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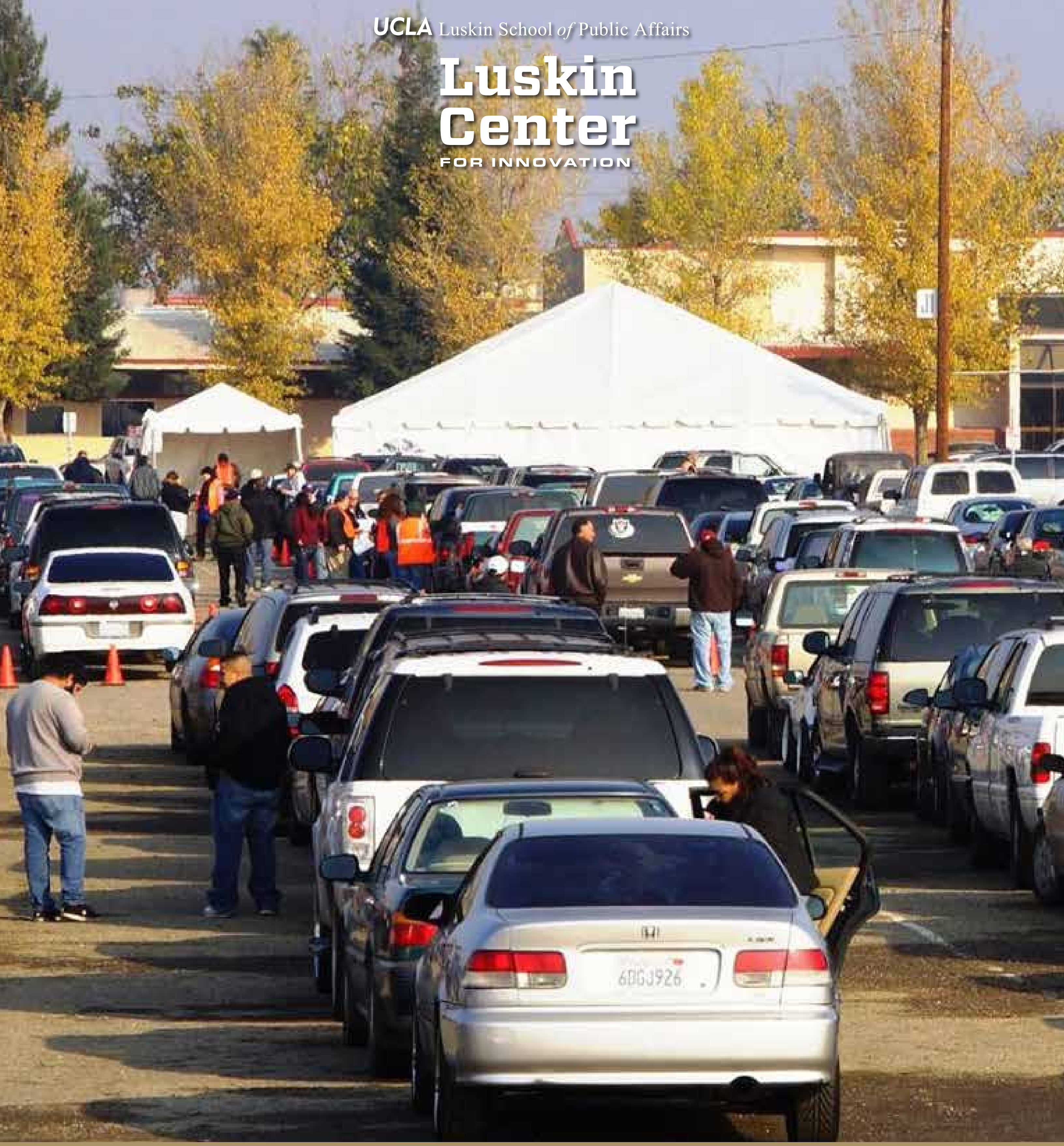

Can Smog Repairs Create Social Justice?

The Tune In & Tune Up Smog Repair Program in the San Joaquin Valley

Valley CAN staff member speaks with a participant at the Enhanced Fleet Modernization Program tent during a Tune In & Tune Up event in Bakersfield, California. PHOTO: TONY MORENO/VALLEY CAN

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Contents

Executive Summary

The San Joaquin Valley (SJV) in California is historically afflicted by poor air quality, in part due to the presence of two major interstate freeways, high dependency on light-duty vehicles, and the resulting transportation emissions. There are many adverse health impacts associated with exposure to air pollution, and studies have found measurable negative health effects associated with poor air quality in the SJV specifically. The SJV is home to a higher proportion of minority and low-income residents than the state as a whole.

California is also at the forefront of progressive environmental initiatives in the United States, including many innovative transportation-related environmental justice programs. As environmental justice initiatives grow throughout the state, transportation programs are increasingly expected to provide substantial emission reductions as well as serve distributional justice objectives.

TI&TU events provide free emission tests. Owners whose vehicles don't pass may receive vouchers up to $850 for repairs. Photo: Tony Moreno/Valley CAN

This report examines the performance of the Tune In & Tune Up (TI&TU) smog repair program, which has operated since 2005 in the San Joaquin Valley and is one of the first transportation programs to take both environmental and equity considerations into account. The program has taken a community organizing approach to improving regional air quality by targeting for repair high-emitting light-duty vehicles in state-designated disadvantaged communities.

Tune In & Tune Up is a program of the San Joaquin Valley Air Pollution Control District (SJVAPCD), funded by enhanced vehicle registration fees and implemented by a nonprofit, Valley Clean Air Now (Valley CAN). The program provides free smog checks for residents in the eight counties in the SJV. Owners of vehicles that do not pass emissions tests at TI&TU events receive vouchers for up to $850 in smog repairs. Using a variety of descriptive statistics and econometric methods, this report reviews and analyzes internal TI&TU program data from 2012 to 2017, conducting a thorough evaluation of the program with regard to program efficiency, equity, and environmental impact.

More than 40,000 individuals attended a TI&TU event between July 2012 and April 2017, representing about 4 percent of all households in the region. We find that the program operates efficiently, not only adhering to eligibility requirements, but also effecting participation from residents of 97 percent of the census tracts in the Valley throughout this period. Multivariate regression analysis, using the internal TI&TU data as well as CalEnviroScreen 3.0 data, determined that the program distributed more financial benefits to neighborhoods with lower incomes, higher percentages of minority households, and greater environmental concerns than the regional average. Finally, regarding environmental benefits, the program successfully targeted vehicles that are more likely to be high emitters. In other words, TI&TU vehicles are much older, have higher odometer readings, and are more often unregistered than the state fleet's average. The program distributed over $12 million in voucher benefits to SJV residents over the study period.

Using methods developed by the California Air Resources Board for calculating emission reductions from pre- and post-repair measurements, we estimate a cost of $6,700 per ton of emissions reduced via the Tune In & Tune Up program.

This analysis demonstrates that the TI&TU program effectively and efficiently reduced emissions, and distributed benefits to the neighborhoods most in need in the SJV. These findings indicate that TI&TU can be used as a model for implementation in other areas of the state or country that are expected to implement regional light-duty vehicle emission reduction programs that satisfy specific equity, efficiency, and environmental objectives. This model is particularly promising in regions that are unable to build public transit infrastructure or provide incentives for clean vehicle purchases to meet the travel needs of a substantial proportion of their low- to moderate-income residents.

Introduction

Transportation-related environmental programs in California are increasingly being asked to not only achieve emissions reductions but also demonstrate cost-effectiveness and equity in opportunity and benefit distribution. An emphasis on distributional equity can be seen in both recent changes to the administration of California's Greenhouse Gas Reduction Fund (CalEPA, 2017) and the recent passage of Assembly Bills 398 and 617, which together prioritize criteria pollutant reductions in state-identified disadvantaged communities.

All eight counties in the San Joaquin Valley (SJV) are classified by the Environmental Protection Agency (EPA) as nonattainment areas for various particulate matter (PM) and ozone national standards (U.S. EPA, 2017b), while the air basin is one of only two in extreme nonattainment for federal eight-hour ozone standards.

The region also has the highest percentage of disadvantaged communities statewide per CalEnviroScreen 3.0, with 20 of the 30 most impacted census tracts lying within the Valley. Transportation emissions are a significant contributor to San Joaquin Valley's air quality challenges. The West Coast's two major north-south interstate freeways run the 300-mile length of the region, both of which contribute significantly to the region's total vehicle use and consequently, air pollution (U.S. EPA, 2017a).

Driving is more prevalent in the SJV than the state as a whole while the vehicle fleet is among the oldest on average statewide (U.S. Census Bureau, 2010-2014). A 2014 report identified that 50 percent of the light-duty smog production in the state can be attributed to only 10 to 15 percent of vehicles, many of which are the 1999-and-older type of vehicles commonly driven in the SJV (Wheeler, Morris, and Gordon, 2014). This report also highlighted the fact that there may be many more unregistered vehicles in regions like the Valley than are currently assumed in state models (Wheeler et al., 2014). These vehicles are often unable to pass smog checks, remain unregistered, and therefore continue to emit disproportionately high amounts of pollution. Researchers suspect that this lack of compliance, even from a small percentage of vehicles, negatively impacts air quality in the region (Mérel and Wimberger, 2012).

Finding viable alternatives to vehicle use in the region is challenging. While targeted transit investments are needed in the region (Karner and London, 2014), most of the SJV is insufficiently dense to envision cost-effective and convenient transit that is competitive with automobile travel. Modernizing the fleet into zero- and near-zero emissions options is a long-term solution, but it has proven difficult to significantly accelerate this trend without generous state or regional incentives for vehicle purchase. However, there is not nearly enough existing capital at the state level to offer large enough incentives to induce demand for zero- and near-zero-emissions vehicles from most moderate-income households, and many low-income households are unable to finance the purchase of new or lightly used vehicles made available through these programs (DeShazo, Sheldon, and Carson, 2017).

In short, there is limited reach of transit or clean vehicle incentives to significantly affect the scope of the San Joaquin Valley's transportation emissions problem. As a short-term solution while working toward long-term fleet modernization, targeted programs to mitigate disproportionate sources of vehicle emissions, such as gross polluting and unregistered older vehicles, are crucial. These programs can serve as a complementary approach to prevent excessive emissions from unrepaired vehicles that are unable to pass smog checks.

Recognizing this opportunity, in 2005 Valley CAN began developing a program to incentivize SJV residents to bring their vehicles for free emissions testing at a series of events held throughout the region. If their vehicle failed the initial screening, they would receive a complimentary voucher for smog repair. Building on subsequent years of experimentation and development, the current Tune In & Tune Up program model was ramped up by the SJVAPCD and Valley CAN using grant funding from a court settlement in 2010 and then adopted as an ongoing program funded by the discrict's Polluting Automobile Scrap & Salvage (PASS) program in 2012. Since then, the Tune In & Tune Up program has provided over $12 million in direct financing for smog repair service to more than 20,000 unique, qualified residents of the region.

A resident at a Bakersfield TI&TU event awaits the results of smog test. Photo: Tony Moreno/Valley CAN

Tune In & Tune Up may be the only, and is certainly the largest, program operating in the state (and perhaps the U.S.) that offers light-duty transportation-related assistance to a substantive number of low-income households through a grassroots programmatic approach.

Given its reach and unique approach, we describe and assess the program's success with respect to efficiency and environmental and equity outcomes, and consider its relevance for adoption in other regions. To perform this analysis, we draw on previously unanalyzed data provided to us by Valley CAN on neighborhood of origin, vehicle characteristics and redemption of smog repair vouchers for nearly 42,000 households attending Tune In & Tune Up events from 2012 to 2017. To further inform our understanding of the program, we also attended several Tune In & Tune Up events, interviewed Valley CAN staff, and conducted interviews of 11 Tune In & Tune Up program participants.

In terms of efficiency, we find that the program adhered to its own eligibility requirements strictly, ensuring that intended beneficiaries of the program were the ultimate recipients. Moreover, the program's outreach strategy effected participation from nearly every part of the San Joaquin Valley. More than 40,000 individuals attended an event between July 2012 and April 2017, representing about 4 percent of all households in the region, and with every county receiving substantial benefits. The impressive depth of program outreach was achieved on a budget of approximately $16 million over a six-year period. The multiyear, regionwide cost of the Tune In & Tune Up program compares quite favorably to the cost of one-off, limited-location transit investments made in the region over this same period.

In terms of environmental impact, and as expected, we find that the vehicle fleet attending Tune In & Tune Up events was much older, had higher odometer readings, and was less likely to be registered than the general vehicle fleet in California. In other words, the program effectively reached cars most likely to be contributing substantially to air pollution emissions. Using the Carl Moyer Program method, we estimate a cost of $6,700 per ton of emissions reduced during the entire period via the Tune In & Tune Up program. Moreover, given that many of these vehicles were unregistered, they were likely not included in the state's current emissions estimation models and thus represent a novel source of emissions reductions.

In terms of equity, event turnout relies on grass-roots outreach and community organizing, which ensures equal opportunity to access the program, and effected a broad base of households in the Valley attending Tune In & Tune Up events. Of the region's 760 census tracts, 741 had a household that attended a Tune In & Tune Up event during this period, with no less than 88 percent of all tracts represented by participating customers each year. Moreover, while participation and eligibility were equal opportunity, multivariate regression analysis suggests that the program effectively distributed more of its benefits to neighborhoods with lower incomes, higher percentages of minority households, and greater environmental concerns than the regional average. Considering that the region is disadvantaged with respect to environmental justice as compared to the rest of the state, this suggests that the program is truly reaching the areas in California most in need of transportation-related environmental incentives.

These findings are also relevant to scholars studying policies to support transportation equity and environmental justice more broadly. Several studies have assessed the efficiency of smog repair as a cost-effective emissions abatement strategy (Mérel, Smith, Williams and Wimberger, 2014) and the optimality of the uniform rebate design of the TI&TU program (Mérel and Wimberger, 2012). However, this study sheds new empirical light on the distributional outcomes of transport-emissions programs that are increasingly being posed conceptually by scholars (Karner, Rowangould and London, 2016; Pereira, Schwanen and Banister, 2017), while taking into account the efficiency and environmental impacts of the program. Moreover, it is the first-known study to demonstrate a program that meets the preferences of low-income households for vehicles (Blumenberg and Pierce, 2012; Bacon and McGranahan, 2008), but also demonstrates how the environmental impacts of greater access to vehicles among low-income households can be mitigated.

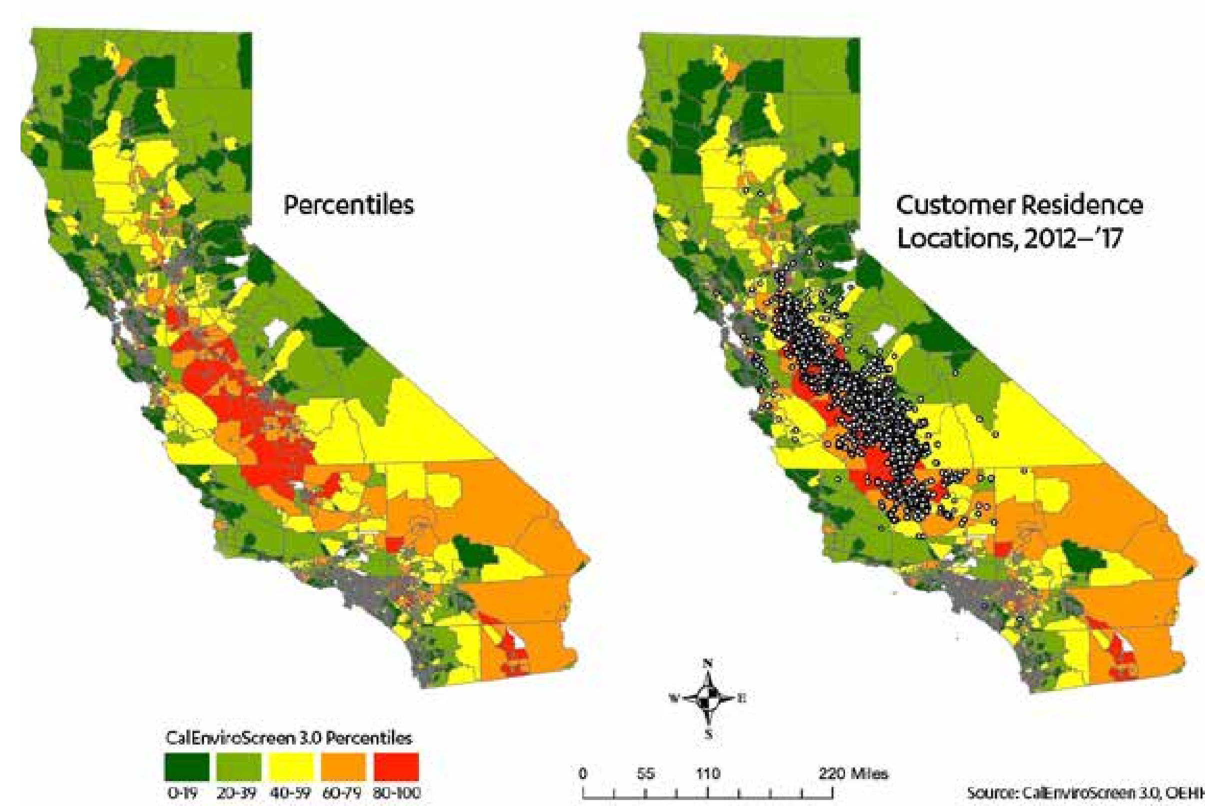
Findings from this research should also inform future policy efforts to target economic transfers to support reliable transportation access in a mode responsive to the needs of and preferred by residents of the region, which also yield both local and global positive environmental externalities. The Tune In & Tune Up program serves as a model that should be considered by legislators, funders and administrators of ongoing and prospective regional light-duty vehicle programs expected to achieve a combination of equity, efficiency and environmental goals.

The Need for Reliable, Clean Transportation Access in the San Joaquin Valley: Evidence From Socio-Demographics, Automobile Reliance, and Air Quality Indicators

The San Joaquin Valley comprises eight counties and 10 percent of the state's population. The American Lung Association's State of the Air report consistently ranks the majority of SJV counties in the top 10 in its "People at Risk In 25 U.S. Cities Most Polluted" listings for ozone and PM (American Lung Association, 2017). Various recent studies have associated exposure to air pollution in the SJV region with negative health impacts, including an increase in asthma symptoms (Meng et al., 2010), asthma-related emergency department visits, and effects on pregnancy (Padula et al., 2013, 2014).

Census data for 2011-2015 (see Appendix 1 for full comparison) clearly show that residents of the Valley as a whole (and each county within it) are lower-income and have a higher percentage of minorities than the state average. Moreover, census data shows that only 1 percent of workers (16 years and older) in the SJV take public transportation during their commute (as opposed to 5 percent for the state), indicating that there is a high reliability on light-duty vehicles in this region (U.S. Census Bureau, 2017). The high percentage of minority and low-income residents in this region, combined with outsized air pollution

Figure 1:
CalEnviroScreen Percentiles and Tune In & Tune Up Customer Residence Locations



burden, suggests that this is a substantial environmental justice concern.

The relative vulnerability of the San Joaquin Valley can be alternatively illustrated by Figure 1 above, which depicts the CalEnviroScreen percentiles for census tracts in the SJV region. CalEnviroScreen is an environmental justice screening tool developed by the Office of Environmental Health Hazard Assessment (CalEnviroScreen 3.0, 2017). The percentiles are based on a series of indicators that fall into two categories: pollution burden and population characteristics. Higher percentiles indicate a larger risk for a particular region and are indicated in red.

The left panel of the map clearly visually demonstrates that many of the high-risk areas in the state are in the San Joaquin Valley. This can also be easily demonstrated using the numerical scores of the screening tool; the average CalEnviroScreen percentile for SJV census tracts is 72.5, compared to the state average of 50. The right panel, which overlays the residential locations of Tune In & Tune Up customers, suggests that the support provided by the program was passed through to at-risk areas. We further evaluate the effectiveness of this support in the remainder of this report.

In the last two decades, an increasing amount of scholarly and policy attention has addressed environmental injustice in the SJV. Much attention has been paid in particular to documenting and addressing deficient access to drinking water (C.L. Balazs and Ray, 2014; C. Balazs, Morello-Frosch, Hubbard, and Ray, 2011) and the determinants of high levels of air pollution (Huang and London, 2012; Pastor, Morello-Frosch, and Sadd, 2005) in the Valley. While the greatest contributors to high levels of criteria air pollution are agricultural operations, industrial producers, and heavy-duty vehicles, light-duty vehicles are also a substantial contributor to the Valley's historical nonattainment of government standards for criteria pollutants and greenhouse gases (SJVAPCD, 2016).

Relatively little has been written about transportation's role in contributing to or remediating environmental injustice in the region. A few studies have outlined challenges in transportation that hold broadly across the Valley (Karner, 2016; Karner and London, 2014; Margonelli,

Long lines form as early as 5 p.m. the night before the Saturday TI&TU events. Gates open at 6:30 a.m. and tests start at 8. Photo: Tony Moreno/Valley CAN

2014), including the inadequacy of existing transit services to connect households to diverse activities and the vital function of satisfying travel demand for work trips by vanpools. To the best of our knowledge, however, no other study has analyzed existing, scaled responses devoted to addressing these related problems, such as the Tune In & Tune Up program. Moreover, ours is the first study to analyze potential differences in EJ and transport-related benefits *within* the Valley. While some studies mention differences at the county level, none analyze outcomes at the neighborhood level.[1]

The Tune In & Tune Up program has applicability for expansion and implementation beyond the SJV region. In our review of existing light-duty vehicle repair, retirement and/or replacement programs, Tune In & Tune Up may be the only, and is certainly the largest, program operating in the state (and perhaps the U.S.) that offers light-duty transportation-related assistance to a substantive number of low-income households through a grassroots programmatic approach. Other light-duty programs, such as the California Bureau of Automotive Repair's Consumer Assistance Program and the California Air Resources Board's Clean Vehicle Rebate Program, are larger in scale and also target benefits to low-income households. Neither program, however, employs the same participatory approach as Tune In & Tune Up. Other vehicle assistance programs that employ grassroots approaches are limited in scope.

[1] This lack of geographic granularity in analysis holds true for EJ studies focused on other sectors in the SJV with the exception of the work of Huang and London, 2012.

Data and Research Methods

The primary data analyzed in this study was extracted from Valley CAN's Salesforce database of participant, vehicle, and smog repair information. Data on participants, their vehicle characteristics and initial emissions data was collected from individual attendees and manually input by Valley CAN staff into Salesforce the day of Tune In & Tune Up events.

For our analysis, four Salesforce fields were joined together using RStudio on different keys prior to analysis, using an outer join so as to not eliminate any entries that do not match due to manual entry error. Information on which keys to use was provided by Valley CAN staff and their external data consultant. The total number of individual entries in the final dataset was 46,158, though not every field was filled for each entry.

The data was then examined for errors and cleaned. Reasonable cutoffs were established for determining and excluding outliers and incorrect entries from subsequent analysis.[2] One feature of the Tune In & Tune Up program is that it allows for the same individual to attend and receive a program benefit once every year. Accordingly, over the period analyzed, multiple "duplicate" entries for the same individual could and did occur. There were 4,143 duplicate entries (from all counties) that were coded as "1" in the dataset and analyzed separately from the unique customer visits ("0"). The first date and associated vehicle with which an individual attended a Tune In & Tune Up event was the only entry retained in the final dataset used for subsequent analysis in this study, unless explicitly stated otherwise. The only exception is occasions in which duplicates occurred on the same date (typically due to a customer bringing two vehicles to a Tune In & Tune Up event). Without duplicates, 41,668 total individual entries (SJV residents) were used in the analysis.

Program participant data was explored and descriptively analyzed using the software programs RStudio, Stata, Microsoft Excel, and Esri's Arc Geographic Information Systems (ArcGIS). RStudio and Microsoft Excel were used to develop the tables with descriptive information. ArcGIS was used to create the maps. Stata was used to perform econometric analysis of neighborhood-level determinants of participation and funding receipt and determinants of an individual's successful smog repair completion. To provide context to our understanding of the participant dataset, we also attended several Tune In & Tune Up events in multiple locations (Bakersfield and Stockton) to observe the program process, interviewed several Valley CAN staff extensively, and conducted interviews of 11 program participants at a Tune In & Tune Up event in Stockton on February 25, 2017.

[2] A few incorrect county codes of Tune In & Tune Up events were corrected according to their Tune In & Tune Up event date. Entries from co unties outside the SJV were removed. For the "Years Owned" field, any entries above 65 with a vehicle model more recent than the given year were changed to N/A (n=9). There were several outliers for "Odometer Reading," and all readings that were less than 1,000 (n=80) or greater than 700,000 (n=179) were considered unreasonable and changed to N/A. Values above $20,000 in vehicle repairs were considered to be errors, and they were changed to N/A (n=3). Situations in which the total cost was listed as zero were changed to N/A (n=14) and entries with customer costs listed but no Valley CAN cost listed were changed to N/A (n=2). One model year originally listed as 1942 was changed to N/A.

Findings:

Program Scope and Efficiency

We evaluate the efficiency of the Tune In & Tune Up program using multiple metrics: compliance with stated program eligibility standards, the reach of the program in terms of attendees across the Valley, and the total cost and effective pass-through of funds to program participants as compared to similar investments or programs.

Compliance With Program Eligibility Standards ("Leakage")

One baseline criteria used to evaluate social benefit programs is the percentage of program beneficiaries (households) who received benefits even though they were not eligible for the program. This is commonly termed "leakage" (Coady, Grosh and Hoddinott, 2004).

The format of the Tune In & Tune Up program effectively ensures that only in-need vehicle owners would attend events. Flyers distributed to promote events state, "Please expect a two-hour wait." Attendees typically endure a much more substantial time cost to attend an event and receive a voucher.

Events are held on Saturday mornings at public venues in each of the San Joaquin Valley's eight counties. A line of cars typically begins to form outside the gate at 5 p.m. the night before the event. Valley CAN staff actively monitor the line overnight to make sure it is kept in an orderly fashion and there are no disputes. By 6:30 a.m. the event gate opens and several hundred cars enter, even though the event is officially advertised to commence at 8 a.m. An additional 200 typically arrive in the next hour, and by 9 a.m., the event may have reached Valley CAN's capacity for participants (currently 525 vehicles for a single event). This time-costly format informally functions as a type of means-testing, as households needing financial assistance for smog repair are much more likely to be incentivized to wait than those who could otherwise pay (Alatas et al., 2016).

Once they enter the event parking lot, cars are queued up, and program staff ask participants for basic personal information as well as vehicle registration and emissions testing documentation. To more formally ensure that minimal leakage occurred and that staff time was used on potential beneficiaries, Valley CAN verifies the responses to the following three questions before proceeding with vehicle diagnostics:

- "Are you a San Joaquin Valley resident?"
- "Have you owned your car for more than six months?"
- "Are you here for an emissions test?"

All supporting documentation is copied by Valley CAN staff. Upon initial screening, each vehicle gets one of four color-coded tags that help visually identify the status of each vehicle. Individuals who meet all program eligibility requirements and fail an emissions screen are then given an $850 voucher that can be redeemed at a participating STAR smog shop for qualified emissions repairs. Eight to 12 participating smog shops have representatives on-site at each event so that customers can schedule an appointment at a shop most convenient for them. Valley CAN estimates that each participating smog shop ultimately repairs 20 to 30 vehicles per event.

Compliance with the local residence requirement was high. Less than 1 percent of Tune In & Tune Up attendees lived in counties outside the SJV. A total of 346 unique customers out of 42,014 resided in other counties. Moreover, there were only 52 attendees who owned their car for less than six months before attending a Tune In & Tune Up event, suggesting that the program successfully discouraged needless attendance. Finally, owners of only 11 vehicles that did not fail emissions testing were provided with a voucher that they ultimately used for a repair at a smog shop.

Profile of Tune In & Tune Up Attendees

Another measure of the effectiveness of the program is its reach in terms of total attendees, representation across the Valley, and consistency. Valley CAN has recorded 41,688 unique attendees at its events since 2012, meaning about 4 percent of the region's households have attended an event; this is seen in Table 1. The percentage of attendees from each county generally mirrors the relative population of each county in the SJV, with smaller counties tending to be overrepresented. This makes sense given that Tune In & Tune Up events rotate between counties on a biweekly basis. Fresno County residents comprised the highest percentage of Tune In & Tune Up attendees, with approximately 21 percent. The second-highest was Kern, with 17 percent. These two counties also have the highest reported populations in the SJV.

Table 1: Number of Attendees by Resident County as Compared to Total Population

County	Population	Percent of Total SJV Population	Number of Unique Attendees	Percent
Fresno	956,749	23.5%	8,887	21.3%
Kern	865,736	21.2%	6,963	16.7%
Kings	150,998	3.7%	2,266	5.4%
Madera	153,187	3.8%	3,186	7.6%
Merced	263,885	6.5%	3,865	9.3%
San Joaquin	708,554	17.4%	6,459	15.5%
Stanislaus	527,367	12.9%	4,833	11.6%
Tulare	454,033	11.1%	5,209	12.5%
Grand Total	**4,080,509**	**100.0%**	**41,668**	**100.0%**

Source: Valley CAN and U.S. Census Bureau, 2017

Table 2 shows the average attendance per event each year. The average number of customers at each Tune In & Tune Up event is 392. While there is substantial variation in the number of attendees reflecting county size and seasonality, yearly attendance has remained remarkably constant over the last several years and by event, except for a slight increase in pent-up demand boosting attendance at the outset of the program. The reliability of a program event being held in each county several times per year likely contributes to consistency in attendance.

Table 2: Average Attendance Per Event (by Year)

Year	Mean	Median	Range
2012	439	455	336 – 537
2013	394	394	218 – 591
2014	396	408	236 – 498
2015	381	401	156 – 552
2016	390	389	219 – 507
2017	397	431	270 – 455

Source: Valley CAN

Valley CAN records how attendees learned of Tune In & Tune Up events in order to gain information regarding the effectiveness of its outreach and advertising. Program staff began consistently tracking how attendees learned of events starting in November 2013. As seen in Table 3, over half of customers learned about Tune In & Tune Up through the radio, with "word of mouth" as the next highest means, with approximately 17 percent share, and smog shop third with 9 percent. In other words, the methods that have been most effective in reaching eventual attendees are mostly more traditional forms of local media or interpersonal outreach. Moreover, program staff note that many attendees report hearing about events on Spanish-language radio while driving their vehicles.

Table 3: How Attendees Heard About Tune In & Tune Up Events

Source	Total	Percent of Total
Radio	15,191	51.3%
Word of Mouth	4,914	16.6%
Smog Shop	2,749	9.3%
Newspaper/Flier	2,121	7.2%
Television	1,863	6.3%
N/A and Other	1,557	5.3%
Facebook/Internet	1,004	3.4%
Multiple Sources	210	0.7%
Total	**29,609**	**100.0%**

Source: Valley CAN

Table 4: Per Repair Costs

	Valley CAN Funding	Out-of-Pocket Customer Cost	Total Cost
Mean	$704.71	$95.70	$800.41
Median	$824.62	$0	$829.70
Standard Deviation	$251.46	$222.19	$374.17

Source: Valley CAN

Successful Repairs and Associated Program Expenditures

A final set of measures of program efficiency that we explored was attrition within the program, the total cost of the program, and the effective pass-through of funds to program participants as compared to similar investments or programs. Program attrition matters both in terms of the time program staff spend on supporting individuals who ultimately do not benefit from the program and the welfare loss to individuals who attend an event and potentially visit a smog shop but ultimately have no repairs done. Out of the individuals offered a smog repair voucher at a Tune In & Tune Up event, 78 percent redeemed their voucher at a smog shop, and of those, 87 percent completed full repairs after their car underwent testing and diagnostics.[3] Approximately 3,450 SJV customers declined repair at a smog shop, and over 17,250 completed full repairs.

Table 4 outlines the distribution of per-customer financial assistance that Valley CAN provided for repairs, as well as the distribution of out-of-pocket costs borne by customers.[4] The total average cost per repair was $800, substantially higher than the $500 offered by the statewide California BAR program. The Valley CAN program's higher amount may thus induce repairs that would be infeasible in other programs. On average, customers bore 12 percent of the total cost of repairs. Fifty-six percent of customers who received repairs, however, did not have to pay anything out of pocket, which also highlights the financial benefit of this program for low-income individuals unable to pay for repairs.

Based on the data provided to us, from mid-2012 to April 2017, Valley CAN directly distributed over $12.7 million[5] in funds, the majority of which was used by customers to repair their vehicles and thus resulted in direct benefits to the region's households.[6] This equates to roughly $2.7 million annually allocated to 4,500 annual customers.

Other important points of comparison for the cost of the program are to other investments recently made in the region that support cleaner alternatives for mobility than the status quo.[7] For instance, the EFMP Plus Up program provided $2.9 million in direct incentives to retire residents' existing gross-polluting vehicles and get 361 cleaner vehicles into the hands of Valley residents in its first year of operation in the region, 2015-2016 (calculated based on data from Pierce and DeShazo, 2017). Data on transit investments and households' impact in the region is harder

[3] Valley CAN has examined the determinants of this attrition and is working on reducing this rate as much as possible.

[4] The total number of entries included in these calculations includes all repeat visitors who were excluded from the above analysis. We include repeat visitors because the cost of repair for those vehicles is still relevant.

[5] The average Valley CAN cost from all voucher redemptions, including customers who only did testing and diagnostics, was $614.51. That value multiplied by approximately 20,700 total voucher redemptions (including repeat customers) is approximately $12.7 million.

[6] Valley CAN estimates its overhead rate for the program at around 25 percent. Obtaining or calculating overhead rates for other comparable social benefit programs is difficult as they are not often readily disclosed. The Tune In & Tune Up overhead rate seems appropriate, however, given that the program involves multiple verification steps and places a large emphasis on outreach and in-person communication at events, which allows it to effectively reach its target population. Moreover, the Tune In & Tune Up program not only provides smog repair assistance but also links households up to other household benefit and pollution-mitigation programs for which they may be eligible, including the EFMP Plus-Up and low-cost automobile insurance programs. At Tune In & Tune Up events, participants are also offered health screenings, financial advising, and other services from local businesses, which highlights the program's ability to build and maintain community networks. Valley CAN staff aim to make Tune In & Tune Up events potential hubs for attendees to sign up for a whole range of other programs, which will substantially lower the cost of existing duplicate outreach and enrollment efforts across these programs.

[7] We do not know the overhead or operations costs for these investments, although we note that the EFMP Plus-Up pilot in the region was run under the umbrella of the Tune In & Tune Up program.

to compare to Tune In & Tune Up. However, in 2017, the San Joaquin Regional Transit District spent about $10.2 million to upgrade its BRT Express Route fleet from 44 percent to 100 percent electric (Descant, 2017). While all-electric buses will be the first of their kind in the U.S., this investment is limited to 12 routes in one metro area of the region. The limited scope of hyper-clean mobility investments in terms of residents or regional geography affected compared to Tune In & Tune Up illustrates the need for complementary approaches of programs such as Tune In & Tune Up that can reach a broader group of individuals in the region who otherwise will continue driving polluted cars.

Findings:

Environmental Impact

In addition to efficiency outcomes, we assess the environmental impact of the Tune In & Tune Up program by analyzing whether the program attracted attendees with vehicles most likely to be contributing substantially to air emissions.

Moreover, registration of the participating vehicle fleet with the California Department of Motor Vehicles was considered, given that any repairs made on unregistered vehicles were likely not included in the state's current emissions estimation models and thus represent a novel source of emissions reductions.

Vehicle Fleet Characteristics

Models, Makes, and Vehicle Type

The 10 most prevalent vehicle makes and models make up about 25 percent of the entire vehicle fleet attending Tune In & Tune Up events. As shown in Table 5, the top 10 vehicles comprise a mix of six passenger vehicles and four trucks. The makes and models of the vehicle fleet are very similar to the most sold vehicles in the United States each year; nine of the 10 are listed in the top 20 best-selling vehicles in 2016 as reported by Business Insider. The only vehicle type not listed is the Ford Ranger, which has not been produced since 2012 (Max, 2011; Zhang, 2017). In addition to being generally representative of the U.S. fleet in terms of vehicle type, the Tune In & Tune Up program has served similar numbers of both passenger and truck vehicles; there were 22,813 passenger vehicles and 18,257 trucks reported. This proportional breakdown of passenger to truck light-duty vehicles almost exactly corresponds to the state fleet, which is 44 percent trucks (California Energy Commission, 2017).

Odometer Readings, Model Year, and Years Owned

More important for the purpose of emissions, however, the age of vehicles in terms of miles and year was substantially different from the general vehicle fleet. The model year and odometer reading distributions of Tune In & Tune Up event vehicles are depicted in further detail in Table 6. The average odometer reading recorded among the Tune In & Tune Up vehicle fleet was 182,188 miles. On average, vehicles had been owned by the customers for five years at the time of their event attendance, and the average vehicle model year was 1997.

By comparison, the average age of light vehicles (cars and trucks) in the United States was 11.6 years, as reported by IHS Markit (IHS Markit, 2016). This average aligns with results from the 2010-2013 California Household Travel Survey, which found that the majority of vehicles on the road were made between 2000 and 2010 (California Department of Transportation, 2013). In other words, the vehicles attending Tune In &

Table 5: Top 10 Vehicle Makes & Models Brought by Tune In & Tune Up Attendees

Vehicle Make & Model	Percentage of Total (n = 41,668)
Honda Accord	5.68% (2368)
Honda Civic	4.47% (1862)
Toyota Camry	3.13% (1303)
Chevrolet Silverado	2.29% (953)
Ford F150	1.98% (827)
Toyota Corolla	1.97% (822)
Nissan Altima	1.56% (648)
Nissan Sentra	1.51% (631)
Ford Ranger	1.48% (617)
Ford Explorer	1.42% (590)

Source: Valley CAN

Table 6: Tune In & Tune Up Vehicle Characteristics

Vehicle Fleet Characteristic	Mean	Median	Range
Odometer Reading (Miles)	182,188	178,354	1,017 – 698,941
Vehicle Model Year	1997	1998	1966 – 2014
Years Owned	5	3	Several months – 45
Registered at DMV	65%	N/A	N/A
Insured	84%	N/A	N/A

Source: Valley CAN

Tune Up events were nearly twice the age of the average U.S. vehicle. A California Air Resources Board report identifies the highest-emitting group as vehicles from 1992 and older; approximately 20 percent of the vehicles in the TI&TU program fall into that category (Cackette, Wallauch, Hedglin, and Ford, 2012); and a RAND report shows that 39 percent of reactive organic gas and nitrogen oxide emissions come from 15-year-old or older vehicles (Dixon and Garber, 2001).

Registration

Moreover, 35 percent of the vehicle fleet examined at Tune In & Tune Up events was unregistered with the California Department of Motor Vehicles at the time of the event. By contrast, a 2004 Bureau of Transportation Statistics field study investigated registration rates of light-duty vehicles in California and observed unregistration rates of 3 to 8 percent, which is significantly lower than the Tune In & Tune Up rate (Younglove et al., 2004). There are two potential explanations for the large discrepancies between the registration rates of the typical California vehicle fleet and the vehicles attending Tune In & Tune Up events: an undercounting of unregistered vehicles statewide, or an overrepresentation of unregistered vehicles in the region and at Tune In & Tune Up events compared to the statewide average.

Valley CAN program staff statements and our interviews with program participants indicate that this high prevalence of unregistered vehicles was due to the uncertainty or inability of these vehicles to pass a smog check without considerable repairs, which their owner did not have the means to finance. This explanation is supported by the program's allowance that, in lieu of a day-of emissions test, attendees can bring a Vehicle Inspection Report (VIR) to the event as proof of a previous failed emissions test at a smog shop to receive vouchers for smog repair. Approximately 20 percent of Tune In & Tune Up vehicles bring such a VIR report to each event. This discrepancy may also highlight undercounting of underregistered vehicles statewide (Mérel and Wimberger, 2012).

Approximately 16 percent of vehicles have been self-reported as uninsured. This value was highest in 2012, when the percent of cars listed as uninsured was 25 percent, but the value has remained relatively constant around 15 percent since 2013. According to recent statistics released by the Insurance Research Council, it appears that the vehicle fleet at Tune In & Tune Up events has similar insurance rates compared to California's drivers as a whole (Megna, 2017).

Emissions Failure Rates

As described above, BAR-97 two-speed idle tests are conducted on vehicles attending Tune In & Tune Up events to determine eligibility for a smog repair voucher. These tests are meant for field use without the use of a dynamometer and are limited to measuring hydrocarbons (HC) and carbon monoxide (CO). Given that Tune In & Tune Up vehicles are significantly older than the average vehicle fleet, it is not surprising that they would have a significantly higher smog test failure rate than the fail rate of the vehicle fleet in California, which is approximately 10 percent (Reese-Preese, 2016; California Bureau of Automotive Repair, 2017). However, the magnitude of the difference was unexpected. Around 60 percent of Tune In & Tune Up vehicles failed the on-site emissions screen for HC and CO. Within the region, Stanislaus had both the highest failure rate of 69 percent and the highest percentage of customers who brought in a vehicle with a failed VIR, at 35 percent.

We conducted further multivariate statistical modeling of the correlates of emissions failure for vehicles at Tune In & Tune Up events. We found that in addition to the factors of owning a vehicle with an older model year and higher odometer readings significantly influencing emissions test failure, living in areas with higher CalEnviroScreen $PM_{2.5}$ percentiles was also associated with failure. This suggests that emissions reductions via repairs funded by the Tune In & Tune Up program benefited neighborhoods with outsized air pollution burdens within the region.

Cost-Effectiveness of Air Quality Benefits (Moyer Calculations)

CO, HC, and nitrogen oxides (NOx) are three compounds released in vehicle exhaust, which contributes to air pollution and ozone formation, and is known to cause negative health effects (Brugge et al., 2007). To quantify the air quality benefits of the Tune In & Tune Up program, the pre- and post-repair emission values for these three pollutants were used to calculate annual emission reductions for each repaired vehicle, using the California Air Resources Board's light-duty vehicle emissions calculation methodology described in the Carl Moyer Program Guidelines (CARB 2008). These guidelines provide formulas that convert the testing measurements into Federal Test Procedure emission rates (grams/mile) and account for vehicle model year, vehicle weight, and other characteristics in estimating emission reductions. These formulas were input into Salesforce by Jeffrey Williams of the UC Davis Resource Economics department, and for each repaired vehicle entry, the necessary data components were extracted and used in the calculations.[8] The pre- and post-repair emission measurements used in these calculations were sent to Valley CAN from the smog shops that completed the repairs.

The Moyer calculations described above estimate that as of mid-April 2017, repairs in the SJV counties resulted in the average annual reduction of approximately 635,000 pounds (315 tons) of HC, CO, and NOx, and total reductions of 3,800,000 pounds (1,900 tons) over the entire study period, with the assumption that the abatement associated with repairs diminishes linearly in the years post-repair (Mérel, Smith, Williams, and Wimberger, 2014). The calculated comparative reductions in each county align well with the percent of total customers in each county, as well as with total Valley CAN expenditures. Therefore, the cost-effectiveness of Tune In & Tune Up thus far is approximately $6,700 per ton of emissions reduced overall during the study period.[9]

Findings:

Program Reach and Equity at the Neighborhood Level

At the broadest level, the Tune In & Tune Up program's focus on the SJV was designed based on scholarly and legislative recognition that the region was the most in need of transportation-related, environmental-justice oriented investments in California. In addition to demonstrating the overall impact and reach of the program, we also consider the distribution of the program's benefits within the Valley.

Within the region's eight counties, we find that there were only 19 census tracts, or neighborhoods, out of a total of 760 in the region that did not have any reported attendance at Tune In & Tune Up events during 2012-2017. Moreover, the year with the lowest number of tracts that received a benefit from the program was 667, or 88 percent of all neighborhoods in the Valley. These remarkably high levels of engagement and equity in distribution to nearly every neighborhood in the region reflects the work of Valley CAN and other stakeholders in ensuring that the announcement of events was broadcast widely in the SJV.

[8] The majority of vehicles underwent Accelerated Simulation Mode (ASM) testing at smog shops, which involves testing for CO, HC, and NOx in simulated driving conditions. A smaller percentage of vehicles underwent Two-Speed Idle (TSI) testing, and for those vehicles, only CO and HC emissions were measured. Estimated emission reductions for all three pollutants were calculated for these vehicles, using California Bureau of Automotive Repair-sourced formulas (DeFries, 2001).

[9] This calculation excludes counties other than the SJV but includes duplicate customers.

There was some concentration of attendees within certain neighborhoods in the region. Within each county, neighborhoods closer to event sites (which were also more populated) were more likely to have higher numbers of attendees than outlying neighborhoods. Moreover, 9 percent of all visits by unique customers were concentrated within 15 neighborhoods, which had an average CalEnviroScreen score of 86, as compared to the SJV average of 72. On the other hand, among the 19 census tracts with no attendance at Tune In & Tune Up events, the average CalEnviroScreen score was only half of the average score for all of the SJV, and the average particulate matter ($PM_{2.5}$) percentile was only 41, as compared to an overall score of 89 for the SJV. These differences suggest that the population in neighborhoods that have not attended Tune In & Tune Up do not face environmental justice challenges to the same extent as the region as a whole.

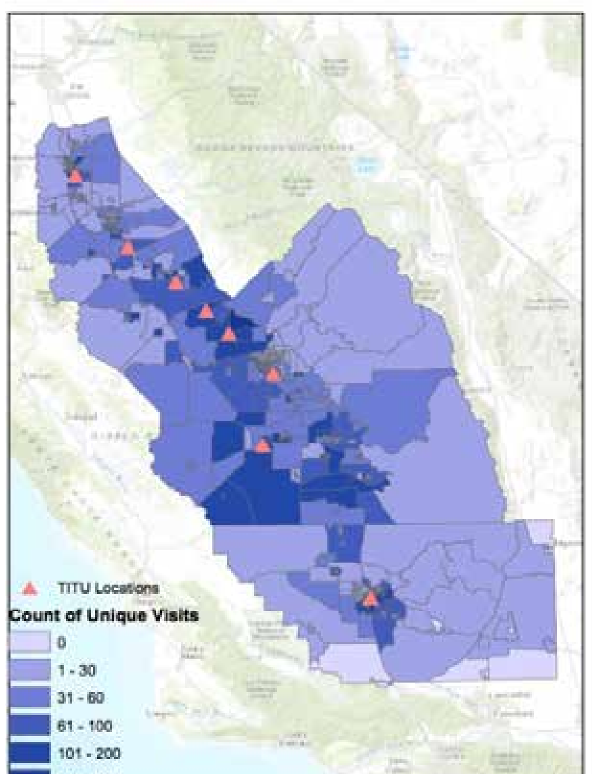
Neighborhood-Level Factors Influencing Participation and Benefit Distribution

We employed multivariate statistical analysis to further understand factors potentially influencing variation in neighborhood-level participation and benefits from the program. We analyze three important outcome variables at the neighborhood level: number of attendees per capita, number of repairs per capita, and successfully redeemed funds for repair per capita. Using publicly available data on neighborhoods within the region, we model these outcomes as a function of the following factors, which we hypothesize may explain program involvement at the neighborhood scale:

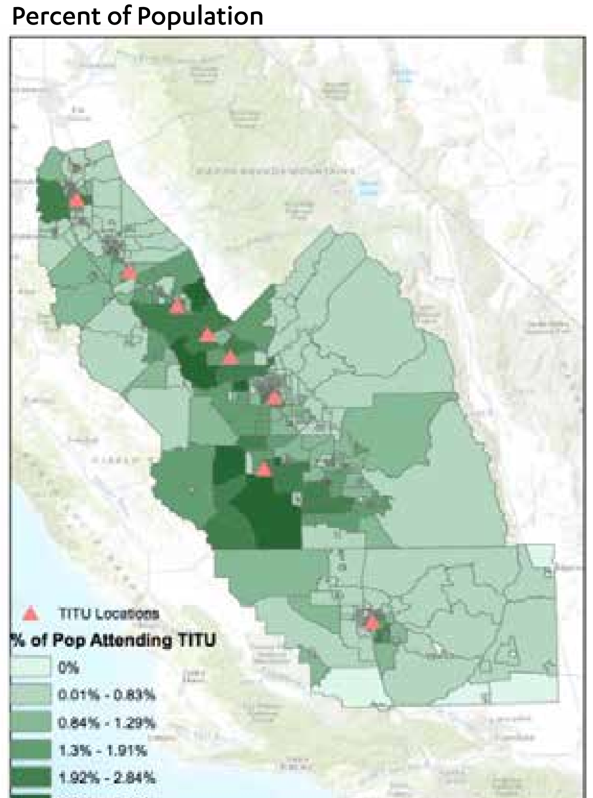
- total population
- race/ethnicity
- income and poverty levels
- travel behavior
- environmental pollution burden

Figure 2:
Tune In & Tune Up Attendee Distribution by Census Tract, SJV Counties

Total Count



Percent of Population



Sources: CalEnviroScreen 3.0, OEHHA American Community Survey

0 50 100 200 Kilometers

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, Increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and GIS User Community

Table 7: Multivariate Model of Neighborhood Characteristics Influencing Tune In & Tune Up Program Involvement

Independent Variable	Model 1: Attendees per person	Model 1: beta weights	Model 2: Repairs per person	Model 2: beta weights	Model 3: Funds for repairs per person	Model 3: beta weights
Population	-2.53e-07 (9.16e-08)**	-.08	-1.43e-07 (4.29e-08)**	-.10	-.0000983 (.0000306)**	-.10
Non-Hispanic White	-.0000467 (.0000162)**	-.09	-5.92e-06 (7.56e-06)	-.03	-.0013959 (.0053999)	-.009
Hispanic	.000098 (.0000156)**	.27	.0000354 (7.32e-06)**	.21	.0246967 (.0052254)**	.21
Solo Driver	-.0000161 (.000034)	-.02	3.75e-07 (.0000159)	.0009	.0012233 (.0113686)	.004
Average Commute Time	-.0000342 (.0000447)	-.02	-5.40e-06 (.0000209)	-.008	-.0027487 (.0149469)	-.006
Median Household Income	-6.711e-08 (2.14e-08)**	-.17	-3.19e-08 (1.00e-08)**	-.18	-.0000239 (7.15e-06)**	-.19
Percent of Households in Poverty	3.50e-06 (.0000338)	.006	-1.39e-06 (.0000158)	-.005	-.008274 (.0112931)	-.04
CalEnviroScreen 3.0 Score	.0001016 (.0000251)**	.19	.0000681 (.0000117)**	.27	.0511195 (.0083718)**	.29
CalEnviroScreen PM Percentile	.0000429 (.0000143)**	.10	.000023 (6.67e-06)**	.12	.0162888 (.0047618)**	.12
Constant Term	.0076819 (.0039176)*	N/A	.0011811 (.0018326)	N/A	.5803907 (1.308596)	N/A
Model Statistics	N=, Adjusted R^2	751, .4051	N=, Adjusted R^2	751, .3905	N=, Adjusted R^2	751, .3732

Notes: **p < .05. **p-value < .01. Omitted category for race/ethnicity is all other race.*

To measure these factors, all but the final category of environmental pollution burden data were derived from the 2011-2015 American Community Survey, a product of the U.S. Census Bureau. Pollution burden data were obtained from the CalEnviroScreen 3.0.

In Table 7, we show the results of ordinary least squares (OLS) models[10] using the three outcomes of interest. We report coefficients, standard errors and beta weights for each independent variable. Variance inflation factors are low for each model iteration, suggesting that our models present little cause for concern regarding collinearity between independent variables, and are well specified. County dummy variables were also considered as control factors but ultimately not included in our preferred specifications as they did not change the sign or magnitude of any independent variables that were found to play a significant role in our preferred specifications.[11]

The results of each model are remarkably similar despite the change in dependent variable, suggesting that different levels of involvement in the program are explained by similar factors. In summary, we find that the program effectively distributed more of its benefits to neighborhoods in the SJV that had lower incomes, higher percentages of Hispanic households and greater environmental pollution burdens than the regional average. This illustrates that the Tune In & Tune Up program successfully addressed equity considerations in its design.

Decreasing population was also associated with more program involvement, which is likely explained by the strictly rotating nature of Tune In & Tune Up events across the Valley. Travel behavior characteristics were not found to be significantly correlated with levels of program involvement.

[10] Alternatively, we ran versions of each model with the natural log of the dependent variable as the outcome of interest to best approximate a normal distribution (results available upon request). However, the results of each regression do not vary substantially from the linear versions, and we thus prefer linear specifications.

[11] We also explored potential temporal trends in explanatory factors by running separate year models but also remarkably consistent across time as no major changes from aggregated model.

Conclusion

This report examines the performance of the Tune In & Tune Up smog repair program financed by the SJVAPCD and operated by Valley Clean Air Now in the San Joaquin Valley of California. The program has taken a community-organizing approach to improving regional air quality by targeting high-emitting light-duty vehicles in state-designated disadvantaged communities. We find that the program not only has reduced vehicle emissions in the most environmentally disadvantaged region of the state but also has done so in an efficient manner that accomplishes equity in opportunity and benefit distribution.

Accordingly, features of program design and administration should serve as potentially replicable models for how others might incorporate the guidance given by the California legislature for future environmental justice programs in the state. More broadly, smog repair programs similar to Tune In & Tune Up should be considered as a complementary approach to meeting air quality standards in low- or moderate-density regions throughout the U.S. where the built environment does not allow for the cost-effective building out of a full-service transit network or where financing for zero-emissions vehicles is constrained.

A second-stage study that will expand upon the findings from this report is in progress. The project has three objectives: (1) quantify the annual and cumulative health and monetary benefits of the Tune In & Tune Up program based on five years of smog repair emission reduction data from 20,000 repaired cars; (2) conduct a cost-benefit analysis and identify the factors (including socioeconomic status and vehicle characteristics) that influence the cost-effectiveness of this program; and (3) compare the effectiveness and distributional equity at a neighborhood scale to similar programs operating in California. This research is interdisciplinary and draws upon methods from multiple fields. The implications of these findings are highly relevant to regional and state policymakers. This study will also inform the work of scholars studying best approaches to support transportation equity, health, and environmental justice, and the trade-offs and synergies between these goals.

Since 2012, the TI&TU program has provided over $12 million in direct financing for smog repairs to more than 20,000 unique, qualified residents of the SJV region. Photo: Tony Moreno/Valley CAN

Appendix 1. 2011-2015 American Community Survey Data on Key San Joaquin Valley Demographics

	California	SJV Counties Combined	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
TOTAL POPULATION	38,421,464	4,080,509	956,749	865,736	150,998	153,187	263,885	708,554	527,367	454,033
NUMBER OF HOUSEHOLDS	12,617,280	1,228,773	292, 550	257,737	41,108	42,723	76,516	217,343	168,090	132,706

	California: Total Number	Percent of Population	San Joaquin Valley: Total Number	As a Percent of Counties	Percent of Total County Population							
					Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
RACE												
Hispanic or Latino (of any race)	14,750,686	38.4%	2,048,280	50.2%	51.6%	51.0%	52.6%	55.6%	56.9%	40.1%	43.6%	62.4%
White alone	14,879,258	38.7%	1,419,866	34.8%	31.2%	36.6%	34.1%	36.3%	29.9%	34.3%	44.7%	30.7%
Black or African American alone	2,160,795	5.6%	180,167	4.4%	4.7%	5.3%	5.9%	3.2%	3.2%	6.7%	2.4%	1.3%
American Indian and Alaska Native alone	142,191	0.4%	20,773	0.5%	0.5%	0.6%	0.7%	1.1%	0.2%	0.3%	0.5%	0.7%
Asian alone	5,192,548	13.5%	302,350	7.4%	9.6%	4.4%	3.5%	2.0%	7.4%	14.5%	5.2%	3.2%
Other races	1,295,986	3.4%	109,073	2.7%	2.3%	2.1%	3.1%	1.8%	2.3%	4.1%	3.50%	1.60%
COMMUTING TO WORK												
Total Workers Above Age 16	16,869,052		1,509,758									
Car, truck, or van – drove alone	12,380,153	73.4%	1,168,536	77.4%	76.9%	77.8%	76.0%	77.1%	76.8%	76.6%	80.2%	76.5%
Car, truck, or van – carpooled	1,823,481	10.8%	205,550	13.6%	12.8%	13.9%	15.5%	13.2%	12.9%	14.8%	11.4%	15.6%
Public transportation (excluding taxicab)	881,550	5.2%	16,660	1.1%	1.3%	1.1%	0.9%	0.3%	0.8%	1.5%	1.0%	0.7%
Walked, worked from home, and other	1,783,868	10.6%	119,012	7.9%	9.0%	7.2%	7.6%	9.4%	9.5%	7.2%	7.5%	7.2%
COMMUTE TIMES												
Total Individuals Reporting Commutes	15,968,724		1,454,702									
Less than 5 minutes	319,461	2.0%	46,754	3.2%	2.7%	2.5%	5.8%	2.2%	5.1%	2.9%	3.6%	4.3%
5 to 9 minutes	1,311,080	8.2%	172,419	11.9%	9.9%	11.6%	15.2%	11.1%	14.8%	10.7%	12.9%	14.7%
10 to 20 minutes	4,538,292	28.4%	511,974	35.2%	39.4%	36.3%	35.4%	32.2%	34.6%	31.1%	32.4%	34.9%
20 to 30 minutes	3,264,954	20.4%	287,322	19.8%	23.1%	21.6%	16.6%	15.6%	15.7%	18.3%	18.3%	17.3%
30 to 34 minutes	2,402,613	15.0%	160,020	11.0%	11.7%	11.6%	9.9%	17.7%	7.6%	9.9%	10.8%	10.8%
35 or more minutes	4,132,324	25.9%	276,213	19.0%	13.1%	16.4%	17.1%	21.2%	22.2%	27.1%	22.0%	18.0%
INCOME AND BENEFITS (IN 2015 INFLATION-ADJUSTED DOLLARS)												
Total Individuals Reporting Income	12,717,801		1,240,249									
Less than $25,000	2,594,624	20.4%	327,714	26.4%	28.2%	26.1%	25.4%	27.1%	28.6%	23.5%	24.0%	29.7%
$25,000 to $34,999	1,134,601	8.9%	142,362	11.5%	12.1%	11.2%	11.5%	11.7%	12.9%	9.9%	11.4%	12.6%
$35,000 to $49,999	1,528,711	12.0%	174,387	14.1%	13.6%	13.4%	16.3%	16.0%	15.1%	13.4%	14.4%	15.0%
$50,000 or more	7,459,865	58.7%	595,786	48.0%	46.0%	49.3%	47.0%	45.2%	43.4%	53.1%	50.1%	42.6%

	California Values	SJV Values	Fresno Values	Kern Values	Kings Values	Madera Values	Merced Values	San Joaquin Values	Stanislaus Values	Tulare Values
Median household income (dollars)	$61,818	$46,713	$45,233	$49,026	$46,481	$45,073	$42,462	$53,274	$50,125	$42,031
Mean household income (dollars)	$87,877	$63,201	$63,314	$65,917	$63,232	$59,598	$58,398	$70,520	$65,947	$58,678
Per capita income (dollars)	$30,318	$19,797	$20,408	$20,644	$18,707	$17,970	$18,204	$22,645	$21,922	$17,876

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