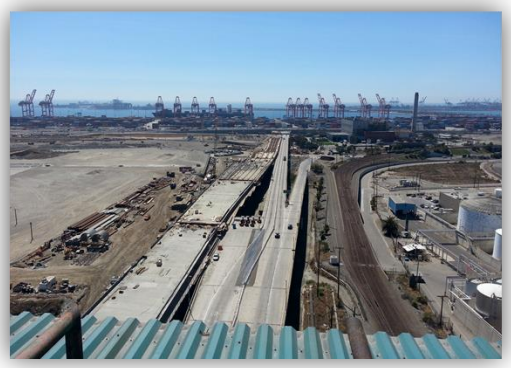
Case Studies of Truck Replacement Mitigation Programs



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Sonoma Technology, Inc.
Environmental Science and Innovative Solutions

Case Studies of Truck Replacement Mitigation Programs

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Cover graphic shows heavy-duty diesel vehicles operating in ports and on freeways.

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Abstract

This work was completed as part of the Near-Road Air Quality Research Pooled Fund TPF-5(284), under the U.S. Federal Highway Administration (FHWA) Transportation Pooled Fund Program. The lead agency for TPF-5(284) is the Washington State Department of Transportation. Other participants include FHWA and the Arizona, California, Texas, and Virginia Departments of Transportation. Sonoma Technology, Inc. (STI) provides TPF-5(284) participants with technical, planning, facilitation, and website support.

Case Studies of Truck Replacement Mitigation Programs

Background – Transportation projects that are at risk for failing transportation conformity tests or that fail to meet other state or local goals related to attaining ambient air quality standards may require mitigation measures to reduce project impacts on air quality. One innovative strategy that has been identified to potentially mitigate project-level emissions is to implement a heavy-duty diesel truck replacement program. Such programs have been widely used to address regional air quality concerns, and recently the Heim Bridge Replacement Mitigation Truck Program (Heim Truck Program) was implemented in southern California to offset construction emissions associated with an individual transportation project. The objective of this study was to identify implementation lessons learned from the Heim Truck Program that could inform future project-level mitigation efforts.

Methods – Heim Truck Program documentation, such as environmental documents, program web pages, and program guidelines and grant solicitations, were collected and reviewed; program administrators were interviewed; and, to put the Heim Truck Program into context, information about three other regional truck retrofit/replacement programs was reviewed to identify common implementation lessons and considerations specific to project-level mitigation efforts.

Results – Common lessons learned among truck retrofit/replacement programs span the planning, recruitment, and implementation phases of the programs. Important considerations include identifying target truck types and target participants early on in the planning stage, being adaptable when challenges arise, advertising heavily and through multiple venues, streamlining administrative requirements, and providing ongoing support to program participants during the application and implementation phases. For truck replacement programs specifically aiming to mitigate project-level emissions, establishing enforcement mechanisms to ensure that air quality benefits occur near the project was identified as an especially important consideration. Although the Heim Truck Program's goal was to mitigate a discrete increase in emissions related to the construction phase of a project, similar truck replacement programs have the potential to offset operational emissions in the near-term until the air quality benefits of fleet turnover are realized.

1. Introduction and Summary

Transportation projects that are at risk for failing transportation conformity tests or that fail to meet other state or local goals related to attaining ambient air quality standards may require mitigation measures to reduce project impacts and facilitate project approvals. Some transportation agencies are experimenting with mitigation actions and gaining practical insights into their effectiveness. Agencies have identified a need to summarize implementation lessons, quantify the benefits of mitigation options for reducing near-road pollutant concentrations, and disseminate this information to inform future decision-making.

This report presents findings from an examination of four truck replacement programs and offers lessons learned and considerations for mitigating project-level air quality impacts. The report focuses on the Heim Bridge Replacement Mitigation Truck Program (Heim Truck Program), which provided support for the replacement of heavy-duty trucks operating in and around the Ports of Los Angeles and Long Beach (San Pedro Bay Ports). The program was developed as a mitigation measure to offset the increase in emissions resulting from marine vessel detours during construction of the Commodore Schuyler F. Heim Bridge in southern California. Related findings from three other truck replacement programs aiming to improve regional air quality are also presented to highlight common lessons learned that can inform future truck programs.

Information in this report was gathered by reviewing truck replacement project documentation, including the Heim Truck Program grant solicitation, sample application forms, sample grant agreement, frequently asked questions, and web links provided by the Alameda Corridor Transportation Authority (ACTA) Heim Truck Program; environmental documents associated with the Schuyler Heim Bridge Replacement Project; program guidelines for a California program to retire or retrofit higher-emitting diesel vehicles (the Carl Moyer Program); the Mid-Atlantic Truck Replacement Program Final Report; and documentation on the Houston-Galveston Area Council Drayage Loans web page.[1] Information about the Heim Truck Program was also gathered by interviewing project administrators from those organizations responsible for implementing the truck program, including the California Department of Transportation (Caltrans), ACTA, and E2ManageTech.[2]

The study findings include implementation lessons and practical insights learned from the truck replacement programs. Section 2 of this report provides background information about the Schuyler Heim Bridge Replacement Project and the Heim Truck Program, and Section 3 summarizes lessons learned from the program. Section 4 presents findings from the Carl Moyer Air Quality Standards Attainment Program, the Mid-Atlantic Dray Truck Replacement Program, and the Houston-Galveston Area Council Drayage Loan/Grant Program. Section 5 summarizes conclusions and discusses important considerations for project-level mitigation efforts. Appendix A contains sample questions developed for interviews with program administrators, and Appendix B contains sample calculations

[1] h-gac.com/taq/airquality/drayage-loans.aspx.
[2] E2ManageTech is an environmental management and engineering consulting firm in Long Beach, California.

for quantifying the offset in emissions achieved by a truck replacement under the Heim Truck Program and for estimating the program's cost-effectiveness.

2. Background

2.1 Mitigating Construction vs. Operational Impacts

The main focus of this report is a case study identifying implementation lessons learned from a truck replacement program. The case study examines truck replacements used to offset air quality impacts from transportation project construction work. The goal of these truck replacements was to mitigate NO_x impacts over a discrete time period by replacing older, higher-emitting diesel-powered trucks with newer vehicles. Since diesel trucks are important sources of NO_x and particulate matter (PM) emissions, implementation lessons from the case study profiled here are also applicable to truck-related PM emissions control.

In addition, although the case study involves mitigation of construction impacts, the lessons learned may also apply to mitigating project-level operational emissions. In some cases, operational emissions may need to be mitigated in the near-term only, since vehicle fleet turnover, given sufficient time, will adequately reduce emissions over the long-term. The case study profiled here illustrates a near-term emissions control approach.

Since fleet turnover is central to considering the near-term use of a truck replacement program to mitigate operational emissions, **Figure 1** is provided here to illustrate fleet turnover effects. Figure 1 shows projected emissions reductions from 2006 to 2035 due to fleet turnover for a hypothetical transportation project with 125,000 annual average daily traffic (AADT) and 8% diesel truck traffic.[3] The figure shows that over the long-term, fleet turnover is expected to have a substantial impact on emissions.

Truck replacement programs have been implemented in various U.S. locations to improve regional air quality; this study briefly discusses several of these programs, identifies lessons learned from their implementation, and allows those lessons to be compared to the case study findings. Although truck replacements have historically focused on improving regional air quality, the case study profiled here illustrates that truck replacements can be implemented to address project-level impacts. The ability to relate truck replacements to specific project locations has been improved through the growing availability and use of tools to spatially and temporally track truck activity. Whether it is financially and technically feasible to implement a truck replacement program for a specific project will depend on that project's unique characteristics. The program implementation insights discussed here should assist in those project situations where truck replacements are worth consideration.

[3] Reid et al. (2015) Scoping study to identify potential project types and situations that will not create PM hot spots. Final report prepared by Sonoma Technology, Inc., for TPF-5(284).

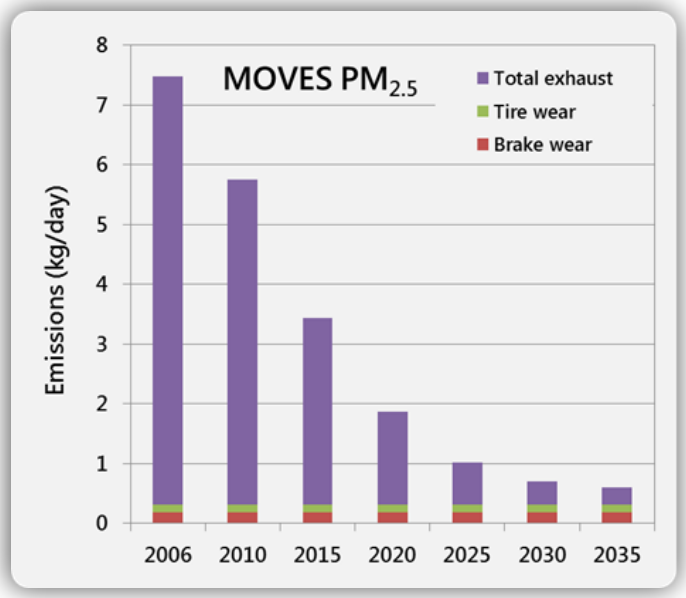

Figure 1. $PM_{2.5}$ emissions from the MOVES model showing the projected impacts of fleet turnover on emissions from a hypothetical transportation project.

2.2 The Schuyler Heim Bridge Replacement Project

The Commodore Schuyler F. Heim Bridge was constructed in 1946 as a vertical-lift bridge spanning the Cerritos Channel (approximately three-quarters of a mile) along State Route 47 (SR-47) in southern California (Figure 2). Located within the City of Los Angeles on land owned by the Port of Long Beach, it serves as a major traffic route connecting Terminal Island within the San Pedro Bay Ports to the mainland cities of Long Beach and Los Angeles. During its operation, the vertical-lift bridge was typically raised several times per day to allow ship traffic to pass underneath.

Figure 2. The Commodore Schuyler F. Heim Bridge before (photograph on the left) and after (architect's rendition on the right) the replacement project.

The Schuyler Heim Bridge Replacement and SR-47 Expressway Project is a joint effort between Caltrans and ACTA. The project is composed of two major construction tasks:

1. Replacing the seismically unsafe lift-span portion of the Schuyler Heim Bridge over Cerritos Channel with a six-lane, fixed-span bridge along and east of the existing bridge alignment (the focus for the air pollution mitigation effort), and
2. Adding a four-lane elevated roadway that bypasses three signalized intersections and five railroad crossings, providing a high-capacity alternative route along the Alameda Corridor between Terminal Island and Alameda Street, south of Pacific Coast Highway (postponed as of August 2015).[4]

Figure 3 shows a map of the project relative to the ports. The replacement bridge will be approximately 13 m wider than the former vertical-lift bridge to accommodate the addition of standard shoulders, and it will maintain a minimum vertical clearance of 14.3 m over the width of the navigable channel (approximately 55 m). The project cost is estimated to be $180 million, with construction occurring from 2011 to 2017.

[4] More project details are available from ACTA (acta.org/projects/projects_planning_SR47.asp) and Caltrans (dot.ca.gov/dist07/travel/projects/details.php?id=28).

Figure 3. Map showing the locations of the Schuyler Heim Bridge Replacement and SR-47 Expressway Projects. Reproduced from "Schuyler Heim Bridge Replacement and SR-47 Expressway Project," available at futureports.org/events/sr47presentationhahnstaff.pdf.

In addition to seismic safety concerns, the Schuyler Heim Bridge Replacement Project was motivated by an increase in truck traffic volume and congestion around the San Pedro Bay Ports that has limited the movement of people, freight, and goods, particularly during traffic flow interruptions when the lift-span bridge was raised for marine traffic. The project was designed to relieve congestion on the Harbor and Long Beach freeways and to improve goods movement by providing alternative routes for port-related truck traffic to Terminal Island and local distribution centers and warehouse facilities in the area.

Project benefits identified by ACTA and Caltrans include:

- Replacement of the seismically deficient Schuyler Heim moveable bridge with a new, safer, fixed-span bridge;
- Creation of an expressway between Ocean Boulevard on Terminal Island and Alameda Street at Pacific Coast Highway;
- Reduction of traffic congestion on local arterials (between Terminal Island and Pacific Coast Highway), as well as on Interstate 110 (I-110) and Interstate 710 (I-710);
- Diversion of trucks from certain commercial and residential areas;
- Facilitation of future improvements to the Long Beach I-710 Freeway;
- Reduction of bridge maintenance costs;
- Creation of an alternative route to the existing near-dock rail yard; and
- Elimination of traffic conflicts at five at-grade rail crossings and three traffic signals.

Planned construction of the new bridge required a temporary closure of the Cerritos Channel to marine vessel crossings during the period of bridge construction. As a result, construction plans included a detour of marine vessels around Terminal Island, causing a net increase in air pollutant emissions during the construction phase of the bridge replacement.

2.3 The Heim Bridge Replacement Mitigation Truck Program

2.3.1 Overview

During the environmental review process of the Schuyler Heim Bridge Replacement Project, emissions of nitrogen oxides (NO_x) were projected to exceed daily significance thresholds set by the South Coast Air Quality Management District (SCAQMD), in part due to marine vessel detours during construction. To offset air quality impacts during construction, the project committed to implementing several mitigation measures, including a heavy-duty truck buyback program known as the Heim Bridge Replacement Mitigation Truck Program (Heim Truck Program). The program offered $25,000 in grant funding to replace each of up to 15 heavy-duty trucks servicing the San Pedro Bay Ports with trucks equipped with newer, lower-emitting engine models. ACTA was responsible for implementing the Heim Truck Program on behalf of Caltrans. Information about the program was made available on the ACTA Heim Bridge Replacement Mitigation Truck Program web page.[5]

[5] acta.org/truckgrant/index.asp.

The air quality technical study[6] for the Schuyler Heim Bridge Replacement Project summarized the implementation of the Heim Truck Program in three major steps: (1) identify target vehicles based on year of make; (2) provide incentives for operators to participate; and (3) establish a means to ensure that replacements meet the net air quality improvement forecasted. The protocols and goals of the Heim Truck Program were consistent with existing truck retrofit/replacement programs in the San Pedro Bay Ports area, including the Carl Moyer Program[7] (see discussion in Section 4.1) and the Gateway Cities Diesel Fleet Modernization Program.[8]

The air quality technical study for the Schuyler Heim Bridge replacement estimated that each truck replacement would reduce NO_x and PM by approximately 0.55 and 0.12 tons per year, respectively; estimates were based on emission factors representative of other buyback programs such as the Gateway Cities Diesel Fleet Modernization Program. A sample calculation for quantifying the emissions offset resulting from a truck replacement is presented in Appendix B. Prior to program implementation, the total program cost was estimated to be approximately $600,000; the estimate was based on the cost of previous truck replacement programs. This cost estimate included grant funding for 15 truck replacements and administrative costs. Emissions reductions from the Heim Truck Program were expected to continue for at least three to five years (exceeding the duration of the project construction phase), with the potential to mitigate truck emissions for a longer period of time if the cleaner replacement trucks continued to operate in and around the San Pedro Bay Ports. The cost-effectiveness of the program at reducing NO_x emissions, based on the cost-effectiveness of recent buyback programs, was projected at approximately $25,000 to $50,000 per ton of NO_x.

2.3.2 Program Eligibility and Requirements

The Heim Truck Program eligibility requirements are described in the grant solicitation[9] and sample grant agreement.[10] In summary, the program offered grant funding for the replacement of on-road, Class 8 heavy-duty "exempt" drayage trucks, as defined by the California Air Resources Board (CARB) Drayage Truck Regulation Exemption.[11] Drayage trucks are trucks that transport goods over a short distance, often operating near a port. The CARB Drayage Truck Regulation required that Class 7 and 8 drayage trucks using model year 2006 and older engines be replaced with trucks using model year 2007 or newer engines by December 31, 2013. The regulation applied to trucks hauling cargo that originated from or was destined for rail yards and ports in California. Trucks that are exempted from the Drayage Truck Regulation and eligible under the Heim Truck Program included dedicated-use, uni-body vehicles such as fuel-delivery vehicles and scrap haulers, concrete mixers, logging trucks, and on-road mobile cranes.

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[6] acta.org/projects/tech%20studies/Air_Quality_Technical_Study_5-09.pdf.
[7] Since 1998, the Carl Moyer Program has offered grants to encourage the owners of diesel engines and equipment to retrofit or replace the equipment with newer, cleaner models (arb.ca.gov/msprog/moyer/guidelines/current.htm).
[8] The Gateway Cities Diesel Fleet Modernization Program provides funding for the replacement of old, highly polluting trucks in the greater Los Angeles area (epa.gov/smartwaytransport/forpartners/documents/drayage/420f06004.pdf).
[9] acta.org/truckgrant/Grant%20Solicitation.pdf.
[10] acta.org/truckgrant/Truck%20Grant%20Program%20Grant%20Agreement.pdf.
[11] arb.ca.gov/msprog/onroad/porttruck/exemption.htm

Eligibility for the Heim Truck Program was largely related to three factors that govern the emissions reductions achieved by a truck replacement: (1) the engine model years of the existing and replacement trucks; (2) the annual vehicle miles traveled (VMT); and (3) the number of trips made to the San Pedro Bay Ports. The average annual VMT of the existing truck for the two years prior to replacement was used to establish the baseline emissions for the existing truck and the engine model needed for the new truck to meet the emissions reduction target of the project. Table 1 lists the minimum annual mileage requirements based on the engine years of the existing and replacement trucks. A form in the electronic application included a VMT calculator to assist applicants in determining the annual mileage requirement for a particular truck replacement.

Table 1. Minimum annual mileage requirements based on engine years of the existing and replacement trucks.[12] (Truck model year may not be the same as the engine model year.) Adapted from the Heim Bridge Replacement Mitigation Truck Program Grant Solicitation.

Existing Engine Model Year	Minimum Annual Mileage	
	Replacement Truck with 2007–2009 Engine Model	Replacement Truck with 2010–2013 Engine Model
1986 or older	25,808	19,080
1987–1990	26,298	19,346
1991–1993	32,678	22,591
1994–1997	33,468	22,966
1998–2002	34,572	23,480
2003–2006	73,604	36,698
2007–2009	Not Applicable	73,187
2010 or newer	Not Applicable	Not Applicable

All applicants were required to submit truck replacement project applications electronically via a link on ACTA's website (acta.org/truckgrant/). Hard copies of grant applications were not accepted. Only one application per applicant was permitted; however, applicants could apply for the replacement of up to three trucks per application.

Existing Truck Requirements

The truck to be replaced had to be an operational, insured, and registered Class 8 on-road vehicle. The truck had to be equipped with a heavy-duty diesel engine of model year 2009 or older, have a

[12] The minimum annual mileage requirement applied to the previous two years of use for the truck to be replaced and to the use of the replacement truck during the term of the grant agreement.

Gross Vehicle Weight Rating (GVWR) of more than 33,001 pounds, and have a history of operating near the San Pedro Bay Ports. Operational eligibility criteria for existing trucks included (1) an annual mileage requirement for the previous two years based on the engine years of the existing and replacement trucks (see Table 1); (2) a port trip requirement that the existing truck made at least 150 service trips to the San Pedro Bay Ports in each of the last two years; and (3) current registration with the California Department of Motor Vehicles (DMV) for the previous two years. The existing truck had to be scrapped with an approved, California state certified recycler, and an ACTA representative had to be present at the scrapping.

Replacement Truck Requirements

The replacement truck had to be a new or used diesel or alternative fuel Class 8 on-road vehicle with a GVWR of more than 33,001 pounds and had to be the same type of truck as the existing truck (for example, a car carrier must be replaced with a car carrier). The replacement truck had to be equipped with a heavy-duty engine that met or exceeded the model year 2007 California heavy-duty, diesel-fueled on-road emissions standards[13] and had to operate in the San Pedro Bay Ports for three consecutive years upon purchase. The truck had to be purchased by the grantee from a California licensed truck dealership, be registered in the state of California, be operational within 60 days of the effective date of the grant agreement, operate within California 100% of the time, and make no fewer than 150 service trips to the San Pedro Bay Ports per year of the agreement (450 port trips total over three years). The grantee was required to disclose the funding methods used to cover the remainder of the purchase price of the truck not covered by the Heim Truck Program grant. During the term of the agreement, grantees had to maintain the replacement truck in operating condition according to manufacturer's records and make the replacement truck available for inspection upon request.

Reporting Requirements

Grantees were required to submit documentation to ACTA when they purchase the replacement truck and every quarter thereafter to demonstrate compliance with Heim Truck Program requirements. Reporting requirements included:

- **Post-Funding Reporting Requirements –** After purchasing the replacement truck and within 60 days of receiving the grant funds, the grant recipient had to provide ACTA with the following items:
  - A copy of the final bill of sale
  - A copy of the certificate of title
  - Copies of the replacement truck registration and proof of insurance
  - A copy of the annual vehicle inspection report conducted within one month of submission in accordance with Federal Motor Carrier Safety Regulations, 49 Code of Federal Regulations (CFR) 396

[13] arb.ca.gov/regact/HDDE2007/hdde2007.htm.

  - Copies of loan or financing documentation (if any portion of the purchase price of the replacement truck was financed)

- **Quarterly Reporting Requirements –** Within five days of the end of each quarterly reporting period, the grant recipient had to provide documentation of (1) the replacement truck odometer reading and (2) the number of service trips made to the San Pedro Bay Ports.
- **Annual Reporting Requirements –** The grant recipient had to submit a report including the following items, as well as any other information requested by the program administrator, within 30 days after each anniversary date (three annual reports total):
  - Up-to-date contact information (including owner name, address, and phone number)
  - An odometer reading and a photo of the odometer
  - A statement of annual miles traveled and annual number of service trips to the San Pedro Bay Ports
  - Documentation supporting the number of service trips reported
  - Copies of current insurance and registration
  - Copies of maintenance records
  - A statement certifying under penalty of perjury that the replacement truck was operated in accordance with the grant agreement and that all information included in the annual report is true and accurate

Grant Review

If a grantee failed to meet the minimum annual service trip requirement, the minimum total service trip requirement, or the annual VMT requirement, the grantee would be required to repay ACTA a fraction of the grant award as outlined below.

Failure to meet the minimum annual service trip requirement (150 annual port trips) – If the grantee failed to make 150 service trips to the San Pedro Bay Ports each year during the three-year period agreed to in the contract agreement, the grantee would be required to pay an amount calculated as the percentage of missed trips times one-third of the grant awarded by the truck program.

Failure to meet the minimum total service trip requirement (450 total port trips over three years) – If the grantee failed to make 450 total service trips to the San Pedro Bay Ports over the three-year period of the agreement, the grantee would be required to pay an amount calculated as the percentage of missed trips times the grant awarded by the truck program, less any amount previously paid for not meeting the minimum annual trip requirement.

Failure to meet the minimum annual VMT requirement – If the grantee failed to meet the minimum annual VMT requirement based on the engine model years of the old and replacement trucks (see Table 1), the grantee would be required to pay an amount calculated from the difference between the miles traveled and minimum miles required, times a per-mile fee between $0.16 and $0.61, based

on the engine model years of the old and replacement trucks (see the grant solicitation Appendix A, *Sample of Grant Agreement*).

2.3.3 Resources Provided to Program Applicants

In addition to the Heim Truck Program grant solicitation and sample application documents detailing the program chronology and requirements, ACTA made several resources available to grant applicants to assist them during the application process. These resources, listed on the ACTA website,[14] include:

- A list of truck dismantlers that have been approved under the SCAQMD Voucher Incentive Program to replace or retrofit heavy-duty trucks
- Information on which drayage trucks are exempt from registration under the CARB Drayage Truck Regulation and thereby eligible for replacement under the Heim Truck Program, and examples of exempt trucks (typically dedicated-use trucks such as tankers, car carriers, and scrap haulers; emergency vehicles; and pneumatic tankers)
- Documentation regarding the On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation to inform applicants about statewide requirements to reduce emissions in upcoming years
- Information on financing and approved lenders[15]

Grant program administrators held an application workshop, open to all interested parties, on Wednesday, April 16, 2014. Program administrators also offered application assistance to program applicants; applicants were directed to email or call administrators to schedule an appointment for assistance and/or to schedule the use of a computer to submit the online application (hard copies of applications were not accepted).

2.3.4 Program Administration and Chronology

Facilitation of the Heim Truck Program was a joint effort between ACTA, Caltrans District 7 (the Los Angeles area office), and E2ManageTech, an environmental consulting firm with experience managing truck mitigation programs in the area. Caltrans was responsible for overseeing the implementation of the program, participating in planning stages, and reviewing the criteria that ACTA uses to select grant awardees. ACTA was responsible for managing the Heim Truck Program funds, including executing grant agreements and awarding funds to successful applicants. E2ManageTech developed the program screening documents and forms and helped facilitate the applicant screening process. They also helped facilitate recruitment efforts.

Table 2 provides a timeline of key events related to implementation of the Heim Truck Program.

[14] acta.org/truckgrant/Truck%20Grant%20Program%20INTERNET%20WEB%20LINKS.pdf.
[15] treasurer.ca.gov/cpcfa/calcap/arb/lenders.pdf.

Table 2. Timeline of key Heim Truck Program implementation activities.

Date	Activity
August 2009	Record of Decision (ROD) for the replacement of the Schuyler Heim Bridge is approved; truck program is listed as a mitigation measure to offset indirect construction emissions bridge replacement
October 2011	Construction work on the Schuyler Heim Bridge begins
October 2013	Heim Truck Program planning begins
March 2014	Outreach/recruitment for the truck program begins
April 2014	Grant solicitation is released
May 2014	Deadline to submit Phase 1 application for the truck program
October 2014	First truck is replaced
2017 (scheduled)	Construction of the Schuyler Heim Bridge is complete

As the Heim Truck Program began, the San Pedro Bay Ports had reached the tail end of a port truck replacement program under the San Pedro Bay Ports Clean Air Action Plan (CAAP).[16] As a result, while the Heim Truck Program originally planned to replace heavy-duty diesel vehicles (HDDV), program administrators found that many of these vehicles had already been replaced or were in the process of being replaced under the CAAP. In response, facilitators identified a new pool of target trucks for replacement under the Heim Truck Program: heavy-duty diesel trucks that had been exempt from replacement under the CAAP. Vehicle types exempt under the CAAP include dedicated-use trucks such as car carriers, pneumatic tankers, and scrap haulers.

The new pool of trucks targeted for replacement by the Heim Truck Program was substantially smaller than the original pool, resulting in fewer applications than anticipated. Program administrators sent an estimated 7,000 emails to reach potential applicants and visited locations frequented by truck owner/operators (e.g., truck stops and union meetings) to post flyers to publicize the program. They identified eligible candidates by consulting a list of trucks that were exempt from the CARB Drayage Truck Regulation and reached out to the owner/operators of those trucks. The Heim Truck Program was advertised on the Caltrans and ACTA websites, and recruitment efforts and materials were made available in English and Spanish.

Implementation of the Heim Truck Program consisted of two application phases. In the first phase, program applicants were required to fill out several initial screening forms, including (1) an initial survey covering existing truck and activity information and a commitment to meet the minimum

[16] The San Pedro Bay Ports Clean Air Action Plan was adopted in 2006 to reduce air pollution and health risks associated with port activity. A major component of the plan was a truck replacement program to phase out all older diesel trucks operating in the ports within five years by replacing the trucks with retrofitted or newer vehicles that operate more cleanly. The program established a progressive ban on highly polluting trucks between 2008 and 2012, ending with a ban on all trucks that did not meet the 2007 Federal Clean Truck Emissions Standards (http://epa.gov/otaq/hd-hwy.htm) by January 1, 2012.

mileage and port service trip requirements; (2) a form covering applicant details, including contact information for the truck owner and program applicant; and (3) a program obligations form on which the applicant committed to meet all program requirements. Phase 1 forms were reviewed by E2ManageTech and ACTA. Qualified candidates were to be entered into a random number lottery for selection to participate in Phase 2 of the application process; however, given the small pool of applicants, all eligible applicants were allowed to move on to Phase 2. In Phase 2, program applicants were required to fill out additional forms within two weeks of being requested to do so by ACTA, including (1) supplemental information about the existing truck; (2) dealership information for the replacement truck to be purchased; (3) funding information for the replacement truck; and (4) a post-funding documentation report. If, upon review of the Phase 2 forms, it was determined that the program applicant was eligible to participate in the Heim Truck Program, ACTA executed a 42-month legal grant agreement with the grantee. Grantees were required to return a signed copy of the agreement to ACTA within two weeks of when it was received. Once the grant agreement was fully executed, the grantee was required to notify the grant administrator of when the existing truck would be scrapped. Once the existing truck had been scrapped, the grantee was awarded the $25,000 grant. Table 3 lists the approximate timeline for grantee and ACTA obligations under a Heim Truck Program grant agreement.

Table 3. Approximate timeline for obligations under a Heim Truck Program grant agreement.

Time	Actions
Start	The grant agreement is executed by both parties and an agreement effective date is set.
Months 1–2	The grantee scraps the existing truck and purchases the replacement truck. The "anniversary" date is set.
Months 3–38	The grantee operates the replacement truck and submits quarterly and annual reports. ACTA reviews grantee operations periodically.
Months 39–42	The grantee submits the final reporting materials. ACTA completes administrative duties to close out the agreement.

As of August 2015, four heavy-duty diesel trucks had been replaced and two applications for the replacement of three additional trucks were under review (one of the trucks under review was anticipated to be replaced in early September 2015). The trucks replaced were scrap haulers with engine model years in the 1980s. The total cost of the replacement trucks ranged from approximately $70,000 to $170,000, depending on whether a used or new truck was purchased. As of August 2015, truck replacements resulted in larger air quality benefits than originally anticipated on a per-truck basis because the trucks replaced had been particularly old, high-emitting vehicles. Program administrators offered a revised estimate of seven trucks needed to mitigate air quality impacts associated with the bridge construction. They intended to replace at least one truck more than was

needed to meet program goals, so that if a participant defaulted on a contract, the target emissions reduction would still be met.

The planning phase of the Heim Truck Program required a high level of effort for program administrators. This was due in part to the need to identify a new pool of program applicants and to recruitment challenges, but was also due to the effort required to draft and revise the program contract to address the consequences of a default. Legal advice was sought to help craft, review, and revise contract language, a process that required additional time and increased administrative costs from what was originally anticipated for the planning phase. Once the planning phase was complete, day-to-day administrative costs decreased substantially. Administrators estimate that the staff time requirement for program administration decreased to approximately one-half full-time equivalent (FTE) and that once all participants had been recruited, program administration would decrease further to approximately one-quarter FTE. Despite the extended application and implementation phases beyond what was originally anticipated, the project remained on budget.

3. Lessons Learned and Recommendations from the Heim Truck Program

3.1 Implementation Lessons Learned

Heim Truck Program administrators offered the following implementation lessons learned:

Identifying eligible applicants was a challenge due to the success of previous truck retrofit/replacement programs – Facilitators had to identify a new pool of target trucks and selected heavy-duty trucks that had been exempt from replacement under the CAAP. This new target truck type posed a challenge because only a small pool of these trucks met the program criteria. Thus, a large recruitment effort was required to identify eligible applicants. E2ManageTech visited truck stops, union meetings, and other facilities frequented by truck owner/operators to post flyers and sent out emails to approximately 7,000 possible applicants. The Heim Truck Program administrators anticipated receiving 500 or more applications; however, only about 15 to 20 applications were received in the first month, and many of the applicants were not qualified to participate. Because of the low number of qualified candidates, the open application process was repeated several times. As of August 2015, four trucks had been replaced, and applications for the replacement of an additional three trucks were under review.

Providing documentation to establish activity (VMT and San Pedro Bay Port trips) for previous years was a challenge for applicants – Administrators had planned to use radio-frequency identification (RFID) tags that monitor port entry and exit, along with trip destination records, to validate port trips and VMT; however, while the types of heavy-duty trucks originally targeted by the program had RFID tags, the types of trucks that ended up being replaced by the project did not. This meant that port "trip slips" issued by the San Pedro Bay Ports for each trip had to be used, and many applicants did not have complete records (i.e., port trip slips from each trip over the previous two years) to demonstrate that they met the requirements. As a solution, administrators allowed applicants who were unable to assemble all trip slips to submit the trip slips that they had in their possession along with an affidavit affirming that the activity requirements had been met in previous years.

Program implementation took longer than expected – Even after an applicant qualified to participate in the program, it could take months to complete the steps and paperwork necessary for executing the grant agreement. For some applicants, additional time was needed to pay off a loan on the existing truck before it could be scrapped. Applicants also faced challenges and delays in securing financing to cover the cost of the replacement truck not covered by the $25,000 grant.

Furthermore, a common challenge faced by many program applicants was the lack of time to complete the necessary paperwork. All but one of the program participants were individual owner/operators working long hours with little free time to complete the paperwork. Those owner/operators often solicited assistance from their wives or significant others to help complete the necessary paperwork.

There are pros and cons associated with online application and document management – Program administrators acknowledged that online document management is particularly helpful when many applications are anticipated, because it can increase processing efficiency. A downside to online document management, however, is that it requires more effort to develop the process, and users who do not have much computer experience may require more support to complete applications and submit documentation online.

There are many nuances to program implementation, and it is important to be flexible to address unforeseen issues – Program administrators emphasized that there are many nuances to program implementation and that while some lessons learned may be applicable to future programs, others may be specific to a project's area or region. For example, for the Heim Truck Program, local programs and regulations, including previous truck programs, impacted program implementation. Additionally, program facilitators found that eligible candidates were reluctant to make the financial commitment of purchasing a new truck because of concerns over the state of the economy.

Word of mouth can be valuable for recruitment – Program administrators found that word of mouth was an important component of recruitment. Several program applicants indicated they learned about the program from other truck owner/operators. Flyers were also a useful outreach tool. Electronic media was not as useful as word of mouth or flyers.

Time and effort are required to ensure that candidates understand contract terms – Program administrators stressed the importance of ensuring that applicants fully understand all of the terms of the contract. For the Heim Truck Program, these terms included the three-year term length and reporting requirements; the timeline for applying for the program, scrapping the old truck, and purchasing the replacement truck; and that truck maintenance is not covered by the program.

Contractor experience is valuable to program implementation – Program administrators emphasized the value of experienced contract support during program implementation. A good candidate for contracting support has local outreach contacts with port terminals (in the case of a port truck replacement program), truck recycling companies, financing institutions, trucking unions, and the community.

3.2 Recommendations

Heim Truck Program administrators offered the following recommendations to parties interested in developing a similar truck retrofit or replacement program in the future:

Be aware of any state and/or regional-level efforts to replace/retrofit target trucks – Research programs that are currently in place in the project area, as well as local issues and other requirements, may influence the design of a truck program. Knowledge of such programs early in the planning process will save time in the long run.

Be aware of target truck costs and select the award amount accordingly – Replacement of more expensive trucks will likely require a higher award amount to encourage participation. For example, for the Heim Truck Program, the $25,000 award amount was more attractive to owner/operators of scrap haulers (less expensive trucks) than owner/operators of car carriers (more expensive trucks). Identify the types of trucks that will be targeted by the program early in the planning stage to ensure that award amounts are sufficient to cover a substantial fraction of the total truck cost and attract qualified applicants. Higher award amounts will likely draw more interest.

Streamline application and implementation processes as much as possible – Implementation of a truck mitigation program can be time-consuming for a variety of reasons. The application process may take longer than expected if recruitment issues are encountered, and applicants may require more support along the way than anticipated. Furthermore, funding transfer delays can result in project delays. It is important to streamline the implementation process as much as possible to retain qualified applicants. A major concern for applicants is the amount of time the process takes, particularly the time between scrapping the old truck and receiving funding for the purchase of the new truck, because owner/operators rely on their trucks for their livelihood. In the case of the Heim Truck Program, program administrators attended the truck scrapping and handed the grant award check to the applicant immediately following the truck destruction to minimize the amount of time that the applicant was without a truck. Another consideration is that truck dealers will not necessarily hold the new truck targeted for purchase. If the target truck is sold, the applicant will be required to repeat much of the application process, resulting in additional delays.

Be prepared to provide assistance to applicants throughout the application process – Applicants may not have computer experience and may need help with applications. Applicants may also face challenges related to language barriers; three out of five of the participants in the Heim Truck Program (as of August 2015) spoke very little or no English—offering information in Spanish was critical to those applicants. As discussed earlier, program administrators found that applicants have very little time to complete applications and gather necessary documentation, particularly during normal business hours. The availability of technical support may need to be scheduled to accommodate applicants' schedules (e.g., periodically provided after normal business hours or on weekends).

4. Findings from Other Truck Retrofit/Replacement Programs

Many truck retrofit and truck replacement programs have been implemented across the United States in recent years. While the goal of these programs has often been to reduce local or regional air quality impacts, as opposed to mitigating project-level emissions, many of these programs share a similar design with the Heim Truck Program. Furthermore, many of the lessons learned from these programs parallel findings from the Heim Truck Program and offer additional insights that could inform project-level truck replacement mitigation efforts.

This section provides an overview of three programs:

1. **The Carl Moyer Air Quality Standards Attainment Program (California) –** A statewide program that provides a framework for replacement programs across California air districts, making it applicable to areas with different needs and resources;
2. **The Mid-Atlantic Dray Truck Replacement Program (Maryland, Pennsylvania, Virginia, and Delaware) –** A regional port truck replacement program that was completed in 2014; and
3. **The Houston-Galveston Area Council Drayage Loan/Grant Program (Texas) –** A regional program, established in 2009 to help Houston meet the National Ambient Air Quality Standards (NAAQS), that engaged in a wide range of outreach activities to recruit eligible applicants and offered a combination of grants and bridge loans.

4.1 The Carl Moyer Program

Overview

The Carl Moyer Air Quality Standards Attainment Program (Carl Moyer Program) was established in 1998 to support California's State Implementation Plan (SIP) and clean air attainment strategy. The program provides financial incentives to encourage the voluntary purchase of cleaner-operating engines, equipment, and emissions-reduction technologies. The goals of the program are to accelerate the turnover of old highly polluting engines, accelerate the commercialization of advanced emissions controls, and reduce air pollution impacts on environmental justice communities. The program was designed so that the emissions reductions are quantifiable and creditable toward legally enforceable obligations in the SIP. Program funds can be applied to a range of project types, including:

- **Repower –** Replacement of an engine with a cleaner-operating engine.
- **Retrofit –** Addition of an emissions-control system.
- **New purchase –** Purchase of new vehicles or equipment that meet emissions standards.

- **Fleet modernization or equipment replacement –** Replacement of an older vehicle or equipment that is still functional with an equivalent newer, cleaner-operating version.
- **Vehicle retirement –** Payment for disposing of highly polluting functional vehicles that would not be disposed of if not for the monetary incentive.

CARB oversees the Carl Moyer Program and is in charge of managing and distributing funds to local air districts, developing and revising guidelines and protocols, and determining methods for evaluating project cost-effectiveness.[17] The program is designed to address the needs of air districts across California. Air districts can choose how to focus funds from the Carl Moyer Program to best coordinate with local funding and meet their individual air quality objectives.

This report focuses on fleet modernization requirements and lessons learned that are relevant for comparison with the Heim Truck Program. Grant awards for fleet modernization projects are awarded based on truck usage during the previous 24 months (VMT or fuel consumed) and the projected emissions reduction that will be achieved by replacing the truck. The grant amount is the lesser of the cost-effective value of the project (based on the weighted emissions benefits) and the maximum grant amount (Table 4). Air districts must establish a mechanism to ensure that participants fulfill all contractual obligations (e.g., require that if the vehicle is sold during the contract life, the new owner must assume obligations under the participant's contract).

Table 4. Maximum funding amounts for fleet modernization (truck replacement) projects funded by the Carl Moyer Program. The Carl Moyer Program provides limited funding for drayage truck replacement. Adapted from Table 5-1 in the 2011 Carl Moyer Program Guidelines (arb.ca.gov/msprog/moyer/guidelines/2011gl/2011cmpgl_12_30_14.pdf).

Vehicle Class	NO_x Emission Standard (g/bhp-hr) for Replacement Truck	Maximum Funding[a]
Heavy Heavy-Duty	0.20	$60,000
	0.50	$50,000
	1.20	$40,000
Medium Heavy-Duty	0.20	$40,000
	1.50	$30,000
	1.20	$25,000
Light Heavy-Duty	0.20	$30,000
	0.50	$20,000
	1.20	$10,000

[a] For fleets of three of fewer vehicles, the funding amount cannot exceed 80% of the invoice (vehicle value) for the replacement vehicle.

[17] As of September 2015, the cost-effectiveness limit for Carl Moyer Program funding was $18,030 per weighted ton of pollutants reduced.

Program Requirements

Existing Vehicle Requirements

- The truck must be equipped with an engine model year 2006 or older
- The applicant must be able to demonstrate ownership, California registration, and proof of insurance for the previous 24 months
- The truck must be light heavy-duty (LHD), medium heavy-duty (MHD), or heavy heavy-duty (HHD), and the applicant must document GVWR with a photo of the vehicle's manufacturer tag
- The applicant must provide documentation of annual VMT or gallons of fuel consumed for the previous 24 months (in California)
- The truck must be in operational condition
- The truck must be in compliance with air quality laws and regulations, and any previous citations must have been paid
- The truck must be dismantled and removed from service

Replacement Vehicle Requirements

- The truck's engine must be certified to 2007 or newer emissions standards (PM: 0.01 grams per brake horsepower hour [g/bhp-hr]; NO_x: 1.20 g/bhp-hr)
- The vehicle must meet the following applicable mileage requirement upon purchase: HHD, less than 500,000 miles; MHD, less than 250,000 miles; LHD, less than 150,000 miles
- The truck's engine must have no more than 25% greater horsepower than the engine in the scrapped truck
- The truck must be in the same weight class and body and axle configuration as the scrapped truck
- The applicant must purchase a 1-yr or 100,000-mile major component engine warranty covering parts and labor for the truck
- The applicant must own and insure the replacement vehicle during the contract life
- Funds cannot be used for maintenance or repairs related to vehicle operation

Reporting Requirements

- The applicant must annually provide proof of registration and insurance
- The applicant must annually report information including hours of operation, VMT in the air district and in California, fuel consumed in the previous 12 months, and any maintenance and servicing completed
- The applicant must report any accident within 10 days, provide a police report and letter from the insurance company, and repair the vehicle if possible

Outcomes

Between the program's initiation in 1998 and December 2014, over $980 million in funding was distributed via the Carl Moyer Program to replace more than 46,000 vehicles and vehicle engines.[18] These vehicle and vehicle engine replacements have resulted in estimated reductions of 174,600 tons of ozone precursors (approximately 90% of which was NO_x and 10% was reactive organic gases [ROG]) and 6,400 tons of primary PM emissions. The health benefits of the program are estimated to be the avoidance of 40 premature deaths per year. Statewide for all types of engines, the cost-effectiveness of the program is estimated to be $10,000 per weighted ton of pollutant reduced; for replacement of on-road vehicles only, the cost-effectiveness is estimated to be approximately $15,000 per weighted ton of NO_x.

Lessons Learned

The Carl Moyer Guidelines have been and continue to be revised over time to address lessons learned during implementation of the program. Revisions to the guidelines have been made to

- **Increase project eligibility –** The program now allows 2-for-1 truck replacement transactions, replacement of LHD and MHD trucks (instead of only HHD trucks), and replacement of trucks that previously operated as drayage trucks. The program has increased the maximum mileage for used replacement trucks, reduced the minimum project life for replacements and retrofits for small fleets, expanded the eligible fleet size to 10 vehicles or less, and increased the cost-effectiveness limit for individual projects.
- **Simplify the application process –** Applicants are now allowed to verify usage by providing historic hours of operation on a case-by-case basis, and the guidelines were revised to clarify program requirements for each source category.
- **Increase maximum funding amounts –** Maximum funding amounts were increased for trucks equipped with engines meeting the 0.20 g/bhp-hr NO_x emission standards.
- **Streamline administrative requirements –** Contracts are no longer required to address prior usage as long as it has already been verified, interest reporting and tracking was simplified, the fund disbursement process was streamlined to minimize the number of requests from air districts for disbursements, and requirements for rural air districts were reduced.
- **Adjust to economic conditions –** Usage requirements were modified in contracts for those negatively affected by the economic downturn, cost-effectiveness limits and cost recovery factors were updated to reflect consumer price index adjustments, and the match formula was updated to allow for adjustments according to available Carl Moyer funds.

[18] See arb.ca.gov/msprog/moyer/moyer%20staff%20report.pdf.

4.2 The Mid-Atlantic Dray Truck Replacement Program

Overview

The Mid-Atlantic Dray Truck Replacement Program (Mid-Atlantic Truck Program) offered incentives of $20,000 toward the purchase of a new cleaner-operating truck that meets or exceeds the 2007 U.S. Environmental Protection Agency (EPA) engine emissions certification standard. The program began in 2010, and trucks were replaced between 2011 and 2014. The goal of the program was to reduce air pollution and greenhouse gases associated with the transport of goods to and from the Ports of Baltimore, Philadelphia, Virginia, and Wilmington (Delaware). The program was administered by the Mid-Atlantic Regional Air Management Association (MARAMA) and the University of Maryland Environmental Finance Center; it was initially funded by a grant from the U.S. EPA, although additional funds were contributed by other groups. More information about the Mid-Atlantic Truck Program (including a final report on the program) is available online.[19]

Program Requirements

Existing Vehicle Requirements

- The vehicle must be equipped with an engine model year 2003 or older (preference given to model year 1997 and older trucks)
- The applicant must be able to demonstrate ownership for the previous 12 months
- The applicant must provide documentation showing registration, proof of insurance, and a photo of the truck
- The truck must have been used to transport cargo to/from the Ports of Baltimore, Philadelphia, Virginia, and/or Wilmington
- The truck must be in operational condition
- The truck must be dismantled and removed from service

Replacement Vehicle Requirements

- The truck must be equipped with an engine certified to 2007 or newer emissions standards
- The truck must be purchased from a pre-screened approved vendor
- The owner must have a good financial record and be pre-approved for a loan

[19] efc.umd.edu/cleandiesel#.VP85RfnF98F.

Outcomes

The anticipated reductions resulting from implementation of the Mid-Atlantic Truck Program were constrained using the following two scenarios:

1. Scrapped trucks would consist of 75 model year 1994–1997 trucks, 17 model year 1991–1994 trucks, and 17 model year 1984–1990 trucks; and all 110 trucks would be replaced with 2007 or newer vehicles at an estimated purchase price of $65,000 each.
2. Scrapped trucks would consist of 82 model year 1994–1997 trucks, 41 model year 1991–1994 trucks, and 41 model year 1984–1990 trucks; and all 164 trucks replaced would be replaced with 2004 or newer vehicles at an estimated purchase price of $40,000 each. (For this scenario, more trucks are replaced because 2004 model year trucks cost less than 2007 model year trucks).

EPA's Diesel Emissions Quantifier (DEQ)[20] was used to quantify emissions reductions and the cost-effectiveness of truck replacements. For inputs, the DEQ requires engine model years of the existing and replacement trucks; the year of the replacement; the annual fuel consumed, average annual time spent idling, and annual VMT for the existing truck; and the cost of the replacement truck. The DEQ estimates tons of pollutants reduced annually, assuming a 30-year lifetime for each replacement truck.

Program administrators received applications for 344 truck replacements between 2011 and 2014; 258 applications (75%) were approved, and 45 (18%) of those withdrew because they could not secure a loan. The Mid-Atlantic Truck Program originally anticipated replacing approximately 110 trucks; however, additional funding covered a total of 213 trucks, and forecasted emissions reductions were exceeded. Replacement trucks were newer than anticipated, contributing to even larger emissions reductions. The estimated emissions reductions and estimated project cost-effectiveness are detailed in the Mid-Atlantic Dray Truck Replacement Program Final Report.[21] In summary, replacement trucks were typically equipped with an engine model that was 10 to 15 years newer than the engine in the scrapped truck. The engine model years of scrapped trucks ranged from 1984 to 2003 (1996 on average). The engine model years of replacement trucks ranged from 2006 to 2013 (2009 on average); 33 trucks were equipped with engines with model years 2010 or newer. The average price of the replacement trucks was $52,000; thus, the incentive grants ($20,000) typically covered less than half of the replacement vehicle price. Truck owners invested a total of approximately $6.7 million dollars of their own money to replace the trucks. The average cost-effectiveness of the program, not including administrative costs, was estimated to be approximately $3,000 per ton of NO_x reduced. **Table 5** compares the range of the program's anticipated annual emissions reductions based on the two truck replacement scenarios to the actual annual emissions reductions achieved.

[20] EPA's DEQ is an interactive tool that estimates emissions reductions, cost-effectiveness, and health benefits of clean diesel projects. It relies on data generated using EPA's Motor Vehicle Emission Simulator (MOVES) 2010 model. See epa.gov/cleandiesel/quantifier/ for more information.
[21] See efc.umd.edu/assets/smartway_marama_final_report__9.29.14.pdf.

Table 5. Comparison of anticipated and actual annual emissions reductions from the Mid-Atlantic Truck Program. Source: Mid-Atlantic Dray Truck Replacement Program Final Report, efc.umd.edu/assets/smartway_marama_final_report__9.29.14.pdf.

Pollutant	Anticipated Annual Emissions Reductions (tons/yr)	Actual Annual Emissions Reductions (tons/yr)
NO_x	137.95–139.21	323
PM	2.53–3.14	16
HC	2.35–2.47	13
CO	12.76–18.86	85

Lessons Learned

The Mid-Atlantic Dray Truck Replacement Program Final Report offers the following lessons learned and recommendations for future programs:

- Using word of mouth was a successful way to recruit participants.
- Providing application assistance was highly involved but ultimately worthwhile.
- Program applicants preferred to communicate via mobile phones.
- Providing dedicated communications equipment increased staff efficiencies and improved customer service.
- Using a database to track applicant and fleet information may have increased program efficiencies.
- Ensuring applicants' financial readiness prior to program approval reduced staff administrative time and enabled grantees to complete the application process more quickly.
- Implementing more stringent lending requirements helped reduce the number of loan defaults and repossessions.
- Maintaining a pre-selected set of truck vendors enabled the program to deliver a higher level of customer service.
- Promoting the program to eligible customers and assisting them with the application process made vendors more successful.
- Forming relationships with quality truck centers was key to the program's success.
- Policies regarding the release of applicants' information needed to be re-evaluated.
- Following up with participants after approval was highly involved but ultimately worthwhile.
- Appraising new vehicles may help to alleviate applicants' concerns.

- Education on the care and maintenance of diesel particulate filters increased grantees' efficacy and improved vehicle care.
- Encouraging participants to purchase an additional warranty contract can help them deal with unforeseen mechanical issues that could pose a major financial obstacle.
- Securing administrative funding for additional leveraged resources was necessary.
- Establishing organizational policies regarding leveraged resources was important.
- Sponsorship packages must have achievable benefits and timeframes.
- The time and skill needed to obtain program sponsors should be considered during the planning stages of the program.
- Limiting the number of truck replacements permitted for a single owner would allow more owner/operators to take advantage of the program.
- Establishing an adaptive management approach allowed staff to improve the program as new lessons were learned.
- Replacing older trucks with shorter remaining lifetimes results in a smaller reduction in lifetime emissions.[22]

Recommendations

- Build on the success of similar programs when possible
- Leverage local stakeholders
- Solicit the support of the local Port Authority
- Educate and build relationships with local truck vendors
- Provide a variety of lending options to program applicants
- Educate and build relationships with reputable truck scrapping companies

4.3 The Houston-Galveston Area Council Drayage Loan/Grant Program

Overview

The Houston-Galveston Area Council Drayage Loan/Grant Program (HGAC Drayage Loan/Grant Program) was created in 2009 as a joint effort between HGAC, EPA, the Environmental Defense Fund,

[22] This outcome is consistent with recent work by Preble et. al (2015) (available at http://pubs.acs.org/doi/abs/10.1021/acs.est.5b01117). These studies suggest that replacing the newer of the high-emitting trucks will result in greater air quality benefits over the long-term.

and the Port of Houston Authority (PHA). The program received funding from EPA's Clean Diesel SmartWay Finance Program, which issued competitive grants to establish national low-cost revolving loans or other financing programs to help reduce emissions from diesel fleets by replacing or retrofitting trucks equipped with pre-2007 model year engines with newer, cleaner, and more fuel efficient models. The goal of the program is to help Houston meet the NAAQS by reducing NO_x emissions (an important precursor to ozone formation) from diesel-fueled trucks. (As of 2015, Houston was classified as marginal nonattainment for the 8-hr ozone standard.)

Administered by HGAC, the program established a revolving loan fund that enables an individual borrower to obtain a low-interest loan to help finance the purchase of a newer heavy-duty diesel truck. The program is meant to work in concert with emissions reduction incentive grants offered through the Texas Commission on Environmental Quality's (TCEQ) Texas Emissions Reduction Plan (TERP), the HGAC Regional TERP, or the HGAC Congestion Mitigation and Air Quality Improvement (CMAQ) Program. Incentive grant amounts are based on the estimated emissions reduction that will be achieved by replacing the old truck and may provide up to 80% of the purchase price of a new truck. Loans offered by the HGAC Drayage Loan Program act as a "bridge loan" to finance the difference between the cost of a new truck and the incentive grant that the truck owners apply for through the TERP or CMAQ programs. Low-interest loans range from $5,000 to $100,000. As loans are paid off, interest and principal payments on established loans are used to award new loans.

Program Requirements

The process for applying for the incentive grant and loan program has been streamlined so that truck owners can apply for both the Regional TERP incentive grant and the HGAC Drayage Loan Program through a single application process. To begin, the truck owner/operator must complete a pre-qualification form[23] that covers contact information, qualification information based on the existing truck, mileage, and usage within the nonattainment area, and vehicle and engine make, model, and year. If the applicant prequalifies, the applicant is invited to complete a loan application and provide additional supporting documentation to complete the overall program application process.

Existing Vehicle Requirements

The existing vehicle to be replaced must be an operational, Class 8a or 8b (GVWR 33,001 lb or greater) heavy-duty diesel truck that is licensed, registered, and owned by the applicant. The truck must conduct port-related drayage business in the eight-county Houston-Galveston-Brazoria ozone nonattainment area[24] and must be destroyed prior to the purchase of a new truck.

[23] mysolutionis.com/fleet-management/drayage-loan-program/Documents/Drayage-Loan-Program-Prequalification-Form-2014.pdf
[24] The Houston-Galveston-Brazoria ozone nonattainment area includes Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties.

Replacement Vehicle Requirements

The replacement vehicle must be a Class 8a or 8b truck equipped with a 2012 or newer engine. The applicant must make a commitment to operate the truck for a minimum of seven years, and at least 25% of the annual VMT must occur within the eight-county nonattainment area. The applicant must also agree to have a global positioning system (GPS) unit installed on the new truck to facilitate grant compliance monitoring.

Outreach

HGAC hosted and attended numerous events to inform potential applicants about the HGAC Drayage Loan Program and distribute program applications and flyers. The following outreach activities were performed:

- Coordinated with PHA and the Ports of Freeport and Galveston to host outreach events for drayage business owners and operators. Area truck dealers were recruited to participate in workshops to share information about new truck models and answer questions.
- Held a workshop with drayage truck vendors to educate truck sales associates on program requirements and to solicit their assistance in recruiting qualified applicants for the program.
- Presented information about the program at the Texas Motor Transportation Association (TMTA) Houston Chapter Meeting.
- Contacted TERP recipients to inform them about the loan program.
- Attended local trucking company safety meetings to speak to owner/operators about program benefits.

Program administrators also advertised the loan program and outreach events on social media such as Facebook. The program received media coverage, which HGAC published on YouTube to reach additional applicants (e.g., youtube.com/watch?v=L0pBCDlPrSU). Information about and outreach for the HGAC Drayage Loan Program was made available in English and Spanish.

Outcomes

Over 200 drayage trucks operating in the Houston nonattainment area have been voluntarily replaced as part of the HGAC Drayage Loan/Grant program. Approximately 35% of participants are independent truck owner-operators, and there have been no loan defaults or repossessions. The program has contracted commitments that will yield a reduction of approximately 970 tons of NO_x emissions; as of August 2015, a reduction of over 220 tons of NO_x had been achieved. Approximately $13.5 million has been dispersed in the form of TERP and CMAQ incentive grants, and $11 million has been dispersed as low interest rate loans. The cost-effectiveness of the program is estimated to be approximately $14,000 per ton of NO_x reduced.

Compliance monitoring for the HGAC Drayage Loan Program is achieved via GPS tracking. Geo-fencing[25] is used to define the geographical areas of interest (nonattainment and maintenance areas) and to establish mileage and idling data within areas of interest for all program participants. Administrators found that data collected by GPS monitors also offer opportunities for analyzing hot-spots due to vehicle idling, examining the speed and distance that freight is transported, and investigating how emissions change as trucks age. The GPS data also may inform strategic planning such as truck travel demand forecasting and mobility improvement measures (e.g., identifying bottlenecks and identifying truck use by roadway or land use type).

Lessons Learned

- A major factor contributing to the success of the program was the substantial outreach effort, which accommodated both English and Spanish speakers.
- Truck owner/operators noted that important benefits of the program include improved fuel economy and reduced maintenance costs.
- GPS units increased the transparency of monitoring protocols and reduced the reporting burden for participants.
- GPS data can be used to target and reduce idling, and help position HGAC to assist owner/operators in shaping their business model to ensure compliance with grant terms.

[25] Geo-fencing is a feature in a software program that defines geographical boundaries using GPS or RFID.

5. Conclusions and Discussion

5.1 Conclusions

Although replacement of trucks under the Heim Truck Program was still underway at the time this report was prepared, review of program materials and interviews with administrators indicate the program was in the process of successfully mitigating air quality impacts resulting from the construction phase of the Schuyler Heim Bridge Replacement Project. Despite challenges, program success was due to the flexibility of administrators and their willingness to make adjustments to the original scope of the program as needed. For example, a major challenge was identifying eligible candidates for truck replacements, given that previous programs had eliminated many of the dirtiest heavy-duty diesel trucks operating near the San Pedro Bay Ports. However, by targeting a different category of trucks, the program replaced trucks that were dirtier than those originally targeted. As a result, fewer trucks needed to be replaced to meet the program's emissions reduction targets.

Review of the Carl Moyer Program, the Mid-Atlantic Dray Truck Replacement Program, and the HGAC Drayage Loan/Grant Program revealed that the design and implementation lessons learned from the Heim Truck Program are consistent with other truck replacement/retrofit programs. These three programs were chosen to highlight geographically diverse examples of truck retrofit and replacement programs. Many such programs have been implemented throughout the United States, including a national effort funded through the American Recovery and Reinvestment Act.[26]

Common recommendations for future truck replacement/retrofit programs by project phase are listed below.

Planning

- Learn from and build on the success of previous programs.
- Identify target trucks/applicants early during the planning stage.
- Develop an approach that will allow administrators to adapt if a challenge arises.
- Be aware of state and local programs that could impact program recruitment and implementation.

Recruitment

- Advertise the truck program through multiple venues to reach as many potential applicants as possible.

[26] epa.gov/cleandiesel/projects-national.htm.

- Expand project eligibility to maximize participation.
- Plan to recruit more participants than needed to meet target reductions, because some participants may withdraw from the program for financial or other reasons.

Implementation

- Simplify the application process to minimize administrative costs.
- Streamline administrative requirements to award grants as efficiently as possible.
- Require applicants to determine financial readiness in advance.
- Develop relationships with program participants, maintain contact with them, and provide ongoing support to them throughout the application and implementation processes.

5.2 Discussion: Additional Considerations for Project-Level Mitigation

In addition to the findings discussed in Section 5.1, key considerations for designing a truck program to mitigate project-level air quality impacts include:

- **Will the program be implemented to offset construction or operational emissions?** The Heim Truck Program was designed to offset a discrete increase in emissions from a specific source related to the construction of the bridge replacement project. Given that fleet turnover is expected to continue to reduce emissions on a per-vehicle basis over time, there may be opportunities to implement a truck program to offset operational emissions in the near-term before the air quality benefits of fleet turnover occur. The design of a program to offset operational emissions would involve additional considerations. For example, a longer contract period may be required to offset emissions until fleet turnover reductions occur, and allowances for the transfer of a vehicle and contract obligations may be needed to attract eligible applicants. Furthermore, implementation of a truck program to offset operational emissions may require coordination with FHWA and EPA for approval.
- **Who are the target participants of the program?** For projects that are not located near a port, identifying trucks that routinely operate near the project site may be a challenge. A truck replacement/retrofit program is likely to be a more feasible mitigation strategy for projects located near facilities such as ports, airports, and distribution centers where a large fraction of traffic consists of a particular pool of HDDVs.
- **What enforcement mechanisms will be established to ensure that program benefits occur near the project site?** In the case of truck programs operating near ports, port entry/exit slips and RFID tag tracking allow program administrators to track truck activity. Projects that are not located near a port may need a feasible tracking alternative. Toll receipts may be a tracking option for a project located near a bridge or along a toll road. Electronic monitoring

units that track vehicle movement via GPS technology may also be an option to facilitate grant compliance monitoring. GPS units have been required by previous programs, including the HGAC Drayage Loan/Grant Program, and GPS has been found to provide valuable insight into activity patterns and idling information. Additional considerations related to GPS tracking include added cost, additional effort required to establish geo-fencing to define the geographical area of interest, and data management.

Appendix A. Interview Information

Several telephone interviews about the implementation of the Heim Truck Program were conducted with program administrators. This appendix includes sample questions asked during interviews with Caltrans, ACTA, and E2ManageTech staff.

Interview Questions

- How many trucks have been replaced to date? How many trucks replacements are pending?
- Can you walk us through the chronology of the program?
- What types of trucks have been replaced? What are the engine model years of the old and replacement trucks?
- Have there been any changes to how the program has been implemented compared to what was originally planned?
- What were the real-world challenges for getting truck operators to participate in the retrofit program? Was recruitment an issue?
- What steps were taken to ensure that retrofitted trucks were/are operated in the vicinity of the bridge?
- What was/are your expectations for the length/frequency of operation of retrofitted trucks near the bridge? Do you keep track of the operation of retrofitted trucks?
- How has the effectiveness of the program been gauged?
- Have the emissions reductions met your expectations?
- What fraction of vehicle miles traveled is required (or assumed) to occur in and around the San Pedro Bay Ports? Have any of the truck program participants failed to meet the port service or mileage requirements?
- Have truck owner/operators been interviewed to assess the program or are there plans to do so in the future?

Appendix B. Quantifying Heim Truck Program Impacts

Rerouting marine vessels during the construction phase of the bridge replacement project was estimated to contribute 132.8 lb of NO_x per day (24.2 tons of NO_x/yr). The SCAQMD significance threshold for NO_x emitted during construction is 100 lb/day.[27] Thus, the Heim Truck Program sought to reduce NO_x emissions by 32.8 lb/day over the three-year truck program term in order to mitigate emissions to a level below the SCAQMD significance threshold for construction emissions.

The air quality benefits of a truck replacement depend on the engine model years of the existing and replacement trucks and on truck activity. The Schuyler Heim Bridge Replacement and SR-47 Expressway Project Air Quality Impacts Technical Study report offers the following equation for quantifying the impacts of a truck replacement:

$$OFFSET = \frac{(EF_{base} - EF_{opt} \times AL)}{454\ g/lb}$$

where

$OFFSET$ = Mobile source emissions reduction offset (lb NO_x)
EF_{base} = Baseline emission factor (g NO_x/mi, existing truck)
EF_{opt} = Optimal emission factor (g NO_x/mi, replacement truck)
AL = Activity level (mi/yr)

Using emission factors from CARB's Emission Factors (EMFAC) model, and assuming that an old truck equipped with a 1988 model engine is replaced with a truck equipped with a 2008 model engine, the example below estimates an offset of 0.86 tons of NO_x per year per truck. Table B-1 lists NO_x emissions factors from EMFAC as a function of engine model year.

$$OFFSET = \frac{(21.07\ g/mi - 6.62\ g/mi) \times 54{,}000\ mi/yr}{454\ g/lb}$$

$$= 1719\ lbs\ of\ NOx\ per\ year\ per\ truck$$

$$= 0.86\ tons\ of\ NOx\ per\ year\ per\ truck$$

Note that this example was prepared as part of this study to help illustrate identification of truck modification targets, and is not meant to serve as official documentation of program benefits.

[27] aqmd.gov/docs/default-source/ceqa/handbook/scaqmd-air-quality-significance-thresholds.pdf?sfvrsn=2

Table B-1. Emission factors for mileage-based calculations (g/mi) for heavy-duty vehicles over 33,000 lb GVWR. Values are based on EMFAC2011 zero-mile emission factors. This table is adapted from Table D-4 in the Carl Moyer Guidelines (arb.ca.gov/msprog/moyer/guidelines/2011gl/2011cmpgl_12_30_14.pdf).

Engine Model Year	NO_x Emission Factor (g/mi)
Pre-1987	21.37
1987–1990	21.07
1991–1993	18.24
1994–1997	17.92
1998–2002	17.61
2003–2006	11.64
2007–2009	6.62
2007–2009 (0.50 g/bhp-hr NO_x or cleaner)[a]	2.88
2010 or newer	1.27

[a] Use interpolated values assuming 1.2 g/bhp-hr NO_x standards for 2007–2009 model year grouping and 0.2 g/bhp-hr NO_x standards for 2010 and newer model years.

Using the estimated 0.86 tons of NO_x per year per truck and a target offset of 32.8 lb of NO_x per day, the number of trucks that would need to be replaced to meet the target can be calculated as follows:

$$\textit{Offset Target} = 32.8 \textit{ lb } NO_x \textit{ per day} = 6.0 \textit{ tons } NO_x \textit{ per year}$$

$$Number\ of\ trucks = \frac{6.0\ tons\ NOx\ /\ yr}{0.86\ tons\ NOx\ /\ yr\ \ truck}$$

$$\approx 7\ trucks$$

This sample calculation approximates how many trucks would be required to meet the Heim Truck Program target reduction in emissions. The NO_x reduction per year per truck, based on the model years of the existing and replacement engines and the average VMT, will vary for each truck.

The cost effectiveness of the truck program can be estimated using the offset in emissions and the cost of program implementation as follows:

$$Total\ NOx\ reduced = \frac{0.86\ tons\ NOx}{yr \cdot truck} \times 3\ yrs\ \times 7\ trucks = 18.06\ tons\ NOx$$

$$Cost\ Effectiveness = \frac{\$400K}{18.06\ tons\ NOx} = \$22{,}150\ per\ ton\ NOx$$

This sample calculation uses the administrative costs included in the original $600,000 total program cost estimate and a reduced total grant award cost for seven trucks (instead of 15):

$$\$25K\ per\ truck\ \times 7\ trucks + \$225K\ for\ admin = \$400K\ total$$

Assuming a total program cost of $400,000 and the replacement of seven trucks with an average offset in emissions of 0.86 tons NO_x per year per truck, the cost effectiveness of the program is approximately $22,150 per ton of NO_x. If the $600,000 originally budgeted for the project is spent, the cost effectiveness would be approximately $33,200 per ton of NO_x. These estimated values are higher than typical values for other truck replacement programs reviewed because fewer truck replacements offset the administrative costs of program implementation. It is important to note that some truck programs do not include administrative costs when reporting cost-effectiveness; excluding administrative costs, the estimated cost-effectiveness of the program using the above assumptions would be approximately $9,700 per ton of NO_x reduced.