Automobile Inspection and Readjustment Program

Department of Public Health and Environment

Performance Audit
November 2012

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November 21, 2012

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This report contains the results of a performance audit of the Automobile Inspection and Readjustment Program (AIR Program) at the Department of Public Health and Environment. The audit was conducted pursuant to Section 42-4-316, C.R.S., which requires the State Auditor to audit the AIR Program every three years to determine the ongoing public need for the program. This report presents our findings, conclusions, and recommendations, and the responses of the Department of Public Health and Environment.

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Glossary of Terms and Abbreviations

AIR Program – Automobile Inspection and Readjustment Program

Commission – Air Quality Control Commission

Council – Regional Air Quality Council

Department – Colorado Department of Public Health and Environment

EPA – Environmental Protection Agency

OBD System – On-Board Diagnostic System

SIP – State Implementation Plan

AUTOMOBILE INSPECTION AND READJUSTMENT PROGRAM (AIR PROGRAM)

Performance Audit, November 2012
Report Highlights

Dianne E. Ray, CPA
State Auditor

Department of Public Health and Environment

PURPOSE

Determine the ongoing public need for the AIR Program using statutorily mandated factors such as the program's effect on ambient air quality, the program's cost-effectiveness relative to other air pollution control measures, and the need for further reductions in pollution to meet national air quality standards.

BACKGROUND

- The General Assembly established the AIR Program in 1980 to reduce vehicle emissions and meet federal air quality standards.
- The program covers all or parts of nine counties in the Front Range and requires motorists to have their vehicles pass an emissions test periodically. Vehicles that fail the test must be repaired and pass the test before having their registration renewed.
- Colorado currently meets all national air quality standards except for ozone. The Department has developed the *State Implementation Plan* to achieve compliance with the ozone standard and to maintain compliance with other standards.

OUR RECOMMENDATIONS

The Department should improve the cost-effectiveness of the AIR Program by working with the Air Quality Control Commission to:

- Adopt a longer model-year exemption period, including the 7-year exemption period currently being proposed as well as additional years, as warranted.
- Implement on-board diagnostic (OBD) system testing and consider the possibility of extending OBD testing further to include all model year 1996 and newer vehicles as well as basing its OBD testing on diagnostic codes specifically related to a vehicle's emissions system.

The agency partially agreed with these recommendations.

EVALUATION CONCERN

The ongoing public need for the AIR Program in its current form is uncertain because the benefits of the program on air quality are small and are likely to decrease over time. In addition, there are measures that the Department can take to increase the cost-effectiveness of the program without significantly affecting its emissions reduction benefits. As a result, revamping or eliminating the program should be considered.

KEY FACTS AND FINDINGS

- Using Calendar Year 2011 data, the AIR Program is estimated to reduce emissions of ozone precursor gases by 25.3 tons per day in the program area. These emissions reductions are estimated to decrease ozone levels in the program area by up to 0.34 parts per billion, which represents 0.5 percent of the 75 parts per billion ozone national air quality standard.

- The annual cost of the AIR Program increased 36 percent between Calendar Years 2008 and 2011 due primarily to the overall increase in the number of vehicles in the program area, including those added from the expansion to Larimer and Weld counties in 2010.

- The cost-effectiveness of the program was measured at $7,200 per ton of pollutants removed from the atmosphere. Our 2009 audit reported cost-effectiveness at $7,700 per ton; however, the comparability of these figures is diminished due to different methodologies being used in the two audits. The Department reported in its AIR Program annual reports that the cost per ton of removed pollutants increased from $4,200 per ton in Calendar Year 2008 to $7,400 per ton in Calendar Year 2011.

- Because of stricter vehicle manufacturing standards, air quality will continue to improve with or without the AIR Program, as older vehicles are retired and replaced with newer, cleaner vehicles.

- Extending the AIR Program's model-year exemption period beyond the current four years and using OBD testing instead of the traditional emissions test for model year vehicles 1996 and newer would reduce program costs without significantly affecting the AIR Program's emissions reduction benefits. Various options were modeled with the most cost-effective ranging from $37.7 million to $45.9 million annually in costs, compared to the $66.1 million cost in 2011.

COST SAVINGS

Increasing the AIR Program's model-year exemption period and using OBD testing for some model years would save motorists up to $28.4 million annually, depending on the option chosen.

For further information about this report, contact the Office of the State Auditor
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RECOMMENDATION LOCATOR
Agency Addressed: Department of Public Health and Environment

Rec. No.	Page No.	Recommendation Summary	Agency Response	Implementation Date
1	28	Improve the cost-effectiveness of the Automobile Inspection and Readjustment Program by working with the Air Quality Control Commission to adopt a longer model-year exemption period, including the 7-year exemption period currently being proposed as well as additional years, as warranted.	Partially Agree	January 2015
2	33	Improve the cost-effectiveness of the Automobile Inspection and Readjustment Program by working with the Air Quality Control Commission to implement on-board diagnostic (OBD) system testing and consider the possibility of extending OBD testing further to include all model-year 1996 and newer vehicles and of basing its OBD testing on diagnostic trouble codes specifically related to a vehicle's emissions system instead of on the EPA's failure guidelines for OBD testing.	Partially Agree	January 2015

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Overview of the Automobile Inspection and Readjustment Program

Chapter 1

The General Assembly established the Automobile Inspection and Readjustment Program (AIR Program) in 1980 to reduce vehicle emissions and meet federal air quality standards. Under the federal Clean Air Act, the federal Environmental Protection Agency (the EPA) establishes air quality standards designed to reduce pollutants to levels that do not endanger human health. Currently, the EPA has adopted National Ambient Air Quality Standards (national standards) for six pollutants: ozone, carbon monoxide, nitrogen dioxide, particulate matter, sulfur dioxide, and lead. The EPA refers to a geographic area that fails to comply with any national standards as being in "nonattainment" and requires the area to take specific actions to come into compliance.

As of September 2012, Colorado's Front Range (i.e., the Denver Metropolitan Area and Larimer and Weld counties) complied with national standards for all pollutants except ozone. The EPA requires states to implement pollution reduction strategies, such as the AIR Program, in populated areas that fail to meet national standards for ozone or carbon monoxide. The AIR Program currently covers all of Broomfield, Boulder, Denver, Douglas, and Jefferson counties and parts of Adams, Arapahoe, Larimer, and Weld counties. We will refer to these counties as the "program area" throughout this report. Initially, reducing carbon monoxide was the primary concern of the AIR Program. However, the program area has not exceeded the national standard for carbon monoxide since 1999. As a result, the AIR Program now focuses on reducing ozone levels below the national standard.

Ozone Air Quality Standards

Although ozone occurs naturally in the stratosphere to provide a protective layer above the Earth, it can harm public health and the environment at ground level. For example, excessive levels of ground-level ozone have been linked to acute respiratory problems in humans, such as aggravated asthma, and reduced crop and forest yields. Ground-level ozone is formed when hydrocarbons, carbon monoxide, and nitrogen oxides mix together in the presence of sunlight. As a result, ozone formation is typically more problematic during the summer. Hydrocarbons, carbon monoxide, and nitrogen oxides may come from natural

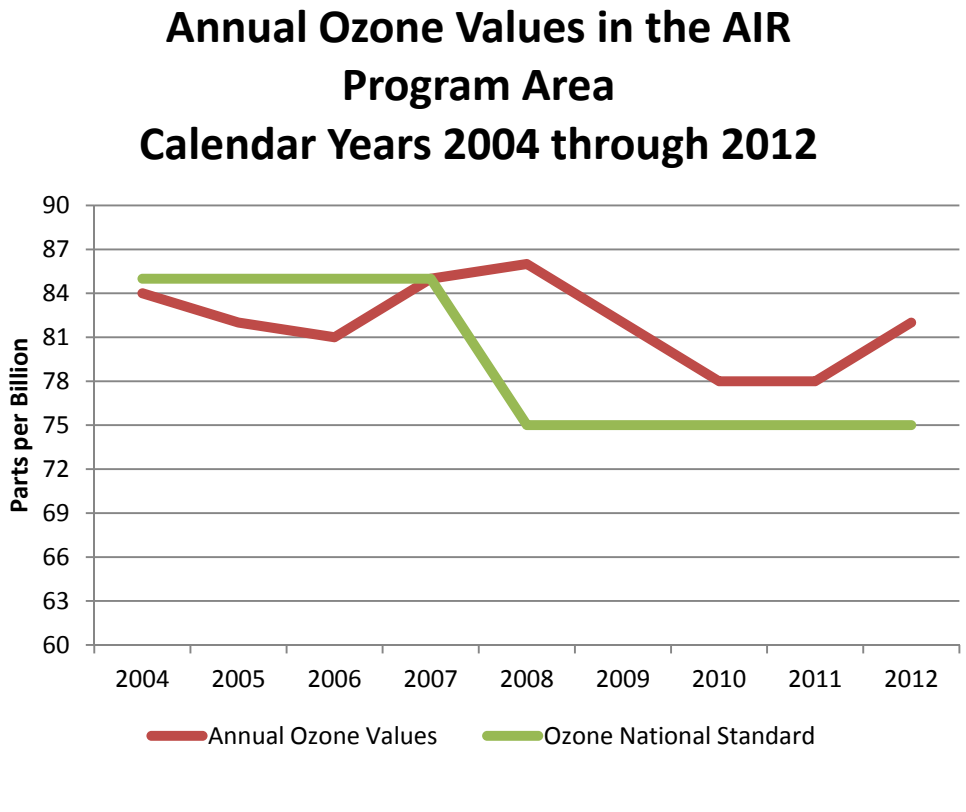
sources, such as trees and wildfires, or from manmade sources, such as vehicle exhaust or solvent fumes.

The federal Clean Air Act requires the EPA to periodically review air quality standards and revise them if necessary. The EPA set the current national standard for ozone in March 2008 at a concentration of 75 parts per billion in ambient air (i.e., the air that we breathe), down from the previous standard of 85 parts per billion. By comparison, the EPA estimates that the typical natural background concentration of ozone ranges from 25 to 45 parts per billion on an average summer day. The EPA considered lowering the ozone standard further to somewhere between 60 and 70 parts per billion, but the Obama administration rejected this proposal in September 2011 because of concerns that the stricter standard would impose too severe a burden on industry and local governments in a time of economic distress. The EPA is scheduled to reconsider the ozone standard during Calendar Year 2013.

Noncompliance with Ozone Standard

The EPA has classified the program area as being in "marginal" nonattainment of the ozone standard, which is the least severe of five nonattainment classifications. Specifically, the program area's ozone "value" at the end of Calendar Year 2011 was 78 parts per billion, or three parts per billion higher than the national standard. The Department of Public Health and Environment (the Department) calculates this value by taking readings at 16 monitoring stations located throughout the program area. The monitors record ambient ozone levels over successive 8-hour periods each day. In compliance with EPA standards, at the end of each calendar year the Department records the fourth-highest ozone reading for each monitor. The Department then averages the fourth-highest ozone reading for each monitor for each of the past 3 years to determine each monitor's ozone value for the current year. In other words, the Department would take the fourth-highest ozone readings from a monitor's 2009, 2010, and 2011 readings and average them to determine the monitor's ozone value for 2011. If any individual monitor's 3-year average of its fourth-highest ozone readings exceeds the national standard, then the entire program area is considered to be in nonattainment status with the standard. For 2011, three of the 16 monitors had 3-year averages above 75 parts per billion, with the highest average being the 78 parts per billion figure mentioned above.

The Department's calculated ozone values for the program area have generally trended slightly downward since 2002 with a few spikes upward, including in 2012, as the chart below shows. The 2012 value of 82 parts per billion was preliminary as of September 2012. The chart also shows that the program area met the previous national standard for ozone of no more than 85 parts per billion from 2004 to 2007, but it has not yet attained the 75 parts per billion standard instituted in 2008.



Source: Office of the State Auditor's analysis of data provided by the Department of Public Health and Environment.

Plans to Achieve Ozone Standard Compliance

States work with the EPA to establish plans and deadlines for attaining the national standards for air quality when the states are out of compliance. Colorado implemented its first ozone compliance plan in 2002 with the *Early Action Compact*, which required the State to adopt air pollution control strategies that would allow the program area to meet the ozone national standard by the end of 2007. The State then developed its *Ozone Action Plan* in 2008 as part of its overall *State Implementation Plan* (*SIP*) for ensuring compliance with all of the national standards. The *SIP* details all of the strategies that the State is using to reduce ozone levels below the national standard and to remain compliant with the other national standards. The strategies related to ozone reductions include:

- The AIR Program.
- Establishing controls on stationary source emissions, which include power plants and oil refineries.
- Establishing controls on emissions from oil and gas well production.
- Setting maximum evaporability limits on gasoline.

The intent of the 2008 *SIP* is to bring the program area into compliance with the ozone national standard by the end of Calendar Year 2015. If the program area achieves compliance, then the State will have to develop a plan for maintaining compliance with the ozone standard. If the program area does not achieve compliance, then the State will have to develop another *SIP*.

Test and Inspection Procedures

The AIR Program requires that cars and gasoline-powered trucks pass an emissions test and, in some cases, an inspection before they can be registered in the program area. Vehicles that fail the emissions test or inspection must be repaired by the owner and then pass the test and inspection before being registered in the program area. The frequency of the test and inspection depends on the age of the vehicle, according to the following guidelines:

- Vehicles are exempt from testing and inspection for the four most recent model years.

- Model-year 1982 and newer vehicles are subject to biennial testing and inspection after the four-model-year exemption.

- Model-year 1981 and older vehicles are subject to annual testing and inspection.

In addition, vehicles must be tested and inspected upon a change in ownership or upon initial registration in the program area with a few exceptions. Under the AIR Program, the emissions and inspection processes typically contain the following three elements:

- **Emissions Test.** Model-year 1982 and newer vehicles undergo a dynamometer test, which utilizes a treadmill-like device to simulate a driving cycle typical of urban driving. Called IM240, the driving cycle corresponds to 240 seconds of the Federal Test Procedure, which is used on all new vehicles to determine if they meet new vehicle certification standards. The IM240 test evaluates emissions of hydrocarbons, carbon monoxide, and nitrogen oxides, which, as noted previously, form ozone when mixed together in the presence of sunlight. Vehicles that exceed Colorado's emissions standards (or cutpoints, as they are commonly called) for these pollutants fail the test. Colorado's cutpoints for hydrocarbons, carbon monoxide, and nitrogen oxides are set much higher (i.e., tolerate higher levels of emissions) than the federal certification standards for new vehicles. This approach helps ensure that the IM240 test only fails those vehicles that clearly emit these pollutants at substantially higher rates than the federal standards for new vehicles. Some vehicles

receive a "fast-pass" IM240 test, which has a shorter duration, because they are less likely to fail the test.

Model-year 1981 and older vehicles and heavy-duty vehicles weighing more than 8,500 pounds receive a two-speed idle test for emissions. This test measures emissions when the vehicle is at idle and at raised idle (i.e., the gas pedal is depressed to increase the engine speed to 2,500 revolutions per minute). The two-speed idle test measures only hydrocarbon and carbon monoxide emissions and does not evaluate nitrogen oxide emissions.

- **Gas Cap Test.** Gas cap pressure is measured to determine if the cap is allowing a significant amount of hydrocarbons to evaporate into the air, which would contribute to the formation of ozone. If the gas cap cannot hold pressure or is missing, the vehicle will fail this test.

- **Anti-Tampering Inspection.** A visual inspection is made to ensure that all of a vehicle's key emissions devices (e.g., catalytic converter) are present, appear to be working, and have not been subject to tampering. The vehicle fails the test if any device is missing, not working, or shows evidence of tampering.

The emissions test, gas cap test, and anti-tampering inspection collectively make up the traditional emissions test currently conducted at Colorado's 18 emissions testing stations in the program area. The price for the test is currently $25 for the IM240 test and $15 for the idle test. In Calendar Year 2011, approximately 933,000 vehicles received traditional emissions tests in the program area.

The Rapid Screen Program (Rapid Screen) serves as an alternative to the traditional emissions test. Rapid Screen uses remote sensing devices to measure emissions as vehicles drive past monitors in roadside vans. Specifically, the monitors capture a vehicle's hydrocarbon, carbon monoxide, and nitrogen oxide emissions levels and license plate information to determine if the vehicle meets Colorado's emissions standards. If a vehicle passes the Rapid Screen test, the vehicle owner is notified that he or she can forego the traditional emissions test and use the Rapid Screen results to register the vehicle, thereby saving a trip to one of the centralized testing stations. If the owner chooses to use the Rapid Screen results to register his or her vehicle, he or she must pay the $25 emissions testing fee along with the registration renewal fee. Vehicles passing the Rapid Screen test do not receive a gas cap test or an anti-tampering inspection. In Calendar Year 2011, owners registered approximately 242,000 vehicles via Rapid Screen. This means that about 21 percent of the 1,175,000 vehicles registered in the program area in Calendar Year 2011 were registered using Rapid Screen and without taking the traditional emissions test. This result is similar to information contained in our 2009 audit of the AIR Program, which reported that 22 percent of vehicles were registered via Rapid Screen.

Changes in the AIR Program Since 2009

Following is a summary of the major changes made to the AIR Program since our last audit in 2009.

Expansion of Program. Effective January 1, 2010, Larimer and Weld counties were added to the AIR Program. As a result, additional centralized testing stations and Rapid Screen vans were put into place to expand testing. The Department expected that the expansion of the program to Larimer and Weld counties would provide additional emissions reduction benefits of 1 ton per day of both hydrocarbons and nitrogen oxides by reducing emissions from vehicles registered in those counties.

Nitrogen Oxide Testing in Rapid Screen. In response to a recommendation in our 2009 audit, the Department began testing for nitrogen oxides, one of the gases responsible for forming ozone, in the Rapid Screen program. At the time of our 2009 audit, the contractor that conducted the audit estimated that having Rapid Screen test for nitrogen oxides would increase emissions benefits of the AIR Program by the equivalent of 0.1 parts per billion of ozone.

End of High-Emitter Program. House Bill 06-1032 required the Department to develop a plan for increasing the use of Rapid Screen for identifying high-emitting vehicles, or vehicles that should fail the traditional emissions test. The rationale for the high-emitter program was to use Rapid Screen to identify the vehicles with the highest emissions and only require those vehicles to take the traditional emissions test, which they would presumably fail, and then the vehicles would have to be repaired. The Department initiated a high-emitter pilot program in 2007, which was reviewed in the 2009 audit. Both the Department and the audit concluded that Rapid Screen could not be effectively used to identify high-emitting vehicles, as it frequently identified vehicles that passed the traditional emissions test, meaning they were not high-emitters, as high-emitters while not always identifying vehicles that failed the traditional emissions test as high-emitters. The 2009 audit recommended that the Department end the high-emitter program, which was accomplished through the passage of Senate Bill 12-034.

Program Administration

Two departments share responsibility for the administration of the AIR Program. The Department of Public Health and Environment is responsible for the technical aspects of the AIR Program, including maintaining and analyzing emissions inspection data, reporting emissions data to the Colorado Air Quality Control Commission (the Commission), and administering the licensing tests for emissions inspectors and mechanics. The Department was appropriated about

$4.9 million and 49.5 full-time-equivalent staff (FTE) for activities related to the AIR Program for Fiscal Year 2013.

The Department of Revenue is responsible for most of the oversight of the emissions testing facilities. These duties include (1) issuing all inspection station, facility, mechanic, and inspector licenses and (2) performing announced and unannounced audits of inspection stations and facilities (including Rapid Screen vans) to ensure compliance with statutes, rules, and regulations. For Fiscal Year 2013, the Department of Revenue was appropriated about $1.2 million and 15 FTE for the AIR Program. We reviewed the Department of Revenue's activities related to the AIR Program in the September 2010 *Vehicle Emissions Program Performance Audit*. As a result, the scope of our current audit did not include the Department of Revenue.

In addition to these two departments, two boards have responsibilities for improving air quality in the program area. The Commission mentioned above is a nine-member citizen board appointed by the Governor and confirmed by the Senate. The Commission is housed at the Department of Public Health and Environment, and its general duties include developing air pollution control policy for the State, regulating pollution sources, and conducting hearings involving violations of the State's air pollution laws. The Commission is also responsible for evaluating the AIR Program to ensure compliance with federal law and the *SIP*, which explains how the State will meet national air quality standards and which is submitted to and approved by the EPA. The Commission is also primarily responsible for developing and implementing specific measures for inclusion in the *SIP*, such as the aforementioned *Ozone Action Plan*.

Working with the Commission is the Regional Air Quality Council (the Council). The Council is a 25-member board first established by an Executive Order of the Governor in 1989 to serve as the lead air quality planning agency for the Denver Metropolitan Area. The Council's membership includes state and local government leaders and representatives of the business community, environmental groups, and the general public. The Council collaborates with the Commission in developing plans for ensuring compliance with national air quality standards.

Audit Scope and Methodology

Statute (Section 42-4-316, C.R.S.) requires the State Auditor to audit the AIR Program every 3 years. The purpose of each audit is to determine the ongoing public need for the AIR Program by taking into consideration the following factors:

- The effect of the AIR Program on ambient air quality (i.e., the air that we breathe).

- The cost to the public of the AIR Program.

- The cost-effectiveness of the AIR Program relative to other air pollution control measures.

- The need, if any, for further reduction of air pollution caused by mobile sources, such as vehicles, to attain or maintain compliance with National Ambient Air Quality Standards.

- The effect of the program in ensuring that vehicle manufacturers comply with federal emissions control system warranty requirements.

The State Auditor contracted with Sierra Research, Inc. (Sierra), to conduct the bulk of the work in this audit. Sierra, in turn, contracted with de la Torre Klausmeier Consulting to perform some of the audit work. In addition to evaluating the statutory requirements above, the audit also analyzed data to determine:

- The effectiveness of the Rapid Screen Program, which measures vehicle emissions from the roadside.

- Alternatives for improving the existing AIR Program.

To accomplish the audit objectives, Sierra:

- Obtained and analyzed testing data from the Department for traditional emissions tests and for Rapid Screen tests to estimate the amount of emissions reductions for which the AIR Program is responsible.

- Reviewed federal requirements related to national air quality standards and the State's efforts to comply with them to determine if the AIR Program is still needed.

- Obtained and analyzed cost information about the AIR Program to determine the cost-effectiveness of the program.
- Reviewed similar programs in other states to identify possible alternatives to the AIR Program and to develop estimates of the potential cost-effectiveness of those alternatives.

- Assessed whether the recommendations from the 2009 audit had been implemented.

Sierra used data provided by the Department from the traditional emissions test and from Rapid Screen testing to perform its analysis. For the traditional emissions test, the testing data were limited to results from the AIR Program's

audit testing program. The AIR Program's computer system randomly selects vehicles for audit. Audited vehicles receive full-duration IM240 tests, while many non-audited vehicles receive the fast-pass IM240 test described previously. The fast-pass IM240 test did not provide enough data for Sierra to meet the audit's objectives. For Rapid Screen testing, Sierra analyzed the entire Rapid Screen database.

Audit work was performed from April through November 2012. We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. We thank the Department for its assistance and cooperation during the audit.

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Need for the AIR Program

Chapter 2

As noted in the previous chapter, statute requires our office to audit the AIR Program every 3 years to determine whether an "ongoing public need for the program has been demonstrated." Statute provides five factors for our office to consider when determining the public need for the AIR Program:

- The effect of the program on ambient air quality
- The cost of the program to the public
- The cost-effectiveness of the program relative to other air pollution control measures
- The need, if any, for further reductions in emissions from mobile sources, such as vehicles, to achieve or maintain compliance with National Ambient Air Quality Standards
- The effect of the program in ensuring that vehicle manufacturers comply with federal emissions control system warranty requirements

Establishing the need for any government program is important so that the general public understands the value they receive for the money they spend. This principle is especially important for the AIR Program, because the program requires all motorists in the program area to participate in the program by paying for and having emissions tests for their vehicles. However, the AIR Program's benefits are primarily derived from the approximately 7 percent of vehicles that fail the traditional emissions tests and are then repaired to reduce their emissions levels. Although the program may achieve some unquantifiable benefits by encouraging repairs before testing and deterring vehicle owners from tampering with their vehicles' emissions control systems, the AIR Program does not receive any direct benefit from the approximately 93 percent of vehicles that pass the traditional emissions test or Rapid Screen testing because no repairs are necessary to reduce their emissions levels.

Overall, the analysis performed by Sierra indicates that the ongoing public need for the AIR Program in its current form is uncertain, meaning that revamping or eliminating the program should be under consideration. As will be discussed in this chapter, while the AIR Program decreases emissions of ozone precursor

gases, the effects of these reductions on air quality are small and the program's emissions reductions are likely to decrease over time. In addition, there are measures that the Department of Public Health and Environment (the Department) can take to lower the cost of the AIR Program without significantly affecting its emissions reduction benefits.

This chapter is organized into two sections. The first section presents the results of Sierra's analysis of the AIR Program. The second section presents our overall findings from the audit and makes recommendations for program modifications.

Key Audit Results

To evaluate the ongoing public need for the AIR Program, Sierra collected and analyzed data related to the five statutory factors mentioned above. The subsections below address each of these factors. Throughout these subsections and the rest of the report, we will be comparing the results from this audit to previous ones conducted by our office. It is important to note that changes in emissions modeling techniques and the requirements of the AIR Program over the years may affect the comparability of these results.

Program Effect on Air Quality

Sierra analyzed data on the effect on air quality of the AIR Program overall and of Rapid Screen specifically, as described below.

Overall Effect on Air Quality. Sierra measured both the direct and the indirect benefits of the AIR Program by using mobile source emissions inventory modeling. This type of modeling uses various factors, such as vehicle miles traveled, type of driving (e.g., high-speed freeway driving vs. stop-and-go in-town driving) and weather to estimate emissions rates. The Environmental Protection Agency (the EPA) has developed multiple mobile source emissions modeling tools, the most recent of which is called MOVES. Sierra used the MOVES model to estimate emissions reductions produced by the AIR Program during Calendar Year 2011. It is important to note that Sierra's analysis reflects the impact of the January 2010 expansion of the AIR Program to Larimer and Weld counties and the effect of Rapid Screen testing on emissions reductions. (We discuss effects of Rapid Screen testing in more detail below.)

Overall, Sierra found that the AIR Program is responsible for removing 25.3 tons per day of ozone precursor gases from the atmosphere. Sierra also estimated the effect on ozone concentration levels created by the removal of 25.3 tons per day of these gases. This effect, which is best assessed based on air quality modeling results, can vary from one location (e.g., ozone monitoring station) to the next because of factors such as weather, topography, and the proximity of emissions

sources. Using the latest published air quality modeling results for the program area and data for the two monitors with the highest ozone levels, Sierra found that the largest effect of the AIR Program at either of these monitoring stations was a reduction in ozone concentration levels of 0.34 parts per billion, which represents 0.5 percent of the 75 parts per billion ozone national standard.

By comparison, our 2009 audit found the decrease in ozone levels attributable to the AIR Program to be 0.60 parts per billion based on the removal of 31.2 tons per day of ozone precursor gases. However, it should be noted that Sierra used a different methodology than the one used in the 2009 audit, which may diminish the comparability of the two figures. For example, Sierra focused more on analyzing the effects of the AIR Program on the fourth-highest ozone readings at monitoring stations, whereas the 2009 audit focused more on the effects of the program on the highest readings at monitoring stations. As discussed in the previous chapter, the EPA bases compliance with the national ozone standard on the fourth-highest ozone reading at monitoring stations.

Rapid Screen. Sierra evaluated Rapid Screen testing in the following three ways:

- **Coverage.** Sierra analyzed Calendar Year 2011 Rapid Screen test results to determine the percentage of vehicles tested by Rapid Screen and the percentage of vehicle owners that have their vehicle registration renewed through passing a Rapid Screen test instead of through the traditional emissions test. Sierra found that 54 percent of vehicles subject to the AIR Program received at least one Rapid Screen test in 2011, and 36 percent received two or more tests. Further, Sierra calculated that about 21 percent of all vehicles registered in the program area received renewals based on Rapid Screen emissions tests, which is similar to the results we found in our 2009 audit. As we discussed in our 2009 audit, increasing Rapid Screen coverage further will be difficult because Rapid Screen vans must be placed in locations that provide specific road conditions, such as traffic that is moving in only one direction and vehicles that are accelerating. Highway on-ramps are a typical location for a Rapid Screen monitoring van. However, many vehicles operate mostly on non-highway surface streets, which are not suitable sites for Rapid Screen monitoring vans because these streets do not provide the road conditions necessary for accurate testing.

- **Effect on Emissions Reduction Benefits.** In general, it would be expected that Rapid Screen testing would lower the emissions reduction benefits of the AIR Program because, as discussed in the previous chapter, Rapid Screen testing is not as comprehensive as a traditional emissions test. For example, Rapid Screen does not test whether a vehicle’s gas cap is leaking evaporative emissions.

Based on Calendar Year 2011 data, Sierra found that Rapid Screen testing slightly lowered the emissions reduction benefits of the AIR Program. For example, Sierra calculated that the overall benefit of the program would have been the removal of 26.8 tons per day of ozone precursor gases, instead of the 25.3 tons per day figure reported above. More specifically, Sierra calculated that Rapid Screen decreased the emissions reduction benefits of the AIR Program by about 5 percent for hydrocarbons, about 4 percent for carbon monoxide, and about 7 percent for nitrogen oxides. Although Sierra found that Rapid Screen negatively impacted the AIR Program's overall effectiveness, these data reflect an improvement from the 2009 audit. At that time, Rapid Screen was estimated to reduce the benefit of the AIR Program by 7 percent for hydrocarbons, 7 percent for carbon monoxide, and 14 percent for nitrogen oxides. According to Sierra, much of this improvement is due to the AIR Program implementing additional emissions standards for nitrogen oxides for vehicles being tested by Rapid Screen, as was recommended in our 2009 audit.

- **Comparability of Rapid Screen to the Traditional Emissions Test.** Sierra matched Calendar Year 2011 test results from vehicles that received both Rapid Screen testing and the traditional emissions test to determine if the tests provide similar results. Vehicles could have received both tests if they were only screened once by Rapid Screen, because program rules require certain vehicle models to pass two Rapid Screen tests before they are exempted from the traditional emissions test. In addition, some drivers whose vehicles have passed the Rapid Screen test still choose to have a traditional emissions test completed.

  Sierra found that average Rapid Screen emissions readings correlate well with the average readings resulting from the traditional emissions test. These results indicate that Rapid Screen tests accurately capture average fleet emissions readings in line with the traditional emissions test.

Overall, the results of Sierra's analyses indicate that Rapid Screen provides comparable benefits to the traditional emissions test and is more convenient for motorists.

Cost of the Program

Sierra calculated the overall cost of the AIR Program for Calendar Year 2011 using the following factors:

- Inspection and Rapid Screen revenue, which represents the fee for taking the traditional and Rapid Screen emissions test, which is $25 for model-year 1982 and newer vehicles and $15 for older vehicles.

- Repair costs, which reflect the amount that motorists reported to the Department that they paid when their vehicles failed the emissions test and were then repaired so that the vehicles would pass the test.

- Registration fees, which motorists pay when registering their vehicles and which pay for the AIR Program's administrative functions performed by the Department and the Department of Revenue.

- Motorist inconvenience, which shows how much it costs for motorists to travel to the centralized emissions stations to have their vehicles undergo the traditional emissions test and wait for the test to be completed. Sierra assumed the cost of operating a vehicle is $0.50 per mile and that motorists drive an average of five miles to a testing station. Sierra also assumed that motorists wait about 7.5 minutes for the emissions test to begin and about 14 minutes for the test to be completed, for a total average wait time of 21.5 minutes. Finally, Sierra assumed that the motorist's time was worth half the State's average hourly wage of $23 per hour, or $11.50 per hour.

These costs are offset by a Fuel Savings Credit, which shows how much fuel is saved by the increased fuel efficiency that results when vehicles are repaired so that they will pass the emissions test.

The table below shows the estimated cost of the AIR Program in Calendar Year 2011 and compares it with the program cost for Calendar Year 2008, which was the period reported in our 2009 audit.

Estimated Cost of the AIR Program
Calendar Years 2008 and 2011

Item	Calendar Year 2008	Calendar Year 2011
Inspection Revenue – Traditional Test	$19,700,000	$24,700,000
Repair Costs	12,400,000	16,300,000
Registration Fees	4,900,000	5,900,000
Fuel Savings Credit	(4,800,000)	(2,400,000)
Motorist Inconvenience – Travel	8,200,000	11,100,000
Motorist Inconvenience – Wait Time	3,100,000	4,100,000
Rapid Screen Revenue	5,100,000	6,400,000
Total	**$48,600,000**	**$66,100,000**
Total Vehicles in the AIR Program Area	**1,986,000**	**2,689,000**
Cost Per Vehicle in the AIR Program Area	***$24.47***	***$24.58***

Source: Sierra Research's analysis of data from the Department of Public Health and Environment.

The cost of the AIR Program has increased significantly since the 2009 audit, from $48.6 million to $66.1 million, or about 36 percent. As the table shows, the cost of testing fees (i.e., Inspection Revenue – Traditional Test and Rapid Screen Revenue) has increased significantly, which is a result of the growth of the vehicle population in the program area including the expansion of the program area to parts of Larimer and Weld counties. Because the program area is larger now than it was at the time of the 2009 audit, the cost of the program per vehicle has risen more modestly, from $24.47 per vehicle to $24.58 per vehicle.

Cost-Effectiveness of the Program

Sierra calculated the cost-effectiveness ratio of the AIR Program by dividing the total annual cost of the program for Calendar Year 2011 by the program's annual emissions reduction benefits, as estimated by Sierra. The table below shows the cost-effectiveness calculation.

Cost-Effectiveness of the AIR Program Calendar Year 2011	
Total AIR Program Cost	$66,100,000
Emissions Reduction Benefit of Program	25.3 tons per day
Annual Emissions Reduction Benefit (ton per day figure X 365 days)	9,200 tons
Cost-Effectiveness Ratio (Total Cost/Annual Benefit)	**$7,200 per ton**

Source: Sierra Research's analysis of data from the Department of Public Health and Environment.

By comparison, we reported in our 2009 audit that the cost-effectiveness ratio for the AIR Program was $7,700 per ton. However, we cannot conclude that the cost-effectiveness of the program has improved because the methodologies used in the two audits were different, which diminishes the comparability of the numbers. Also, the Department stated in its annual reports on the AIR Program that the program's cost-effectiveness ratio was about $7,400 per ton for Calendar Year 2011 versus about $4,200 per ton for Calendar Year 2008. Department staff indicated that the methodologies used in its 2008 and 2011 reports were somewhat different but did not provide evidence to suggest that these different methodologies negated the basic conclusion that the Department's own analysis shows that the cost-effectiveness of the AIR Program declined between 2008 and 2011.

Statute requires our audit to compare the cost-effectiveness of the AIR Program to other emissions reduction measures. Sierra attempted to do this type of comparison by evaluating the AIR Program's cost-effectiveness ratio against national criteria. However, Sierra found that there are no current national

standards or benchmarks for what constitutes a reasonable cost-effectiveness ratio for emissions reduction programs.

Need for Further Reduction in Emissions to Comply with the Ozone National Standard

As noted, the current national standard for ozone is a concentration of 75 parts per billion in ambient air. The ozone value measured in Calendar Year 2011 for the program area was 78 parts per billion, and preliminary data indicate that the Calendar Year 2012 value may be as high as 82 parts per billion. Based on these data, it appears that the current ozone-reducing measures used by the State are not sufficient to meet the ozone national standard and that the State will need to adopt further measures to gain compliance. However, this fact does not necessarily mean that the State must continue the AIR Program in its current form. Specifically, if the Department can identify other ozone-reducing measures that provide as much or more emissions reduction benefits, then the AIR Program could be eliminated or modified to exempt more vehicles from testing or change how vehicles are tested. For example, the EPA approved Colorado's *State Implementation Plan for Regional Haze* in September 2012. The Department estimates that this plan will reduce emissions of ozone precursor gases in the program area by 39 tons per day. By comparison, as discussed earlier, Sierra found that the AIR Program reduced emissions of ozone precursor gases by 25.3 tons per day in Calendar Year 2011, or 35 percent less. We found that other metropolitan areas around the country have been able to eliminate or modify their emissions testing programs. While most of these areas are in compliance with the ozone national standard, Ohio and Kentucky were able to eliminate the emissions testing program for the Cincinnati metropolitan area by adopting other ozone-reducing measures.

Emissions Control System Warranties

In general, the AIR Program should help ensure that vehicle manufacturers comply with emissions control system warranty requirements, because owners of failing vehicles identified by the AIR Program would be expected to seek out warranty repairs when possible. Sierra was not able to identify data that would be suitable for testing this assumption. However, Sierra also did not find any information to suggest that owners have been unable to get emissions systems repairs completed under warranty when those warranties were still in effect.

Findings and Recommendations

As stated above, our overall conclusion is that the ongoing public need for the AIR Program in its current form is uncertain. This conclusion is supported by (1)

Sierra's results reported in the previous section, (2) trends in vehicle manufacturing standards for emissions equipment, (3) the inability to quantify specific health benefits that can be attributed to the AIR Program, and (4) results from our previous audits of the AIR Program. These issues are discussed below.

Audit Results from 2012. As the previous section shows, the AIR Program reduced ozone levels in Calendar Year 2011 by up to 0.34 parts per billion at key monitoring stations, which is relatively small compared with the 75 parts per billion that is the ozone national standard or to the 3-parts-per-billion gap that existed at the end of Calendar Year 2011 between the program area's ozone value (i.e., 78 parts per billion) and the ozone national standard. In addition, the Department's analysis indicates that this small benefit is becoming more costly to achieve, as it has reported that the cost per ton of emissions reductions has risen from about $4,200 in Calendar Year 2008 to about $7,400 in Calendar Year 2011.

Trends in Vehicle Manufacturing Standards. Our overall conclusions from previous audits dating back to 1999 have found that the AIR Program may not be needed in the long term because changes in federal new vehicle manufacturing standards have significantly reduced vehicle emissions. As a result of that and other stricter manufacturing standards, Sierra found that model-year 2010 vehicles produce emissions that are 87 percent lower for hydrocarbons, 77 percent lower for carbon monoxide, and 96 percent lower for nitrogen oxides than model-year 1990 vehicles.

Because of stricter manufacturing standards, air quality in the program area will continue to improve with or without the AIR Program as older vehicles are retired and replaced with newer ones that start out cleaner and stay cleaner as they age. This shift to cleaner vehicles is evident in the program area. For example, data from the Department indicate that 64 percent of vehicles that received a traditional emissions test or Rapid Screen test (i.e., model years 1982 and newer) during Calendar Year 2011 were from model year 2001 and newer, whereas 4 percent were from model years 1982 to 1990. Further, we reported in our 2009 audit that 23 percent of vehicles in the program area fleet consisted of vehicles from 1995 and older. During the current audit, Sierra found that 13 percent of tested vehicles were from model years 1995 and older.

Health Benefits Attributable to the AIR Program. As noted in the previous chapter, studies have associated excessive levels of ozone with various negative effects on public health and the environment, such as acute respiratory problems and reduced crop yields. Sierra attempted to quantify the specific health benefits that could have resulted from the AIR Program's current emissions reductions of 25.3 tons per day of ozone precursor gases. Potential benefits could have included extending average lifespan in the program area or preventing a specific number of respiratory ailments from occurring. Sierra reviewed literature about the health benefits of ozone reduction, including information from the EPA, and was unable

to identify a metric that could translate the emissions reductions of the AIR Program into specific health benefits.

Previous Audit Results. Similar to our 2012 audit, results from our three previous audits indicated that the benefits from the AIR Program, in terms of reducing overall levels of ozone and ozone precursor gases individually, have always been relatively small and appear to be diminishing. As the table below shows, emissions reductions appear to have peaked with results reported in the 2009 audit. Overall ozone reductions were not calculated for the 2003 and 2006 audits. The Department's AIR Program annual reports also indicate that the emission reduction benefits of the program are declining with reported emissions reductions of 16.77 tons per day in Calendar Year 2008 compared with 14.73 tons per day in Calendar Year 2011, a decrease of about 12 percent. Neither figure includes the effect of having Larimer and Weld counties in the AIR Program.

As mentioned before, it is important to note that changes in the AIR Program and modeling techniques over the years may mean that the numbers in the table are not totally comparable from one audit to the next. For example, the AIR Program added cutpoints for nitrogen oxides to the Rapid Screen testing criteria between the 2009 and 2012 audits (in response to our recommendation), which may explain why the program was responsible for the greater nitrogen oxide reductions reported in 2012 compared with 2009. In addition, the AIR Program increased the cutpoints for hydrocarbons and nitrogen oxides between the 2006 and 2009 audits (also in response to our recommendation), which may explain why the 2009 audit shows the highest level of benefits from the AIR Program among the four listed in the table.

Air Pollution Reductions Attributable to the AIR Program

	2003 Audit	2006 Audit	2009 Audit	2012 Audit
Ozone (parts per billion)	N/A[1]	N/A[1]	0.60	0.34
Ozone Precursor Gases (tons per day):				
Hydrocarbons	8.0	15.0	19.0	11.0
Carbon Monoxide[2]	92.0	242.0	160.0	165.1
Nitrogen Oxides	-0.3	N/A[1]	9.5	11.5
TOTAL	9.2	19.0	31.2	25.3

Source: Office of the State Auditor's analysis of data provided by the Department of Public Health and Environment for the 2012 audit. Previous audit reports issued in 2003, 2006, and 2009.

[1]N/A indicates that the audit did not report these figures.

[2]Under standard methodology, the carbon monoxide figure is divided by 60 before being added to the other figures to calculate the total figure. Dividing by 60 accounts for the fact that carbon monoxide plays a small role in ozone formation.

The Department raised concerns about the comparability of the numbers in the table above and the conclusions resulting from these numbers. To address these concerns, Sierra performed additional analysis to calculate emissions reduction benefits that would be comparable from one year to the next. Specifically, Sierra used the MOVES model to determine the AIR Program's emissions reduction

benefits from Calendar Years 2008 and 2011 (which would correspond to the period covered by our 2009 and 2012 audits). Sierra found that the amount of emissions reductions of ozone precursor gases attributable to the AIR Program decreased from to 26.5 tons per day in 2008 to 19.9 tons per day in 2011. The 19.9 figure for 2011 does not include the effect of Larimer and Weld counties, which explains why it is different from the 25.3 ton-per-day figure listed in the table above. Sierra's additional analysis provides more evidence that the benefits of the AIR Program are diminishing over time.

Our conclusion—that the ongoing public need for the AIR Program in its current form is uncertain—raises questions about the future of the AIR Program. Options for the AIR Program include eliminating the program completely or revising the program in ways that would reduce the cost of the program without significantly affecting its emissions reduction benefits. We provide two recommendations in the next section that would modify the current AIR Program to improve its cost-effectiveness. The Department will need to consider the long-term viability of the AIR Program when it develops the next *State Implementation Plan*, expected in 2015, for achieving and maintaining compliance with all national air quality standards,

Program Modifications

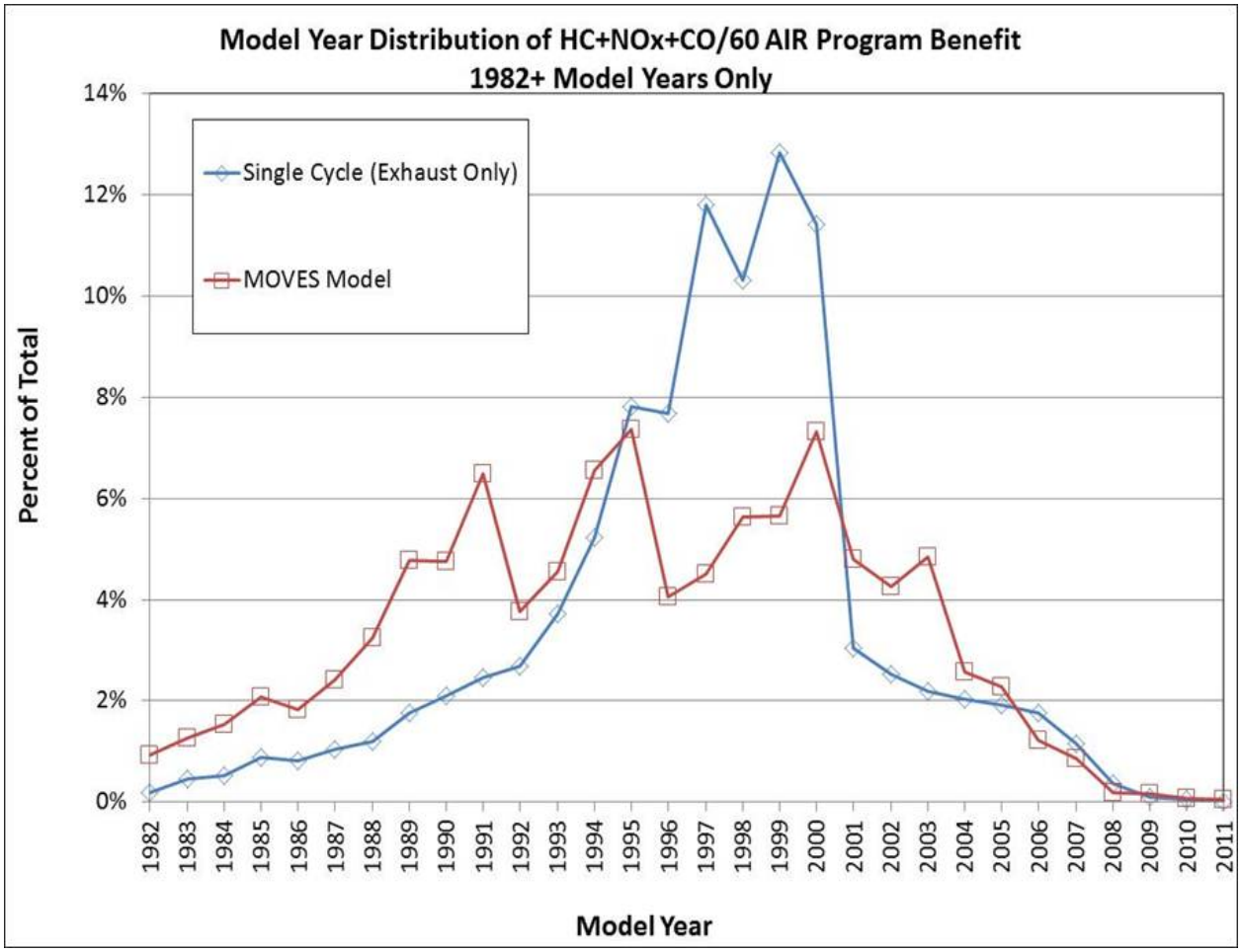
The General Assembly has expressed its interest in finding more cost-effective ways to conduct vehicle emissions testing. For example, in Section 42-4-301, C.R.S., the General Assembly declares its ongoing authority to petition the EPA to implement alternative emissions testing technology that would result in "substantial savings in cost to consumers." In addition, Section 42-4-316, C.R.S., which requires the State Auditor to assess the relative cost-effectiveness of the AIR Program as part our office's triennial audit of the program, demonstrates that the General Assembly wants the AIR Program to be operated as efficiently as possible.

As stated, based on its own analysis of the AIR Program, the Department has reported that the cost-effectiveness of the AIR Program has declined since 2008, as the cost-effectiveness ratio increased from the approximately $4,200 per ton stated in the 2008 AIR Program annual report to the approximately $7,400 per ton stated in the 2011 annual report. Sierra evaluated alternate strategies for decreasing the cost of the program while maintaining similar benefits. Sierra identified two strategies that could meet these criteria: (1) expanding the model-year exemption and (2) using on-board diagnostic system testing in place of the traditional IM240 emissions test. We discuss each of these options below.

Model-Year Exemptions

Section 42-4-306(8), C.R.S., grants the Air Quality Control Commission (Commission) the authority to exempt vehicles of any "make, model, or model year" from the testing requirements of the AIR Program. Currently, the Commission exempts the most recent four model years from testing. As of September 2012, this exemption period covers model years 2009 through 2012.

Because newer vehicles emit fewer emissions than older ones and newer model years are subject to stricter vehicle manufacturing standards, opportunities may exist for expanding the model-year exemption period in the AIR Program without significantly compromising its emissions reduction benefits. Sierra analyzed AIR Program emissions testing data from Calendar Year 2011 to determine the impact that expanding the model-year exemption would have on emissions reductions benefits. The data Sierra used came from a sample of vehicles that failed the exhaust portion of the emissions test and were chosen for audit by the AIR Program. Department staff indicated that this sample was randomly selected and representative of the population. Sierra calculated the amount of emissions reductions that accrue from each model year for each of the ozone precursor gases (i.e., hydrocarbons, carbon monoxide, and nitrogen oxides). As the figure below shows, Sierra's analysis (labeled "Single Cycle") indicates that the percentage of emissions reduction benefits from the AIR Program drops significantly beginning with model-year 2001 vehicles. Sierra also used the MOVES emissions modeling tool discussed previously to estimate emissions reduction benefits by model year. As the figure below shows, the MOVES analysis also indicates a significant decrease in emission reduction benefits with newer vehicles, although the drop-off from model year 2001 is not as pronounced.



Source: Sierra Research's analysis of data from the Department of Public Health and Environment.

To put these results in numerical rather than graphic form, Sierra's single cycle analysis found that model-year 2001 and newer vehicles represented 64 percent of the vehicles tested but provided only 6 percent of the emissions reductions for hydrocarbons, 9 percent for carbon monoxide, and 28 percent for nitrogen oxides. The MOVES analysis projects that model-year 2001 and newer vehicles provided 13 percent of the emissions reductions for hydrocarbons, 32 percent for carbon monoxide, and 25 percent for nitrogen oxides, which are similar to results found in separate testing completed by the Department. These results are consistent with the fact that newer vehicles are responsible for fewer emissions because of stricter vehicle manufacturing standards.

Sierra's results indicate that the AIR Program's current four-model-year exemption period is not cost-effective. Sierra recalculated the AIR Program's cost-effectiveness ratio to reflect the lower costs and lower emissions benefits that would result if model-year 2001 and newer vehicles had been exempted from testing. We chose model year 2001 as the starting point because it represents a

peak in the emissions reduction benefits in both the single cycle and MOVES modeling analyses. The table below compares the cost-effectiveness ratio of extending the model-year exemption to cover these vehicles to the cost-effectiveness ratio of the current AIR Program, which exempts the newest four model years.

Cost-Effectiveness of the AIR Program
Current Program vs. Scenario of Exempting Model-Year 2001 and Newer Vehicles

	Current Program[1] Calendar Year 2011	Exemption of Model Years 2001 and Newer
Total Costs	$66,100,000	$37,700,000
Emissions Reduction Benefit of Program	25.3 tons per day	20.0 tons per day
Annual Emissions Reduction Benefit (ton per day figure X 365 days)	9,200 tons	7,300 tons
Cost-Effectiveness Ratio (Total Costs/Annual Benefit)	**$7,200 per ton**	**$5,200 per ton**

Source: Sierra Research's analysis of data from the Department of Public Health and Environment.

[1] Model years 2008, 2009, 2010, and 2011 (i.e., the four most recent model years) would have been exempted from testing in Calendar Year 2011.

As the table above shows, the cost of the AIR Program would decrease by 28 percent, from $7,200 per ton to $5,200 per ton, if model years 2001 and newer were exempted from testing. In addition, exempting model years 2001 and newer would result in cost savings to the public of about $28.4 million annually (i.e., the decrease in total program costs from $66.1 million to $37.7 million), based on Calendar Year 2011 data, with relatively little impact on emissions reductions.

Our 2003 and 2006 audits reached similar conclusions about the positive effects that increasing the model-year exemptions would have on the cost-effectiveness of the AIR Program. We therefore recommended in both audits that the Department evaluate the issue and make recommendations to the Commission for changing the exemption period. At the time that this audit started (April 2012), the Department had not brought a recommendation forward to the Commission for extending the model-year exemption period.

In October 2012, the Department reported to us that it made a recommendation to the Commission to increase the model-year exemption to 7 years, which would be the most expansive exemption range in the country, according to the Department. Sierra analyzed the Department's proposal using the same methodology it used to evaluate the scenario in which model-year 2001 and newer vehicles would be exempted. The cost-effectiveness of the AIR Program would improve under the Department's proposal. Specifically, Sierra found that the Department's proposal would result in a cost-effectiveness ratio for the AIR Program of $5,800 per ton,

compared with $5,200 per ton if all model-year 2001 and newer vehicles were exempted. On the other hand, the AIR Program's ozone precursor emissions reduction benefits would decrease by 5 percent under the Department's proposal versus 21 percent if all model-year 2001 and newer vehicles were exempted.

The Commission is scheduled to consider the Department's proposal to extend the model-year exemption period to 7 years in December 2012. If approved, the new model-year exemption period would go into effect in 2015. The Department should study the possibility of extending the exemption period further to include additional model years and making recommendations to the Commission, as warranted.

Recommendation No. 1:

The Department of Public Health and Environment (the Department) should improve the cost-effectiveness of the Automobile Inspection and Readjustment Program by working with the Air Quality Control Commission to adopt a longer model-year exemption period, including the 7-year exemption period currently being proposed as well as additional years, as warranted.

Department of Public Health and Environment Response:

Partially agree. Implementation date: January 2015.

The Department has proposed regulatory changes to Air Quality Control Commission (Commission) Regulation No. 11 to extend the current four-model-year exemption to 7 years, which would constitute the longest exemption period in the country. If adopted by the Commission and approved by the General Assembly and the federal Environmental Protection Agency, the Department will work with the Department of Revenue to implement the new exemption period.

The Department disagrees with the conclusion that the ongoing need for the AIR Program is uncertain. The Denver Metro/North Front Range Area continues to be in violation of the federal ozone standards, and the AIR Program continues to lower ozone concentrations in the area. The AIR Program reduces 25 tons per day of ozone forming emissions. Vehicles are the largest source of ozone precursor emissions in the non-attainment area. At this time, there is no known set of strategies that Colorado could employ that would both make up for the ozone reductions achieved by the AIR Program and further reduce ozone concentrations below national air

quality standards. All of these factors compel the conclusion that the AIR Program continues to be a necessary and appropriate strategy.

Auditor's Addendum:

Sierra's analysis, as outlined in this chapter, supports our conclusion questioning the ongoing public need of the AIR Program in its current form. As Sierra's analysis also indicates, extending the model-year exemption period beyond the 7-year proposal currently under consideration may provide additional opportunities for the Department to make the AIR Program more cost-effective without significantly affecting the program's emissions reduction benefits. Therefore, the Department should study the costs and benefits of extending the exemption period beyond the 7 model years currently being proposed.

On-Board Diagnostic System Testing

Most model-year 1996 and newer vehicles sold in the United States come equipped with engine/emissions on-board diagnostic (OBD) systems. OBD systems monitor virtually all components that make up the engine management and emissions control systems. These systems can detect malfunctions or deterioration of these components often well before the motorist becomes aware of any performance problems. When a potential emissions-related problem occurs, the malfunction indicator lamp (e.g., "check engine" or "service engine soon" lights) on the vehicle instrument panel comes on. Technicians can then diagnose the problem by utilizing diagnostic trouble codes within the on-board computers.

Prior to 2003, the AIR Program used information from a vehicle's OBD system during the traditional emissions test to fail vehicles if the malfunction indicator lamp was on. In 2003, the Commission decided to discontinue this practice because the EPA's OBD standards for failing vehicles were more stringent than AIR Program standards. In addition, the EPA's OBD standards include trouble codes that are not directly related to emissions problems. The Commission also recommended that information from each vehicle's OBD system continue to be collected during the traditional emissions test but that vehicles not be passed or failed based on this information.

In general, the national trend has been for states to move away from the traditional tailpipe emissions test, such as the IM240 test used as part of the AIR Program, and toward OBD testing, because the OBD test is less cumbersome and more flexible. Specifically, OBD testing involves hooking up the vehicle to an OBD monitor, determining whether the malfunction indicator lamp is on, and, if

so, evaluating trouble codes provided by the monitor which indicate the nature of the problem that needs to be repaired. The OBD test takes a short amount of time and does not require vehicles to be run through a simulated driving cycle like the traditional emissions test. Further, some states have set up self-service kiosks where motorists can test their own vehicles at their convenience. If a vehicle fails the self-service test, then the motorist must take the vehicle to a centralized testing station to find out why it failed and what repairs must be made to pass the test.

Prior audits have evaluated the possibility of incorporating OBD testing into the AIR Program under various scenarios. These audits have generally found that OBD testing using trouble codes provided by EPA guidelines for failing vehicles would be less cost-effective than the current AIR Program, primarily because many more vehicles would fail and have to be repaired.

Sierra analyzed the use of OBD testing for model-year 1996 and newer vehicles during the current audit and found results similar to those reported in prior audits. Specifically, Sierra compared the cost-effectiveness of the AIR Program's traditional emissions testing system with several scenarios for replacing the traditional test with OBD testing and making the changes to model-year exemptions discussed in the previous section. Sierra's analysis of OBD testing considered tests using the EPA's complete list of OBD trouble codes as well as tests using only trouble codes more specifically targeted to a vehicle's emissions system. It is important to note that for this analysis, Sierra assumed that the price of the OBD test would be $21 instead of the $25 currently being charged for the traditional emissions test. According to the Department, $21 represents the average cost of OBD tests nationwide. As the table below shows, the cost-effectiveness of OBD testing may be better or worse than the current AIR Program, depending on which option is used. In general, Sierra found that using the EPA's guidelines for failing vehicles was less cost-effective than only using specific trouble codes related to the vehicle's emissions system.

Cost-Effectiveness of the AIR Program
Current Program vs. Scenarios of On-Board Diagnostic Testing
For Model-Year 1996 and Newer Vehicles

		On-Board Diagnostic Options[1]					
	Current Program Calendar Year 2011	**Use EPA Failure Guidelines and Current Model-Year Exemptions**	**Use Specific Trouble Codes and Current Model-Year Exemptions**	**Use EPA Failure Guidelines and Exempt 7 Model Years**	**Use EPA Failure Guidelines and Exempt 2001 Model Year and Newer**	**Use Specific Trouble Codes and Exempt 7 Model Years**	**Use Specific Trouble Codes and Exempt 2001 Model Year and Newer**
Total Costs (millions)	$66.1	$81.0	$73.3	$67.1	$45.9	$60.0	$41.3
Emissions Reduction Benefit of Program (tons per day)	25.3	30.1	28.6	28.5	22.7	27.1	21.8
Annual Emissions Reduction Benefit (tons per day x 365)	9,200	11,000	10,400	10,400	8,300	9,900	8,000
Cost-Effectiveness Ratio (Costs/Benefit) (per ton)	**$7,200**	**$7,400**	**$7,000**	**$6,500**	**$5,500**	**$6,100**	**$5,200**

Source: Sierra Research's analysis of data from the Department of Public Health and Environment.
[1] Shaded areas indicate options that are more cost-effective (i.e., less expensive on a cost-per-ton basis) than the current AIR Program.

Based on this analysis, the most cost-effective OBD option would be to only fail vehicles for specific trouble codes targeted to emission-related problems and exempt model-year 2001 and newer vehicles from testing. This option would decrease the cost per ton of pollution reductions associated with the AIR Program from $7,200 per ton to $5,200 per ton, or about 28 percent, as well as reduce overall program from the current $66.1 million to $41.3 million. As discussed in the previous section, using the current traditional emission test while extending the exemption period to model-year 2001 and newer vehicles would also result in a cost-per-ton ratio of $5,200. However, using OBD testing for model-year 1996 and newer vehicles in addition to exempting model year 2001 and newer would decrease the emissions reduction benefits by 14 percent (from 25.3 tons per day to 21.8 tons per day) compared with 21 percent when using the traditional emissions test with an exemption period starting with model year 2001, as reported in the previous section. The main reason for the difference between the two options is that using OBD testing would fail more vehicles resulting in higher emissions reduction benefits and increased repair costs for motorists.

Our previous audits in 2006 and 2009 recommended that the Department evaluate the feasibility of using OBD testing to improve the cost-effectiveness of the AIR

Program. When the current audit began, the Department reported that it was still studying this issue and did not anticipate reaching a determination about whether to use OBD testing until 2013 or 2014. However, in October 2012, the Department informed us that it had made a recommendation to the Commission for implementing OBD testing into the AIR Program. The Commission will consider the Department's proposal in December 2012, at the same time that it considers the Department's proposal to extend the model-year exemption period to 7 years. If approved, the new OBD testing will start in 2015.

We reviewed the Department's proposal and found that it would replace the traditional emissions test with OBD testing based on the EPA's failure guidelines for the first four model years after the new 7-year exemption, discussed in the previous section, runs out. In other words, if both of the Department's two new proposals were currently in place for model year 2012, model years 2006 through 2012 (the most recent 7 model years) would be exempted from all emissions testing, model years 2002 through 2005 (the next four model years) would undergo OBD testing, and model-year 2001 and older vehicles would continue taking the traditional emissions test. The Department's proposal assumes that motorists would be charged the aforementioned national average of $21 for the OBD test.

Sierra analyzed the Department's proposal (i.e., extending the exemption period to 7 years and using OBD testing for the next 4 model years) and found that it would result in a cost-effectiveness ratio of $6,100 per ton compared with $7,200 per ton for the current AIR Program and $5,200 per ton for a program that extends the model-year exemption period to model year 2001 with OBD testing based on trouble codes specific to a vehicle's emissions system (described in this section) or with the traditional emissions test (described in the previous section) for older vehicles.

Although the Department's proposal would increase the cost-effectiveness of the AIR Program, Sierra's analysis indicates that additional opportunities for cost savings exist. For example, Sierra compared the Department's proposal to the $5,200-per-ton scenario described in the table above, which combines a model-year exemption period to 2001 and OBD testing based on specific trouble codes, and found that the Department's proposal would result in the reduction of 1,300 additional tons of pollutants annually, but at a cost of about $11,800 per ton to remove the additional 1,300 tons of pollutants. Therefore, regardless of the Commission's decision in December, the Department should study the possibility of extending OBD testing further to include all model-year 1996 and newer vehicles and of basing its OBD testing on diagnostic codes specifically related to a vehicle's emissions system instead of on the EPA's failure guidelines for OBD testing. Part of this analysis should include determining the feasibility of conducting OBD testing based only on diagnostic codes specifically related to a vehicle's emission system which, while a promising practice, has not yet been used in other jurisdictions.

Recommendation No. 2:

The Department of Public Health and Environment (the Department) should improve the cost-effectiveness of the Automobile Inspection and Readjustment Program by working with the Air Quality Control Commission to implement on-board diagnostic (OBD) system testing and consider the possibility of extending OBD testing further to include all model-year 1996 and newer vehicles and of basing its OBD testing on diagnostic trouble codes specifically related to a vehicle's emissions system instead of on the EPA's failure guidelines for OBD testing.

Department of Public Health and Environment Response:

Partially agree. Implementation date: January 2015.

The Department has proposed regulatory changes to Air Quality Control Commission (Commission) Regulation No. 11 to implement OBD testing in lieu of tailpipe emissions testing for the first four model years following the expiration of the proposed seven-year vehicle exemption period. If adopted by the Commission and approved by the General Assembly and the federal Environmental Protection Agency (EPA), the Department will work with the Department of Revenue to implement the OBD testing provisions in accordance with EPA rules and accepted inspection and maintenance procedures.

The Department will continue to evaluate opportunities to further expand OBD testing as a possible replacement for tailpipe testing, including the possible use of code-based OBD. The Department notes, however, that there is not an EPA-approved tool to evaluate the emissions reductions from a code-based system, and that to the best of our knowledge such a system has never been employed in a regulatory context. Accordingly, the Department disagrees with any conclusion that code-based OBD system is a currently viable strategy.

Auditor's Addendum:

Although the Department of Public Health and Environment has partially agreed to this recommendation, the narrative of its response indicates that it intends to fully implement this recommendation. As we note in the report, we agree that the Department will have to determine the feasibility of using a code-based system for performing OBD testing.

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