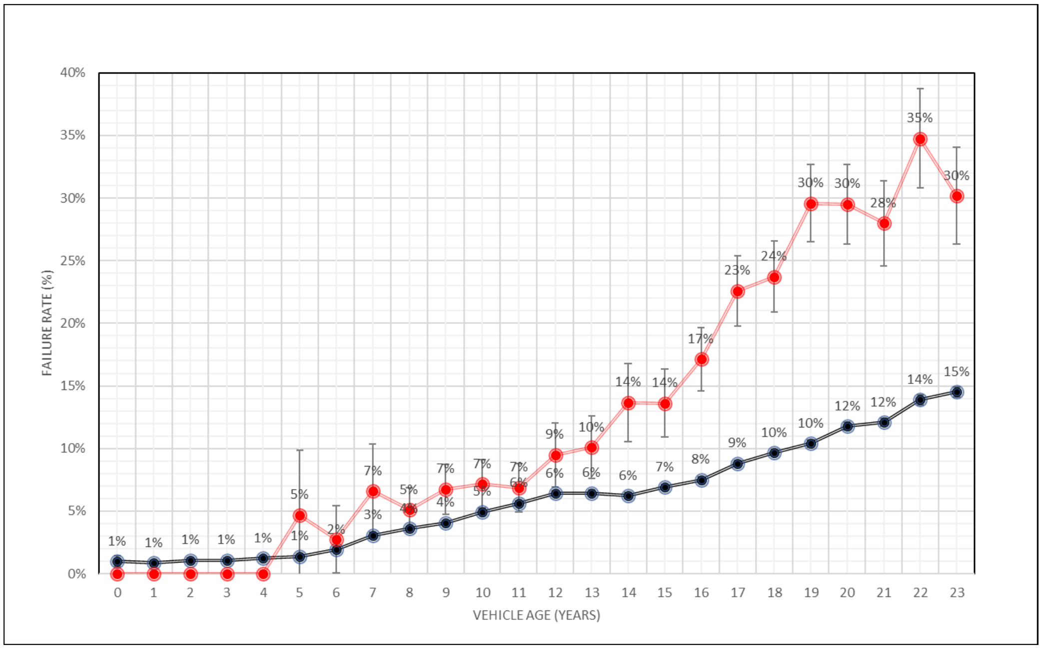
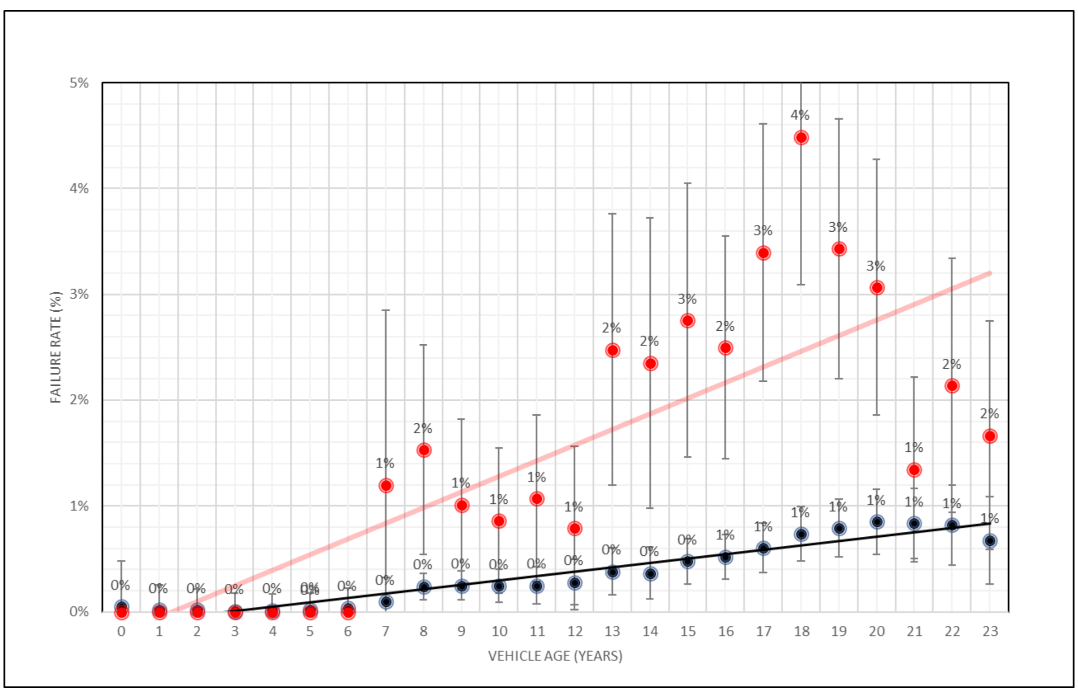


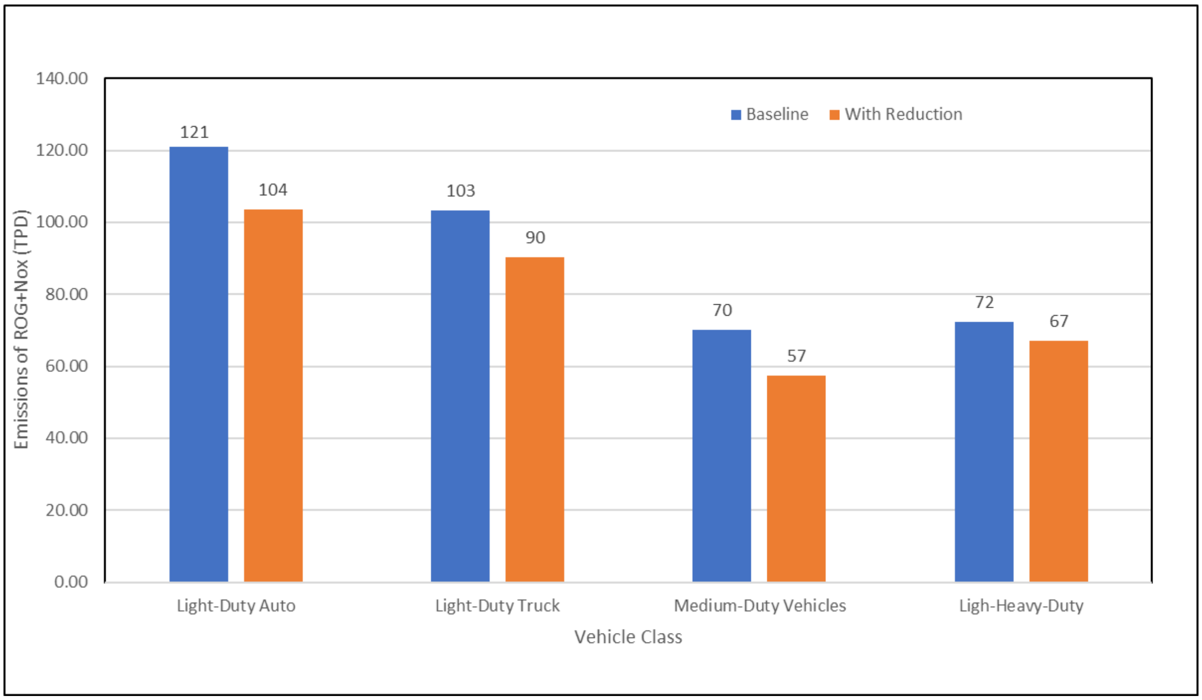
Figure C-7
OIS Failure Rates by Vehicle Age for
Smog Check and Roadside Test Data (Evaporative Only)



Applying the methodology described above for exhaust and evaporative emissions control failures separately, which is a more exact computation, it is estimated that an additional 48 tons per day of ROG + NOx could have been realized if all smog check stations operated at a high level of effectiveness. A reduction of 48 tons per day of emissions would be equivalent to removing over 5.2 million LDA's from the fleet (See equation 4).

Equation 4:
Vehicle Removal = Total Benefit (tons/day) / LDA Fleet Average Emission Rate (tons/vehicle-day) 48 tpd / 9.24E-06 tons/vehicle-day = 5,235,652 fleet average, gasoline-powered LDAs

Figure C-8
Estimated Additional Emission Reduction Achievable Through Improvement to Smog Check



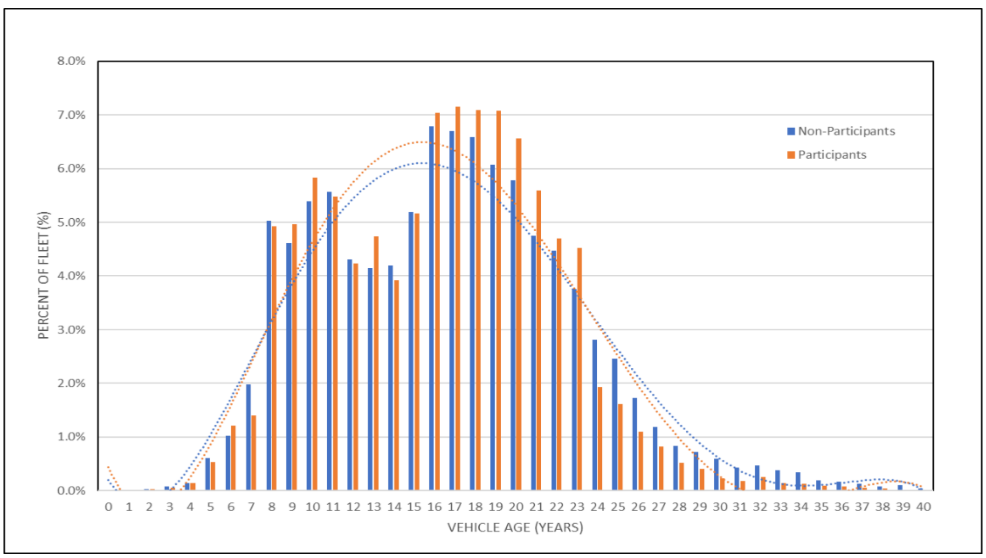
The reader should note that this methodology and the estimate of additional benefit imply reducing the emission rates of failing vehicles back to their certification levels. Given the fact that in most cases the MIL is not required to be illuminated unless the malfunction would result in emissions greater than 1.5 times the certification standard, the potential additional benefit presented here may be overestimated. The specific comments received from the independent reviewer urge BAR work with CARB to better model the overall benefit of Smog Check and to develop the capability to estimate the impact on the emissions inventory related to specific changes to programmatic elements. (Please see "Specific Suggestions for Program Improvement" prepared by CE-CERT (above)).

Attachment D
Issues Related to Roadside Inspection Program Representativeness

In CY 2022-2023, some 12,000 vehicle owners, close to half of those who were directed by CHP and pulled over, declined to permit inspection of their vehicle. Although there are a wide variety of reasons for refusal, if these reasons include prior knowledge, or suspicion of failure on the part of vehicle owners, the resulting sample could be skewed, and the overall roadside (and on-road) failure rates underestimated.

In assessing whether significant differences might exist between the inspected and non-participating fleets, the MY distribution of the two were compared. Figure D-1 illustrates that the two distributions appear similar with the average age of the non-participating fleet being slightly older (16.7 yrs.) compared to average age of the roadside fleet (16.3 yrs.).

Figure D-1
Population Distributions by MY for Participants and Non-Participants in Roadside Inspection



While the current failure rates within the non-participating fleet are unknown, other relevant characteristics can be assessed through an examination of Smog Check histories.

No histories were found for 800 of the non-participating vehicles as they were determined to be either registered outside of California, registered in COO only areas, or were exempt from inspection due to age. Where historical data were available, Table D-1 provides a comparison of the characteristics of the remaining non-participants vs. the resulting roadside sample. Although the two samples are generally similar when comparing prior smog check pass/fail rate, station status, etc., for most of variables investigated, it is notable that 31% of non-participants received their last Smog Check at non-STAR stations compared to only 4% of participants. As discussed in more detail earlier in this report, vehicles certified by non-STAR stations tend to fail at higher rates at roadside.

Table D-1
Comparison of Non-Participant and Roadside Inspected Fleets

Prior Smog Check Result	Non-Participants	Roadside Sample
Fail	46.4%	53.6%
Pass	47.0%	53.0%
Station License Status	**Non-Participants**	**Roadside Sample**
Good Standing	92%	92%
Suspended/Revoked	8%	8%
Station FPR Rank	**Non-Participants**	**Roadside Sample**
Low	15.8%	10.7%
Medium	64.2%	68.4%
High	20.0%	20.9%
Smog Check Area Type	**Non-Participants**	**Roadside Sample**
Enhanced (95%)	47.2%	52.8%
Partial (2.9%)	39.6%	60.4%
Other Areas (<2%)	46.3%	53.7%
Station Type	**Non-Participants**	**Roadside Sample**
STAR	69%	96%
Non-STAR	31%	4%

Procedural differences also exist that may impact the direct comparison of Smog Check tests and roadside inspections. Table D-2 presents the relative failure rates by inspection category observed during Smog Check and at roadside. It is important to note that while visual and functional checks are performed during Smog Check, these elements are not feasible to perform at roadside without impacting participation rates, testing throughput, and causing undue incidental damage to vehicles. Therefore, visual and functional failures (if any) are not reflected in the RFRs.

Table D-2
Smog Check and Roadside Failure Rates by Inspection Category

Inspection Category	Pre-2000 MY (ASM/TSI) Smog Check	Pre-2000 MY (ASM/TSI) Roadside	2000+ MY (OIS) Smog Check	2000+ MY (OIS) Roadside
Fail Emissions	10.1%	16.0%	-	-
Fail Gross Polluter	2.4%	4.7%	-	-
Fail Functional	9.7%	-	7.0%	-
Fail Visual	3.2%	-	1.2%	-
Fail OBD	-	-	6.9%	10.6%
Fail Readiness	-	-	4.3%	6.3%
Fail Smoke/Liquid Leak	-	-	0.1%	-

*Emissions are not measured for 2000+ MY vehicles. Visual and functional checks are not performed at roadside.

As a courtesy to their customers, some Smog Check stations perform pre-inspection to determine whether a vehicle is likely to pass or fail, allowing issues to be corrected prior to an official test. As a result, the SCFRs may be artificially suppressed. It is important to note that the practice of pre-inspection and repair, whether performed by Smog Check stations or individual vehicle owners, does not adversely impact the benefits of Smog Check, however it makes the direct comparison of SCFRs and RFRs problematic.

For all the reasons listed above, BAR continually evaluates issues related to sample representativeness and improvements are continually made to the roadside testing procedures.

The following are specific suggestions by CE-CERT for modifying the protocol and procedures geared toward improving the representativeness of the data collected at roadside.

- **Eliminate the Testing of pre-OBD Vehicles**
  - Pre-OBD vehicles comprise less than 10% of the fleet subject to Smog Check, however these vehicles are certified to less stringent emissions standards and are much more likely to fail Smog Check compared to newer, OBD-equipped vehicles. Although the inspection and maintenance of this segment of the fleet will remain a priority for the foreseeable future, once these vehicles are subject to centralized testing, it is unlikely that more will be learned through roadside inspection. It is recommended that BAR consider suspending roadside testing of pre-OBD vehicles and devote these resources to gathering more data on the remaining fleet which can be used to better inform management decisions.

- **Limit testing of diesel-powered vehicles**
  - Approximately 4% of the fleet subject to Smog Check and only 1% of the vehicles inspected at roadside in CY 2022-2023 were powered by diesel fuel. It is unlikely that a sufficient number of diesel-powered vehicles can be inspected at roadside to make any useful determination about the status of maintenance in

the larger diesel-powered fleet. Therefore, it is suggested that BAR consider eliminating testing diesel vehicles at roadside.

- **Implement Approaches to Increase Participation**
  - Allowing motorists the option to opt-out of roadside inspection raises serious concerns regarding the representativeness of the resulting roadside dataset. If data collected at roadside is skewed such that it cannot be reliably compared to Smog Check, the utility of the entire program might be questioned. Given the importance of the roadside program and the considerable resources expended to collect this data, BAR should consider approaches to increase participation. If increased participation cannot be incentivized, BAR should consider taking a more aggressive stance, including exercising their legal authority to compel participation. It is recommended that at the very least, roadside staff should conduct a visual check of the vehicles' MIL. Alternatively, as motorists are more likely to comply with an authority figure, BAR should consider having CHP officers question motorists about MIL illumination prior to informing them of the voluntary nature of participation.

- **Use Remote Sensing in Conjunction with Roadside Inspection**
  - As a follow up to the previous suggestion, BAR should consider deploying RSD units at random roadside test areas to capture a snapshot of the emissions of both participating and non-participating vehicles. Recording the emissions readings of vehicles entering or exiting roadside inspection via RSD would be used to correlate recorded DTCs of inspected vehicles to measured pollutant levels.

- **Conduct a Special Project to Assess Evaporative Emissions Control Issues**
  - As neither visual nor functional tests are performed at roadside, no independent assessment of Smog Check's effectiveness at identifying and rectifying evaporative emission related issues can be performed. BAR should conduct, perhaps in partnership with CARB, a special test project to assess the frequency and severity of evaporative control system failures, including fraudulent practices, within the regulated fleet.

- **Test Age Exempted Vehicles**
  - An analysis of Smog Check COO data revealed that the failure rate for age exempted vehicles is greater than zero. BAR should consider inspecting age-exempted vehicles at roadside in order to determine whether problems exist in this segment of the fleet beyond that indicated by Smog Check.