TR1: Clean Air Teleworking

Brief Summary:
The primary objective of the Clean Air Teleworking measure is to increase the number of employees who telework in the Bay Area, especially on Spare the Air days, by providing outreach and assistance to employees and employers.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, toxic air contaminants and greenhouse gases by reducing vehicle use associated with commuting throughout the Bay Area, especially on poor air quality days.

Travel Market Affected:
This measure would affect intraregional and inter-regional commute travel for people who work in the Bay Area.

Regulatory Context and Background:
Since July 1, 1995, each state agency has been required to implement a telecommuting plan as part of its telecommuting program in work areas where telecommuting is identified as being both practical and beneficial to the organization. In 2008, state policy went further when then Governor Schwarzenegger signed Executive Order S-04-08 encouraging telecommuting to ease congestion in the Sacramento area during the temporary closure of Interstate 5.

The state's policies on telecommuting are based on the theory that "appropriately planned and managed, telework is a viable work option that can benefit managers, employees, and customers of the State of California." According to the state's Executive Order, a good telework program increases the state's ability to respond to emergencies, amplifies effective use of new technologies within state service, and improves employee morale, which results in increased job effectiveness.

At the regional level, in 1995 the Association of Bay Area Governments (ABAG) operated a regional telecommuting assistance program. The program was funded through a grant of $185,000 from the Air District. The objective of the program was to eliminate automobile trips by increasing the number of people telecommuting to work. The Bay Area Telecommuting Assistance Project was a partnership of ABAG and the Alameda County Transportation Commission (then called the Alameda Congestion Management Agency), who provided matching funds.

ABAG's Telecommuting Assistance Project targeted employers with 100 or more employees to reduce the number of automobile trips to their work site. The project provided regional information and referral service to all employers and public agencies interested in telecommuting. The project also included one-on-one implementation assistance to selected employers. ABAG staff also developed and provided training for employee transportation

coordinators on how to implement a telecommuting program. After a couple years of funding, ABAG's telecommuting program ended due to limited staff funding.

Bay Area Commuter Benefits Program; Alternative Benefit Option
The Bay Area Commuter Benefits Program includes a provision for employers to propose an alternative commuter benefit (Option 4). The alternative option may be especially relevant for employers whose work sites are not well served by transit. In March of 2015, the Air District and MTC developed an Option 4 Guide, which is intended to assist employers in developing and implementing an alternative commuter benefit, pursuant to Option 4.

Option 4 includes teleworking as a primary measure for employers in the region. For the purpose of administering a telework program, the Air District and MTC recommends that employers implement a companywide telework policy, and suggest that employees who participate in teleworking do so at least once per week on a regular basis.

Implementation Actions:
MTC will:
- Continue to provide support to employers for regional telecommuting programs in partnership with 511 Rideshare and the Bay Area Commuter Benefits Program.
- Continue to fund MTC's Regional Climate Initiatives Program: Innovative Grants.
- Initiate a Telecommute Pilot Project as part of the 2040 Plan Bay Area.

The Air District will:
- Include Spare the Air notifications to all Employer Program members that include the promotion of teleworking/telecommuting on Spare the Air Days.

Emission Reductions:

Pollutants*	2020	2030
ROG	1,474	620
NO_x	886	389
$PM_{2.5}$	157	118
PM_{10}	374	282
DPM	475	390
TACs	0.20	0.15
CO_{2e}	430,675	319,517

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
MTC's regional travel demand model (Version 0.3 of Travel Model One) was used to estimate the VMT impacts of this measure. The California Air Resources Board emission model (EMFAC 2014) calculated pollutant impacts. CO_2 conversion/equivalency factors were used to estimate the emission reduction benefits for the criteria pollutants and mobile source air toxics (MSATs). MTC's regional travel demand model provides the framework for simulating the impacts of

telecommuting, including assumptions regarding employment status and whether or not individuals choose to work at home or not on a given day.

Exposure Reduction:
This measure will reduce air pollution emitted by vehicles and therefore will reduce the concentration of air pollution that people are exposed to on a daily basis. Impacted communities near freeways and roads with significant auto and truck traffic will benefit.

Emission Reduction Trade-offs:
None identified.

Cost:
Cost estimates are not available for this measure.

Co-benefits:
Telecommuting benefits both the employer and the employee. Employers gain an increase in productivity, a reduction in office space costs, improved employee retention, and a reduction in recruiting and training costs. Telecommuters benefit from having less stress associated with commuting, and spending more time with family and friends, rather than commuting.

Issues/Impediments:
The most common challenges to implementing a telecommuting program are convincing management to support the necessary scheduling and technological changes required for telecommuting and navigating through a number of legal issues relating to federal and state wage and hour laws. With the worker off-site, it becomes difficult to track time worked, overtime liability, and compliance with meal and rest periods.

Sources:
1. Noonan, Mary C., Glass, Jennifer L., *The Hard Truth about Telecommuting,* Monthly Labor Review, July 2012, http://www.bls.gov/opub/mlr/2012/06/art3full.pdf
2. California Government Code, Chapter 1389 Statutes of 1990, Section 14200 -14203 (as authorized by AB 2963 – Klehs)
3. Lewis, Patricia, A Feasibility Study of Implementing a Telecommuting Program at Booz-Allen and Hamilton, 1994 http://pfigliola.tripod.com/project.html
4. The Association of Bay Area Governments, the Bay Area Telecommuting Assistance Project, http://www.abag.ca.gov/abag/overview/pub/newsletter/svm295.html
5. Global Workplace Analytics, http://www.globalworkplaceanalytics.com/telecommuting-statistics
6. Maryland Department of the Environment, *Plan to Improve Air Quality in the Baltimore an, MD Region: State Implementation Plan (SIP) "Serious Area SIP",* July 2013

TR2: Trip Reduction Programs

Brief Summary:
The Trip Reduction measure includes a mandatory and voluntary trip reduction program. The regional Commuter Benefits Program, resulting from SB1339, and similar local programs in jurisdictions with ordinances that require employers to offer pre-tax transit benefits to their employees are mandatory programs. Voluntary programs include outreach to employers to encourage them to implement strategies that encourage their employees to use alternatives to driving alone.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, greenhouse gases, particulate matter and toxic air contaminants by reducing commute trips, vehicle miles traveled, and vehicle emissions.

Travel Market Affected:
This measure would affect commute trips for people who work in the Bay Area.

Regulatory Context and Background:
While commute trips make up less than a third of personal trips they tend to be longer distance trips and they make up most peak hour trips when traffic congestion is the worst. For these reasons, reducing commute vehicle trips can have a significant impact on reducing congestion and improving air quality.

Employees may choose to drive alone to work for a variety of reasons:
- Workplaces are not near transit or home locations.
- Barriers to ridesharing, e.g. information, personal preferences, lack of other riders, etc.
- Lack of pedestrian or bicycle connectivity to transit.
- Lack of “first mile” or “last mile” connectivity at origin or destination.
- Lack of bicycling amenities such as bicycle racks/lockers or showers at transit stations or workplaces.
- Availability of free (or underpriced) vehicle parking.

Mandatory Programs
Senate Bill 1339 authorized the Air District and the Metropolitan Transportation Commission to adopt and implement a Bay Area Commuter Benefits Program on a pilot basis through the end of 2016. The bill was modeled on local commuter benefit ordinances that have already been adopted by several Bay Area cities in recent years, including the cities of Berkeley, Richmond, and San Francisco (as well as San Francisco International Airport). In response to Senate Bill 1339, the Air District adopted Regulation 14, Rule 1: Mobile Source Emissions Reduction Measures, Bay Area Commuter Benefits Program. Shortly thereafter, MTC ratified the rule. Senate Bill 1128, approved September 2016, extended the Commuter Benefits Program indefinitely.

SB 1339 requires employers with greater than 50 employees to provide one of four alternative commute friendly strategies: 1) establish the option for employees to set aside pre-tax salary to pay for their transit or vanpool costs, 2) provide at least a $75/month transit subsidy to all employees, 3) provide a shuttle service from a transit hub to the work location, or 4) provide another approved alternative.

While it is assumed that all employers subject to SB1339 will implement a Commuter Benefits Program, MTC and the Air District support compliance through web-based self-help tools and other employer outreach efforts. Through 511.org, employers may access detailed employer assistance materials to select a commuter benefit option and an on-line registration process. Employer services representatives are also available in each county to offer employers with additional assistance through the 511 Regional Rideshare Program or local county programs.

Compliance with the Commuter Benefits Program is also monitored by Air District staff through verification of on-line registrations against lists of all Bay Area employers with greater than 50 employees. Air District staff conducts outreach to companies and government agencies subject to this Rule and participates in regular meetings with partners MTC and 511.org regarding implementation and management of the registration database. Staff also reviews alternative compliance plans from employers and complaints from employees for compliance with the Commuter Benefits Rule.

Voluntary Programs

The 511 Program has evolved to keep pace with the changing needs of consumers, advances in technology, and the availability of travel data. MTC has delivered traveler information since the mid-1990s, when it launched a multi-modal telephone service and a separate regional transit information website. 511 is now a consolidated, comprehensive, multi-media, multi-modal traveler information service. While Bay Area 511 information is available via phone and web, there are slight differences in how the information is presented due to limitations of the media. Because of web capabilities, the 511.org website is able to offer broader information and more detailed and interactive information to users than what could reasonably be provided via the 511 phone service.

511 Rideshare is one component of the 511 Program. Historically, 511 Rideshare has reached out to employers to encourage them to implement strategies to reduce vehicle trips to their worksites. However, 511 Rideshare's mission is carpool and vanpool formation. Therefore, beginning in approximately mid-2016, 511 Rideshare will move from employer-focused outreach to commuter-focused outreach. The program will leverage partnerships with private sector carpool matching applications for ridematching, instead of maintaining its own ridematch system. 511 Rideshare will also include a permanent Vanpool Support Program to offset ongoing vanpool capital and/or operating costs, incentivizing vanpool service providers to form more vanpools.

The purpose of changing 511 Rideshare is to improve carpool and vanpool formation, embrace private sector innovation/tools, and get the biggest 'bang for the buck' out of limited program funds.

In 1991, the California State Legislature authorized the Air District to impose a $4 surcharge on motor vehicles registered within the San Francisco Bay Area to fund projects that reduce on-road motor vehicle emissions. The Air District has allocated these funds to its Transportation Fund for Clean Air (TFCA) program to fund eligible projects. The statutory authority for the TFCA and requirements of the program are set forth in California Health and Safety Code Sections 44241 and 44242.

Sixty percent of TFCA funds are awarded directly by the Air District to eligible projects and programs implemented directly by the Air District (e.g., Spare the Air, Plug-in Electric Vehicle Program) and to a program referred to as the TFCA Regional Fund. The remaining forty percent of TFCA funds are forwarded to the designated agency within each Bay Area county and distributed by these through the County Program Manager program. Approximately $4 million is allocated through the Regional Fund each year to support trip reductions projects, including shuttle and rideshare service, which reduce single-occupancy vehicle commute-hour trips by providing the short-distance connection between a mass transit hub and employment centers and rideshare projects that reduce single-occupancy commute-hour vehicle trips by encouraging mode-shift to other forms of shared transportation.

Trip Cap Programs
Multiple trip cap programs have been developed in Stanford, Menlo Park, Mountain View, Sunnyvale, and Cupertino. A "trip cap" restricts the number of commute trips into an employment site or into an employment area. For example, in Menlo Park, the trip cap at the Facebook East Campus restricts the number of vehicle trips allowed to the campus during peak commute periods, "Between 7AM and 9AM, Facebook East Campus may have no more than 2,600 vehicle trips. Hourly trip measurement must be provided to the City of Menlo Park, using sensors at driveway entrances. For each trip above the cap, Facebook shall pay a penalty of $50 per day per trip. After noncompliance over 6 months, the fee increases to $100 per day per trip."

Implementation Actions:
MTC will:
- Refocus 511 Rideshare on carpool and vanpool formation.
- Create a Vanpool Support Program.
- As part of the Climate Initiatives Innovative Grants program, continue to fund travel demand management projects.
- Study new opportunities for Trip Cap program development in Plan Bay Area 2040.

The Air District will:
- Work with employers to support implementation and compliance with the Commuter Benefits Program.

- Continue to provide grants through the Transportation Funds for Clean Air (Regional Fund and County Program Manager Fund) to support trip reduction efforts.
- Encourage local governments to require mitigation of vehicle travel as part of new development approval, adopt transit benefits ordinances in order to reduce transit costs to employees, and to develop innovative ways to encourage rideshare, transit, cycling, and walking for work trips.
- Encourage transit agencies and shuttle providers to continue to implement and expand shuttle and feeder bus services to complement fixed route transit service and reduce the demand for parking at transit stations.

Emission Reductions:
Emission reductions for Commuter Benefits Program portion of this control measure are estimated as follows:

Pollutants*	2020	2030
ROG	61	41
NO_x	54	24
$PM_{2.5}$	10	10
PM_{10}	24	24
CO_{2e}	28,739	20,066

**criteria pollutants are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

Emission Reductions Methodology:
Emission reduction estimates are based on a 2015 analysis of the results of the Commuter Benefits Program over the first twelve months of the pilot project, *Commuter Benefits Program: Evaluation of Trip, VMT and Emission Impacts* Report, including participation rates in the program. That report is available here: http://www.baaqmd.gov/~/media/files/planning-and-research/commuter-benefits-program/reports/true-north-employee-survey-report_commuter-benefits-program_6_19_15-pdf.pdf?la=en) Reductions in vehicle miles traveled were estimated based on the results of a survey of employees who work for employers that are subject to the regulation, in combination with employer registration information. Years 2020 and 2030 emission factors were applied to estimated year 2015 vehicle trip reduction estimates, assuming continuation of the program into 2030.

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
Air District Commuter Benefits Program costs are estimated at $1.4 million per year. For TFCA funded projects, approximately $4 million is allocated per year to provide funding for existing shuttle/feeder bus and regional ridesharing services.

For MTC programs, Plan Bay Area funds trip reduction programs, including the 511 Rideshare program, Vanpool Support, and travel demand projects via the Innovative Grants program. Funds are programed through 2020, and equal approximately $2.6 million. Beyond 2020, $52.7 million is allocated toward these trip reduction programs.

Co-benefits:
- Reduced travel costs for employees.
- Reduced costs in provision of parking for employers.

Issues/Impediments:
Employers can experience the following barriers to Employer-Based Trip Reduction program implementation: insufficient employee interest, minimal perceived benefits to organization, lack of upper management support, and worksite's distance to public transit.

Sources:
1. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy, July 2013
2. Bay Area Air Quality Management District, Regulation 14, Rule 1: Bay Area Commuter Benefits Program, March 19, 2014
3. True North Research, Inc., Bay Area Commuter Benefits Program: Evaluation of Trip, VMT and Emission Impacts, June 19 2015
4. Transportation Fund for Clean Air, California Health and Safety Code, Sections 44241 and 44242 2

TR3: Local and Regional Bus Service

Brief Summary:
The Local and Regional Bus Service Improvements control measure will improve existing transit service on the region's core transit systems, and include new bus rapid transit lines in San Francisco, Oakland and Santa Clara County.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gases by improving bus service throughout the Bay Area.

Travel Market Affected:
This measure would affect intraregional travel, including commute travel, shopping, personal business, school trips, as well as social and recreational travel.

Regulatory Context and Background:
Over the next 28 years, operating and capital replacement costs for Bay Area transit providers are projected to total $161 billion. This includes $114 billion in operating costs plus $47 billion for capital replacement to achieve an optimal state of repair. Committed revenues over the same period are expected to total only $131 billion ($110 billion for operations and $21 billion for capital). The result is $30 billion in initial unfunded needs, approximately $26 billion of which is needed to bring the capital assets up to an optimal state of repair.

To address transit operating and capital needs, Plan Bay Area invests $13 billion in discretionary revenues. This includes more than $2 billion in discretionary revenue plus almost $2 billion in revenues that are expected to come from the new extension of the transportation sales tax in Alameda County to eliminate the $4 billion forecasted operating shortfall over the plan period. Another $9 billion in discretionary revenue will be invested in transit capital, leaving unfunded capital needs of $17 billion to achieve a state of optimal repair.

Plan Bay Area assumes that the region can attract approximately $2.5 billion in additional federal New Starts and Small Starts funding through 2040. Building on the successful delivery of Resolution 3434, and the results of the Performance Assessment and transit-specific project evaluation, Plan Bay Area's priorities for the next generation of federal New Starts and Small Starts funding include major rail and bus rapid transit (BRT) investments.

Along with identifying these significant future transit investments, Plan Bay Area also retains $660 million in financial capacity for projects that are in the planning stages. The $660 million New and Small Starts reserve, or a regional investment equivalent, is proposed to support transit projects that are located in or enhance transit service in the East and North Bay counties.

The Core Capacity Challenge Grant program commits $7.5 billion — including $875 million from Cap and Trade funds, $402 million in bridge toll revenues, and over $3 billion in federal

transportation funds — over 15 years for capital improvements to the region's largest transit systems: San Francisco Muni, BART and AC Transit. Over 80 percent of the region's transit riders, and 75 percent of low-income and minority riders, are accommodated by these three systems. The program would fund transit vehicle replacement, fleet expansion and key facility upgrades. To receive the money, operators would need to meet certain performance and efficiency objectives, and match 30 percent of the grant money with their own funds.

The Transit Performance Initiative (TPI) has two components – the Incentive program and the Investment program. The TPI Incentive program has an annual funding distribution of $15 million, based on a formula related to annual passenger increase, annual passengers per hour increase, and annual passengers, with large operators receiving 85 percent of total funding and small operators receiving 15 percent. The TPI Investment program is a competitive grant program with $82 million total split over three rounds. To date, two rounds have been awarded to fund projects to improve bus and light rail service, with a third round expected in 2015 or 2016.

Implementation Actions:
MTC will assist in the funding of:

- Operations of existing bus services where feasible with available funding ($2 billion)
- Regional Measure 2 Express Bus North Improvements ($20 million)
- Transit Performance Initiative – ongoing annual Incentive program, third round of Investment program ($500 million)
- Bus Rapid Transit Service on the Telegraph Avenue/International Boulevard/E. 14th Street Corridor ($217.8 million)
- Sustain all bus service and operations, including Express Buses, at existing level of service where feasible with available funding ($2.3 billion)
- Replace and/or rehabilitate buses, vans and electric trolley buses ($1.95 billion)
- Bus Rapid Transit Service on the Grand-MacArthur Corridor ($41 million)
- Bus Rapid Transit project on Van Ness Avenue to include dedicated transit lanes, signal priority and pedestrian and urban design upgrades ($125.6 million)
- In Santa Clara County, implement:
    - BRT improvements in the Santa Clara/Alum Rock route ($146.6 million)
    - King Road Rapid Transit Project ($61.9 million)
    - BRT improvements on El Camino Real/The Alameda Corridor ($233.7 million)
    - Bus Rapid Transit improvements along in the Stevens Creek Corridor ($165.8 million)

Supporting Actions by Partner Entities:

- Transit agencies and CMAs to work with MTC, as appropriate, to implement service improvement

Emission Reductions:

Pollutants*	2020	2030
ROG	7.65	2.98
NO_x	5.92	1.87
$PM_{2.5}$	0.86	0.57
PM_{10}	2.03	1.36
DPM	2.61	1.88
TACs	<0.01	<0.01
CO_{2e}	2,365	1,536

**criteria pollutants and TACS are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:

The emission reduction estimate for this measure is based on various transit projects. Project include: AC Transit's BRT route from Uptown Station to 20th Street and the Grand-MacArthur corridor; BRT on Van Ness corridor; Regional Measure 2 Express Bus North Improvements, and various BRT projects in Santa Clara County, including the Santa Clara/Alum Rock route, King Road, El Camino Real/The Alameda Corridor, and Steven Creek Corridor. AC Transit's East Bay BRT Final Environmental Impact Statement/Environmental Impact Report (Jan. 2012) methodology was used to estimate emission reduction benefits for both AC Transit's and Muni's BRT routes. This approach included the use of CARB's EMFAC model series to calculate CO2 emissions for motor vehicles by average operating speed for use in estimating total corridor on-road transportation CO2 emissions associated with the BRT projects. Emission reduction data was updated to reflect the current version of the EMFAC model, EMFAC2014.

Exposure Reduction:

This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:

None identified.

Cost:

See above implementation actions.

Co-benefits:

- Improved connectivity between transit services and destinations
- Travel time savings from new express/enhanced bus projects that provide faster and/or more direct service between trip origins and destinations
- New transit options may allow some households to own fewer or no automobiles
- Community enhancements through the creation of higher quality transit options and services

Issues/Impediments:
Implementation requires funding to be available for programs. Bay Area transit providers continue to face challenges in maintaining and sustaining their existing systems and, in light of financial constraints, are cutting transit budgets and service and increasing fares, and/or are delaying capital maintenance and service enhancements. Therefore, simply maintaining the existing fleet, sustaining service, and restoring service will require new funding sources. New revenues may come from higher gas taxes, bridge tolls and/or county-wide voter-approved sales tax revenues.

Source:

1. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy, July 2013

TR4: Local and Regional Rail Service Improvements

Brief Summary:
Improve rail service by sustaining and expanding existing services and by providing funds to maintain rail-cars, stations, and other rail capital assets. Specific projects for implementation include BART extensions, Caltrain electrification, Transbay Transit Center building and rail foundation, Capital Corridor intercity rail service, and Sonoma Marin Area Rail Transit (SMART) District commuter rail project.

Purpose:
The purpose of this measure is to reduce emissions of the key ozone precursors, ROG and NOx, as well as particulate matter, air toxics and greenhouse gases by sustaining and improving rail service throughout the Bay Area.

Travel Market Affected:
This measure would affect intra and inter-regional commute and non-commute travel.

Regulatory Context and Background:
Plan Bay Area relied on a transportation Project Performance Assessment, which, together with public involvement, helped identify priorities for the next generation of transit investments. These include improvements to the region's core transit systems, new bus rapid transit lines in San Francisco and Oakland, rail extensions that support and rely on high levels of future housing and employment growth, and an early investment strategy for high-speed rail in the Peninsula corridor.

MTC's Resolution 3434, a 2001 framework that identified regional priorities for transit expansion projects, has guided transit investments in the Bay Area. Resolution 3434 established the region's priority projects for federal New Starts and Small Starts funds, creating a unified regional strategy to secure commitments from this highly competitive national funding source. In 2012, the Bay Area secured commitments for nearly $2 billion in federal funding for its two most recent New Start projects — San Francisco's Central Subway and the extension of BART to Berryessa in Santa Clara County. These successes pave the way for a new generation of projects that can leverage current and future development patterns to create financially stable transit service in these corridors.

The Bay Area's rail system includes light-rail (such as Muni Metro and VTA Metro), rapid rail (such as BART), and commuter rail (such as Caltrain, Capitol Corridor and ACE) services. During weekday peak hours in 2010, heavy and commuter rail transit (combined) provided 58.6 million seat miles on a typical weekday in the Bay Area.

Originally adopted as part of the 2001 Regional Transportation Plan, MTC's Resolution 3434 Regional Transit Expansion Program is a long-term, and multifaceted funding strategy for directing local, regional, state and federal dollars to nearly two dozen high-priority bus, rail and ferry expansion projects.

MTC's Resolution 3434 – or Regional Transit Expansion Program – identifies the top priorities for new Bay Area transit projects. And it helps the region compete with other metro areas for state and federal funding.

Several Regional Transit Expansion Program projects are now under construction:
- AC Transit Oakland-San Leandro Bus Rapid Transit
- BART to Warm Springs/Milpitas/San Jose
- e-BART extension in East Contra Costa County
- Transbay Transit Center (Phases 1 and 2)
- Muni Central Subway
- Sonoma-Marin Area Rail Transit (open for service in late 2016)
- Transbay Transit Center

Among the many Regional Transit Expansion Program projects already in service are:
- BART-Oakland Airport Connector
- Caltrain Baby Bullet
- Capitol Corridor and ACE Service Expansions
- San Francisco Bay Ferry Service Expansion
- Regional Express Bus

A handful of Resolution 3434 projects are still several years away from completion:
- Caltrain electrification
- Caltrain extension to Transbay Transit Center
- Dumbarton Rail
- Muni Bus Rapid Transit

Implementation Actions:
MTC to fund:
- Extension of BART/East Contra Costa Rail (eBART) eastward from the Pittsburg/Bay Point BART station into eastern Contra Costa County ($493 million)
- Transbay Terminal Phase 1: construct the new Transbay Transit Center Building and rail foundation ($1.6 billion)
- Caltrain electrification, including replacement of railcars and an advanced signal system ($451 million)
- Transit operations needs through 2040 at existing service levels ($2 billion for operating costs)
- Rail expansion and enhancement projects ($2.2 billion)
- Transit access improvements to BART in the Tri-Valley ($168 million)
- Sonoma-Marin Rail lnitial Operating Segment ($360 million)
- Extension of BART from Fremont (Warm Springs) to San Jose/Santa Clara ($6.3 billion)
- Extension of Caltrain Express service (Phase 2) ($427 million)
- Transbay Terminal Phase 2: extend Caltrain to the new Transbay Terminal ($2.6 billion)
- Capitol Corridor: Phase 2 enhancements ($254 million)
- MUNI Third Street Light Rail Transit Project – Central Subway ($1.6 billion)

- Implement Bus Rapid Transit in Santa Clara County and provide light rail extensions ($1.1 billion total):
    - To the Eastridge Transit Center in East San Jose
    - From the Winchester Station to Route 85 - Vasona Junction
- Revenues forecasted to be available for High-Speed Rail within the region ($1.5 billion)

The Air District will:

- Assist with funding for the electrification of the Caltrain corridor ($20 million)

Emission Reductions:

Pollutants*	2020	2030
ROG	318	134
NO_x	155	68
$PM_{2.5}$	34	26
PM_{10}	81	61
DPM	103	84
TACs	0.04	0.03
CO_{2e}	93,099	69,070

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year (100 yr GWP)*

Emission Reduction Methodology:

Travel Model One produced all of the key outputs used in assessing the significance of local and regional rail service transportation impacts, including outputs such as vehicle miles traveled, vehicle hours of delay, and accessibility, as well as other outputs such as volume to capacity ratios and level of service.

This analysis uses existing ridership projections for rail developed by transit operators for each project. Growth factors, based on increases in each transit operator's ridership modeled as a part of the Travel Model One travel forecasts for Plan Bay Area, are applied to bring the ridership estimates to analysis year 2020. Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access rail, resulting in the number of vehicle trips reduced.

This analysis excludes estimates of emissions reduced from maintaining existing rail services and transit access improvements to BART, Caltrain, Sonoma-Marin Area Rail Transit (SMART), Capitol Corridor, ACE commuter rail systems and supporting infrastructure for high-speed rail. In addition, CO2 conversion/equivalency factors were used to estimate the emission reduction benefits for the criteria pollutants and mobile source air toxics (MSATs).

Exposure Reduction:

This measure will reduce air pollution emitted by vehicles and therefore will reduce the concentration of air pollution that people are exposed to on a daily basis. Impacted communities near freeways and roads with significant auto and truck traffic will benefit.

Emission Reduction Trade-offs:
None identified.

Cost:
See above Implementation Actions.

Co-benefits:
- Improved connectivity between transit services and destinations
- Travel time savings from providing new rail services that provide faster and more direct service between trip origins and destinations
- Transportation cost savings by providing new rail transit options that may allow some households to own fewer or no cars
- Community enhancements through the creation of more and higher quality transit options

Issues/Impediments:
Implementation requires available funding. Bay Area transit providers continue to face challenges in maintaining and sustaining their existing systems and, in light of financial constraints, are cutting transit budgets and service and increasing fares, and/or are delaying capital maintenance and service enhancements. Therefore, simply maintaining the existing fleet, sustaining service, and restoring service will require new funding sources. New revenues may come from higher gas taxes, bridge tolls and/or county-wide voter-approved sale tax revenues. Environmental clearance, right-of-way availability and the level of public support are major impediments to sustain, improve, upgrade, and expand regional rail service.

Source:
1. Metropolitan Transportation Commission, Association of Bay Area Governments, *Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy*, July 2013

TR5: Transit Efficiency and Use

Brief Summary:
This measure will improve transit efficiency and make transit more convenient for riders through continued operation of 511 Transit, full implementation of Clipper® fare payment system and the Transit Hub Signage Program.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gases by improving transit efficiency and use through financial incentives, improved real-time transit service information, coordinated fare payment and collection, and improved transit connectivity.

Travel Market Affected:
This measure would affect intra and inter-regional commute and non-commute travel.

Regulatory Context and Background:
Launched by MTC in 2002, 511 is a 24-hour, toll-free phone and Web service (511.org) that consolidates Bay Area transportation information into a one-stop resource. 511 provides up-to-the-minute information on traffic conditions, incidents and driving times; schedule, route and fare information for dozens of public transportation services; instant carpool and vanpool referrals; and bicycle routes and more.

MTC, in close coordination with the region's over two dozen Bay Area transit operators, continues to operate, maintain, and further develop the 511 Transit information system, which includes the 511 Transit website and its features: the 511 Transit Trip Planner, 511 Departure Times, 511 Popular Destinations, as well as schedule, fare, route and agency-specific information for the region's numerous transit operators.

511 Transit also provides special service announcements for changes to services or transit disruptions and promotion of special services for events. Transit information and tools are also provided via the 511 SF Bay Transit applications for smart phones as well as the 511 Mobile site at m.511.org. Users can also receive transit departure times via text message, e-mail alert, or on a personalized Transit Tracker display. A new feature, the Enhanced Trip Planner, compares transit-only trips with drive-to-transit trips and drive-only trips. The 511 Transit Trip Planner generates approximately 800 thousand to 1 million itineraries per month.

Clipper offers transit riders a convenient and secure way to pay fares on multiple transit agencies. The reloadable Clipper card stores value in the form of electronic cash. Clipper is currently available on Muni, BART, AC Transit, Caltrain, SamTrans, Golden Gate Transit & Ferry, VTA and SF Bay Ferry. Clipper can also be used on transit agencies in Napa and Solano counties and on Livermore-Amador Valley Transit Authority (WHEELS) in Alameda County, County Connection, WestCAT and Tri-Delta Transit in Contra Costa County. The Clipper network expanded again in the spring of 2016 to include Santa Rosa City Bus, Sonoma County Transit,

and Petaluma Transit in Sonoma County. Clipper also will be the fare payment method used by Sonoma-Marin Area Rail Transit (SMART) when it begins operation.

In 2010, Clipper began operating a pre-tax transit benefit program called Clipper Direct. Clipper Direct works with employers in the Bay Area to put cash value and transit passes directly onto Clipper cards using employees' pre-tax dollars. Clipper also has agreements with other pre-tax transit benefit providers so that customers of those programs can also use their transit benefits to put value onto their Clipper cards.

Currently, MTC and the participating transit agencies are beginning the planning process for the next version of Clipper. The current contract ends in 2019, and so the design phase for the new contract requirements has begun.

MTC, in partnership with transit operators, implemented the Hub Signage Program to address wayfinding signage, transit information and real-time transit information recommendations at 21 transit hubs and 3 airports. The design work for the Hub Signage Program at all 24 regional transit hubs was completed in 2012 and the entire program has been installed at all 24 Hubs.

Implementation Actions:
MTC will:

- Implement ridesharing measures (includes ride matching, vanpool services, and commute trip planning/consulting) ($14 million)
- Deploy, operate and maintain Clipper® on Bay Area transit agencies. Clipper® capital replacement costs for all operators are included and a portion of Clipper's operating costs ($584 million)
- Implement, operate and maintain wayfinding signage, transit information displays and real-time departure displays via the Hub Signage Program (HSP) ($10 million)
- Complete the Core Capacity study and fund grant projects via the Core Capacity Grant Challenge Program.

Supporting Actions by Partner Entities:

- Local governments and transit agencies to work with MTC on the Transit Hub Signage Program.
- Local governments, CMAs, transit agencies and other agencies to work with MTC to deploy, operate and maintain Clipper® and 511 Transit.
- Local governments are encouraged to implement programs that offer residents, students and employees free or discounted transit passes, such as Santa Clara's Ecopass program, and other innovations to encourage transit use.

Emission Reductions:

Pollutants*	2020	2030
ROG	15	6.23
NO_x	13	5.58
$PM_{2.5}$	0.23	0.17
PM_{10}	0.41	0.31
DPM	4.32	3.55
TACs	<0.01	<0.01
CO_{2e}	3,917	2,906

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
MTC developed a methodology to evaluate the expected emission reductions due to the expansion of the Clipper® program. The methodology calculates emissions reduction benefits based on time savings from using Clipper®. Time savings are realized from more efficient boarding resulting in shorter vehicle dwell times. While not explicitly captured by the analysis, there would be additional emission reductions resulting from Clipper® such as more reliable transit service through less vehicle bunching and shorter idling time at bus stops. The reduction in transit travel time increases transit ridership, thereby reducing emissions by offsetting automobile trips.

Route level transit operational characteristics from MTC's travel demand model provided average transit passenger miles per boarding, average transit travel time per boarding and average transit boarding per hour statistics which were input into the elasticity equations. In addition, current transit ridership (by operator) and current and projected Clipper® boardings were also put into emissions benefit calculations.

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
$608 million, see above implementation actions for details

Co-benefits:
- Improved transit customer experience
- Travel time savings

Issues/Impediments:
Implementation of this measure requires that funding is available for these programs. In addition, technological issues, institutional support, and market penetration are factors that may impede full implementation of 511 and Clipper®.

Source:

1. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy, July 2013

TR6: Freeway and Arterial Operations

Brief Summary:
This measure improves the performance and efficiency of freeway and arterial systems through operational improvements, such as implementing the Freeway Performance Initiative (FPI), the Bay Area Freeway Service Patrol (FSP), and the Arterial Management Program.

Purpose:
Implementation of this measure will reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gases by improving the efficiency of existing freeways and roadways throughout the Bay Area.

Travel Market Affected:
This measure would affect intra and inter-regional commute and non-commute travel.

Regulatory Context and Background:
Plan Bay Area supports MTC's Freeway Performance Initiative (FPI), which is designed to maximize the efficiency and improve the operations and safety of the existing freeway, highway and arterial network. FPI addresses both recurrent daily traffic that comes from the surge of commuters using the freeways during rush hours and nonrecurring congestion that results from unanticipated incidents and blockages of highway lanes. Half of all traffic congestion experienced in the Bay Area is caused by vehicle breakdowns, vehicular accidents, material spills and other incidents.

FPI investments made through Plan Bay Area have expanded the number of metered ramps throughout the Bay Area, directly resulting in reduced travel times and improved safety on major freeway corridors while managing the impact on local arterial operations. FPI investments also support the Program for Arterial System Synchronization (PASS), which was previously called the Regional Signal Timing Program, through which an average of 500 traffic signals is re-timed each year.

The role of MTC in the PASS is to provide program administration, project management, and facilitation of inter-agency communication and coordination. The primary responsibility for the operation and retiming of traffic signals resides with the agency that owns them. Under this regional program, technical assistance will be focused on traffic signal systems that: 1) interact with freeways and state highways, 2) involve traffic signals from multiple jurisdictions, 3) operate on corridors with established regional significance, 4) provide priority for transit vehicles, and 5) developed in conjunction with other regional programs.

FPI funding for the FSP and call boxes has enhanced the region's ability to quickly identify and respond to planned and unplanned freeway incidents. Currently, FSP includes 78 tow trucks that cover 552 miles of Bay Area freeways and respond to an average of 130,000 incidents per year. The 2,200 call boxes in place along the region's freeways and bridges receive an average of 22,000 calls per year.

The Bay Area Freeway Service Patrol is a fleet of tow trucks deployed during peak travel times (typically, 6-10am and 3-7pm) as part of an incident management program to detect and clear accidents, assist motorists and remove dangerous debris from freeways which cause more than 50 percent of traffic congestion. The Freeway Service Patrol is free at the time of service, funded through the state highway fund and supplemented by the SAFE motorist aid driver registration fee.

The MTC Arterial Operations Program provides assistance to Bay Area jurisdictions in their efforts to improve traffic operations on arterial streets by sponsoring various projects that address signal coordination and other arterial operations issues; developing and implementing initiatives to promote improved arterial operations; and supporting the Arterial Operations Committee (AOC) as a forum for discussion of shared issues and lessons learned for both public and private agencies. The program provides direct benefits through projects that reduce travel time and emissions and enhance traffic safety on arterial streets; as well as indirect benefits through projects that help local traffic engineers do their job more efficiently and effectively.

Implementation Actions:
MTC will:

- Through FPI, install additional ramp meters at entrance ramps, and monitor and adjust meter timing as appropriate.
- Through the PASS program, coordinate additional traffic signals and continue to update timing plans.
- Expand Freeway Service Patrol on I-280 from SR 92 to SR 85 in San Mateo and Santa Clara counties.

Emission Reductions:

Pollutants*	2020	2030
ROG	46	19
NO_x	63	18
$PM_{2.5}$	11	8
DPM	41	33
TAC	<.01	<.01
CO_{2e}	36,883	27,364

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
Emission reductions for the Program for Arterial System Synchronization (PASS) program and the expanded Freeway Service Patrol (FSP) service (on I-280 from SR 92 to SR 85 in San Mateo and Santa Clara counties) were calculated by two separate approaches.

For the PASS program emissions calculation, the synchronization of signals along an extended route was analyzed by using EMFAC 2011 emission factors. Emission factors dependent on the before-project (lower speeds, higher emission factors) and after-project (higher speeds, lower emission factors) average traffic speeds were applied to the corresponding before and after project vehicle miles traveled (VMT) to calculate the emission reductions for this component of measure. EMFAC 2011 emission factors were updated to reflect the current version of the EMFAC model, EMFAC2014 and CO2 conversion/equivalency factors were used to estimate the emission reduction benefits for the mobile source air toxics (MSATs).

For the expanded FSP service, CO2 emissions were calculated by applying an updated fuel consumption rate (from the Caltrans Mobility Performance Report 2011) and the other pollutant emission rates were estimated using ARB's emission model EMFAC 2007 were updated to reflect the current version of the EMFAC model, EMFAC2014. FY 13/14 FSP expanded service emission reductions were adjusted and forecasted to the 2020 and 2030 analysis years. As with the PASS program component of the transportation measure, CO2 conversion/equivalency factors were used to estimate the emission reduction benefits for the mobile source air toxics (MSATs).

Emission reductions generated from the FPI program were not generated in this analysis.

Exposure Reduction:
This measure will reduce air pollution emitted by vehicles and therefore will reduce the concentration of air pollution that people are exposed to on a daily basis. Impacted communities near freeways and roads with significant auto and truck traffic will benefit.

Emission Reduction Trade-offs:
None identified.

Cost:
Approximately $2.7 billion.

Co-benefits:
- Health (congestion can lead to stress, and increases drivers and nearby resident's exposure to harmful air pollutants) and economic savings for both businesses and travelers from reduced congestion
- Shorter travel times, reduced fuel consumption and fewer collisions secondary accidents.

Issues/Impediments:
By making more efficient use of existing capacity, the FPI should help to improve air quality by reducing peak period congestion, as well as incident-related delay, on the Bay Area's freeways. But, past research has shown (Levinson and Zhang, 2006) that ramp-metering may provide a greater travel time savings for vehicles making longer trips. Reducing travel time for long distance commuters could, at least in theory, encourage longer commutes from residential locations in the periphery of the region. If this were to occur, it could erode the air quality benefits of this measure over time.

Local jurisdictions may be concerned that ramp meters will spill over onto local streets and disrupt their arterial operations (although these impacts are most often mitigated prior to the operation of the ramp meters through protocols for the ramp metering timing or local street improvements to accommodate the ramp queues).

Where arterial signal coordination requires cooperation of multiple jurisdictions, the negotiations can take time to resolve both technical and policy issues.

Sources:
1. Metropolitan Transportation Commission, Program for Arterial System Synchronization (PASS), http://www.mtc.ca.gov/services/arterial_operations/pass.htm
2. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy, July 2013
3. Metropolitan Transportation Commission, Arterial Operations Program, http://www.mtc.ca.gov/services/arterial_operations/
4. Metropolitan Transportation Commission, Freeway Service Patrol, http://www.mtc.ca.gov/services/fsp/

TR7: Safe Routes to Schools and Transit

Brief Summary:
This measure will facilitate safe routes to schools and transit by providing funds and working with transportation agencies, local governments, schools, and communities to implement safe access for pedestrians and cyclists. Likely projects will include implementation of youth outreach and educational programs to encourage walking and cycling, the construction of bicycle facilities and improvements to pedestrian facilities.

Purpose:
The purpose of this measure is to reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gases by improving bicycle and pedestrian access to schools and transit throughout the Bay Area.

Travel Market Affected:
This measure would affect intraregional travel for students traveling to and from school and for transit riders throughout the Bay Area.

Regulatory Context and Background:
Safe Routes to School is a state, regional and local program that encourages children to walk or bicycle to school by removing barriers. Barriers include lack of infrastructure, unsafe facilities that result in uninviting walking and bicycling conditions, and lack of education and enforcement programs aimed at children, parents and the community at large. Another important component is outreach and education in schools to encourage students to bike and walk to school, leading to mode shifts away from automobile trips and therefore VMT reductions. In 2010, grade school trips in the Bay Area accounted for nearly 2.2 million trips/day, or 9.5 percent of total personal trips. Safe Routes to School reduces vehicle trips to school and parents' vehicle trips to work, to the extent that parents may be able to switch to another mode if they do not need to drop their children off at school.

Safe Routes to Transit (SR2T) is a program that funds bicycle and pedestrian planning and capital projects that facilitate walking and bicycling to regional transit, thereby reducing vehicle trips to transit. The SR2T Program originally received Bay Area voter approval in March 2004 through Regional Measure 2, the $1 bridge toll increase for transit. By improving the safety and convenience of biking and walking to regional transit, SR2T encourages commuters to leave their cars at home and reduce emissions.

In May 2012, MTC approved a new funding approach that directs specific federal funds to support more focused growth in the Bay Area. The OneBayArea Grant (OBAG) program commits $320 million of federal surface transportation funding through 2017. The OBAG program allows communities flexibility to invest in transportation infrastructure that supports infill development by providing funding for bicycle and pedestrian improvements, local street repair, and planning activities, while also providing specific funding opportunities for Safe Routes to Schools projects.

Through the Air District's Bikeways, Roads, Lanes and Paths program, up to $3.84 million is available (fund made available in FYE 2016) for bicycle parking and bikeway projects. Funding is offered on a first-come, first-served basis, until all funds have been spent. In order to be eligible for funding projects must be included in an adopted countywide bicycle plan, Congestion Management Plan (CMP), or MTC's Regional Bicycle Plan. Funding is available for new Class-1 bicycle paths; new Class-2 bicycle lanes; new Class-3 bicycle routes; and new Class-4 cycle tracks or separated bikeways. Bike projects may support or be paired with a Safe Routes to School or Safe Routes to Transit projects.

Implementation Actions:
MTC will:

- Continue to award the Regional MTC County Safe Routes to School Program at Cycle 1 and Cycle 2 annual funding levels of $5 million a year through 2017 ($20 million)
- Explore new funding and program opportunities for Safe Routes to School and Safe Routes to Transit in Plan Bay Area 2040.

The Air District will:

- Distribute funding and manage grants distributed through the Bikeways, Roads, Lanes and Paths program. ($3.8 million)

Emission Reductions:

Pollutants*	2020	2030
ROG	0.94	0.39
NO_x	0.56	0.25
$PM_{2.5}$	0.10	0.08
PM_{10}	0.24	0.18
DPM	0.30	0.25
TACs	<0.01	<0.01
CO_{2e}	274	203

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
Shifting school trips away from family vehicles reduces start-up emissions and per-mile trip emissions. In addition, an increase in active transportation in the region resulted in a reduction in vehicle miles traveled in all counties analyzed. This translates to a reduction in GHG emissions, based on trip length as well as number of trips (i.e. student enrollment and mode split).

MTC's Climate Initiatives Program evaluation estimated that the Regional Safe Routes to School Program projects resulted in an annual GHG emission reduction of over 420,000 pounds (210 tons), an average 10.7 percent reduction in GHG emissions for trips one mile or less from school.

The emission reduction estimates for the Regional Safe Routes to School Program projects are the per student daily changes multiplied by 175 (the typical number of school days) and then by the follow up period enrollment to reflect changes over an entire school year for all counties included. Note that this analysis includes trips within one mile of school only. GHG-CO_2 conversion/equivalency factors were used to estimate the emission reduction benefits for the criteria pollutants and air toxics (all emission reductions, except CO_2, are nominal).

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
MTC: $20 million; Air District $3.8 million

Co-benefits:
- Improved safety/reduced pedestrian-motor vehicle and bicycle-motor vehicle accidents.
- Improved public health/reduced obesity.
- Reduced travel costs.

Issues/Impediments:
Implementation of this measure requires that funding is available for these programs. The Safe Routes to School and Safe Routes to Transit programs receive a high volume of grant applications and have only limited amount of funds to award to projects. While funding for these programs has been identified in the short-term, many of these sources will sunset in the future. Future federal transportation legislation could include additional funding for Safe Routes to School and Transit. New funds may also be available from higher gas taxes, bridge tolls, and voter approved sales tax measures in individual counties.

Source:
1. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy, July 2013

TR8: Ridesharing and Last-Mile Connections

Brief Summary:
The Ridesharing and Last-Mile Connections measure will promote ridesharing services and incentives through the implementation of the 511 Regional Rideshare Program, as well as local rideshare programs implemented by Congestion Management Agencies. These activities will include marketing rideshare services, operating a rideshare information call center and website, and provide vanpool support services. In addition, this measure includes provisions for encouraging car sharing programs.

Purpose:
This measure will reduce motor vehicle emissions of key ozone precursors, ROG and NOx, particulate matter, air toxics, and greenhouse gases by reducing single occupancy vehicle trips through the promotion of rideshare services and incentives.

Travel Market Affected:
This measure would affect intra and inter-regional commute and non-commute travel.

Regulatory Context and Background:
The Bay Area has had an organized vanpool program since 1981. The current program is managed by local, county, and regional partners including MTC's 511 program. The region's vanpool program helps people with long commutes that are not well-served by transit. Plan Bay Area enhances the appeal of vanpooling by dedicating $6 million to reduce the cost of van pool vehicle rentals and encouraging more people to participate in the vanpool program.

The 511 Regional Rideshare Program is operated by MTC and is funded by grants from the Federal Highway Administration, U.S. Department of Transportation, the MTC, the Air District, and county Congestion Management Agencies.

Barriers to ridesharing include:
- Difficulty for individuals in identifying others who both live and work proximate to them.
- Difficulty in setting up the logistics of a vanpool (such as establishing driver(s), shared payment for gas and other costs, identifying parking places).
- Additional travel time needed to pick up other carpoolers.
- Difficulty to change travel schedule due to emergencies.

The 511 Regional Rideshare Program provides a suite of services to facilitate carpooling and vanpooling online (511.org) and by telephone (511). These programs help remove some barriers to ridesharing identified above, and provide additional incentives for ridesharing. 511 is managed by a partnership of public agencies led by MTC, the California Highway Patrol, and the California Department of Transportation. 511 was developed with the mission to provide comprehensive, accurate, reliable and useful multimodal travel information to meet the needs of Bay Area travelers.

Additional 511 partners include:

- 511 Contra Costa
- Bishop Ranch Transportation Center
- City of Menlo Park, Transportation Department
- City of Pleasanton
- Contra Costa Centre Association
- Emeryville Transportation Management Association
- Hacienda Owners Association
- Moffett Park Business and Transportation Association
- Peninsula Traffic Congestion Relief Alliance
- San Francisco Department of Environment
- San Francisco Municipal Transportation Agency (SFMTA)
- San Jose State University
- Solano Napa Commuter Info
- Transportation Management Association of San Francisco

The Innovative Grants Program funds demonstration projects to test innovative strategies to promote changes in driving and travel behaviors. For Ridesharing Services and Incentives projects, the Innovative Grants Program includes the Dynamic Rideshare Programs, a pilot project which will coordinate the efforts of Contra Costa, Marin and Sonoma counties to offer a new form of carpooling, called "dynamic ridesharing."

Carpooling has declined precipitously since 1980 due to workers' increasingly variable work schedules, which are incompatible with the fixed plans required for traditional carpooling. Dynamic ridesharing – also called real-time ridesharing – addresses this problem using technology to match drivers and riders in real time right before their trips.

Dynamic, or real-time, ridesharing involves the use of information technology—namely a mobile app—to match drivers and riders in real time. This form of ridesharing does not require commuters to commit to a particular carpool with fixed routes and schedules; instead, it facilitates the matching of riders and drivers on an ad-hoc basis through a smartphone user platform offered by the vendor, Carma, which has developed a ridesharing app for use in a number of U.S. markets.

While the pilot project in Contra Costa, Marin and Sonoma counties share a software platform (custom-designed for the project by the vendor), the ridesharing effort has been managed somewhat differently in each county. The programs have used different outreach approaches; targeted different "affinity groups" (for example, employers/businesses or colleges and universities); contracted with different parties to provide support for program deployment and delivery; and, at times, offered different incentives to participants (to recruit participants, the programs have offered incentives to both drivers and riders and also have relied on payments from riders to drivers).

An evaluation of the Dynamic Rideshare Programs revealed that this measure, while still limited in its application, has a place in the transportation demand management (TDM) toolbox; unlike most TDM programs which rely on self-reported data, this type of program generates robust data that tracked use in detail.

In March 2016, MTC, through its 511 Rideshare program, began a partnership with Lyft to launch a new carpooling option for commuters. The partnership brings together Lyft's peer-to-peer ridesharing platform and MTC's established efforts to promote carpooling to make it easier for commuters to share rides.

Lyft's new carpooling service will allow commuters to offset the costs of driving on their regular commute routes. The partnership with Lyft represents MTC's first official partnership with a Transportation Network Company. MTC also has partnerships with the carpool-matching apps Carma (gocarma.com (link is external)) and Scoop (takescoop.com).

Car Sharing

Car sharing allows individuals to rent vehicles by the hour, thus giving them access to an automobile without the costs and responsibilities of individual ownership. Car sharing is growing rapidly in the Bay Area in traditional for profit/non-profit services (City CarShare, Zipcar, U Car Share, WeCar), new peer-to-peer car sharing (Getaround, RelayRides), and 1-way car share services (BMW DriveNow).

Traditional car sharing businesses operate on a membership basis. Users pay an annual or monthly fee in addition to hourly and/or per mile rates. Gas, maintenance, parking, insurance, and 24-hour access is all included in the membership and usage rates for car sharing. The pricing scheme encourages the use of the vehicles for short duration trips, such as running errands. For trips longer than one day, it is usually less expensive to rent a vehicle through a traditional car rental agency. Traditional car sharing works best for households in neighborhoods that are highly served by transit where vehicles are only infrequently needed, where parking is limited, and for households that share a primary car and have an occasional need for a second car. After joining a car sharing program, households in transit-dense neighborhoods can often shed all vehicles and just participate in car sharing. In less dense neighborhoods, car sharing may allow a two or three car family to shed one car and then use car sharing for the rare times that multiple vehicles are needed. Businesses are also signing up for business memberships to avoid maintaining a company fleet of vehicles.

Acknowledging the importance of car sharing on both the community and the environment, Plan Bay Area invests $13 million in car sharing over the course of the plan to achieve a 2.6 percent per capita reduction in greenhouse gas emissions. To support the car sharing goals identified in Plan Bay Area, in April 2014, MTC approved the Car Sharing Program - a $2 million grant program that helps expand car sharing services throughout the region. In July 2014, MTC released a call for projects for the Car Sharing Program to expand car sharing in the following areas:

- Suburban or urban communities that do not currently have robust car sharing service
- Underserved minority or low-income communities
- Business parks and transit connections
- Innovative/new technologies, i.e. point-to-point car sharing, electric vehicle (EV) fleets, etc.

In April 2015, MTC programmed the following car sharing projects into the 2015 Transportation Improvement Program (TIP) which allowed sponsors to obtain federal authorization (obligation) for their projects:

- Santa Rosa Car Share (Sonoma County Transportation Authority)
- CarShare4All (Contra Costa Transportation Authority)
- Car Sharing – A Catalyst for Change (City of San Mateo)
- Oakland Car Share and Outreach Program (City of Oakland)
- City of Hayward RFP for Car Sharing Services (City of Hayward)
- Car Share CANAL (Transportation Authority of Marin)

The Air District is also currently exploring options for expanding use of its TFCA funding to provide incentives for pilot projects that implement car sharing and other innovative last-mile solution trip reduction strategies. Beginning in FYE 2016, the Air District will increase the annual funding allocation for trip reduction programs by approximately $500,000 (to $4.5 million from $4 million).

Implementation Actions:
MTC will:

- Reduce cost of vanpooling through dedicated funding used to reduce cost of van rentals and to encourage more people to participate in vanpools ($6 million)
- Fund the Climate Initiatives Innovative Grants Ridesharing Services and Incentives project to support Dynamic Rideshare Programs, Contra Costa Transportation Authority, Sonoma County Transportation Authority, Transportation Authority of Marin ($2.4 million)
- Continue to provide 511 RideMatch services
- Continue to provide rideshare support services, including call center services, program marketing and materials
- Implement incentive programs sponsored by the congestion management agencies, county transportation authorities, cities and counties, and transit agencies.

The Air District will:

- Encourage employers to promote ridesharing to their employees through the Commuter Benefits Program.
- Provide incentive funding to pilot projects to determine feasibility of implementing cost-effective car sharing and other innovative last-mile solution trip reduction strategies.
- Encourage local governments to require ridesharing as a potential CEQA mitigation and/or explore the possibility of requiring new projects to include dedicated ridesharing parking spaces and car sharing services in-lieu of required parking spaces.

Supporting Actions by Partner Entities:

- Local government and Congestion Management Agencies to encourage ridesharing and create incentives to promote ridesharing and car sharing

Emission Reductions:

Pollutants*	2020	2030
ROG	0.81	0.34
NO_x	0.49	0.22
$PM_{2.5}$	0.09	0.07
PM_{10}	0.21	0.16
DPM	0.26	0.22
TACs	<0.01	<0.01
CO_{2e}	237	176

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:

The Ridesharing and Last-Mile Connections measure emission reduction calculation was separated into three strategies:

- Dynamic Rideshare Demonstration Project
- Local Government EV Fleet Project
- eFleet: Car Sharing Electrified

Dynamic Rideshare Demonstration Project - Vehicle trips reduced were used to estimate starting-exhaust emissions (from cold starts) while VMT reduced was used to estimate running-exhaust emissions. Vehicle trips and VMT are translated into emissions using emission factors from EMFAC2011, the 2011 update of the computer model for estimating emissions from on-road vehicles in California. The factors used for the calculations are averages of the factors for light-duty autos operating in Contra Costa, Marin and Sonoma Counties, and weighted by each county's share of the number of shared rides (we assume that light-duty autos is the category that best represents the vehicles used).

Local Government EV Fleet Project - GHG emissions were quantified for the 90 vehicles purchased through the MTC grant program and were compared to the baseline control group vehicles to estimate emission reductions resulting from this project. The emissions were assessed on a lifecycle basis, which includes emissions related to processes upstream of the point of use in the vehicle, in addition to the direct emissions resulting from fuel combustion in the vehicle. Therefore, for electric vehicles, emissions from the generation and transmission of electricity were included in the analysis. For conventional gasoline and hybrid vehicles, this

accounting included the production and delivery of the fuel and the combustion of the gasoline in the vehicle.

eFleet: Car Sharing Electrified - To compare project BEV and PHEV criteria pollutant emissions to baseline vehicle types, six months of activity data was analyzed from City CarShare (CCS) to determine the number of miles driven on all-electric mode and gasoline mode - for each vehicle model. For the miles driven in all-electric mode, there are no tailpipe emissions. For PHEVs, the CCS activity data does not distinguish between electric and gasoline powered VMT. Therefore, the vehicle models' estimated fuel economy was applied in all electric mode (kWh/mi) to the ChargePoint data for electricity consumption to determine the number of miles driven in all electric mode. The remaining mileage balance (total VMT minus electric VMT) then represents the gasoline-only VMT estimate.

Once the VMT was broken out by fuel type, criteria pollutant emissions factors were applied to the gasoline powered VMT to quantify the total amount of ROG, NOx, and PM emitted during the six-month data period. This quantity was then divided by the total VMT (both electric and gasoline) to determine the average amount of criteria pollutant emitted for each vehicle mile driven.

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
See above implementation actions

Co-benefits:
- Reduced travel costs for employees through ridesharing and for Bay Area residents, businesses and visitors through car-sharing.
- Reduced costs in provision of employee parking, due to reduced single-occupancy driving.

Issues/Impediments:
Ridesharing
Many commuters need flexibility in their daily trips to conduct errands, or pick-up and drop-off children, and this can reduce the market for carpooling and vanpooling as traditional participation requires fixed schedules among participants. In addition, legal challenges such as Americans with Disabilities Act compliance, local regulations, insurance policies can also limit the growth of ridesharing as a travel option.

Car-Sharing
Car-sharing works best in dense urban areas; it may not be viable in all parts of the Bay Area.

Sources:

1. Metropolitan Transportation Commission, Program for Arterial System Synchronization (PASS), http://www.mtc.ca.gov/services/arterial_operations/pass.htm
2. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy, July 2013
3. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy - Summary of Predicted Traveler Responses, July 2013, http://planbayarea.org/pdf/final_supplemental_reports/FINAL_PBA_Predicted_Traveler_Responses.pdf
4. Metropolitan Transportation Commission, Arterial Operations Program, http://www.mtc.ca.gov/services/arterial_operations/
5. Metropolitan Transportation Commission, Freeway Service Patrol, http://www.mtc.ca.gov/services/fsp/
6. Metropolitan Transportation Commission, Programming and Allocations Committee (December 2014 Meeting), http://apps.mtc.ca.gov/meeting_packet_documents/agenda_2327/3a_Car_Sharing_Program_Reso-4035.pdf
7. Metropolitan Transportation Commission (April 2015 Meeting), http://apps.mtc.ca.gov/meeting_packet_documents/agenda_2401/6_Reso-4175_TIP_Amendment-2015-09.pdf

TR9: Bicycle and Pedestrian Access and Facilities

Brief Summary:
The bicycle component of this measure will expand bicycle facilities serving employment sites, educational and cultural facilities, residential areas, shopping districts, and other activity centers. Typical improvements include bike lanes, routes, paths, and bicycle parking facilities. The bicycle component also includes a bike share pilot project that was developed to assess the feasibility of bicycle sharing as a first- and last-mile transit option.

The pedestrian component of this measure will improve pedestrian facilities and encourage walking by funding projects that improve pedestrian access to transit, employment sites, and major activity centers. Improvements may include sidewalks/paths, benches, reduced street width and intersection turning radii, crosswalks with activated signals, curb extensions/bulbs, buffers between sidewalks and traffic lanes, and street trees.

Purpose:
This measure will reduce motor vehicle emissions, including key ozone precursors ROG and NOx, particulate matter, air toxics, and greenhouse gases by sustaining and improving bicycle and pedestrian access and facilities, and encouraging walking and bicycling throughout the Bay Area.

Travel Market Affected:
This measure would affect all intraregional travel.

Regulatory Context and Background:
Bicycles are an inexpensive and widely available type of zero emissions vehicle. They promote health and in urban contexts, bicycles compete well with cars and transit in terms of door-to-door travel time. Bikes can be combined with public transit for longer trips and trans-Bay trips. Walking is the least expensive way of travelling and also provides benefits of improved health.

The average trip length for all personal trips in the Bay Area is just under 3 miles, a distance short enough for travelling by bicycle. Of the total personal weekday trips in 2010, 1 percent used bicycles and had an average travel distance of 2.4 miles. In 2010, 10 percent of total weekday personal trips were in exclusively the walk mode and 3.8 percent of total weekday personal trips were walk trips to transit.

Many barriers exist that prevent people from taking more bicycling and walking trips. In particular, parts of the Bay Area lack bicycle routes that include features such as lower speed limits, bicycle lanes, loop detectors that detect bicyclists waiting at red lights, and other complete street features. Low levels of pedestrian travel can be attributed to low population density, single-use land use patterns and development of streets, roads and land uses that lack adequate attention to the pedestrian environment.

Improved bicycle facilities can increase perceived and actual safety of travel by bicycle as well as its overall attractiveness, encourage mode shift for shorter trips, and encourage park-and-ride users to shift modes to bike-and-ride. Similarly, improved pedestrian facilities can increase perceived and actual safety of walking trips as well as the overall attractiveness of walking, encourage more mode shift for shorter trips, especially those less than a mile, and encourage park-and-ride users to shift modes to walk-and-ride.

Funding Sources

Transportation Fund for Clean Air (TFCA). From 2005 through 2015, TFCA has provided more than $31 million in funding to support the expansion of bicycle facilities. This investment has resulted in the installation of 176 miles of new bike paths and lanes, the creation of more than 14,000 new bicycle rack parking spaces and electronic locker parking spaces, and the Bay Area Bike Share Pilot Program. Funding for the TFCA program is provided by a $4 surcharge on motor vehicles registered within the Bay Area as authorized by the California State Legislature. To obtain TFCA funding, local jurisdictions must have the project identified in an adopted countywide bicycle plan, Congestion Management Plan (CMP), or within MTC's Regional Bicycle Plan. In addition, bicycle facilities must serve a major activity center (e.g. transit station, office building, or school) and be publicly accessible and available for use by all members of the public.

Since 2013, the Air District has administered an annual allocation of approximately $900,000 in TFCA Regional Fund monies for projects that expand access to bicycle parking and bikesharing. In 2013, the Air District launched the Bicycle Rack Voucher Program (BRVP) and the Electronic Locker Program to reduce motor vehicle emissions by cost-effectively expanding availability of new bicycle parking facilities in the nine-county Bay Area. The BRVP is a streamlined voucher-based program that provides local public agencies with access to discounted and no-cost bicycle rack equipment.

In 2013, the Bay Area Bike Share pilot project was launched as the nation's first regional bike sharing initiative. The pilot (funded in part by the Air District and MTC's Innovative Grants Program described below) was developed to assess how bicycle sharing could result in mode shifts that eliminate vehicle miles traveled (VMT) by single occupancy vehicles. One of the program's key goals is to offer a first- and last-mile transit option for public transit riders, with docking stations at train and ferry terminals and at locations 1-2 miles from public transit, enabling riders to bike to their destination without having to take a bicycle on the entire trip.

The Air District served as the lead administrator for the pilot project, which was conducted in partnership with MTC, the City and County of San Francisco, the San Mateo County Transit District, the City of Redwood City, the County of San Mateo, and the Santa Clara Valley Transportation Authority. In the summer of 2015, MTC took on the role of system administrator for Bay Area Bike Share. In upcoming years, the system is planned to expand the fleet to 7,000 bicycles.

Looking ahead, the Air District's TFCA Regional Fund will continue to be an eligible source of funding for bicycle facility improvement projects. Based on prior year funding awards for

bicycle parking projects, it is anticipated that between 2015-2020 more that $7 million in TFCA Regional Funds will be available to help support the expansion of bicycle parking and bikeways.

OneBayArea Grant Program. The OneBayArea Grant Program is a new funding approach that better integrates the region's federal transportation program with the Sustainable Communities Strategy, or Plan Bay Area. OneBayArea grants provide funds for a wide range of bicycle and pedestrian improvements including bicycle facilities, bicycle education, outreach, sharing and parking, sidewalks, ramps, pathways and pedestrian bridges, user safety and supporting facilities, and traffic signal actuation.

OneBayArea also provides funds for Transportation for Livable Communities (TLC) projects to support community based transportation projects that bring new vibrancy to downtown areas, commercial cores, high density neighborhoods, and transit corridors, enhancing their amenities and ambiance and making them places where people want to live, work and visit. The TLC program supports Plan Bay Area by investing in improvements and facilities that promote alternative transportation modes rather than the single-occupant automobile.

Innovative Grants Program. MTC's Innovative Grants Program funds demonstration projects to test innovative strategies to promote changes in driving and travel behaviors. For Bicycle and Pedestrian Access and Facilities Improvements projects, the Innovative Grants Program includes the following strategies.

- Bay Area Bike Share Pilot Program - the nation's first regional bike sharing initiative included 700 bicycles and 70 kiosk stations in five cities: San Francisco, Redwood City, Palo Alto, Mountain View, and San Jose.
- Innovative Bicycle Detection Systems - The City of San Jose aims to reduce bicycle accidents by testing and adopting bicycle signal detection technologies and installing them on key corridors in the city's Primary Bikeway Network. It will test four types of technologies: video detection, radar, inductive loop and wireless magnetometer.
- Alameda County Bikemobile - The Bikemobile makes visits to schools and other sites, offering three specific services: Bike Safety Education, Bike Repair Education and Bike Riding Encouragement.

Transportation Development Act. The California Transportation Development Act (TDA) provides two major sources of funding for public transportation: the Local Transportation Fund and the State Transit Assistance fund. These funds are for the development and support of public transportation needs in California and are allocated to areas of each county based on population, taxable sales and transit performance. A share of the TDA goes to fund pedestrian and bicycle projects. To obtain TDA funding from MTC, local jurisdictions must have a Bicycle Advisory Committee to plan and prioritize funding for bike projects. TDA funds are assumed to grow at rates that take into account demographic and economic factors such as median income, regional employment and population growth.

Implementation Actions:
MTC will:

- Fund the Climate Initiatives Innovative Grants program for Bicycle and Pedestrian Access and Facilities Improvement projects ($500,000)
- Fund regional bike share program ($8.7 million)
- Fund bicycle and pedestrian improvement projects through State Transportation Development Act (TDA) and local sales tax funds ($4.6 billion)
- Fund complete streets projects, including stand-alone bicycle and pedestrian paths, bicycle lanes, pedestrian bulb-outs, lighting, new sidewalks, and Safe Routes to Transit and Safe Routes to Schools projects (see TR7) to improve bicycle and pedestrian safety and travel via the OneBayArea Grant program. ($14.6 billion One Bay Area Grant program total)

The Air District will:

- Continue to fund bike lanes, routes, paths, and bicycle parking facilities with TFCA funds through Bicycle Facilities Program ($7.2 million)
- Continue to encourage planning for bicycle and pedestrian facilities in local plans, e.g. general and specific plans

Emission Reductions:

Pollutants*	2020	2030
ROG	41	17
NO_x	32	14
$PM_{2.5}$	4	3
PM_{10}	10	8
DPM	14	11
TACs	0.01	<0.01
CO_{2e}	12,303	9,128

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
Emission reductions were estimated using data collected for bicycle and pedestrian projects in the Merced County Association of Governments (MCAG) planning area. In addition, emission benefits calculations are based on the applicable pollutants for the region, including the components of ozone (NOx and ROG) and particulate matter (PM). The emission reductions result from the decrease in emissions associated with auto trips replaced by bicycle trips for commute or other non-recreational purposes. Pedestrian facilities reduce emissions when auto trips are replaced by walking. ARB's emission model EMFAC 2014 was used to calculate emission reductions.

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
Through 2020, $7.7 million; beyond 2020, over $4.6 billion

Co-benefits:
- Improved safety/reduced bicycle-motor vehicle accidents.
- Improved safety/reduced pedestrian-motor vehicle accidents
- Improved public health/reduced obesity.
- Reduced vehicle trips.
- Reduced travel costs.

Issues/Impediments:
Pedestrian travel and bicycle use is limited by factors such as physical ability, terrain, weather, and the need to carry cargo. Personal safety concerns may also prevent some people from switching modes to bicycle and pedestrian travel. Improving bicycle and pedestrian facilities and public education for pedestrians, bicyclists and drivers can increase perceived and actual safety.

Sources:
1. Metropolitan Transportation Commission, Association of Bay Area Governments, *Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy*, July 2013
2. Bay Area Air Quality Management District, Proposed TFCA Regional Fund Policies and Evaluation Criteria for FYE 2017

TR10: Land Use Strategies

Brief Summary:
Local land use decisions can directly and indirectly impact air quality and greenhouse gas emissions, as well as people's exposure to toxic air contaminants (TACs). This measure supports land use patterns that reduce vehicle miles traveled (VMT) and associated emissions and exposure to toxic air contaminants, especially within infill locations and impacted communities.

Purpose:
The purpose of this control measure is to reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gases by promoting land use patterns, policies, and infrastructure investments that support higher density mixed-use, residential and employment development near transit. This measures also includes actions to reduce exposure to toxic air contaminants.

Travel Market Affected:
This measure affects all intraregional travel.

Regulatory Context and Background:
Promote Land Use that Reduces Vehicle Miles Traveled
Land use and zoning are powerful tools local governments can use to reduce vehicle use and emissions. Transportation, and particularly passenger vehicle use, is responsible for the majority of air pollution in the Bay Area. Motor vehicles contribute significantly to ozone precursor emissions (23 percent of ROG and 43 percent of NOx), peak PM2.5 concentrations (20 percent) and nearly 40 percent of GHGs. Vehicle use also contributes to 31 percent of toxic air contaminant emissions.

A significant body of research has demonstrated the relationship between land use and travel behavior. People who live in areas with higher densities, a mix of residential, retail and office uses, with well-designed pedestrian, bicycle and transit infrastructure take more trips by transit, bicycle, and walking which results in reduced driving. The National Research Council concludes that "the most reliable studies estimate that doubling residential density across a metropolitan area might lower household VMT by 5 to 12 percent, and perhaps by as much as 25 percent, if coupled with higher employment concentrations, significant public transit improvements, mixed uses, and other supportive demand management measures."

Additionally, key findings from MTC's Station Area Residents Survey (STARS) Report include the following:

- People who live within ½ mile of a rail/ferry station are four times as likely to use transit as people living farther than ½ mile from a rail/ferry station.
- Individuals living and working within ½ mile of a rail/ferry station use transit for 42 percent of their commute trips, whereas those who neither live nor work within ½ mile of a station use transit for only 4 percent of their commute trips.
- Households within ½ mile of rail/ferry stations generate about half of the vehicle miles

traveled compared to their suburban and rural counterparts.
- People who live within ½ mile of rail/ferry station walk about 50 percent of the time for all short trips (less than one mile), whereas residents who live greater than ½ mile away walk for only about 25 percent of short trips.

The significant contribution automobile use makes to air pollution and GHGs and the compelling land use and travel behavior connection prompted the state to require that regional planning agencies consider how land use and transportation investments may be better coordinated to reduce vehicle emissions, specifically GHGs. Senate Bill 375, signed into law in September 2008, required the Air Resources Board (ARB) to adopt regional GHG reduction targets for emissions associated with automobiles and light trucks. Metropolitan planning organizations were then required to develop a Sustainable Communities Strategy (SCS) in their long-range transportation plans to reach the GHG reduction targets. The SCS must demonstrate how the land use development pattern and the transportation network can work together to reduce GHG emissions. In addition, SB 375 requires that regions house all of their projected population, by income level, thereby integrating the Regional Housing Needs Allocation (RHNA) into the long-term regional plan for transportation investments.

The Regional Housing Needs Allocation is a state-mandated program to identify the total number of housing units (by affordability level) that each jurisdiction must plan for to meet state housing goals. And since the adoption of SB 375, RHNA also plays a key role in meeting regional GHG targets. The California Department of Housing and Community Development (HCD) identifies the total housing need for the San Francisco Bay Area for an eight-year period (current cycle is 2014 to 2022). ABAG and MTC must then develop a methodology to distribute this need to local governments. The methodology takes into account projected job and population growth, access to transit and existing development. The method also needs to ensure that allocation is consistent with the long-term development pattern in the SCS. Once a local government has received its final housing allocation, it must develop an updated plan to accommodate its portion of the region's housing need (via the Housing Element of the General Plan). Both the SCS and RHNA are, therefore, powerful regional planning tools to ensure that land use and transportation work together to reduce GHG emissions from vehicle trips.

The Bay Area's first Sustainable Communities Strategy – known as Plan Bay Area - was developed and adopted by ABAG and MTC in 2013. The plan accomplishes its GHG reduction goals established by ARB (7 percent per capita reduction by 2020 and 15 percent per capita reduction by 2035) through a strategy to meet 80 percent of the region's future housing needs in Priority Development Areas (PDAs). PDAs are neighborhoods within walking distance of frequent transit service, that offer a wide variety of housing options, and amenities such as grocery stores, community centers, and restaurants. For the transportation component of the plan, Plan Bay Area specifies how $292 billion in anticipated federal, state and local funds will be spent through 2040.

Local governments play a fundamental role in implementing the land use component of Plan Bay Area, as they are responsible for land use, zoning and planning for affordable housing

within their communities. Plan Bay Area assists jurisdictions in implementing the SCS through funding of land use planning and transportation investments in infill locations near transit, i.e. in PDAs. The One Bay Area Grant (OBAG) program is the funding mechanism for Plan Bay Area. OBAG programs include approximately $800 million for projects over a four-year period (through FY2016). Funds are distributed to local governments that plan for and build affordable housing, as allocated through the RHNA process. Funds also support local transportation projects within Priority Development Areas.

The Bay Area Transit-Oriented Affordable Housing (TOAH) fund provides additional financing for the development of affordable housing and other community services near transit throughout the Bay Area. Through the fund, developers can access flexible, affordable capital to purchase or improve available property near transit stations for the development of affordable housing, retail space and other residential services, such as child care centers, fresh food outlets and health clinics. The TOAH fund was made possible through a $10 million investment from MTC.

The Air District also offers incentive programs to support investments in infill locations and PDAs. Incentive programs are largely funded through the Air District's Transportation Fund for Clean Air (TFCA). In 1991, the California State Legislature authorized the Air District to impose a $4 surcharge on motor vehicles registered within the San Francisco Bay Area to fund projects that reduce on-road motor vehicle emissions. Sixty percent of TFCA funds are awarded directly by the Air District to eligible projects and programs implemented directly by the Air District; through a grant program known as the Regional Fund Program. The remaining forty percent is forwarded to each Bay Area county through the County Program Manager program (see www.baaqmd.gov/tfca4pm for details).

Both the Regional Fund and the County Program Manager program support infill development. The Regional Fund includes up to $13.6 million annually in incentives for a variety of trip reduction programs; a portion of these funds have been reserved for trip reduction pilot projects within PDAs. Projects must reduce single-occupancy commute-hour vehicle trips by encouraging mode-shift to other forms of shared transportation. The County Program Manager fund is nearly $10 million annually; it includes funding for a variety of pedestrian, transit, and other trip reduction programs, including programs that support "smart growth" or infill development.

Additionally, the Air District helps inform local land use plans by incorporating smart growth model policies and guidance within its California Environmental Quality Act (CEQA) Guidelines. CEQA was adopted in 1970 and is intended to inform policy-makers and the public about potential environmental effects of a project; identify ways to reduce adverse impacts; offer alternatives to a project; and enhance public participation in the planning process. The Air District's CEQA Guidelines were developed to assist lead agencies in analyzing and minimizing air quality impacts associated with proposed land use decisions and development projects. The most recent guidelines include numerous sample mitigation measures and model local plan policies to implement infill or smart growth principles to reduce vehicle trips.

Promote Infill Development to Preserve Open Space and Agricultural Lands
Promoting development within PDAs may take development pressure off of the region's open space and agricultural lands. Open space and agricultural lands play a vital role not only as landscapes that can sequester carbon, but also generate far fewer GHG emissions than urban or suburban uses. Urban and suburban uses encourage greater vehicle miles traveled and contribute to greater air quality impacts relative to open space and agricultural lands.

Plan Bay Area identifies Priority Conservation Areas (PCAs), which are open spaces that provide agricultural, natural resource, scenic, recreational, and/or ecological values and ecosystem functions. These areas are identified through consensus by local jurisdictions and park/open space districts as lands in need of protection due to pressure from urban development or other factors. Plan Bay Area includes a target to direct all non-agricultural development within the existing urban footprint, which represents existing urban development and urban growth boundaries.

Local Agency Formation Commissions (LAFCOs), regional planning agencies responsible for approving boundary changes of cities and special districts, can also play a role in agricultural preservation by guiding development toward PDAs and away from open space and agricultural lands (See AG1: Agricultural Guidance and Leadership and NW1: Carbon Sequestration in Rangelands for more information).

Reduce Population Exposure to Toxic Air Contaminants
Communities are exposed to TACs as a result of emissions from numerous stationary and mobile sources of air pollution. Communities near large industrial sources, distribution centers, major freeways and seaports experience relatively higher pollution levels and corresponding health effects, compared to other parts of the region. To reduce exposure to local air pollution, the Air District regulates a variety of stationary sources through the New Source Review for Toxics permitting process for new and modified sources of toxic air contaminants. Stationary sources are also regulated by the Air District via source-specific regulations. The Air District also limits TACs through the administration of the Air Toxics "Hot Spots" Program. (See SS20: Air Toxics Risk Reduction from Existing Facilities and SS21: New Source Review for Toxics)

The Air District's CARE program, *Planning Healthy Places*, CEQA Guidelines and CEQA review process also address local exposure to toxic air contaminants, from both vehicle and non-vehicle sources. The Air District initiated the Community Air Risk Evaluation (CARE) program in 2004 to evaluate and reduce health risks associated with local exposures to air toxics in the Bay Area. The program examines air toxics emissions from stationary sources, area sources and on-road and off-road mobile sources with an emphasis on reducing population exposure to diesel exhaust. CARE combines technical analysis, outreach to impacted communities, and policy mechanisms to reduce emissions and health risks in those communities.

The Air District provides technical assistance and guidance to local governments specifically to address local air pollution exposure when planning for infill development through a guidance document, *Planning Healthy Places*. Infill locations are often near freeways, distribution

centers, or large industrial sources. *Planning Healthy Places* promotes "healthy infill development", by encouraging local governments and developers to address and minimize potential local air pollution issues early in the land-use planning and development process. As part of this effort, the Air District provides information, recommendations, and technical tools to assist cities in incorporating air quality considerations into their planning processes.

Tools and assistance in *Planning Healthy Places* include:

- Web-based, interactive mapping tools to locate areas in the region that are estimated to have elevated levels of fine particulates and/or toxic air contaminants.
- Best practices that may be implemented by local governments and developers to reduce health risks from air pollution in areas that experience elevated levels of air pollutants.

As stated above, the Air District's CEQA Guidelines were developed to assist lead agencies in analyzing and minimizing air quality impacts associated with land use development projects. In regards to local air pollution exposure, the Guidelines identify strategies on how local governments or project sponsors may avoid and mitigate population exposure to toxic air contaminants and criteria pollutants.

Implementation Actions:

The Air District will:

- Assist local governments with the implementation of Plan Bay Area:
  - Maintain land use plan guidance and best practices resources for local governments.
  - Continue to provide, and increase as appropriate, emission reduction incentive funding opportunities and vehicle trip reduction program funds (TFCA funds) for local government's with impacted communities and/or Priority Development Areas.
  - Assist local governments in securing incentive/grant funding for affordable housing projects or land use planning grants in transit rich areas, i.e. Priority Development Areas.
  - Work with local governments, regional agencies, and LAFCOs to discourage conversion of agricultural and natural lands, identified as PCAs in Plan Bay Area.
- Participate in the development of the land use scenario in the Sustainable Communities Strategy for 2040 Plan Bay Area to emphasize reduction of vehicle miles traveled and achievement of GHG emission reduction targets.
- Assist local governments with health protective infill development by:
  - Assisting local governments in accessing and utilizing on line maps via *Planning Healthy Places*.
  - Improving datasets for local-scale air pollution assessments, especially for permitted sources.
  - Assisting with the development of local plans to reduce exposure to air pollution.
  - Developing improved datasets on community health in impacted communities.
- Continue to assess health impacts to sensitive receptors living near highways and other emission sources.
- Continue to focus enforcement action on emission sources in impacted communities and look for opportunities to partner with local jurisdictions.
- Continue to provide land use planning guidance and best practices to local governments.

- Update the CEQA Guidelines to reflect new data and current policy approaches.
- Conduct outreach to local jurisdictions, consultants, developers, and community members on revised CEQA Guidelines and provide technical assistance to lead agencies.
- Continue CEQA commenting by the Air District:
  - Review CEQA documents prepared for projects that could impact the Bay Area and recommend mitigation measures as appropriate.
  - Continue to provide on the Air District's CEQA website a listing of all CEQA comment letters.

MTC will:

- Fund the One Bay Area Grant Program Regional PDA Planning Program including: $10 million to the Transit Oriented Affordable Housing (TOAH) fund; $8 million to Regional PDA Planning and Technical Assistance; and $2 million to ABAG for its research and planning activities. ($20 million)
- Monitor and manage all awarded project contracts associated with the Regional PDA Planning, PDA Technical Assistance, and PDA Staffing Assistance grants.
- Continue to fund the TOAH revolving loan fund for affordable housing projects near transit in PDAs throughout the region. ($50 million)

Emission Reductions:

Pollutants*	2020	2030
ROG	103	43
NO_x	62	27
$PM_{2.5}$	11	8
PM_{10}	26	20
DPM	33	27
CO_{2e}	30,024	22,275

**criteria pollutants and diesel PM are reported in lbs/day; all toxics, except diesel PM are in grams/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:

The methodology for estimating emission reductions for this measure utilizes the concept of transportation efficiency by concentrating dense, mixed-use, and pedestrian-friendly urban "nodes" around public transportation. The overall approach for estimating infill vehicle-trip generation is based on adjusting baseline Institute of Transportation Engineers (ITE) vehicle-trip data[1].

The methodology has three steps:

1. Baseline ITE trip generation data are used to estimate the vehicular trip generation of the proposed infill development.

[1] See: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_758.pdf
NCHRP Report 758; Trip Generation Rates for Transportation Impact Analyses of Infill Developments

    a. Baseline/Suburban development assumed single family (9.57 trips per dwelling unit) residential trip rates and retail/shopping center (42.94 trips per dwelling unit) commercial trip rates
2. Infill vehicle trips ITE trip generation data are used in the evaluation of site traffic impacts.
    a. Infill development assumed multifamily (6.65 trips per dwelling unit) residential trip rates and general office building (11.01 trips per dwelling unit) commercial trip rates
3. Emission reductions result from the decrease in emissions associated with auto trips reduced by infill development compared to baseline/suburban development.

CO2 conversion/equivalency factors were used to estimate the emission reduction benefits for the criteria pollutants and mobile source air toxics.

Exposure Reduction:
As stated above, the Air District's CARE program, Planning Healthy Places, CEQA Guidelines and CEQA review process address local exposure to toxic air contaminants, from both vehicle and non-vehicle sources. The CARE program, specifically, evaluates health risks associated with local exposures to air toxics in the Bay Area. The program examines air toxics emissions from stationary sources, area sources and on-road and off-road mobile sources with an emphasis on reducing population exposure to diesel exhaust.

Emission Reduction Trade-offs:
None identified.

Cost:
Costs for MTC programs are listed above.

For Air District programs, specific costs are unknown. The Air District will provide technical support to cities and counties to reduce demands on local resources.

Co-benefits:
- Reduced travel costs.
- Community enhancements through revitalized downtowns, transit centers, and other major activity nodes.
- Closer integration of transportation and land use.
- Increased access to jobs, services, and stores.
- Improved public health by reduced driving and increased walking and biking.
- Enhanced collaboration with local governments, resulting in more wide spread and effective implementation of Air District programs.

Issues/Impediments:

Land use changes and new development occur slowly and are directly regulated by local jurisdictions, not regional agencies. In addition, higher density development can raise neighborhood concern over impacts on traffic, parking, localized air pollution, and other issues.

Sources:

1. State of California, Office of Planning and Research, *CEQA Guidelines and Greenhouse Gases*, http://opr.ca.gov/index.php?a=ceqa/index.html
2. California Air Pollution Control Officers (CAPCOA) CEQA and Climate Change White Paper, http://www.capcoa.org/CEQA/CAPCOA%20White%20Paper.pdf
3. Metropolitan Transportation Commission, Association of Bay Area Governments, Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy, July 2013
4. California Air Pollution Control, *CAPCOA Model Policies for Greenhouse Gases in General Plans,* May 2009, http://www.capcoa.org/modelpolicies/CAPCOA%20Model%20Policies%20for%20Greenhouse%20Gases%20in%20General%20Plans%20-%20June%202009.pdf
5. California Air Resources Board, Air Quality and Land Use Handbook: A Community Health Perspective, April 2005, http://www.arb.ca.gov/ch/handbook.pdf
6. Metropolitan Transportation Commission, Characteristics of Rail and Ferry Station Area Residents in the San Francisco Bay Area: Evidence from the 2000 Bay Area Travel Survey, September 2006, http://www.mtc.ca.gov/planning/smart_growth/stars/
7. Cervero, Robert; Kickelman, Kara; National Research Council, *Travel Demand and the 3Ds: Density, Diversity, and Design*, September 1997

TR11: Value Pricing Strategies

Brief Summary:
This measure will pursue implementation of value pricing strategies such as tolling on trans-bay bridges and cordon pricing on roads, as well as auto pricing options, such as a VMT fee and pay-at-the-pump auto insurance.

Purpose:
The purpose of this measure is to reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gases by managing travel demand during congested conditions on Bay Area bridges, in San Francisco, and on other heavily congested freeways and roadways around the Bay Area.

Travel Market Affected:
The Value Pricing Strategies measure would affect intraregional travel, including commute travel, shopping, personal business, school trips, as well as social and recreational travel.

Regulatory Context and Background:
Congestion pricing involves charging drivers a fee to drive in congested areas. Revenue generated from fees are then used to fund transportation improvements — such as better transit service, signal coordination, and bicycle and pedestrian projects — that improve travel options and traffic flow. Congestion pricing is being advanced in San Francisco through a demonstration project as a part of the Treasure Island development project, and through ongoing planning for congestion pricing in downtown San Francisco.

In June 2011, the City of San Francisco approved development plans for Treasure Island, including 8,000 residential units, along with retail and commercial uses. The Treasure Island Transportation Implementation Plan, adopted as part of the development project's approval, calls for an integrated approach to managing traffic and improving mobility management, including a congestion fee to be assessed for residents traveling by private automobile on or off the island during peak hours. The congestion fee, in combination with parking charges and a pre-paid transit voucher for each household, will help fund a comprehensive suite of transportation services including new ferry service to San Francisco and enhanced East Bay bus services.

During rush hours, congestion in the greater downtown San Francisco area results in average bus transit and automobile speeds below 10 miles per hour. A study prepared by San Francisco County Transportation Authority found congestion pricing in downtown San Francisco to be a feasible and potentially effective way to manage and grow the transportation system while supporting new businesses and residents. San Francisco's mobility and pricing program could result in:

- 12 percent fewer peak-period vehicle trips and a 21 percent reduction in vehicle hours of delay
- 5 percent reduction in greenhouse gases citywide

- $60–80 million in annual net revenue for mobility improvements
- 20–25 percent transit speed improvement and 12 percent reduction in pedestrian incidents

In addition to congestion pricing in San Francisco, other pricing strategies could be considered region-wide to reduce VMT and congestion. Pricing strategies increase the marginal cost per mile driven, providing a greater incentive to reduce travel; resulting in fewer trips, shorter trips, greater use of alternative modes, and travel shifts to periods of lower congestion. The specific impacts depend on the alternatives available to travelers (i.e., mode, destination) and price sensitivity, which varies by income, personal and household characteristics, and specific aspects of the trip.

Pricing can take a number of forms, including:

- VMT fees (charging drivers per mile of travel)
- Increases in the existing gasoline tax or new fuel or carbon taxes that price travel according to fuel consumed or carbon emitted (providing an incentive to purchase more efficient vehicles as well as to reduce travel)
- Facility-specific tolls
- Congestion pricing (pricing roadway facilities when they are congested to reduce traffic on those facilities to an improved level of service)
- Cordon/area pricing (applying a fee for vehicles to enter or operate within a selected area, such as a central business district)
- Pay-As-You-Drive (PAYD) insurance (converting a significant portion of the essentially fixed cost of insurance to a marginal cost based on mileage).

VMT fees target reductions in vehicle miles of travel. Unlike road pricing measures where costs can be reduced by switching travel times, use of routes, or type of vehicle used, the only way for an individual to reduce costs under VMT fees is to drive less, thus reducing traffic and emissions. VMT fees do not, however, discourage peak-period driving (since every mile costs the same regardless of when it is driven) or encourage a shift to cleaner burning engines. They are not facility- or time-specific fees so they do not affect the entire vehicle fleet.

Past pricing studies have suggested that with higher travel costs region-wide, people and households tend to move to locations where accessibility to job opportunities is plentiful, so as to offset the impacts from an increase in travel costs. Correspondingly, employers will relocate to key locations to better align themselves with the newly emerging concentration of workers and households.

To assist in the implementation of the Sustainable Communities and Climate Protection Act of 2008 (SB 375), MTC is considering acquiring a federal Value Pricing Pilot Program grant from the Federal Highway Administration to examine road and auto pricing options, such as a VMT fee and pay-at-the-pump auto insurance.

Additionally, as mentioned in TR14: Cars and Light Trucks, MTC is considering proposing to use a feebate program to incentivize consumers to scrap older vehicles and purchase higher performing, cleaner vehicles. A feebate program uses a combination of fees and rebates to change consumer behavior. Consumers purchasing a vehicle that emits more CO_2 on a gram per mile basis than a defined standard are assessed a fee at the point of purchase. These fees are used to provide rebates to consumers that purchase vehicles that emit less CO_2 on a gram per mile basis than the defined standard.

Implementation Actions:
MTC will:

- Implement congestion pricing projects in San Francisco, as identified in Plan Bay Area ($150 million)
- Study ways to use pricing more effectively in funding of transportation by seeking a federal Value Pricing Pilot Program grant from the Federal Highway Administration to examine road and auto pricing options, such as a VMT fee.
- Explore options for developing a feebate program, as a funding mechanism for electric vehicle purchase incentives.

The Air District will:

- Support MTC in its grant application for a federal Value Pricing Pilot Program grant.
- Advocate for value pricing strategies that demonstrate their cost effectiveness in reducing vehicle emissions.

Emission Reductions:

Pollutants*	2020	2030
ROG	1,268	534
NO_x	762	335
$PM_{2.5}$	135	102
PM_{10}	322	243
DPM	409	336
TACs	0.17	0.13
CO_{2e}	370,601	274,947

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
MTC's regional travel demand model (Version 0.3 of Travel Model One) was used to estimate the VMT impacts of this measure. The travel model assumes travel choices are determined by the perceived cost of operating an automobile, relative to the perceived cost of taking transit, paying a bridge toll, paying for parking, etc. As a simplification, the model assumes a uniform (across all travelers, across all travel conditions) perceived automobile operating cost. VMT fee could be implemented in a variety of ways and the method of implementation could impact the behavioral response, i.e. response to cost of automobile travel. For example, the VMT fee could be charged "at the pump", with the car communicating with the gasoline pump to determine

the fee. Or, the fee could be collected annually/monthly/weekly as part of a vehicle registration process. The travel model assumes, implicitly, that paying the fee is similar to paying for gasoline and routine vehicle maintenance.

The California Air Resources Board emission model (EMFAC 2014) was used to calculate pollutant impacts. CO_2 conversion/equivalency factors were used to estimate the emission reduction benefits for the criteria pollutants.

Exposure Reduction:
Reducing high speed driving should help to reduce emissions of ROG, NOx, PM, and CO_2 and therefore exposure to air pollution throughout the Bay Area. Impacted communities near freeways and roads with significant auto and truck traffic will benefit.

Emission Reduction Trade-offs:
None identified.

Cost:
$150 million for implementation of congestion pricing projects in San Francisco, as identified in Plan Bay Area

Co-benefits:
- Generation of new funds for multi-modal transportation improvements
- Travel time savings
- Reduce congestion
- Community enhancements through the creation of more and higher quality transit options
- Shift demand from the peak travel period, thereby making non-peak public transit more sustainable and financially viable
- Give residents an incentive to live at higher densities in more central locations

Issues/Impediments:
Congestion pricing raises several equity issues, including income equity, geographic equity and modal equity. With income equity, low-income groups could be negatively affected by pricing strategies, as fees or other pricing strategies could place the burden of travel-behavior change disproportionally on low-income individuals. In geographic equity, some parts of the region could be made worse off than others, as traffic diversion from tolled routes could negatively impact neighborhoods or reduce performance on alternative toll-free route. Finally, with modal equity, public perceptions with regard to encouragement of multi-modal transportation can be an issue, as some individuals believe that it is not fair to offer the same travel-time savings to those who pay a toll as to those who "do the right thing" by carpooling or taking transit.

Sources:
1. Metropolitan Transportation Commission, Association of Bay Area Governments, *Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy*, July 2013

2. San Francisco Transportation Authority, San Francisco Mobility, Access & Pricing Study, 2010
3. Rodier, Caroline J., University of California, Davis, A Review of the International Modeling Literature: Transit, Land Use, and Auto Pricing Strategies to Reduce Vehicle Miles Traveled and Greenhouse Gas Emissions, October 2009, http://eprints.cdlib.org/uc/item/2jh2m3ps
4. De Corla-Souza, Office of Innovative Program Delivery, Federal Highway Administration, U.S. Department of Transportation, Income-Based Equity Impacts of Congestion Pricing, December 2008, http://ops.fhwa.dot.gov/publications/fhwahop08040/fhwahop08040.pdf

TR12: Smart Driving

Brief Summary:
Smart Driving is a set of strategies and techniques that maximize fuel efficiency and reduce emissions by improving driving habits and vehicle maintenance. This measure would implement a smart driving pilot program that includes installing temporary in-vehicle devices that display vehicles gas mileage in real time, a social marketing campaign, vehicle maintenance tips, trip planning tools through 511.org and other public information/education initiatives.

Purpose:
The purpose of this measure is to reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gas emissions by educating drivers and improving vehicle maintenance.

Travel Market Affected:
This measure would affect intraregional travel, including commute travel, shopping, personal business, school trips, as well as social and recreational travel. This measure would primarily address freeway travel.

Regulatory Context and Background:
MTC has conducted an analysis on emissions created by vehicles traveling over 65 mph on freeways. The analysis demonstrated that by limiting passenger car travel to 65 mph, there is a potential to reduce VOC by 2,000 to 5,600 pounds per day and NOx by 1,800 to 3,800 pounds per day, if applied throughout the Bay Area. Approximately 60 percent of Bay Area driving (VMT) takes place on the freeway system and, based on Caltrans speed monitoring data, 34 percent of freeway driving occurs at speeds over 65 mph. Therefore, by addressing over-the-limit freeway driving, this measure could achieve significant emission reductions. A vehicle driven at 75 mph consumes approximately 40 percent more fuel and emits 35 percent more emissions than one driven at 60 mph.

There are a variety of techniques known as “smart driving”, “green driving”, or “eco-driving” that increase the fuel efficiency of auto travel, thereby reducing emissions and saving money; these include:

- Avoiding quick starts and aggressive driving
- Reducing highway speeds (55 mph is the most efficient speed for fuel consumption)
- Using overdrive and cruise control
- Avoiding driving in rush hour
- Using air conditioning sparingly
- Reducing idling
- Reducing drag by removing roof racks, tow-hook carriers, and other items that cause wind resistance
- Removing heavy unneeded items from cars
- Properly maintaining vehicles including optimal tire pressure

Smart driving also entails driver decisions such as vehicle selection and maintenance, route selection, vehicle load, and driver behavior, including vehicle speed.

The Metropolitan Washington Council of Governments (MWCOG) in Washington, D.C. completed an analysis of what it would take to meet their GHG goals. They found that the most cost effective and productive strategy that could be implemented at the regional or local level to reduce vehicle emissions was through smart driving strategies. For this reason, MWCOG joined in partnership with the Delaware, Maryland, New York, North Carolina, New Jersey, and Massachusetts Departments of Transportation, along with several other MPOs and Port Authorities to launch the I-95 eco-driving campaign, a public information campaign on the benefits of smart driving.

The largest smart driving study undertaken to date was by Fiat in 2010. The study analyzed the effects of their eco:Drive software with 5,700 drivers, over 428,000 journeys, 150 days and five countries. Over the course of the study, the average improvement in fuel economy was six percent. The top ten percent of participants improved their fuel efficiency by 16 percent. Based on the positive results of this study, Fiat has continued to expand their eco:Drive software to include in-vehicle displays and real time mobile apps. These improvements are mirrored in the technology that MTC is testing in their smart driving pilots (see below for more information). It is expected that with real-time feedback on driving habits, improvements in fuel efficiency could exceed the six percent seen in the initial study.

While there have been recent studies in the United States on smart driving, they have all been conducted with small sample sizes of twenty participants or less. In order to learn more about the potential of smart driving in the Bay Area, MTC is implementing the following smart driving pilots:

- In-vehicle devices, displaying real time miles per gallon (MPG) and/or feedback on efficient acceleration, deceleration, and maintaining a steady speed. These devices are mounted on the dashboard of the participants' vehicles; and
- MPG mobile apps, similar to the in-vehicle device pilot, but in a telephone application format. This pilot will be conducted in conjunction with ITS-UC Davis.

The in-vehicle display is connected to the vehicle's on-board diagnostic (OBD) port. The port receives information from the vehicles computer system in real-time to inform the display. The smart phone application calculates the driver's behavior based on the phone's GPS system. In both pilots, baseline driving habits over the course of at least one month will be collected. The devices will be in the participants' vehicles for a minimum of three months to see how quickly the smart driving habits are learned and if the behaviors persist over time.

Implementation Actions:

MTC will:

- Implement a smart driving social marketing campaign that will aim to teach drivers the basics of smart driving in-vehicle and maintenance behaviors in addition to trip linking and route planning. ($56 million)
- Offer several trip planning tools through 511.org. 511 provides real time and predicted future traffic information page which allows drivers to plan their trips to avoid congested routes.
- Implement a smart driving rebate program, linked to fuel efficiency meters. Under this program MTC will offer a $100 rebate to consumers who purchase an OBD-connected after-market device. This device would be very similar to the in-vehicle devices being tested through MTC's two pilots. The real time information on efficient driver behavior will quickly train drivers to alter their behavior in order to save money and gas, and reduce emissions. ($105 million)

The Air District will:

- Promote/implement a voluntary certification program with fleet operators that could be used as a marketing tool, utilizing Sustainable Earth Initiative's Green Fleets Toolkit
- Consider expanding Spare the Air Day messaging to include how complying with speed limits and other smart driving techniques can reduce smog forming pollution on Spare the Air Days, and reduce GHG's every day.

Emission Reductions:

Pollutants*	2020	2030
ROG	1,962	825
NO_x	1,178	518
$PM_{2.5}$	209	158
PM_{10}	497	376
DPM	633	519
TACs	0.20	0.02
CO_{2e}	573,189	425,247

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:

Different equations were used to calculate the various component of this control measure. Equations were developed specifically for the social marking elements. These equations incorporated driving behavior, such as acceleration and deceleration, maintenance, route planning and trip linking. The equations were used to calculate how driving behaviors impact VMT and therefore emission reductions. Emission reduction estimates were estimated via EMFAC 2014 trip end and exhaust emission rates. CO2 conversion/equivalency factors were used to estimate the emission reduction benefits for the criteria pollutants and mobile source air toxics (MSATs). Emission reductions estimated for criteria pollutants and toxics are nominal.

Exposure Reduction:
Reducing high speed driving should help to reduce emissions of ROG, NOx, PM, and CO_2 and therefore exposure to air pollution throughout the Bay Area.

Emission Reduction Trade-offs:
None identified.

Cost:
$161 million

Co-benefits:
- Reduced/less frequent servicing, maintenance and repair costs that result from reduced wear and tear of various vehicle components (i.e. tires, clutch, and engine).
- Economic savings from reduced costs associated with automobile crashes.
- Economic benefits from fuel savings to individual drivers and to the Bay Area economy as whole. For vehicles employing smart driving techniques, a range from 4.5 to 16.5 percent reductions in fuel consumption could be achieved.

Issues/Impediments:
Implementation of this control measure is dependent on available funding, collaboration between multiple agencies and the public's recognition of the consequences of high-speed driving and the positive effects of smart driving habits, e.g. maximizing fuel efficiency, fewer accidents.

Sources:
1. Metropolitan Transportation Commission, Association of Bay Area Governments, *Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy*, July 2013
2. Fiat, 2009. Eco-Driving Uncovered: The benefits and challenges of eco-driving based on the first study using real journey data.
3. Kurani, K., Stillwater, T., and Jones, M., 2013. Ecodrive I-80: A Large Sample Fuel Economy Feedback Field Test: Final Report. Institute of Transportation Studies Report: ITS-RR-13-15. Available at http://www.fueleconomy.gov/feg/pdfs/EcoDrive%20I-80.pdf

TR13: Parking Policies

Brief Summary:
Parking policies and practices have a profound impact on vehicle travel and mode choice, as well as land use patterns and the quality of the built environment. Parking policies are also an important tool in implementing focused growth strategies. This control measure outlines how MTC and the Air District, in cooperation with regional agency partners, will 1) take actions at the regional level to implement parking policies that will benefit air quality, and 2) encourage and support local agency parking policies to reduce motor vehicle travel and promote focused growth.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gases by implementing parking policies that support in-fill and transit-oriented development and reduce vehicles miles traveled.

Travel Market Affected:
This measure would affect intraregional travel, including commute travel, shopping, personal business, school trips, as well as social and recreational travel.

Regulatory Context and Background:
Local governments have traditionally implemented parking policies that provide plentiful parking. Although "free" parking is often provided, there are both direct and indirect costs associated with all parking. Parking policies and zoning codes that promote an oversupply of parking contribute to reliance on the automobile and undermine infill and transit-oriented development.

Promoting parking policy reform will require political leadership in combination with technical assistance, resources, and incentives and disincentives. Parking policy reform and strategies could come in various forms, including:

- Eliminate or reduce minimum parking requirements;
- Limit the supply of off-street parking in transit-oriented areas;
- Encourage developers and property owners to unbundle the price of parking spaces from rents and purchase prices;
- Promote shared parking by different users;
- Implement market-rate pricing for off-street parking in high-use areas;
- Implement parking assessment districts that use revenue from street parking to fund pedestrian and streetscape improvements;
- Adopt design guidelines and policies to minimize surface area for parking;
- Implement car sharing and bike sharing programs in appropriate locations in exchange for reduced parking requirements, and provide as a benefit to renters;
- Encourage a coordinated parking policy approach among jurisdictions to minimize spillover to other jurisdictions and fears of unfair competition.

Cities and counties have direct authority over parking policies. However, regional agencies can assist local governments by providing technical resources, recommending best practices, and leading by example in adopting internal and external policies. MTC has provided such assistance through the following:

- "Parking Advanced Implementation Labs" offers professional assistance to local governments in adopting and implementing a specific parking strategy.
- Training: MTC provided training for local governments on the MTC publication *Reforming Parking Policies to Support Smart Growth*.
- Technical Assistance: MTC surveyed local jurisdictions' parking policies, interests and challenges, provided technical assistance for five specific locations, prepared an economic assessment of parking structures at transit stations, and conducted parking fundamentals workshops for local jurisdictions and other interested parties.
- Parking Workshops: In 2012-2013 MTC focused on technical analyses and communications methods, culminating in a series of parking workshops aimed at planning and transportation professionals. This effort included quick engaging videos summarizing key parking policy issues, best practices workshops, and additional technical reports.
- Transit Oriented Development - Technical Assistance Program (TOD-TAP): funds for planning efforts that include parking policy analysis in numerous communities. MTC developed guidance for the parking policy analysis section of the station area plans, and staff comments on the parking elements in the draft plans.
- Value Pricing Pilot Program for the Parking Pricing Regional Analysis Project: MTC was awarded a competitive grant from the Federal Highway Administration (FHWA) to establish a regional parking database, analyze a number of regional parking pricing policy options, and create and demonstrate local parking analysis tools. This specific effort was completed in 2015; however, this project has created a foundation for additional future development of the parking database, regional policy analyses and local strategies.
- *Parking Technology Roundtable.* In December 2014 MTC sponsored a round table discussion to share information, experiences and questions on how to best evaluate and implement parking technologies in support of local smart growth policies.
- MTC's Innovative Grants Program funds demonstration projects to test innovative strategies to promote changes in driving and travel behaviors.

Implementation Actions:
MTC will:

- Continue to provide technical assistance to local jurisdictions through the Transit Oriented Development Technical Assistance Program (TOD TAP) and offering best practices workshops.
- Consider parking projects as part of future Climate Program grant opportunities, such as the Transportation Demand Management program.
- Incorporate parking issues into the broader public outreach program for climate action.
- Continue support for State and Federal bills to reduce subsidies for parking.

- Conduct the VPP Parking Pricing Regional Analysis Project, which will create a foundation for additional future development of the parking database, regional policy analyses and local strategies.
- Fund the Climate Initiatives Innovative Grants Parking Policy project, including: goBerkeley, City of BerkeleyGrant ($2 million)

The Air District will:

- Highlight parking best practices, mitigation strategies, and/or guidance documents on the Air District's web site.
- Consider funding parking technology projects, including: real-time parking information, pay-by-phone parking, and parking hotlines.
- Encourage parking cash-out programs to employers and local governments.
- Encourage local agencies to adopt innovative parking strategies, including:
    - Eliminate or reduce minimum parking requirements;
    - Limit the supply of off-street parking in transit-oriented areas;
    - Encourage developers and property owners to unbundle the price of parking spaces from rents and purchase prices;
    - Promote shared parking by different users;
    - Implement market-rate pricing for off-street parking in high-use areas;
    - Implement parking assessment districts that use revenue from street parking to fund pedestrian and streetscape improvements;
    - Adopt design guidelines and policies to minimize surface area for parking;
    - Implement car sharing and bike sharing programs in appropriate locations in exchange for reduced parking requirements, and provide as a benefit to renters;
    - Encourage a coordinated parking policy approach among jurisdictions to minimize spillover to other jurisdictions and fears of unfair competition.
- Continue to provide comments, in regard to parking policies, on CEQA analysis of local plans and other projects to lead agencies.

Emission Reductions:

Pollutants*	2020	2030
ROG	1.41	0.59
NO_x	0.85	0.37
$PM_{2.5}$	0.15	0.11
PM_{10}	0.36	0.27
DPM	0.45	0.37
TACs	<0.01	<0.01
CO_{2e}	412	306

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
According to the City of Berkeley, average daily traffic on the streets in the three pilot areas is 105,500. Commonly used figures are that 30% of traffic consists of drivers looking for a parking space and that the average cruising distance to find a curb space is 0.5 miles (this is based in part on research by UCLA Professor Donald Shoup). This translates to 15,825 daily VMT from "search driving" in the pilot areas. Also according to the City, the number of blocks in high parking demand areas that have on-street parking occupancy greater than 85 percent has decreased by 12 percent. This increase in parking availability is assumed to yield a corresponding 12 percent decrease in search driving. This results in a reduction of 1,899 VMT daily, or 693,135 VMT annually.

It is assumed that under demand-responsive parking management, it is easier to find parking but that the same number of trips continues to be made—in other words, there is no reduction in vehicle trips.

The above figures for reduced vehicle trips and VMT are translated into reduced GHG emissions using starting- and running-exhaust emission factors from EMFAC2011, the 2011 version of the computer model for estimating emissions from on-road vehicles in California. EMFAC 2011 emission factors were updated to reflect the current version of the EMFAC model, EMFAC2014 and the emission factors applied were for light-duty autos operating in Alameda County. Starting-exhaust emission factors are applied to the reduced trips while running-exhaust factors are applied to the reduced VMT. Emissions are given in metric tons of carbon dioxide-equivalent (CO2e), a measure of the aggregate global-warming potential of various air pollutants. CO2 conversion/equivalency factors were used to estimate the emission reduction benefits for the criteria pollutants and mobile source air toxics (MSATs).

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
Approximately $2.6 million for grants.

Co-benefits:
- Improved housing affordability.
- Conservation of energy.
- Improved water quality / reduced storm water run-off.
- Promotion of more efficient use of land.
- Increased transit ridership, walking, and cycling.
- Enhanced community design and quality of life.
- Cost savings to those providing parking cash-out program.

- Reduced vehicle cruising and associated congestion and emissions.
- Reduced health risks from vehicle emissions and enhanced walkability.
- Potential to use any revenue generated by parking fees to fund improvements to transit and other alternative modes of travel.

Issues/Impediments:
Local government parking reform can be impeded by limited resources and technical expertise, especially in small municipalities. Parking policies are a highly political issue on the local level. Local governments may be reluctant to adopt parking reforms due to lack of political support, business concern that their city will be at a disadvantage with competitors in neighboring cities without similar parking reforms. Since parking costs are often hidden in rents and purchases, residents may not understand the basis or need for parking reform.

Local governments develop local parking policies based upon local needs and priorities. Willingness to implement policies consistent with regional parking policies will vary among these entities.

Sources:
1. Donald Shoup. *The High Cost of Free Parking.* Washington D.C.: APA Planners Press, 2005.
2. Metropolitan Transportation Commission, Association of Bay Area Governments, *Plan Bay Area, Regional Transportation Plan and Sustainable Communities Strategy,* July 2013
3. Metropolitan Transportation Commission, Reforming Parking Policies to Support Smart Growth; Toolbox/Handbook: Parking Best Practices & Strategies for Supporting Transit Oriented Development in the San Francisco Bay Area, June 2007 http://mtc.ca.gov/sites/default/files/Toolbox-Handbook.pdf

TR14: Cars & Light Trucks

Brief Summary:
This control measures summarizes actions by the Air District, MTC, local businesses, city and county governments, and state and federal agencies to expand the use of Zero Emission Vehicles (ZEVs) and Plug-in Electric Vehicles (PEV), comprising both battery electric and plug-in hybrid passenger vehicles and light-duty trucks within the Bay Area.

Purpose:
This measure will reduce key ozone precursors of ROG and NOx, particulate matter, air toxics, and greenhouse gases by providing incentives for the purchase of electric and plug-in hybrid vehicles and light-duty trucks.

Travel Market Affected:
This measure would affect inter- and intraregional travel, including commute travel, shopping, personal business, school trips, as well as social and recreational travel.

Regulatory Context and Background:
In September 1990, ARB adopted the Low-Emission Vehicle Regulation to reduce pollution from passenger cars and light-duty trucks. This regulation required large auto manufacturers to bring to market vehicles with zero emissions beginning with 1998 model-year vehicles. The regulation is implemented through the Zero Emission Vehicle (ZEV) program, which originally required, starting with 1998 model year vehicles, that 10 percent of new vehicle sales by large auto manufacturers have zero emissions. ARB modified the program in 1998 and 2001 to allow up to 60 percent of the zero emission requirements to be met with vehicles having extremely low emissions and other specific attributes. Vehicles meeting these standards are referred to as "partial zero emission vehicles" (PZEV) and "advanced technology partial zero emission vehicles" (AT-PZEV).

Since its adoption, the ZEV Program, as part of the Low Emission Vehicle Regulation, has reduced the amount of air pollution from passenger cars and light-duty vehicles through the gradual introduction of partial and zero emission vehicles into the California fleet. The Low Emission Vehicle Regulation, which affects passenger cars and light-duty trucks, has been amended on several occasions since its inception (most recently in January 2012 and October 2013) to reflect the pace of ZEV development, the emergence of new ZEV and near-ZEV technologies, and the need to clarify the language of the regulation.

In January 2012, in order to address the need to further reduce vehicle emissions and achieve California's goals of meeting ambient air quality standards and reducing greenhouse gas emissions (GHG), ARB approved the Advanced Clean Cars (ACC) program. The ACC program incorporated three elements that combine the control of smog-causing (criteria pollutant) emissions and GHG into a single coordinated package of requirements for model years 2015 through 2025. These three elements included: the Low-Emission Vehicle III (LEV III) regulations, the Zero-Emission Vehicle (ZEV) regulations, and the Clean Fuels Outlet regulations.

Additionally, hydrogen fueling infrastructure was provided with a dedicated funding source by the California Legislature through passage of Assembly Bill 8 (AB 8 - 2013),

ARB's *Mobile Source Strategy*
As part of the development of the 2016 State Implementation Plans for the South Coast and San Joaquin Valley Air Basins, ARB developed a comprehensive strategy to reduce criteria, toxic and greenhouse gas emissions from mobile sources. For passenger vehicles, the strategy calls for increasing the penetration of plug-in hybrid electric vehicles (PHEV) and zero-emission vehicles (ZEV) such as battery-electric (BEV) and hydrogen fuel cell electric vehicles (FCEV) by over 50 percent compared to current programs. Additional, renewable energy will comprise at least 50 percent of the electricity and hydrogen supply supporting these electric vehicles. A large portion of the liquid fuels for combustion engine vehicles will also need to be sourced from renewable feedstock.

To implement the Mobile Source Strategy, ARB staff will propose modifications to the Advanced Clean Cars to increase the number of new ZEVs and PHEVs sold in California. The regulation may include lowering fleet emissions further beyond the super-ultra-low-emission vehicle (SULEV) standard for the entire light-duty fleet through at least the 2030 model year, and look at ways to improve the Smog Check and On-Board Diagnostics programs to ensure continued reductions in emissions. Additionally, new standards would be considered to further increase the sales of ZEVs and PHEVs in 2026 (and later years) beyond the levels required to ensure future emission reduction, climate, and petroleum targets are met.

MTC's Climate Initiatives Program and Plan Bay Area
In response to the passage of climate change legislation AB32 and SB375, in December 2009, MTC adopted a Climate Initiatives Program. The overall objective of the program is to make short-term investments that reduce transportation-related emissions by reducing vehicle miles traveled, and encouraging new technologies.

The Climate Initiatives Program is a key component of MTC's GHG emissions reduction strategy, which anticipates a 16 percent per capita reduction in GHG emissions from light duty vehicles by 2035.

Bay Area Plug-In Electric Vehicle (PEV) Readiness Plan
To further accelerate the purchase and lease of zero-emission and plug-in hybrid vehicles in the Bay Area, in 2013 the Air District, in partnership with MTC and ABAG, developed the *Bay Area Plug-In Electric Vehicle (PEV) Readiness Plan*. This plan is guiding the actions of the Air District, MTC and ABAG, as well as other regional public and private partners, in developing financial incentives for the purchase and lease of PEVs, locating charging locations at worksites and public areas, and developing local planning and building code best practices to ensure PEVs are well integrated into the region. The plan also includes a siting analysis, which seeks to guide and coordinate future PEV charging infrastructure-siting efforts based on anticipated or projected demand for PEVs.

PEV Incentives

Plug-in electric vehicles are being purchased at significant levels today in the Bay Area. As of May 2016, PEVs comprise nearly 2 percent of the Bay Area's light duty fleet, and monthly sales are estimated to be approximately 5 percent of total new light-duty vehicle sales. Nearly 70 percent of PEVs registered to Bay Area drivers are battery electric vehicles.

One of the main drivers for PEV sales has been the High Occupancy Vehicle (HOV) lane access. HOV facilities are intended to increase the total number of people moved through a congested corridor by offering two kinds of travel incentives: 1) a substantial savings in travel time, and 2) a predictable travel time. The use of HOV lanes can increase the average number of persons per vehicles, preserve the person-movement capacity of the roadway, reduce congestion, and enhance bus operations.

The DMV issues Clean Air Vehicle decals to vehicles that meet specified emissions standards, which allow a vehicle to be operated in an HOV lane by a single occupant. White Clean Air Vehicle decals are currently available to an unlimited number of qualifying Federal Inherently Low Emission Vehicles (ILEVs). Cars that meet these requirements are typically certified pure zero emission vehicles (100 percent battery electric or hydrogen fuel cell) and compressed natural gas (CNG) vehicles. Per AB 266, the expiration date for the white stickers has been extended to January 1, 2019. Green Clean Air Vehicle decals were originally available to the first 40,000 applicants that purchased or leased cars meeting California's transitional zero emission vehicles (TZEV) requirement, also known as the enhanced advanced technology partial zero emission vehicle (AT PZEV) requirement. Per SB 286, the expiration date for the green decals has also been extended to January 1, 2019. Additional legislation raised the green decal limits to 85,000 vehicles, which was reached in December 2015.

Additionally, because the higher purchase price of PEVs makes it difficult for middle and low income consumers to purchase a PEV and associated fueling stations, significant funding for incentives to help reduce the cost of PEV ownership/operation are being made available by the Air District's Transportation Fund for Clean Air and MTC's Climate Initiatives Program. Incentive funding to purchase a PEV will be provided, when combined with the buyback of an older, less efficient vehicle (See Vehicle Buy Back Program below). This is intended to extend the market for PEVs into a broader range of income classes. The combination of vehicle buyback and incentive program is intended to induce demand in middle and lower income brackets that might otherwise delay car purchasing, purchase a new conventional vehicle, or purchase a used vehicle.

Vehicle Buy Back Program

The Air District's Vehicle Buy Back Program (VBB) is a voluntary program that takes older, high polluting vehicles off the road. The VBB program pays $1,000 for an operating and registered 1994 and older vehicle. Vehicle dismantlers contracted by the Air District scrap the vehicles. The program is funded through the Air District's Carl Moyer, Mobile Source Incentive Fund and Transportation Fund for Clean Air (TFCA) programs.

The state administers a Voluntary Accelerated Vehicle Retirement (VAVR) program which targets vehicles that fail the biennial Smog Check. This program provides money to vehicle owners to retire older, more polluting vehicles. The purpose of this program is to reduce emissions by accelerating the turnover of the existing fleet to newer, cleaner vehicles. This program is a component of California's State Implementation Plan, which outlines the State's strategy for meeting health-based ambient air quality standards. The State's program provides $1,000 per vehicle ($1,500 for low-income vehicle owners) for old vehicles that fail the most recent biennial Smog Check Test.

To accelerate the removal of old, highly polluting cars from the San Joaquin Valley and South Coast Air Basins, ARB in 2015 ran a successful small enhancement to the VAVR program. The "Plus-Up" enhancement provide additional cash to low-income residents participating in the VAVR program if they purchased of a newer, cleaner car. The"Plus-Up" program is expanding in 2017; $40 million has been allocated to programs in the San Joaquin and South Coast Air Basins, with an additional $20 million to other parts of California.

Clean Vehicles Fee-bate Program
A fee-bate program uses a combination of fees and rebates to change consumer behavior. Consumers purchasing a vehicle that emits more CO_2 on a gram per mile basis than a defined standard are assessed a fee at the point of purchase. These fees are used to provide rebates to consumers that purchase vehicles that emit less CO_2 on a gram per mile basis than the defined standard.

Fee-bates have been used with some success in other countries, including Denmark, France, the Netherlands, and Norway. In the early 1990s, ARB studied a fee-bate program for California, and again in 2007, in response to a legislative initiative (AB 493, 2007). The Air District will, in cooperation with MTC and ARB, obtain legislative authority to implement a fee-bate program in the Bay Area.

Implementation Actions:
The Air District and/or MTC will:

- Consistent with the goals of the *Bay Area PEV Readiness Plan*, both the Air District and MTC will commit regional clean air funds toward qualifying vehicle purchases and infrastructure development subsidies.
- Partner with private, local, state and federal programs to promote the purchase and lease of battery-electric and plug-in hybrid electric vehicles.
- Partner with private, local, state and federal programs to install and expand public charging infrastructure and to promote existing charging infrastructure. Advocate for increased government incentives and research programs with local businesses, non-profits and governments.
- Develop model ordinances and/or direct local governments to existing ordinances (such as in Sonoma, Santa Clara, and Contra Costa County) concerning installation of vehicle charging in new homes.

- Support the use of renewable electricity in both ZEVs and PHEVs, with additional support for low carbon, renewable fuels in the onboard internal combustion engines in PHEVs.
- Support research programs advancing technology for plug-in hybrid, battery electric and hydrogen-fueled vehicles.
- Promote the DMV's Clean Air Vehicle decal program to encourage purchase of ZEVs and PHEVs
- Obtain legislative authority for a regional fee-bate initiative. Work with ARB and MTC to implement the program.
- In 2017, apply for funding to run a "Plus-Up" program in the Bay Area as part of the State's VAVR program. This funding will be used to assist low-income residents to retire older vehicles that fail Smog Check and purchase a newer, cleaner vehicle.
- In 2020, implement a regional "Plus-Up" program as part of the Vehicle Buy Back; this regional effort will assist vehicle owners in replacing older vehicles that still pass Smog Check with new a new zero emission or plug-in hybrid electric vehicle.
- Work with MTC to ensure ZEVs and PHEVs have access to the region's HOV lanes and the Express Lane Networks.

Emission Reductions:

Pollutants*	2020	2030
ROG	84	64
NO_x	84	64
$PM_{2.5}$	16	14
PM_{10}	17	15
DPM	-	-
TACs	-	-
CO_{2e}	4,566	3,963

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:

Emission reductions for this measure have been calculated for the years 2016 through 2030, and are based only on the Air District's and MTC's ongoing incentives for new fleet vehicles and the Vehicle Buy-back Program. For new vehicle purchases, the annual VMT is assumed to be 15,000 miles.

Emission reductions were calculated by assuming that each ZEV and PHEV will be purchased in lieu of an average brand new gasoline powered vehicle. For zero emission vehicles, the emission reductions are calculated as the difference between new vehicle emissions and zero emissions in the years 2016 through 2030. For these estimates, we assume that during the 15 year period, older vehicles are retired and replaced like-for-like with new vehicles, and the new vehicles remain in operation during the entire period; that is a vehicle purchased in 2017 would still be in operation in 2030. Because new standards haven't yet been adopted for MY 2026-2030, we assume that new gasoline and PHEV vehicles meet the existing SULEV20 standard.

For plug-in hybrid vehicles, it is assumed that the vehicles will be certified by ARB as Super Ultra Low Emission Vehicles and will operate in electric mode for 50 percent of the annual VMT, or 7,500 miles. For PHEV's, we have assumed that 75 percent of the electricity used by the vehicles will come from grid-electricity, while the remaining 25 percent of the electricity comes from burning gasoline in the vehicle engine.

Exposure Reduction:
Reduction in the use of gasoline will also reduce public exposure to air toxics, particularly in communities near heavily traveled roads and freeways.

Emission Reduction Trade-offs:
This measure will not increase emissions of any pollutant from motor vehicles; however, to the extent that it helps to increase the number of ZEVs and PHEVs in use within the Bay Area, it may increase emissions of criteria pollutants and greenhouse gases from power plants that generate the required electricity.

Cost:
Cost for the measure consists of $14 million allocated by the Air District Board of Directors for the FY 2015/16 incentives, plus the assumption that the Air District and MTC will subsequently provide up to $5 million per year from 2017 through 2021 and that the Air District will provide up to 2.5 million from 2022 through 2030 for subsidies towards the purchase of qualifying vehicles and infrastructure. Additional benefits from incentives will occur if the region receives funding from state and federal incentive programs, tax refunds and rebates, and private sources.

Co-benefits:
The expanded use of newer, cleaner electric powered cars will reduce water pollution and decrease reliance on crude oil for transportation fuel. Benefits of "green" job creation are dependent on commitments to manufacture compliant vehicles within the Bay Area.

Issues/Impediments:
- Funding for vehicle subsidies
- Limited availability of ZEV and Plug-in Hybrid vehicles
- Vehicle price and ongoing maintenance costs
- Advances in battery technology

Sources:
1. BAAQMD, *Grant Application, U.S. Department of Energy (DOE), National Energy Technology Laboratory, Funding Opportunity: Clean Cities FY09 Petroleum Reduction Technologies Projects for the Transportation Sector, Area Interest #4; Funding Opportunity Number DE-PS26-09NT01236-04; CFDA Number 81.086.* June 2009
2. BAAQMD, et al., *Bay Area Plug-in Vehicle Readiness Plan*, December 2013. Available online at http://www.bayareapevready.org/.

3. BAAQMD, Presentation to the California Energy Commission's "Integrated Energy Policy Report Workshop," June 5, 2014
4. Bunch, David S. and David L. Greene (2010) Potential Design, Implementation, and Benefits of a Feebate Program for New Passenger Vehicles in California: Interim Statement of Research Findings. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-10-13
5. CARB, *Initial Statement of Reasons for Rulemaking: Proposed 2014 Amendments to the Zero Emission Vehicle Regulation*, September 2, 2014
6. CARB, *Staff Report: Initial Statement Of Reasons For Proposed Rulemaking, Public Hearing To Consider The "Lev Iii" Amendments To The California Greenhouse Gas And Criteria Pollutant Exhaust And Evaporative Emission Standards And Test Procedures And To The On-Board Diagnostic System Requirements For Passenger Cars, Light-Duty Trucks, And Medium-Duty Vehicles, And To The Evaporative Emission Requirements For Heavy-Duty Vehicles,* December 7, 2011.
7. MTC, *Draft 2017 Transportation Improvement Program (TIP) For the Nine-County San Francisco Bay Area,* June 24, 2016
8. United States Department of Energy, Office of Energy Efficiency and Renewable Energy, Alternative Fuels Data Center, "Hybrid and Plug-in Electric Vehicle Emissions Data Sources and Assumptions," retrieved on 7/1/2015 -- http://www.afdc.energy.gov/vehicles/electric_emissions_sources.html

TR15: Public Outreach

Brief Summary:
The Public Outreach control measure includes activities to encourage Bay Area residents to make choices that benefit air quality. This measure includes various public outreach campaigns to educate the public about the health effects of air pollution and the air quality benefits of reducing motor-vehicle trips and choosing transportation modes that reduce motor vehicle emissions. The measure includes outreach and education regarding electric vehicles, smart driving, carpooling, vanpooling, taking public transit, biking, walking, and telecommuting.

Purpose:
The purpose of this measure is to reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, air toxics and greenhouse gas (GHG) emissions.

Travel Market Affected:
This measure would affect intraregional travel, including commute travel; shopping, personal business, school trips, social and recreational travel. In addition, this measure may help to reduce emissions from the use of lawn and garden equipment and recreational watercraft.

Regulatory Context and Background:
Electric Vehicle Strategy
The Air District and MTC view PEVs as a promising technology for reducing tailpipe emissions, thus helping the region achieve local, state, and federal criteria pollutant and GHG emission reduction targets. In December 2013, the Air District, in partnership with MTC and ABAG, completed a *Bay Area Plug-in Electric Vehicle Readiness Plan* (www.baaqmd.gov/EVready). The plan outlines a series of strategies and best practices that can be taken by regional agencies and other PEV stakeholders to remove potential barriers and accelerate deployment of PEVs.

An EV Promotional Campaign is one of the strategies outlined in the Readiness Plan and a well-coordinated regional PEV marketing campaign that specifically targets Bay Area consumers is needed in order to successfully capture the attention and acceptance of the broader general public. This campaign was implemented in 2013-2016 by MTC and the Air District.

Campaign development began in October 2012 and included research into which activities would be the most successful to increase EV adoption. Research indicated that allowing interested individuals to test drive EVs in an environment free of sales pressure would be the best strategy. An initial one-year ride-and-drive campaign was then launched in Spring 2014, marketed as Experience Electric. Through the Experience Electric campaign, MTC offered twenty-one free, interactive Ride-and-Drive events at venues around the Bay Area. The ride-and-drives allowed drivers to test-drive EVs and share their experience via social media.

To evaluate the campaign, MTC implemented a pre-drive, post-drive and follow-up surveys (several months after the ride and drive) to event participants. Overall, the events yielded positive effects on perceptions of EVs, perceived barriers to EV purchase, and intent to

purchase an EV immediately following the events in the post-drive survey. Because of these results, the Air District provided additional funds for six ride-and-drive events in winter 2015 and spring 2016.

In addition to the campaign, the Air District provides funding for outreach and activities including implementing the training described in the PEV Plan for local government agencies and the public, conducting workshops and participating in workgroups and other opportunities to support PEV deployment and sharing best practices.

Spare the Air

The STA Every Day Program is the backbone of the Air District's efforts to encourage the public to take direct action to reduce emissions and improve air quality. Since motor vehicles are the leading source of ozone forming emissions in the Bay Area, efforts to reduce vehicle travel, particularly on days with Spare the Air Alerts, can help avoid exceedance of federal and state standards. STA Every Day includes the following components:

- Outreach Program
  - STA Alert notifications via media channels, alert notification sign up lists, and the employer program.
  - Advertising campaign through print, billboards, TV ads and website ads.
  - Media outreach through news programs and community based outreach channels, such newsletters.
  - Outreach at community events, such as county fairs.
  - Coordination with MTC/511.
- Employer Program
  - Employer coordinators inform their workforce of impending Spare the Air days, educate employees about the ways individuals can improve air quality, and motivate them to take action.
- Community Resource Teams
  - Local civic groups, agencies, businesses and environmental organizations meet regularly and work collaboratively to implement projects that promote cleaner air. Team members, with Air District support, are responsible for developing and carrying out local projects.
- Winter Spare the Air
  - The Winter Spare the Air program notifies residents when particulate matter levels are anticipated to be unhealthy. On these high pollution days, the Air District issues a Winter Spare the Air Alert which prohibits wood burning throughout the Bay Area.
- Youth Programs
  - Protect Your Climate Curriculum: 16 lessons for 4th and 5th grade students that focus on air pollution, energy, waste reduction and transportation.
  - Clean Air Challenge Curriculum: a science-based curriculum which includes experiments that help students understand air pollution and climate change.
  - Cool the Earth: a greenhouse gas reduction program for K-8th grade students and their parents.

- As the World Warms: a classroom supplement including news stories and puzzles on climate change for elementary aged students.
- eCO2 Commute Challenge Project Manual: a tool to help high school students become a part of the solution to climate change by taking action in their schools to reduce greenhouse gas emissions from student commutes by promoting walking, biking, riding the bus and carpooling.

In addition, Spare the Air Youth is a regional program, implemented by MTC and the Air District, that aims to educate, inspire and empower youth and families in the San Francisco Bay Area to walk, bicycle, carpool and take transit. Spare the Air Youth seeks to find effective ways to reduce GHG and other emissions related to transportation, while also providing a regional resource for students, parents, teachers and program providers.

Non-Commute Trip Reductions Campaign

Non-commuting travel generally includes vehicle trips associated with schools, hospitals, medical centers, banks, stores, post offices, entertainment, recreation, etc. Reducing non-commute trips may contribute to the overall goal of reducing vehicle miles traveled (VMT) and therefore air pollution in the Bay Area.

Non-commute trip reduction strategies have been successfully implemented in the Bay Area and other regions of the nation. For example, the City of Walnut Creek and Emeryville offer free shuttles to and from shopping districts. In the Denver area, retail shopping centers are also operating shuttles that are realizing high ridership. Shuttles may be funded privately or through public-private partnerships. In the instance of shopping centers, retail benefits from shared underwriting of the shuttle costs; these costs return benefits for both shoppers and employees, especially in high shopping seasons where parking is limited.

Non-commute trips may also be the focus of residentially-based education and marketing campaigns. A particularly strategic time to approach people about travel behavior changes is when they change either their place of work or residence. The Sacramento Area Council of Governments (SACOG) is working with outreach partners throughout the region to expand on commute campaigns with information on non-commute trip reduction strategies. Outreach partners will be supported with collateral materials to share with real estate agents, rental and lease agents, and new home welcome services.

Outreach could also include presentations to interest groups, including but not limited to, realtor associations, business organizations, chambers of commerce and service clubs. Information could also be developed for new home buyers, seniors in assisted living facilities, recreation and park districts, school districts, senior centers, neighborhood associations, and advocacy groups for alternative modes, including bicycling and walking.

The Spare the Air Everyday Campaign has a non-commute emphasis as well. In addition to reducing commute trips, the campaign speaks to reduce driving and other activities that generate air pollution, not only during weekdays, but on all days of the week. Spare the Air

Everyday asks residents to reduce pollution by making clean air choices every day. This can include walking and biking more often, taking transit, telecommuting or carpooling, driving less, reducing energy consumption at home, and making many other daily choices that improve air quality.

Implementation Actions:
The Air District will:

- Implement the Spare the Air Every Day Campaign including Spare the Air alerts, employer program, and community resource teams
- Implement outreach and education efforts in partnership with MTC, including the Spare the Air Youth Program

MTC will:

- Implement the Spare the Air Youth Program with the Air District
- Encourage alternative modes of travel for non-commute trips, including walking, bicycling, transit and carpooling via the development of outreach programs to targeted travel sector groups
- Explore ways to expand public awareness of availability and benefits of transit, bicycling, walking, or carpooling/vanpooling for non-commute trips

Emission Reductions:
N/A

Emission Reduction Methodology:
N/A

Exposure Reduction:
N/A

Emission Reduction Trade-offs:
None identified.

Cost:
Spare the Air Program: $6 million/year
EV Outreach: approximately $500,000/year
Non-Commute Trips Campaign: N/A

Co-benefits:
This measure raises public awareness about the causes of and solutions to air pollution. People who choose to change their travel or other behaviors in response to a voluntary request for a STA Alert may reduce vehicle use or change other polluting activity on a regular basis, as advocated in the STA Every Day and the Spare the Air Youth programs. Additionally, increased travel by bike and walk modes may increase individuals' physical health and quality of life.

Issues/Impediments:
Implementation of this measure requires that funding is available for these programs. In addition, because the Spare the Air program is voluntary in nature, its effectiveness depends on the cooperation of the general public.

Sources:

1. Purvis, Charles L., *Incorporating Work Trip Accessibility in Non-Work Trip Generation Models in the San Francisco Bay Area*, January 1996 http://www.mtc.ca.gov/maps_and_data/datamart/research/paper96.htm

TR16: Indirect Source Review

Brief Summary:
An indirect source review (ISR) rule would reduce construction and operating emissions associated with new or modified land uses in the Bay Area. The Indirect Source Review measure is intended to address potential increases in air pollutant emissions related to economic and population growth in the region. Indirect sources are development projects that generate or attract motor vehicle trips, thus "indirectly" cause air pollution from vehicles and area sources. Area source emissions include fireplaces, home heating furnaces, hot water heaters, and landscape maintenance equipment.

Purpose:
This measure will reduce emissions of key ozone precursors, ROG and NOx, particulate matter, toxic air contaminants and greenhouse gases by reducing construction and operational emissions associated with new or modified land uses.

Travel Market Affected/Source Category:
On-road and off-road mobile emission sources are the main source categories targeted by this measure. However, space heating, landscape maintenance and wood burning emission source categories could also be included.

Regulatory Context and Background:
The California Clean Air Act (CCAA) explicitly grants air districts authority to adopt and implement regulations to reduce or mitigate emissions from indirect and area wide sources of air pollution. This may be done by air districts through the use of measures which reduce the number and length of vehicle trips (Health and Safety Code §40716(a)(1)). Based on CCAA enabling legislation, it is the intent of the legislature "that districts shall endeavor to achieve and maintain state ambient air quality standards…by the earliest practicable date. In developing attainment plans and regulations to achieve this objective, districts shall consider the full spectrum of emissions sources and focus particular attention on reducing the emissions from transportation and area wide emission sources (H&SC §40910)." The CCAA also states that this ISR authority does not limit or supersede local land use authority of cities and counties.[1]

Varying degrees and forms of ISR rules have been implemented in air districts throughout California, including Colusa County, Great Basin Unified, Imperial County, Mendocino County, San Joaquin, and Shasta County. Some of these rules are strictly cost recovery mechanisms for air districts to recoup the costs associated with CEQA review while others encourage new development to implement on-site emission reduction strategies or require applicants to pay an off-site mitigation fee.

[1] Other relevant ISR sections in the CCAA include: 40717(g), 40918(a)(4), and 42311(g).

In 2005, the San Joaquin Valley Air Pollution Control District (San Joaquin Valley APCD) adopted Rule 9510 as an ISR rule. The rule applies to residential, commercial, industrial, office and recreational development projects above a certain size (e.g., 50 residential units or 2,000 square feet of commercial space). Development projects must reduce their construction and operational emissions to be below two tons per year of NOx and PM10 through onsite mitigation or pay an off-site mitigation fee. The fee formula is structured to encourage on-site mitigation measures. San Joaquin Valley APCD uses the fees to fund off-site mitigation projects that reduce NOx and PM10 emissions. To date, San Joaquin Valley APCD has mostly funded off-site projects that include retrofitting or replacing engines in on-road and off-road vehicles and agriculture equipment.

Imperial County APCD adopted Rule 310, Operational Development Fee, in 2007. It assesses a per square foot fee on all new commercial development and a per unit fee on residential development above four units. Project proponents have the option to either provide on and off site mitigation, pay the mitigation fee, or do a combination of both. Fees collected are used to fund mitigation projects that reduce ozone precursors and PM10.

On November 2, 2010, Proposition 26 passed by over 52 percent of California voters. Proposition 26 amended the California Constitution by redefining "tax" to include any "levy, charge, or exaction of any kind" and requiring any new fees (or taxes) that meet this definition be approved by a 2/3 vote from each house of the State Legislature for statewide fees or by 2/3 voter approval for local fees. It should also be noted that there are seven exemptions to Proposition 26 requirements. Therefore, any ISR developed by the Air District that would include fees would have to be consistent with Proposition 26 requirements.

Implementation Actions:

The Air District will:

- Consider developing a rule that sets air quality performance standards for new and modified development.
- Reconvene a broad-based stakeholder workgroup to discuss Indirect Source Rule concepts.

Emission Reductions:

Pollutants*	2020	2030
ROG	0.30	Na
NO_x	0.24	Na
$PM_{2.5}$	0.11	Na
PM_{10}	0.47	Na
CO_{2e}	333	Na

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:

The emissions reduction methodology for this measure is based on a methodology developed and reported by the San Joaquin Valley APCD Indirect Source Review (ISR) program. The San

Joaquin Valley APCD rule requires the payment of mitigation fees for projects that will result in 2 tons of NOx or 2 tons of PM emissions per year or more. Air District staff looked at the number of development projects and plans listed in the Air District CEQA database (estimated for the year 2020) that may be subject to the ISR program. The emission reductions above estimate the results if 15 percent of emissions from new construction are mitigated through off-site mitigations.

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions. This measure will also reduce localized population exposure to air pollution.

Emission Reduction Trade-offs:
None identified.

Cost:
Specific costs will be determined during rule-making.

Co-benefits:
- Improved project design and planning.
- Public health benefits from reduced emissions, improved pedestrian access, and use of green building elements.

Issues/Impediments:
Regional rules or regulations that impact local land use decisions and/or development can be politically challenging to develop or implement.

Sources:
1. Memo to Mobile Source Committee, September 11, 2007: *2005 Ozone Strategy Further Study Measure 18: Indirect Source Mitigation Program*
2. SCAQMD ISR: http://www.aqmd.gov/home/regulations/rules/proposed-rules/pr2301
3. SJVAPCD ISR Web site http://www.valleyair.org/ISR/ISRHome.htm
4. Imperial Valley Rule 310 Operational Development Fee
5. 2008 Annual Report on the District's Indirect Source Review Program, SJVUAPCD http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2008/June/Item%2013/GVB%20Agenda%20Item%2013.pdf
6. Socioeconomic analysis SJVAPCD http://www.valleyair.org/ISR/Documents/RULE_9510_AppendixF.pdf

TR17: Planes - Cleaner Aircraft Engines and Renewable Jet Fuel

Brief Summary:
This measure consists of the efforts of the Federal Aviation Administration's (FAA) Continuous Lower Energy, Emissions and Noise (CLEEN) Program. The goals of the CLEEN Program include the development of new commercial aircraft engines by 2023-25 that would emit 60 to 75 percent fewer NOx emissions than current aircraft engines, as well as demonstrate the feasibility of jet fuel derived from crops and other renewable resources.

Purpose:
This measure will reduce emissions of a key ozone precursor, NOx, through the development and use of cleaner aircraft engines, and reduce GHGs through improvements in engine efficiencies and increased use of jet fuel derived from renewable sources.

Travel Market Affected:
This measure will affect airline travel into and out of the Bay Area.

Regulatory Context and Background:
Commercial aircraft engines operating from the three major airports in the Bay Area – San Francisco International, Oakland International and San Jose International – contribute 3.2 percent to the region's NOx inventory, while small aircraft, military planes, and ground support equipment contribute an additional 1.2 percent. All aircraft operations contribute 1.6 percent of the region's ROG emissions, and less than 1 percent of the region's PM2.5 emissions.

Aircraft emission standards have been in place for about 30 years and essentially apply to all commercial aircraft. Over the years, emission standards have been set for different aspects of aircraft engines:

- in 1974 for engine smoke (revised several times since) and fuel venting
- in 1984 for hydrocarbon emissions
- in 1997 for NOx and carbon monoxide emissions
- in 2005 for NOx emissions

The U.S. Environmental Protection Agency (US EPA) works with the FAA and the United Nations International Civil Aviation Organization (ICAO) in the development of international aircraft emission standards. The FAA is responsible for enforcing the aircraft emission standards set by US EPA. ICAO was established by the United Nations to ensure safety, equality, and consistency among international air transport services. One of ICAO's objectives is to lead international bodies in the development of standards and procedures for aircraft engines. The US EPA's current rules on aircraft emissions are equivalent to the ICAO standards.

To further reduce emissions from commercial jet engines, the FAA established the Continuous Lower Energy, Emissions and Noise (CLEEN) program in partnership with commercial airlines, jet engine manufacturers and airplane manufacturers. The CLEEN program (and some companion, subsidiary programs, such as the "Farm to Fly" program and the Airline

Sustainability Center [ASCENT]), is an effort to accelerate development and commercial deployment of environmentally promising aircraft technologies and sustainable alternative fuels. The aircraft technologies focus on reduction in aircraft noise, emissions, and fuel burn, while the renewable fuel programs focus on development of direct replacement of petroleum derived jet fuel.

In February 2016, the International Civil Aviation Organization finalized performance standards for new aircraft that will require improved fuel efficiency and reductions in Co2 emissions. The new standards will apply to all new commercial and business aircraft delivered after January 1, 2028. The standards require an average of 4% reduction in fuel consumption, with actual reductions ranging from 0 to 11%, depending on the size of the aircraft. The EPA is currently developing a federal regulation that will apply these standards to all domestic aircraft.

Implementation Actions:
The Air District will:

- Support efforts, via letters of support on legislative action or other activities, to increase the use of cleaner burning jet fuel and low-NOx engines in commercial jets arriving and departing the Bay Area.

Emission Reductions:
Emission reduction estimates for this measure are not available. The Air District will be encouraging airlines and the FAA to deploy cleaner planes, but there is too much uncertainty to reasonable estimate benefits over the next four to five years.

Exposure Reduction:
This measure may reduce region-wide population exposure to air pollutants.

Emission Reduction Trade-offs:
None identified.

Cost:
Unknown

Co-benefits:
More efficient engines and use of cleaner fuels will reduce GHG emissions.

Issues/Impediments:
Commercial aircraft emissions are regulated by US EPA and international treaties, which can take years to develop and implement any lower emission standards. Local air districts are preempted from adopting regulations controlling emissions from these sources.

Sources:

1. Federal Aviation Administration, Continuous Lower Emissions, Energy, and Noise (CLEEN) Program website; accessed February 9, 2015;

https://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/

2. Federal Aviation Administration, website for Annual Meeting of the CLEEN Consortium, November 2014, accessed February 9, 2015. https://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/2014_consortium/
3. Environmental Protection Agency, Office of Transportation and Air Quality, Regulatory Announcement, November 2005, http://www.epa.gov/oms/regs/nonroad/aviation/420f05015.pdf
4. Environmental Protection Agency, "Finding That Greenhouse Gas Emissions From Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare," Federal Register Volume 81, Number 157, August 15, 2016
5. International Civil Aviation Organization, *On Board a Sustainable Future: Environmental Report*, 2016

TR18: Goods Movement

Brief Summary:
The measure includes regional programs to reduce emissions associated with goods movement, including funding for goods movement related infrastructure, planning work to update the Regional Goods Movement Plan and participation in the regional Goods Movement Collaborative. Goods movement is a critical component of the Bay Area's economic and transportation system, and a significant source of air pollutant emissions. Exposure to diesel particulate matter from goods movement disproportionately impacts the health of residents near ports, rail yards, distribution centers, and roads with high truck volumes. Investing in the Bay Area's trade corridors will address existing air quality and public health issues as well as help the region to prepare for continued growth in this economic sector. This measure focuses primarily on regional planning and infrastructure, while Control Measures TR19, 20, 21, & 22 focus on reducing emissions from trucks and other equipment used to move goods.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, particulate matter, toxic air contaminants and greenhouse gases associated with goods movement.

Travel Market Affected:
This measure would affect goods movement activity within the region.

Regulatory Context and Background:
Goods movement is a critical component of the Bay Area's economic and transportation system. Whether it is delivering construction materials or consumer goods to the growing population, or exporting electronics and food throughout the world, a robust goods movement system is essential for both business and residents to function and thrive in the Bay Area.

Exposure to diesel particulate matter from goods movement operations greatly impacts the health of community residents near ports, rail yards, distribution centers, and roads with high truck volumes. Analysis by the Air District has found that emissions of diesel particulate matter (PM) account for 80 percent of the risk from toxic air contaminants (TACs) in the Bay Area. Twenty-two percent of the total California population living in close proximity to goods movement corridors is located in the Bay Area.

Nearly a third of the region's employment is in goods movement related industries, such as manufacturing, freight transportation, and the warehouse and distribution businesses. Goods movement is a critical source of job diversity in the region, providing job opportunities for people with lower levels of education and providing opportunities for training and career advancement.

The region is home to five maritime ports, including the Port of Oakland, which is the fifth busiest container port in the nation, as well as the gateway to two small river ports in Sacramento and Stockton. The Port of Oakland plays a particularly important role in supporting

the state's agricultural sector, providing the primary means of exporting produce from the Central Valley to the Pacific Rim. The other four marine ports (Port of Redwood City, Port of Benicia, Port of Richmond and Port of San Francisco) are primarily niche ports serving bulk products, including petroleum products, construction material and scrap metal. In addition, both Oakland International Airport and San Francisco International Airport play key roles in air cargo trade.

In November 2006, California voters approved Proposition 1B, a $19.9 billion transportation infrastructure bond. Proposition 1B included a $2 billion Trade Corridors Improvement Fund (TCIF) to improve goods movement infrastructure statewide. In 2008 the state augmented the TCIF fund to nearly $2.5 billion and programmed just over $3 billion for high-priority goods movement projects. Nearly $585 million of this total will fund seven key Bay Area goods movement projects, including I-580 Truck Climbing Lane, I-880 Reconstruction at 29th and 23rd Avenues, the Outer Harbor Intermodal Terminal, and the Richmond Rail Connector.

Proposition 1B also included $1 billion for a Goods Movement Emissions Reduction program. The Air District is responsible for developing various programs for the bond, including a diesel truck replacement program. (See TR19: Medium and Heavy Duty Trucks)

In addition, ARB's 2007 Goods Movement Action Plan seeks to meet five specific goals for addressing the air pollution associated with goods movement, including reducing "total statewide international and domestic goods movement emissions to the greatest extent possible and at least back to 2001 levels by year 2010."

On July 16, 2015, Governor Brown issued an Executive Order directing state agencies to coordinate on the development of "… an integrated action plan that establishes clear targets to improve freight efficiency, transition to zero-emission technologies, and increase the competitiveness of California's freight system." The final plan was released on July 29, 2016. The plan and additional information on the State's sustainable freight efforts is available at More information is available at http://www.casustainablefreight.org/.

ARB's *2016 Mobile Source Strategy* includes a number of new regulatory proposals to further reduce emissions from the goods movement sector. These new proposals include lower NOx standards for new truck engines, a "last-mile" regulation requiring the use of near-zero and zero emission delivery trucks, and expansion of the current shore power regulation to cover bulk carriers and oil tankers.

Regional Goods Movement Planning

The Alameda County Transportation Commission (ACTC) is leading a Bay Area *Goods Movement Collaborative* which brings together partners, community members and stakeholders from across the region and the country. The intent is to create an organized structure to understand goods movement needs in the Bay Area and to identify, prioritize and advocate for short- and long-term strategies to address these needs within a Countywide Goods Movement Plan.

The ACTC has also partnered with MTC to jointly develop not only a Countywide Goods Movement Plan, but the Regional Goods Movement Plan – which will outline a long-range strategy for how to move goods efficiently, reliably, and sustainably within, to, from and through the county and the entire region. The joint long-range plan development will ensure consistency between both plans and enable outreach to a wider range of stakeholders to provide a comprehensive understanding of the goods movement system in Alameda County and the Bay Area.

In addition, MTC is developing as part of Plan Bay Area 2040a Freight Emissions Reduction Action Plan (Action Plan). The Action Plan will develop and evaluate strategies to reduce emissions from goods movement throughout the region. The Action Plan will recommend specific programs, projects and policies for the goods movement system, including all modes of transportation. The strategies will focus on potential application of near-zero and zero-emission technologies and also include an assessment of operational and technology-based strategies. MTC will work closely with the Air District as well as local and state stakeholders in the implementation of the Action Plan.

Implementation Actions:

MTC will:

- Fund the I-880 Improvements at 23rd and 29th Avenues via Proposition 1B Trade Corridors Improvement Fund
- Fund the Outer Harbor Intermodal Terminals project via Proposition 1B Trade Corridors Improvement Fund
- Continue work to update the Regional Goods Movement Plan.
- Continue participation in the Goods Movement Collaborative, led by the Alameda County Transportation Commission.
- Adopt the Freight Emissions Reduction Action Plan.

The Air District will:

- Continue participation in the implementation of the Regional Goods Movement Plan. The regional work is being closely integrated with the Alameda County Transportation Commission's countywide goods movement planning effort, as well as the ongoing state and federal freight planning and policy activity to ensure consistency among all plans.
- Continue participation in the Goods Movement Collaborative, led by the Alameda County Transportation Commission.
- Work with MTC on the implementation of a Freight Emissions Reduction Action Plan.
- Work with ARB and Caltrans on the implementation of the Sustainable Freight Action Plan, as well as participate in the development of the proposed freight-related regulations included in the *2016 Mobile Source Strategy*. The initial regulatory effort will focus on converting the fleet of Class 3-6 urban delivery and vocational trucks to near-zero and zero emission operations through introduction of low-NOx engines, hybrid drive systems and battery electric and/or fuel cell propulsion.

Emission Reductions:
This measure will reduce some of the emissions emitted by goods movement sources, as cleaner engines are deployed and improved infrastructure reduces delays. The emission reduction benefits from Air District actions are included in Control Measures TR19, 20, 21 & 22.

Exposure Reduction:
This measure will reduce local population exposure to diesel particulate matter in various parts of the region. Impacted communities near freeways and roads with significant auto and truck traffic will benefit.

Emission Reduction Trade-offs:
Infrastructure improvements that provide congestion relief or new capacity for trucks and trains may increase local exposure to diesel particulate matter.

Costs:
Cost to industries have not been estimated; planning activities are difficult to quantify in terms of financial impacts to trucking industry.

Co-benefits:
- Economic benefits from faster, more efficient goods movement

Issues/Impediments:
- In designing and implementing goods movement efficiency measures, care should be taken to avoid creating induced demand for goods movement that could increase emissions.
- High costs to reduce emissions from aging goods movement equipment and infrastructure may be burdensome for the private sector. For example, large diesel trucks, some of which stay on the road for many years and are replaced at a slow rate, often operate on very small profit margins.
- Funding availability may constrain the implementation of goods movement emission reduction programs.
- Technological issues may be a limiting factor in retrofitting and replacing on- and off-road mobile sources due to technical capabilities, availability and rate of deployment.
- Under existing guidelines, incentive funding can only be made available for projects that reduce emissions that are surplus and not required by existing regulation. As CARB regulations that require owners of diesel engines to replace or retrofit these engines are phased in over the next several years, the number of engines that are eligible for incentive funding will decrease. Therefore, it may be difficult to achieve the same amount of emission reductions through the existing incentive programs.
- The uncertain state of the economy may limit the number of diesel equipment owners willing to enter into contracts to receive incentive funding because it commits them to monitoring and use requirements that have financial implications.

TR19: Medium- and Heavy-Duty Trucks

Brief Summary:
The Air District will directly provide, and encourage other organizations to provide, incentives for the purchase of 1) new trucks with engines that exceed ARB's 2010 NOx emission standards for heavy-duty engines, 2) new hybrid trucks, and 3) new zero-emission trucks. The Air District will work with truck owners, industry, ARB, the California Energy Commission, and others to demonstrate additional battery-electric and hydrogen fuel cell zero emission trucks.

Purpose:
This measure will reduce key ozone precursors ROG and NOx by replacing older, higher emission trucks and engines. In addition, the measure will also reduce diesel particulate matter, toxic air contaminants and greenhouse gases.

Source Category/Travel Market Affected:
Medium- and Heavy Duty On-Road Trucks, including all trucks weighing more than 10,000 pounds in Gross Vehicle Weight (Classes 3-8).

Regulatory Context and Background:
Emissions from medium- and heavy-duty trucks account for nearly 24 percent of NOx emissions in the Bay Area; they are also a significant source of diesel particulate matter, a known carcinogen. Beginning with the model year (MY) 2010 standards adopted by both ARB and the US EPA, truck emissions for both particulate matter and NOx will be substantially lower than earlier model year trucks.

However, because medium- and heavy-duty trucks are kept in service for many years and fleet turnover is slow, it can take a long time to see the air quality benefits of the new emission standards. To accelerate the replacement or retrofit of old trucks, ARB adopted a regulation that requires truck fleets to meet progressively more stringent emission limits as calculated on a fleet-average or model year schedule.

In 2012, Governor Brown signed into law three bills – AB 1532 (Pérez), SB 535 (De León), and SB 1018 (Budget and Fiscal Review Committee) – that established the Low Carbon Transportation Greenhouse Gas Emission Reduction Fund (GGRF). This fund receives Cap-and-Trade auction proceeds and provides the framework for how the auction proceeds will be administered in furtherance of the purposes of AB 32, including supporting long-term, transformative efforts to improve public health and develop a clean energy economy. On June 23, 2015 ARB announced the availability of $47.3 million in Advanced Technology freight demonstration projects as part of their funding plan to distribute GGRF funds. These funds are open to public agencies and nonprofits. The demonstration of advanced freight technologies is an important step in reaching the state's and the Air District's air quality and GHG reduction goals, and reducing exposure to air toxics and PM in impacted communities.

Zero-Emission Drayage Truck Demonstration Project
A portion of the GGRF funds (up to $25 million statewide) will be directed at projects that reduce greenhouse gases, criteria pollutants, and toxic air contaminant emissions in disadvantaged communities. Projects funded under this solicitation are to demonstrate full zero-emission drayage trucks, and drayage trucks that offer zero-emission miles (near zero-emission) by employing on-board range extending internal combustion engines or other technologies. In May 2016, the South Coast Air Quality Management District, in collaboration with the Bay Area air district and other partners, were awarded $23.6 million to demonstrate various zero and near-zero emission technologies on trucks primarily serving the ports of Oakland, Los Angeles, and Long Beach.

In May 2016, ARB released its *Mobile Source Strategy* for meeting federal ambient air quality standards, as well as California's climate change and petroleum reduction goals. For trucks, ARB staff are proposing tighter NOx emission standards, support for EPA's greenhouse gas/fuel economy regulation, a new "Last Mile" regulation that would require use of near-zero and zero emission trucks for local deliveries, and a new fuel requirement that will require 50 percent of diesel fuel sold in California be derived from renewable sources.

In the Bay Area, the Air District will work with local/regional trucking companies to deploy near-zero and zero emission trucks in local service, with particular emphasis on trucks operating within West Oakland and other CARE areas. An example of the steps that can be taken to introduce cleaner trucks in the medium- and heavy-duty weight classes, the Air will provide up to $5 million in funding in 2016 to reimburse a percentage of the difference in cost between a zero emissions truck and a conventionally fueled truck.

Implementation Actions:
The Air District will:

- Directly provide, and/or work with other entities to provide, incentives to accelerate the replacement of heavy-duty on-road diesel engines in advance of requirements of the ARB in-use heavy-duty truck regulation.
- Either directly provide, and/or work with partner agencies and companies to provide, funding to demonstrate the technology of hybrid drive trains for medium-and heavy-duty trucks, to demonstrate the technology of battery electric trucks, and to support further development of hydrogen fuel cell trucks.
- As technologies become commercially available, the Air District will work directly with partner agencies and companies to offer financial incentives to accelerate deployment of near-zero and zero emission trucks.

Emission Reductions:

Pollutants*	2020	2030
ROG	53	44
NO_x	2,278	362
$PM_{2.5}$	4	10
PM_{10}	4	11
DPM	4	10
CO_{2e}	58,234	138,306

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
Because of the complexity of the incentive programs for heavy-duty trucks, the emissions reductions are based on the replacement of 2,500 medium- and heavy-duty (> 10,000 lbs) trucks with new zero emission trucks, at an average rate of approximately 180 trucks per year. The trucks are assumed to average 40,000 miles per year. Baseline emission factors for criteria pollutants are taken from ARB's Appendix D, Carl Moyer Program, 6/29/15. Emission factors for CO_2 are from EMFAC 2014. We assume that between 2017 and 2022, the replaced trucks were built before 2010, while between 2023 and 2030, the replaced trucks are MY 2010 or newer. Potential emissions reduction benefit from short-term truck demonstrations have not been included in the emissions estimates due to the uncertain nature of the cost and implementation timelines.

Exposure Reduction:
This measure will accelerate the realization of the health benefits of an adopted ARB regulation by reducing exposure to diesel PM and by reducing NOx emissions that contribute to regional ozone formation. Impacted communities near freeways and roads with significant truck traffic will benefit.

Emission Reduction Trade-offs:
None identified.

Cost:
The cost to implement this measure will be determined primarily by the level of financial incentive that will be offered to fleet owners to encourage early compliance with the ARB truck regulations, or for the purchased of advanced technologies such as hybrid drive systems and zero emission battery or fuel cell trucks. Incentive funding from the Air District and partner agencies fluctuates from year-to-year and depends upon annual budget allocations, so per truck incentive amounts will be determined during the development of the program. Existing incentive programs managed by the Air District currently provide up to $50,000 per truck.

Co-benefits:

To the extent this measure is successful in replacing diesel trucks with either hybrid drive systems and/or zero emission electric technologies, there will be a reduction in petroleum usage in the Bay Area.

Issues/Impediments:
This control measures sets forth enhancements for an existing program and should not give rise to any new obstacles, as long as funding for the incentives is secured.

Sources:

1. BAAQMD, Carl Moyer Incentive Program, http://www.baaqmd.gov/Divisions/Strategic-Incentives/Funding-Sources/Carl-Moyer-Program.aspx
2. California Air Resources Board, *2011 Carl Moyer Guidelines (as amended)*, December 31, 2001. http://www.arb.ca.gov/msprog/moyer/moyer.htm
3. California Air Resources Board, *Appendix D: Tables for Emission Reduction and Cost-Effectiveness Calculations*, June 29, 2015. http://www.arb.ca.gov/msprog/moyer/guidelines/2011gl/2011cmp_appd_06_29_15.pdf
4. California Air Resources Board, *Mobile Source Strategy*, May 16, 2016.
5. Environmental Protection Agency and Department of Transportation – National Highway Traffic Safety Administration, "Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2: Final Rule," Prepublication Version, August 16, 2016. https://www3.epa.gov/otaq/climate/documents/2016-08-ghg-hd-final-rule-phase2-preamble.pdf

TR20: Ships - Ocean-Going Marine Vessels

Brief Summary:
This measure attempts to replicate the Green Ship Program (Program) that has been implemented at the Ports of Los Angeles and Long Beach. Financial incentives for cleaner Tier 2 and Tier 3 ocean-going vessels to call at the ports serve as the basis of the Program. The Program was initiated as part of the San Pedro Bay Ports Clean Air Action Plan. This measure also recognizes the need to monitor progress under such programs and augment them as necessary to ensure sufficient results.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, through the development and use of cleaner engines in ocean-going marine vessels. In addition, emissions of particulate matter, toxic air contaminants, carbon monoxide and greenhouse gases would be reduced.

Travel Market Affected:
This measure would affect cargo shipping into and out of Bay Area ports.

Regulatory Context and Background:
Large ships such as container ships, tankers, bulk carriers, and cruise ships are significant contributors of ozone precursors (VOC and NOx), carbon monoxide (CO), and particulate matter (PM), within commercial ports and along coastal areas. There are two types of diesel engines used on large ships: main propulsion and auxiliary engines. The main propulsion engines on many large ships are "Category 3" (or C3) marine diesel engines, which can stand over three stories tall and run the length of two school buses. Auxiliary engines on large ships typically range in size from small portable generators to locomotive-size engines. Marine diesel engines were first regulated by the U.S Environmental Protection Agency in 2004.

In a rule published on April 30, 2010, EPA adopted standards that apply to Category 3 engines installed on U.S. vessels and to marine diesel fuels produced and distributed in the United States. That rule added two new tiers of engine standards for C3 engines: Tier 2 standards that took effect in 2011, and applies to all newly constructed marine engines and Tier 3 standards, which will take effect in 2016, and will also apply to newly constructed marine engines. Older Category 3 vessels are not required to adopt new engine standards. It also includes a regulatory program to implement Annex VI to the International Convention for the Prevention of Pollution from Ships (a treaty called "MARPOL") in the United States, including engine and fuel sulfur limits, and extends the Emission Control Area (ECA) for engine and fuel requirements to U.S. internal waters.

The ports of Los Angeles and Long Beach have created the Green Ship Incentive Program, a voluntary clean-air initiative targeting the reduction of smog-causing nitrogen oxides (NOx). It financially rewards qualifying vessel operators for deploying “green” ships (vessels with new

marine engines that meet Tier 2 and Tier 3 standards) to the Port of Long Beach. The program also aims to accelerate the use of Tier 2 and Tier 3 engines.

Vessels with main engines meeting 2011 Tier 2 standards established by EPA and the International Maritime Organization (IMO) will be eligible for an incentive of $2,500 per ship call. For still cleaner vessels meeting 2016 Tier 3 standards, the incentive will increase to $6,000 per ship call.

Tier 2 engines reduce NOx emissions by 15 percent, and Tier 3 engines reduce NOx emissions by 80 percent.

Shore Power

Shore power is the provision of electrical power to a ship at berth while its main and auxiliary engines are shut down. Shore power was first commercially implemented in 2001 by Princess Cruises in Alaska. China Shipping, in 2004, was the first container carrier in California to use shore power at the Port of Los Angeles. Between 2004 and 2012, the ports of Los Angeles, Long Beach, Oakland, and San Diego have installed a total of 5 shore power berths for cruise ships and 11 shore power berths for container vessels. More shore power berths are expected to be installed in the coming years.

Shore power saves consumption of fuel that would otherwise be used to power vessels while in port, and eliminates the air pollution associated with consumption of that fuel. Commercial ships can use shore-supplied power for services such as cargo handling, pumping, ventilation and lighting while in port. A port city may have anti-idling laws that require ships to use shore power. Use of shore power may facilitate maintenance of the ship's engines and generators, and reduces noise.

In December 2007, ARB approved the "Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port" Regulation, commonly referred to as the At-Berth Regulation. The At-Berth Regulation is intended to reduce emissions from diesel auxiliary engines, which emit diesel particulate matter and oxides of nitrogen (NOx) on container ships, passenger ships, and refrigerated-cargo ships while berthing at a California Port. The At-Berth Regulation effects the Ports of Los Angeles, Long Beach, Oakland, San Diego, San Francisco, and Hueneme.

The At-Berth Regulation requires vessel fleet operators visiting to either: 1) turn off auxiliary engines and connect the vessel to some other source of power, most likely grid-based shore power; or 2) use alternative control technique(s) that achieve equivalent emission reductions. Vessels are defined, for the most part, to include cruise ships (which berth in SF) and container ships, which most often berth at the Port of Oakland.

The Air District provides financial support, on a case-by-case basis, for the development of shore-power projects that reduce emissions from ships while at berth. Funds are provided through the Carl Moyer Memorial Air Quality Standards Attainment Program (Carl Moyer

Program) which provides grant funding for cleaner-than-required engines and equipment. The Air District administer these grants and selects which projects to fund. Eligible projects include cleaner on-road, off-road, marine, locomotive, lawn & garden, light duty passenger vehicles being scrapped and agricultural equipment. For shore power projects, only applicants that can demonstrate that the project is not required by the ARB Shore Power Regulation are eligible.

Implementation Actions:
The Air District will:

- Work with the Ports of Oakland, San Francisco, Richmond, & Redwood City to develop a Green Ports incentive program in the Bay Area.
- Continue to provide financial support on a case-by-case basis for the development of shore-power projects that reduce emissions from ships while at berth.

Emission Reductions:

Pollutants*	2020	2030
NO_x	75	38

**criteria pollutants and TACs are reported in lbs/day*

Emission Reduction Methodology:
For the purposes of estimating emission reductions from a Green Ports program, Air District staff assumed that by 2020, the incentives would be sufficient to attract 100 Tier 2 compliant and 50 Tier 3 compliant vessels to Bay Area ports. Vessels are assumed to be container ships that remain in the Bay for 24 hours, proceed directly to and from the assigned berth for a total transit time of 2 hours, operate on fuel compliant with ARB's low-sulfur fuel rule, and are connected to shore power while at berth. Each vessel is assumed to have a main engine rated at 43,000 kilowatts.

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
Based on the assumptions used to estimate emission reductions for this measure, costs in 2020 will be $5.5 million for incentives, while costs in 2030 will be $2 million

Co-benefits:
More fuel efficient engines with lower NOx may also reduce GHG emissions attributable to local shipping activity.

Issues/Impediments:
The most significant challenge to implementing this measure will be the willingness of both the local ports and ship operators to fund and participate in a Bay Area Green Ports program.

Sources:

1. US EPA, Ocean Vessels and Large Ships: EPA Actions website, accessed September 22, 2014; http://www.epa.gov/otaq/oceanvessels.htm https://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/
2. Wyenn, Morgan: *LA and Long Beach Ports adopt Clean Ship Programs in Hopes to Reduce Air Pollution*, May 9, 2012; http://switchboard.nrdc.org/blogs/mwyenn/la_and_long_beach_ports_adopt.html
3. The Port of Long Beach, *The Port of Long Beach Green Ship Incentive Program* brochure; http://www.polb.com/civica/filebank/blobdload.asp?BlobID=9768
4. San Pedro Bay Ports Clean Air Action Plan; The Port of Los Angeles and the Port of Long Beach; October 2010, http://www.cleanairactionplan.org/reports/documents.asp
5. California Air Resources Board, *Mobile Source Strategy*, May 16, 2016.

TR21: Boats: Cleaner Commercial Harbor Craft

Brief Summary:
This measure supports control technologies that could be deployed on commercial harbor craft to reduce emissions beyond what is required by the statewide Harbor Craft Regulation. Possible technologies include wind assist, hybrid systems, use of alternative fuels, retrofit of existing older marine engines with selective catalytic converters, and diesel particulate filters.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, through the development and use of cleaner commercial harbor craft engines. In addition, the measure will reduce emissions of particulate matter, toxic air contaminants and greenhouse gases.

Travel Market Affected:
This measure would affect emissions from travel done via commercial harbor craft, including ferries, excursion vessels, tugboats, towboats, and commercial and charter fishing boats in the Bay Area.

Regulatory Context and Background:
There are several types of harbor craft used in California and in the Bay Area, including crew and supply boats, charter fishing vessels, commercial fishing vessels, ferry/excursion vessels, pilot vessels, towboats or push boats, tug boats, and work boats. Approximately eighty percent of commercial harbor craft engines operating in California are unregulated diesel engines, accounting for approximately 6,600 pounds per day of diesel particulate matter and 146,000 pounds per day of NOx.

On April 12, 2010, ARB submitted to U.S. EPA a request pursuant to section 209(e) of the Clean Air Act, regarding ARB's regulations to enforce emission standards for new and in-use commercial harbor craft operated within California waters and twenty-four nautical miles of the California coastline. ARB approved the final commercial harbor craft regulations on September 2, 2008. ARB's commercial harbor craft regulations became operative under California state law on November 19, 2008. The regulations are codified in title 13, California Code of Regulations (CCR), section 2229.5 and title 17, CCR section 93118.5.

For new harbor craft, each propulsion and auxiliary diesel engine on the vessel is required to be certified to the most stringent federal new marine engine emission standards for that engine's power rating and displacement in effect at the time of sale, lease, rent, or acquisition. The commercial harbor craft regulation imposes additional requirements for larger new ferries (with the capacity to transport seventy-five or more passengers), either by using best available control technology ("BACT"), or by using a federal Tier 4 certified propulsion engine.

For in-use harbor craft, new or in-use diesel engines may not be sold, offered for sale, leased, rented, or acquired unless the diesel propulsion or auxiliary engines are certified to at least the federal Tier 2 or Tier 3 marine emission standards for new engines of the same power rating

and displacement. In-use emission requirements are imposed on Tier 0 and Tier 1 marine engines in ferries, excursion vessels, tugboats, towboats, push boats, and multipurpose harbor craft. Those harbor craft are required to meet emission limits equal to or cleaner than the Tier 2 or Tier 3 standards in effect at the time the engine is brought into compliance.

California's commercial harbor craft regulations also impose requirements related to monitoring, reporting and recordkeeping of compliance on owners and operators of new and in-use harbor craft. Subject to ARB approval, harbor craft owners and operators may opt to meet requirements by implementing alternative emission control strategies.

The Air District offers funding to reduce emissions from commercial marine vessels subject to ARB's commercial harbor craft regulation. Funds are available for engine replacement, engine remanufacture, engine retrofit, and shore-power projects that reduce emissions from a ship at berth (as long as the shore-power project is not required by the ARB shore power regulation).

Implementation Actions:
The Air District will:

- Focus on assisting fleets to achieve early compliance with the ARB harbor craft air toxic control measure and supporting research efforts to develop and deploy more efficient engines and cleaner, renewable fuels for harbor craft.
- Coordinate with ARB, the CEC, local port authorities and vessel owners to support field demonstrations of advanced technology for marine and off-road engines and hybrid drive trains. Targeted technology should be those that reduce both criteria pollutants and greenhouse gases at the same time by focusing on fuel economy and renewable fuels.

Emission Reductions:

Pollutants*	2020	2030
ROG	2	< 0.1
NO_x	59	29
$PM_{2.5}$	2	2
PM_{10}	2	2
DPM	2	2
CO_{2e}	1,543	1,313

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
To estimate emission reductions for this measure, Air District staff assumed that between 2016 and 2020 the typical project will consist of the replacement of pre-1988 off-road engines rated at 350 brake horse power-hour with new Tier 3 compliant engines, and that between 2021 and 2030 the typical project will replace Tier 1 compliant engines with Tier 3 compliant engines. Each engine is assumed to operate 1,000 hours with an average load factor of 43 percent. Emission reductions are based on the replacement of ten engines per year between 2016 and 2030 at an average grant of $100,000. Due to advances in engine design, new Tier 3 engines

are approximately 15 percent more fuel efficient than pre-1988 engines, resulting in reductions of CO_2.

Exposure Reduction:
This measure will reduce region-wide population exposure to air pollutants based on the estimated reduction in emissions.

Emission Reduction Trade-offs:
None identified.

Cost:
The cost to implement this measure will be determined primarily by the level of financial incentives that will be offered for early compliance with the harbor craft regulation and for the new advanced technology demonstration projects.

Co-benefits:
New engines for marine vessels are incorporating better control of lubricating oils and unburned fuel droplets from crankcases, resulting in less oil leaking into vessels, thereby reducing harmful water pollution, as well as expensive disposal procedures by vessel owners. The development of more energy efficient engines and drive-trains, as well as local development of renewable diesel should both result in energy savings and the creation of "green" jobs.

Issues/Impediments:
- Funding for demonstrations of advanced engine designs and hybrid drive trains.
- Interest from fleets in early compliance with ARB's harbor craft air toxic control measure.

Sources:
1. Federal Register Volume 76, Number 125 (Wednesday, June 29, 2011), Notices, Pages 38153-38155, from the Federal Register Online via the Government Printing Office [www.gpo.gov], FR Doc No: 2011-16398, http://www.gpo.gov/fdsys/pkg/FR-2011-06-29/html/2011-16398.htm
2. California Air Resources Board, Commercial Harbor Craft: What Owners/Operators Need to Know; revised January 15, 2014; http://www.arb.ca.gov/ports/marinevess/harborcraft/documents/chcpamphlet01162014.pdf
3. Federal Register, *California State Nonroad Engine Pollution Control Standards; Commercial Harbor Craft Regulations; Notice of Decision*, December 13, 2011; https://www.federalregister.gov/articles/2011/12/13/2011-31916/california-state-nonroad-engine-pollution-control-standards-commercial-harbor-craft-regulations#footnote-7
4. State of California, Air Resources Board, Carl Moyer Program: http://www.arb.ca.gov/msprog/moyer/moyer.htm

TR22: Construction, Freight and Farming Equipment

Brief Summary:
The Air District will work to reduce emissions from off-road equipment used in the construction, freight handling and farming industries by pursuing the following strategies: 1) offering financial incentives between 2015 and 2025 to retrofit engines with diesel particulate filters or upgrade to equipment with electric or Tier IV off-road engines; 2) work with ARB, the California Energy Commission and others to develop more fuel-efficient off-road engines and drive-trains; and 3) work with local communities, contractors, freight handlers, farmers and developers to encourage the use of renewable electricity and renewable fuels, such as biodiesel from local crops and waste fats and oils, in applicable equipment.

Purpose:
This measure will reduce key ozone precursors, ROG and NOx, through the installation of abatement devices on existing diesel equipment and offering financial incentives to replace older diesel equipment. This measure will also reduce toxic air contaminants, such as diesel particulate matter (PM), and greenhouse gases.

Source Category/Travel Market Affected:
Construction, Freight Handling, and Farm Equipment

Regulatory Context and Background:
Construction, freight and farming equipment contribute approximately 15 percent of the regional inventory of NOx emissions, and 5 percent of PM2.5 emissions. Construction equipment is also a contributor to local exposure of diesel PM. Criteria pollutant emissions from the engines in construction, freight and farming equipment, which are primarily diesel, are subject to control under regulations adopted by both ARB and U.S. EPA.

ARB's control of criteria pollutant emissions from off-road engines used in construction, freight and farming equipment was authorized by the California Clean Air Act as codified in the Health and Safety Code sections 43013 and 43018. In 1992, ARB approved initial regulations to control exhaust emissions from heavy-duty off-road compression ignition (CI) engines 175 horsepower (130 kilowatts) and above. These initial standards are referred to as Tier I standards. In 1994, ARB approved the State Implementation Plan (SIP) for ozone, which included measures calling for new state and national emission standards for off-road CI engines beginning in 2005.

U.S. EPA promulgated new emission standards for off-road engines in 1998, with ARB adopting parallel standards in 2000. The standards are phased in through two additional stages which are referred to as Tiers 2 and 3. In 2004, Tier 4 emission standards were adopted and were phased in for new engines between 2011 and 2014. The coordinated efforts of ARB, U.S. EPA, and engine manufacturers to introduce lower-emission off-road CI engines nationwide will result in substantial air quality benefits in California and the rest of the country.

However, recognizing that construction, freight and farming equipment are long-lived, with existing engines remaining in service for many years, in 2007 ARB adopted an off-road equipment regulation to accelerate reductions of NOx and diesel PM from existing off-road engines. Beginning in 2012 and through 2023, the off-road regulation requires operators of older equipment to either install abatement devices, upgrade to Tier 3 and eventually Tier 4 engines, or to retire older equipment. However, equipment used in agricultural operations at least 50 percent of the time are exempt from the performance requirements of the ARB off-road regulations.

ARB's initial AB 32 Scoping Plan, adopted in 2008, identified strategies for reducing CO2 from a variety of sources in California, including construction, freight and farming equipment. ARB's strategies include reducing the carbon content of diesel fuel; promoting alternative fuels and renewable diesel fuels; and investigating ways of increasing fuel economy.

In 2012, Governor Brown signed into law three bills – AB 1532 (Pérez), SB 535 (De León), and SB 1018 (Budget and Fiscal Review Committee) – that established the Low Carbon Transportation Greenhouse Gas Emission Reduction Fund (GGRF). This fund receives Cap-and-Trade auction proceeds and provides the framework for how the auction proceeds will be administered in furtherance of the purposes of AB 32, including supporting long-term, transformative efforts to improve public health and develop a clean energy economy. On June 23, 2015 ARB announced the availability of $47.3 million in Advanced Technology freight demonstration projects as part of their funding plan to distribute GGRF funds. These funds are open to public agencies and nonprofits. The demonstration of advanced freight technologies is an important step in reaching the state's and the Air District's air quality and GHG reduction goals, and reducing exposure to air toxics and PM in impacted communities.

In May 2016, ARB released its 2016 *Mobile Source Strategy*. For construction and other off-road equipment, ARB staff are proposing increased use of fuel derived from renewable sources, measures to improve worksite efficiencies, deployment of zero emission technologies into targeted categories, programs to encourage application of on-road engine advances to off-road equipment, and increased incentives for early deployment of clean technologies.

Implementation Actions:
This measure will primarily focus on assisting fleets to achieve early compliance with the ARB in-use off-road regulation and supporting research efforts to develop and deploy more efficient engines and cleaner, renewable fuels for construction and farming equipment.

The Air District will:

- Between 2016 and 2030 provide incentives for the early deployment of electric, Tier 3 and 4 off-road engines used in construction, freight and farming equipment. Based on the recent four years of incentives, the Air District will likely provide incentives for the replacement of 82 off-road equipment engines annually through 2020. The actual number of replacements will depend on the amount of funding available and the number of engine owners taking advantage of the incentives.

- Between 2017 and 2025, coordinate with ARB and the CEC, as well as construction firms, farmers and others, to support field demonstrations of advanced technology for off-road engines and hybrid drive trains. Targeted technology should be those that reduce both criteria pollutants and greenhouse gases at the same time by focusing on fuel economy and renewable fuels.
- Beyond 2025, provide support for the purchase of commercially available off-road equipment that runs on both renewable electricity and diesel, with an emphasis placed on fuels that can be developed and produced locally.

Emission Reductions:

Pollutants*	2020	2030
ROG	12	0.9
NO_x	111	59
$PM_{2.5}$	4	1
PM_{10}	4	1
DPM	4	1
CO_{2e}	2,575	1,931

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:

To estimate emission reductions for this measure, Air District staff assumed that the typical projects between 2016 and 2020 will consist of the replacement of uncontrolled "Tier 0" off-road engines rated at 175 brake horse power-hour with new Tier 4 compliant engines; and between 2021 and 2030 the typical project will consist of the replacement of Tier 2 compliant engines with Tier 4 compliant engines. Each engine is assumed to operate 500 hours annually with an average load factor of 35 percent. Due to advances in engine design, load sensing, and idle-limit controls, new engines are approximately 25 percent more fuel efficient than Tier 1 engines, resulting in reductions of CO_2Emission reductions are based on the replacement of 82 engines per year at an average grant of $12,195.

Exposure Reduction:

Efforts to reduce diesel PM will reduce exposure of residents and workers in the vicinity of construction sites and farms. Additionally, reduction of NOx emissions will help reduce regional ozone levels/exposure, while reductions in both NOx and diesel PM emissions will contribute to reductions in the directly emitted PM and formation of secondary PM, reducing overall population exposure to fine particulate matter.

Emission Reduction Trade-offs:

The use of diesel PM filters and other abatement devices on Tier 4 compliant engines generally reduces fuel economy by approximately 3 percent however advances in engine design and load sensing generally improve the fuel efficiency of new engines. Additionally, installation of abatement devices on equipment utilizing hybrid drive systems will not result in any fuel penalties.

Cost:
Available funding from the Air District varies from year to year as approved by the Board of Directors. Between 2010 and 2014, funding ranged from $2.8 and $11.3 million. The average incentive offered to a fleet operator to purchase a Tier 4 engine or to participate in a demonstration of near-zero or zero emission equipment varies, as the number of grant applicants vary each year.

Co-benefits:
New engines for construction, freight and farming equipment are incorporating better control of lubricating oils and unburned fuel droplets from crankcases, resulting in less oil leaking on the ground, thereby reducing harmful water pollution. The development of more energy efficient engines and drive-trains, as well as local development of renewable diesel should both result in energy savings and the creation of "green" jobs. In addition, this measure will reduce black carbon, which is short lived greenhouse gas.

Issues/Impediments:
- Limited funding for demonstrations of advanced engine designs and hybrid drive trains.
- Interest from fleets in early compliance with ARB's off-road in-use engine air toxic control measure.

Sources:
1. BAAQMD, Base Year 2008 Emissions Inventory: Summary Report, May 2011
2. BAAQMD, Base Year 2008 Emissions Inventory: Source Categories, May 2011
3. BAAQMD, Source Inventory of Bay Area Greenhouse Emissions, December 2008
4. State of California, Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking: Proposed Regulation for In-Use Off-Road Diesel Vehicles*, April 2007.
5. State of California, Code of Regulations, Title 13, Section 2449 et seq., 2009
6. State of California, Air Resources Board, Carl Moyer Program: http://www.arb.ca.gov/msprog/moyer/moyer.htm

TR23: Lawn Care Equipment

Brief Summary:
Use of gasoline lawn mowers and leaf blowers contribute to air pollution, primarily through the release of volatile organic compounds (VOC) and particulate matter (PM). While progressively more stringent emission standards have reduced pollution from lawnmowers and leaf blowers, sufficient numbers of older two-stroke and four-stroke engines remain in use in the Bay Area. The Air District has pursued removal of these older engines through voluntary exchange programs that target commercial all lawn and garden equipment, including mowers and backpack-style leaf blowers. The Air District will continue this program, as well as seek funding to develop an internet-based exchange program for residential lawn care equipment.

Purpose:
Reduce VOC and PM emissions through the continuation of the Air District's Commercial Lawn and Garden Equipment Replacement program and through the development of an ongoing residential lawn mower exchange program.

Source Category:
Lawn, Garden and Utility Equipment: Gasoline Lawn Mowers and Leaf Blowers

Regulatory Context and Background:
Lawn, garden and utility equipment includes of a wide variety of small engines used in lawn mowers, leaf blowers, chainsaws, trimmers, shredders, stump grinders, commercial turf equipment and other types of equipment that collectively account for less than 6 percent of the total VOC inventory in the Bay Area. This equipment primarily uses gasoline engines, although there is some diesel and propane powered equipment. Electric powered equipment has begun to gain market share, particularly with lawnmowers, chainsaws, leaf blowers and other small equipment used by homeowners.

The small gasoline engines on lawn and garden equipment were first regulated in 1995 by ARB, with the newest, most stringent regulations becoming effective with the MY 2008 equipment. There are over 1.71 million lawnmowers and leaf blowers in the Bay Area, of which approximately 310,000 are two stroke engines. Two stroke engines generate significantly more air pollution, especially particulate matter, compared to four stroke engines. The Air District conducted lawn mower exchange programs between 1999 and 2006 by offering cash incentives to consumers to purchase electric or mechanical equipment. Residents exchanged slightly more than 7,800 two- and four-stroke lawnmowers for new electrical and mechanical mowers. Estimated emission reductions from the program were 10,600 pounds per year of ROG, NOx and PM, at an annualized cost-effectiveness of approximately $3.90 per pound.

In the *2016 Mobile Source Strategy*, ARB staff have proposed three actions to further reduce emissions from small engines: enhanced enforcement, tighter emissions standards, and incentives to increase the use of electric equipment. Because there have been high failure rates have been observed in evaporative emissions testing of small engines, ARB staff is

proposing to increase enforcement of current standards with manufacturers beginning in FY 2016/17. ARB staff would develop and propose a regulation in 2018 to tighten exhaust and evaporative emission standards for small off-road engines; this proposed regulation may include incentives for manufacturers to produce zero-emission equipment and would be phased in between 2022 and 2030. ARB staff also plans to propose a combination of manufacturing and purchasing incentives to replace at least 25 percent of the existing small engines with zero emission equipment, while the remaining engines will would meet exhaust and evaporative emission standards that by 2030 would be approximately 90 percent tighter than today's standards. These proposed actions are not included in the emissions estimates below.

The Air District will focus its efforts through its grant programs by encouraging the purchase of zero emission electrical and mechanical equipment. In November 2014, $470,000 became available for a *Commercial Lawn and Garden Equipment Replacement* effort in Alameda and Contra Costa Counties. These funds were used to replace commercial lawn mowers, leaf blowers, sweepers, chainsaws, line trimmers, and hedge trimmers with zero-emission equipment.

The Air District hopes to secure funds to expand the Commercial Lawn and Garden Equipment Replacement program into all Bay Area counties, as well developing a residential program in the near future.

Implementation Actions:
The Air District will:

- Seek additional funding to expand the Commercial Lawn and Garden Equipment Replacement Program into all nine Bay Area counties.
- Establish a Residential Lawn and Garden Equipment Replacement Program.
- Explore options to expand the program to cover shredders, stump grinders, and commercial turf equipment. Expansion of the program will depend on the availability of cleaner replacement equipment, costs, and a reliable source of incentive funding.

Emission Reductions:

Pollutants*	2020	2030
ROG	1,134	2,835
NO_x	32	315
$PM_{2.5}$	63	630
CO_{2e}	8,742	21,854

**criteria pollutants and TACs are reported in lbs/day; CO_{2e} is reported in metric tons/year*

Emission Reduction Methodology:
For the purposes of estimating cumulative reductions achieved by 2020 and 2030, it is assumed that the incentive program will expend $500,000 per year to encourage the purchase of 2,000 new, zero emission electric or mechanical instead of new gasoline powered pieces of

equipment. The emission reduction estimates in the table above represent the amount of avoided emissions because 8,000 zero emission pieces will be in use in the year 2020 and 20,000 in the year 2030 due to the provision of the Air District's incentive funding. (It is assumed for these calculations that the equipment purchased between 2017 and 2020 will be retired by 2030.) Emission reductions are based on the average new gasoline equipment have small engines rated at 7 hp, consume an average of 0.3 gallons of gasoline per day and operate 1.4 hours on a typical day, and met ARB emission standards for engines manufactured beginning in 2008.

Exposure Reduction:
Gasoline engines emit high levels of hydrocarbons, many species of which are listed as air toxics. Purchasing electric or mechanical zero- emission equipment will result in reductions in toxic emissions.

Emission Reduction Trade-offs:
This measure will reduce emissions of NOx, ROG, CO, PM and CO2, but because it potentially replaces gasoline powered equipment with electric powered equivalent, it will contribute to an incremental increase in electricity production, which may cause slight increases in emissions from power plants.

Cost:
The average incentive amount provided as part of the Commercial Lawn and Garden Equipment program in Alameda and Contra Costa Counties was $940. Because the proposed program will include equipment used for both commercial and residential application, the expected average incentive amount would be $250.

Co-benefits:
Use of push lawn mowers, electric or battery lawn mowers and leaf blowers will result in reductions in water pollution and fossil fuel use. There will also be consumer savings. New leaf-blowers also operate at lower decibel levels, reducing noise impacts.

Issues/Impediments:
The main obstacle is the need to secure funding to implement this measure. While funding is potentially available through the CARB-administered Carl Moyer Program, limitations on the amount available statewide and types of qualifying equipment will mean other sources of funding will be crucial for the success of this control measure.

Sources:
1. Bay Area Air Quality Management District, *Bay Area Emissions Inventory Summary Report: Criteria Air Pollutants*, Base Year 2011, May 2014
2. Bay Area Air Quality Management District, *Staff Report: Acceptance of Funds from the National Fish and Wildlife Foundation for a Commercial Lawn and Garden Equipment Replacement Program*, November 26, 2014

3. Data on total lawn mowers and leaf blowers obtained from California Air Resources Board, Offroad2007 model
4. California Air Resources Board, *California Exhaust Emission Standards and Test Procedures for 2005 and Later Small Off-Road Engines*, July 26, 2004 (www.arb.ca.gov/regact/sore03/sore03.htm; accessed on November 18, 2016.)
5. California Air Resources Board, *Mobile Source Strategy*, May 2016