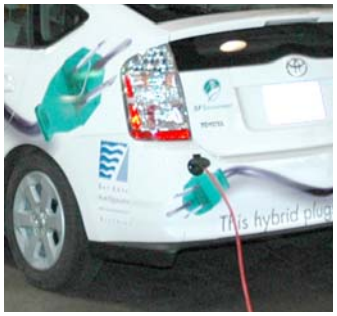
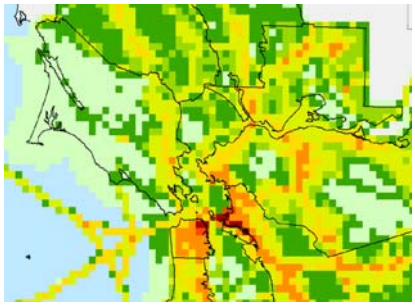
Bay Area Air Quality Management District

Draft Bay Area 2010 Clean Air Plan





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DRAFT
BAY AREA
2010 CLEAN AIR PLAN

VOLUME II

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BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT

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Updated 3/1/10

SSM 1 - Metal Melting Facilities

Brief Summary:
Limit emissions of organic compounds, fine particulates, toxic compounds and odors from foundry operations and metal melting facilities in the District.

Purpose:
Reduce organic compounds, fine particulates, toxic compounds and odor emissions.

Source Category:
Stationary

Regulatory Context and Background:
Foundries specialize in melting and casting metal into desired shapes. Foundry products are most often used in automobiles, truck parts, pipe and plumbing fixtures, train locomotives, airplanes and as metal pieces in other kinds of equipment. Die casting facilities melt metal and inject it into molds under pressure. In addition, some facilities melt metals from scrap to create specific alloys to be re-melted and cast at different locations, either in or out of the District.

Emissions produced by metal melting directly relate to the metal type, the furnace type and the molding technology used. Nonferrous foundries and steel foundries may produce hazardous emissions because of the lead, mercury, zinc, manganese, nickel, cadmium and other metals present.

Emissions of coarse and fine particulate come from mold making, pouring metal into molds, mold removal and any sand reclamation for re-use. Toxic compounds can also be emitted from fine sand particles from the shakeout (mold removal) step. Also, particulate matter is generated from receiving scrap metal for melting. Die casting uses molds, called tools, of machined steel for producing multiple casts, so little particulate matter is generated from the tool once manufactured. Metal melting and pouring can be the source of vaporized toxic compounds and odors can be generated from the organic binder systems used in mold making and from metal pouring and cooling.

Facilities in the District are currently regulated under Title V, the California ATCM for Non-Ferrous Foundries, and NESHAPS rules for Iron and Steel Foundries (40 CFR 63, subpart ZZZZZ), Aluminum, Copper and other Nonferrous Foundries (subpart EEEEE and ZZZZZZ), Secondary Aluminum Production (subpart RRR) and Electric Arc Furnace Steelmaking Facilities (subpart YYYYY). In addition, District standards governing particulate matter (Regulation 6, Rule 1) apply to these facilities and some are subject to the District's odor regulation (Regulation 7).

Implementation Actions:
The control measure would be implemented through the adoption of a new regulation targeted specifically at metal melting industries. The regulation would contemplate particulate matter control for the molding process, also consider controls on the metal melting, pouring and cooling, scrap receiving and processing and odor controls as appropriate. These would likely consist of baghouses. In addition, organic compounds (including odorous compounds) from these steps could be abated by carbon. Sand reclamation, which reduces waste from the facility, is typically done by burning, which generates fine particulate and odors. This could be abated by afterburner. Further requirements of the regulation could enhance capture of emissions through improved operating methods.

Emission Reductions:
Unknown at this time.

Emission Reduction Methodology:
TBD. Methodologies could include setting emission standards, work practice standards and management plans to reduce fugitive emissions.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
If afterburners were used to control PM and other compounds from sand reclamation, NOx and CO2 emissions would result.

Cost:
Unknown at this time.

Co-benefits:
None. The measure would directly target PM and VOC emissions.

Monitoring Mechanisms:
Source testing, parametric / CEM.

Issues/Impediments: The technology to implement the control measure is in place at some operations, however, cost may be an impediment for smaller businesses.

Sources:
1. National Emissions Standards for Iron and Steel Foundries (40 CFR, Part 63, Subpart EEEEE)
2. National Emissions Standards for Iron and Steel Foundries, Area Sources (40 CFR, Part 63, Subpart EEEEE)
3. Iron and Steel Foundries
4. Aluminum, Copper and other Nonferrous Foundries (40 CFR, Part 63, Subpart ZZZZZZ)

SSM 2 - Digital Printing

Brief Summary:
This control measure would reduce ROG emissions from digital printing operations by one of two approaches:

- Adopting VOC limits on inks and solvents used, or
- Adopting control technology requirements.

Purpose:
Reduce emissions of VOC from digital printing operations.

Source Category:
Area Source

Regulatory Context and Background:
District Regulation 8, Rule 20: Graphics Arts Printing and Coating Operations limits organic emissions from traditional graphic arts operations during printing, coating, adhesive, and cleaning activities. Traditional printing technologies include lithographic, letterpress, gravure, flexographic, and screen printing. VOC limits are further differentiated by the types of inks and substrates used during the printing process.

The digital printing (DP) is a fairly new, non-traditional printing process that is emerging virtually every segment of the graphic arts industry. In this process a digital image stored on a computer is converted into an image that can be printed on a wide variety of substrates besides paper, such as textiles; three dimensional objects, like ball bearings; and synthetic skin. This differs from traditional graphic arts printing, which uses fixed-image masters or "plates." One primary reason DP is gaining greater acceptance is that DP has a faster turnaround time because it requires considerably less setup time for each job compared to other printing processes. Furthermore, last minute revisions are easily carried out without having to make significant changes, and may have environmental advantages, such as reduced waste. The five basic types of digital printing technology are liquid inkjet printing; thermal wax printing; laser printing, including liquid electrophotographic printing; solid ink printing; and dye sublimation printing. Of all the digital printing operations, inkjet printing appears to be gaining the largest market share in the graphic arts industry on a world-wide basis. Although DP accounted for only about three percent of the total U.S. printing industry output in 1991, it is forecast to have at least a 21 percent market share by 2025.

Emissions from the DP industry are not regulated by the District's rule to control emissions from printing presses, Regulation 8, Rule 20, however the 2008 amendments to Regulation 8, Rule 20 require certain large commercial digital printing operations to keep records of the usage of ink and other VOC-containing materials. Staff has identified two DP technologies that are believed to have significant emissions, District-wide: liquid electrophotographic printing and solvent-based inkjet printing. Staff reviewed records on one large liquid electrophotographic press and estimated that the VOC emissions were approximately 1

ton/year. Solvent-based inkjet printers can produce images on the widest formats in the printing industry and use inks that contain high VOC contents. Inkjet printing appears to be the most likely to emit significant ROG emissions.

Implementation Actions:
One option is to establish a limit for VOC emissions from DP facilities, such as Maryland's 100 pounds per day limit. Lower VOC inks may be able to be developed, although the necessary properties of inks for some types of DP may preclude low-VOC formulations. Add-on controls or equipment requirements could be developed to prevent emissions, or add-on controls could be required. Finally, emission limits could be established for each printing technology, allowing a combination of low-VOC materials, on-board controls and add-on controls, as necessary.

Emission Reductions:
TBD. It is estimated that 40 – 50 large, liquid electrophotographic presses may exist in the Bay Area. The number of large, commercial inkjet printers is not known.

Emission Reduction Methodology:
TBD

Exposure Reduction:
TBD

Emission Reductions Trade-offs:
Add on control equipment may require the use of electricity or natural gas, increasing GHGs.

Cost:
Unknown at this time. Some DP may reduce emissions through internal controls of ink usage, making ink available for re-use.

Co-benefits:
- Reduction in ROG emissions may reduce emissions of toxic organic compounds.

Monitoring Mechanisms:
Source testing, recordkeeping, parametric monitoring.

Issues/Impediments:
Unlike traditional printing, technical barriers to the development of low-VOC inks may exist due to the nature of how the DP creates images. Inkjet printing relies on ink with a very low viscosity to be sprayed through tiny nozzles. Electrophotographic printing relies on the polarity of ink molecules to be attracted to charged plates.

Sources:

1. EPA Office of Compliance sector Notebook Project: Profile of the Printing & Publishing Industry, 1995 http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/printpt1.pdf
2. EPA Design for the Environment Printing Industry Profile, http://www.p2pays.org/ref/01/00936/execsum.htm
3. Digital Printing: The Reference Handbook, 2004, Uri Levy & Gilles Biscos
4. Today's Digital Imaging: Version 5.0, 2005, Smart Papers
5. Conference call with Sandra Lowe-Leseth, Rule Developer, San Joaquin Valley Air Pollution Control District, 5/2/07
6. Code of Maryland Regulations: 26.11.19.18. 18 Control of Volatile Organic Compound Emissions from Screen Printing and Digital Imaging http://www.dsd.state.md.us/comar/26/26.11.19.18.htm

SSM 3 - Livestock Waste

Brief Summary:
This control measure would reduce organic emissions from livestock waste by requiring best management practices already being implemented in San Joaquin Valley Unified Air Pollution Control District, Sacramento Metropolitan and South Coast Air Quality Management Districts to be applied at Bay Area dairies.

Purpose:
Reduce emissions of organic compounds from livestock waste.

Source Category:
Area source.

Regulatory Context and Background:
California law and District regulations have historically exempted agricultural sources of air pollution from obtaining air quality permits, or complying with most air quality regulation. This exemption was revoked in 2003 with the passing of Senate Bill 700 that requires air districts to adopt regulations for large confined animal facilities and amends air pollution control requirements of the California Health and Safety Code (CH&SC) related to agricultural sources of air pollution, effective January 1, 2004.

Pursuant to Senate Bill 700, the District adopted Regulation 2, Rule 10: Large Confined Animal Facilities in 2006. The regulation requires that large confined animal facilities (at least 1000 milk-producing cows for dairies) obtain a permit to operate and implement control measures to reduce emissions of POC (Precursor Organic Compound), NOx, and PM_{10} from the facility. The rule allows the APCO to establish a reasonable compliance schedule for facilities to implement these control measures within one year of the date on which the permit is issued.

Currently, the District does not provide a list of control measures that are applicable under this regulation. Based on the District's review of USDA census data, no facility in the Bay Area currently meets the applicability requirements of Regulation 2, Rule 10. According to the California Food and Agriculture Report for 2005, there are approximately 100 dairies in the Bay Area with an average herd size of 350 milking cows. Milking cows must give birth to calves in order to produce milk. On average, a milking cow produces 17,000 pounds of milk a year. Due to the high number of calve births required for cows to continue to lactate, dairy operations must also handle calves, heifers, and other support stock. Support stock typically composes about 50 percent of the total cattle on a dairy, although many larger dairies are sending calves and heifers to special farms in order to focus solely on milk producing cows.

In addition to dairies, the Bay Area also supports a small stock of chicken, turkey, goat, and swine farms. Research is ongoing to determine the number of facilities in operation and the average amount of animals being supported at these facilities. Most of these facilities as well as the dairies are located in Sonoma or Marin Counties.

Implementation Actions:
Emission mitigation measures are based on San Joaquin Valley Unified Air Pollution Control District Rule 4570 and South Coast Air Quality Management District Rule 223. Because most Bay Area dairies are smaller operations than those in San Joaquin and South Coast, the District is focusing on implementation of best management practices rather than requiring controls at this time. Preliminary research by Schmidt (2005) has shown that organic compounds emitted from the feed may constitute over 50% of the total organic emissions from animal facilities. Simple techniques such as keeping silage covered and reducing wet feed can potentially reduce organic emissions. Additionally, feeding the animals food that will result in more complete digestion can reduce organic emissions directly from the animal and the waste. The District will review the best management practices implemented in San Joaquin and South Coast and determine if any may be applied to Bay Area dairies. The practices include:

- Prepare feed according to National Research Council guidelines specified in the most recent version of the "Nutrient Requirements of Dairy Cattle"
- Store grain in a weatherproof storage structure from October through May
- Remove feed from the area where animals eat at least once every 14 days
- Cover the horizontal surface of silage piles, except for the area where feed is being removed from the silage pile.
- Flush or hose milking parlor immediately prior to, immediately after, or during each milking
- Flush freestalls more frequently than the milking schedule
- Use non-manure-based bedding for at least 90% of the bedding material, by weight, for freestalls (e.g., rubber mats, almond hulls, sand, or waterbeds)
- Inspect water pipes and troughs and repair leaks at least once every 14 days
- Clean concrete areas such that the depth of animal waste does not exceed twelve inches at any point or time, except in-corral mounding
- Manage corrals such that the animal waste depth in the corral does not exceed twelve inches at any point or time, except for in-corral mounding
- Knock down fence line animal waste build-up prior to it exceeding a height of twelve inches at any time.
- Scrape or flush feed aprons in corrals at least once every seven days
- Maintain corrals to ensure drainage and to prevent water from standing more than 48 hours
- Cover dry animal waste piles outside of the corrals with a waterproof covering from October through May, except for times, not to exceed 24 hours, when wind removes the covering
- Cover dry separated solids outside the corrals with a waterproof covering from

October through May, except for times, not to exceed 24 hours, when wind removes the covering.

- Remove solids from the waste system with a solid separator system, prior to the waste entering the lagoon
- Manage the liquid animal waste so it stands in the fields no more than 24 hours, if it is applied on land as fertilizer
- Do not apply any solid animal waste that has a moisture content of more than 50% as fertilizer on fields.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.30	0.30
$C0_2$-e	65.00	65.00

The emission reductions potential for this measure equals 3.4 tons per day TOG, or 0.3 tons per day ROG and 3.1 tpd of methane. Based on its global warming potential (GWP) factor of 21, the 3.1 tpd of methane emissions are equivalent to 65 tpd of CO2-e.

Emission Reduction Methodology:
The emission reduction estimates considers that a dairy would adopt all of the best management practices listed above. Additional reductions are possible from large facilities that may opt to install advanced control technologies including anaerobic digesters, aerobic lagoons, aerated static piles, and/or biofilters. Because most of these technologies are new and just beginning to reach commercial use, the emission reduction potentials are unknown. Because of the capital costs associated with construction of these technologies, they may be better suited for larger confined animal facilities similar to those typically found in San Joaquin or South Coast.

The 2005 emission inventory estimates emissions from dairy cattle are 13.75 tons per day of TOG and 1.1 tons per day of ROG. Adoption of best management practices is estimated to reduce TOG emissions by 25% or 3.4 tons per day. The majority of dairies in the Bay Area are considered small operations that house an average of 350 milking cows. It is possible that some of the Bay Area dairies are already implementing some of these practices, in which case, the emissions, and potential emission reductions, may not be as significant.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
None.

Cost:
The control costs are based on San Joaquin staff report and knowledge of current operations performed at the affected sources. San Joaquin's Rule 4570 applies only to

Large Confined Animal Facilities and due to their small size, no Bay Area dairy meets this definition. As such, the District only estimated costs for facilities to adopt the best management practices. The annual cost is estimated at approximately $15 per cow. The District has approximately 80,000 dairy cows, so total costs are estimated to be $1.2 million per year. For an average dairy in the Bay Area that houses 350 dairy cows, the cost is estimated at $5,250 per year.

Co-benefits:
The adoption of best management practices may also reduce emissions of ammonia, a secondary precursor to the formation of particulate matter and methane, a greenhouse gas.

Monitoring Mechanisms:
District Compliance and Enforcement Staff will monitor adoption of the best management practices through facility inspections. The success of this control measure in terms of emissions reductions would be difficult to monitor, as the majority of facilities would remain exempt from permitting due to their small size. Furthermore, the ongoing variability in the determination of emission factors for livestock may complicate efforts to quantify the reduction of emissions from adoption of these management practices.

Issues/Impediments:
There may be some opposition from this industry to being regulated when only recently they were exempt from complying with air quality regulations. The best management practices, however, are supported by industry representatives and were developed through a collaborative effort with effected parties in the San Joaquin and South Coast districts.

Sources:
1. Bay Area Proposed Regulation 2, Rule 10: Large Confined Animal Facilities, Staff Report, dated 7/5/2006
2. Mitoehner, F. et al, Volatile Fatty Acids, Amine, Phenol, and Alcohol Emissions from Dairy Cows and Fresh Waste. Final Report, dated 5/31/2006.
3. Sacramento Metropolitan Air Quality Management District, Rule 496 Large Confined Animal Facilities, Staff Report, dated 6/19/2006.
4. San Joaquin Rule 4570: Confined Animal Facilities, Final Draft Staff Report, dated 6/15/2006
5. Schmidt, C.E., and Card, T.R., Dairy Air Emissions, Summary of Dairy Emission Estimation Procedures, dated May 2006.
6. South Coast Rule 1127: Emission Reductions from Livestock Waste, Final Staff Report, dated 8/6/2004

SSM 4 - Natural Gas Production and Processing

Brief Summary:
Equipment at natural gas wells in the District is prone to leaks and excess emissions. Emissions are mostly methane, which is a potent greenhouse gas (GHG), with smaller amounts of volatile organic compounds (VOCs) and some toxic compounds. Exemptions for these gas wells in Rule 8-37 would be reconsidered and excess emissions controlled.

Purpose:
Control fugitive emissions, including methane, from natural gas production wells and associated equipment.

Source Category:
Stationary source.

Regulatory Context and Background:
The District has many natural gas wells in eastern Contra Costa County and southern Solano County. These wells extract natural gas from pockets that are found at greater than 1000 ft below grade. This gas is stripped of moisture and then pressurized to main-line pressure for use by utilities. This gas has been found to contain greater than 90 percent methane. Liquids stripped from the gas often contain toxic airborne contaminants (TAC). These gas wells typically have the following equipment on site:

- Gas well
- Liquid knockout
- Compressor (natural gas fired)
- Dehydrator with associated tanks
- Pneumatic liquid transfer pump
- Oil/water separator
- Fixed roof tank(s) for water and condensate

Gas well: A gas well may have a natural pressure of up to 7200 pounds per square inch (psi) though most wellheads are typically 40 to 150 psi. The gas wells in the District have methane content at about 92 percent with a large nitrogen component in the remaining eight percent of the gas. This gas is “wet” (meaning it contains water vapor), and contains other hydrocarbons, including toxic compounds.

Liquid knockout: The liquid knockout or separator is simple tank that utilizes a series of baffles. The collected liquids are routed to the “produced water” tank via an automatic liquid level controller. These controllers are powered by pressurized natural gas and are of two types. Type one is the normally open variety that continually vents natural gas to atmosphere. Type two is a unit that is normally closed to atmosphere except when liquids are being routed to the produced water tank.

Compressor (natural gas-fired): The engine for the compressor is usually a four-cylinder, natural gas-fired compressor that is exempt from District permits and emission requirements due to being less than 50 brake horse power (Rule 2-1-114.2.1 and Rule 9-8-110.2). However these units are often 1960s units that are in very poor condition. These units should be source tested initially as they may not meet the requirements of Rule 8-2-301 for 300 ppm and 15 lbs/day.[1] The compressor is usually coupled to a two stage horizontally opposed positive displacement compressor with liquid knockout with automatic liquid level controllers that dump to the produced water tankage. Utility line pressure is generally about 500 to 600 psi. These compressors continuously emit natural gas from leaks.

Dehydration units with associated tanks: The dehydration unit is used to remove residual moisture from the gas stream prior to release of the gas to the utility. The gas stream is routed through a contact tower containing a glycol solution. The glycol solution absorbs both water and non-methane hydrocarbons, leaving the natural gas. This "dried" gas is then sent on to the utility. The glycol is regenerated via heating, which drives off the hydrocarbon and water from the glycol and this resulting vapor is then condensed via overhead piping and collected in the "cooling tank".

In the past these dehydration units just vented the vapors to atmosphere; but since 1998, more of these units have captured the vapors, referred to as closed loop systems. This additional condensing and liquid collection equipment has been added to the existing equipment in the field on an 'as needed' basis. There can be many problems with the closed loop systems, primary of which is that the cooling of the vapors is insufficient to collect them effectively. Most systems use a long, gently sloped overhead metal line (two-inch galvanized pipe approximately 50 feet long); often, these systems are not adequate to sufficiently cool the vapors. Dehydration units also generally have flash drums between the absorber tower and the regeneration units that flash methane and other light components from the glycol before generation.

Pneumatic liquid transfer pumps: These pumps are powered with natural gas that vent to the atmosphere with every stroke of the pump.

Pneumatic controls: These controls are powered with natural gas that vents to the atmosphere for safety reasons and because there is generally no electricity at remote locations.

Oil/water separator: Only a few of the facilities separate the hydrocarbons from water via equipment called a "Gun Barrel." This equipment is basically a vertical tower that allows for phase separation. Without the Gun Barrel, sites will co-mingle water and hydrocarbons in

[1] Rule 8-2 applies to miscellaneous sources of VOC emissions that are not addressed by any other rule. It limits VOC emissions from such sources to both 300 ppm and 15 lbs/day.

the single tank that is called the "produced water tank." Phase separation also occurs in the tank.

Fixed roof tank(s) for water and for condensate "produced water": As discussed above the produced water tankage allows for phase separation of hydrocarbons and water. Sampling has shown total vapor pressure of 3.2 to 3.5 psi in these tanks with 1.0 percent benzene, 5.9 percent toluene, and 6.5 percent xylene in the hydrocarbon phase. Vapor headspace sampling of these same tanks found total hydrocarbon concentrations of up to 55,000 ppm; control of these vapors would reduce emissions when tanks are serviced.

These tanks are emptied via vacuum truck from a fitting on the bottom of the tank. Vacuum truck operators commonly remove the lid from these tanks while emptying the tank due to concerns of collapsing the tank. A common problem is that these lids remain open after the unloading of the liquids.

Implementation Actions:
Staff would consider a range of possible controls including the following:

- Pumps / Compressors:
  - Identify "high bleed" pneumatic pumps (bleed natural gas at a rate of 6 scf/h) and replace with "low" (less than 1 scf/h) or no bleed pumps.
  - Address combustion emissions from compressors with requirements similar to those in Rule 9-8: IC Engines.
- Tanks:
  - Amend Rule 8-37 to address the tanks that are associated with the dehydration unit (condensation tank) that is very specialized and should be considered part of the dehydration process unit.
  - Amend Rule 8-5 to address the set pressure PV valves on fixed roof tanks that are the standard in the industry. Many of these facilities use polyethylene tanks where the set pressure of the tank's PV valve is zero, allowing venting of emissions.
  - Require that lids and hatches on tanks remain sealed at all times (including during liquid transfers), except when performing maintenance (reflect language in Rule 8-8: Wastewater Collection and Separation Systems).
- Valves:
  - Include monitoring requirement for leak checking of the pressure vacuum valves installed on the tanks and also on the piping and equipment associated with the dehydration unit.
  - Address adequate flow requirements for pressure vacuum valves when connected to vacuum trucks.
- Pipes / Connectors
  - Address fugitive emissions from vapor return lines when the reboiler burner is off.
  - Address liquids issues on the vapor return line from the cooling tank. During the summer, it is common to see uncondensed vapor at the end of the cooling segments of the vapor return line from the condensation tank. These may be controlled by requiring the condensate to be refrigerated.

- Reconsider the exemption in Rule 8-37 that allows gas wells to petition for an exemption from the standards of Rule 8-37 if the gas is more than 90 percent methane. Gas typically is predominately methane, a potent GHG.
- Require that dehydration units operate as a closed loop systems, as required in Yolo-Solano Air Quality Management District, to prevent the stripped hydrocarbons from being emitted to the atmosphere.
- Identify "high bleed" pneumatic controls and replace with "low bleed" (less than 1 scf/h) controls.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0	0.30
$C0_2$-e	0	120.00

Emission Reduction Methodology:
Emission reductions are based on an overall leakage rate of 1.4 percent and the relative amounts of the components of natural gas, methane, ethane, propane and butane. Total emissions are estimated to be 11.1 tpd of total organic gases (TOG), including 0.44 tpd of ROG. Emissions reductions are estimated to be between 6 - 9 tpd TOG. This includes 0.3 tpd of ROG and 5.7 tpd of methane. Based on its global warming potential (GWP) factor of 21, the 5.7 tpd of methane emissions are equivalent to 120 tpd of CO2-e.

Exposure Reduction:
TBD

Emission Reductions Trade-offs:
Potential increases in CO2 due to combustion control equipment (which would be greatly offset with the reductions in methane emissions).

Costs:
TBD

Co-benefits:
Reductions in GHG, ROG and toxics.

Monitoring Mechanisms:
Source testing, LDAR, and parametric monitors.

Issues/Impediments:
The majority of emissions reductions would be from methane, which has historically been exempt from VOC rules.

Sources:

1. http://72.14.253.104/search?q=cache:w5Ctbf5xgrsJ:www.its.ucdavis.edu/publications/2003/UCD-ITS-RR-03-17E.pdf+emission+factors+%2B+oil+production&hl=en&ct=clnk&cd=16&gl=us or
2. http://www.its.ucdavis.edu/publications/2003/UCD-ITS-RR-03-17E.pdf.
3. http://www.engineeringtoolbox.com/gas-density-d_158.html
4. http://www.epa.gov/gasstar/documents/ll_pneumatics.pdf

SSM 5 - Vacuum Trucks

Brief Summary:
This control measure would reduce organic emissions from vacuum trucks by requiring emission controls on vacuum trucks utilized in liquid clean-up and transfer operations in refineries and at other locations.

Purpose:
Reduce emissions of organic compounds venting from mobile vacuum trucks used to clean up and transfer organic containing liquids.

Source Category:
Area source.

Regulatory Context and Background:
This measure was analyzed in the 1994 Clean Air Plan as Control Measure B6: Control of Emissions from Cleaning Up Organic Liquids. The analysis concluded that the measure would not be cost effective. However, in addition to cleaning up spills, vacuum trucks have been observed in frequent use as part of refinery operations, such as removing water from tank surfaces, cleaning of oil-water separators, and transport of sludge, slop oils and tank bottoms. Further investigation of this source category was recommended as part of the Bay Area 2005 Ozone Strategy, identified as Further Study Measure FS 11, Vacuum Trucks.

At one refinery, it was estimated that over 1,000,000 gallons of hydrocarbon containing liquids were put in vacuum trucks per month, which is the equivalent of approximately 145,000 gallons of hydrocarbons per month. On a volume basis, at least 1.5 gallons of air is emitted for every gallon of vacuum tank capacity. In some cases, emissions from the tanks are controlled by the use of a carbon canister that adsorbs organic vapors as they are emitted from the truck tank, primarily to control odors. Further analysis can more precisely determine the emissions from these activities, emission reductions and costs.

Implementation Actions:
Vacuum trucks are routinely used to transfer organic liquids throughout the District. They operate both from facility to facility and also in dedicated service within the bounds of a facility such as a refinery. Although the trucks are mobile sources, the exclusion from District regulation in Regulation 1 applies only to the engines powering the trucks. Some of these trucks control emissions by carbon adsorption, but this is not universal and usually only employed to control odors.

Additional analysis will be undertaken to more accurately determine the number of vacuum trucks in use and the level of control already employed in practice. Compliance and Enforcement personnel assigned to refineries may be able to facilitate this inventory effort, but the larger equipment providers would need to be queried to determine the extent of

vacuum truck use outside of refinery operations. Source testing could determine the efficiency of carbon adsorbers if in use, and overall emission rates.

Potential control requirements could include a requirement to use carbon adsorption when organic liquids are being collected, a sizing requirement for the carbon based on truck capacity, and a requirement to change out the carbon canister at appropriate intervals before the carbon becomes saturated. Other options could include the use of a balance system to route vacuum tank air back into the evacuated vessel.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	6.00	6.00

Emission Reduction Methodology:
The emission reduction estimates are based on discussions with a supplier of vacuum trucks and other tank degassing equipment. There are roughly 200 hours of vacuum truck operation per day based on rough estimates of the number of operating vacuum trucks in the Bay Area (125 trucks at 80% utilization). Assuming that each truck is likely to pull a vacuum for two hours per day, uncontrolled emissions could be as high as 15 tons per day. Assuming that current control is only 50% due to intermittent use and ineffective monitoring and change out of spent carbon canisters, emissions would still be 7.5 tons per day. Implementation of control requirements coupled with improved monitoring and change-out of the canisters could be expected to achieve 90% control of emissions resulting in emissions reductions of 6 tons per day. Additional research will refine this estimate, including a breakdown of the emission constituents. Vacuum trucks clean up a variety of compounds from a variety of sources, including non-organic materials. The mixtures and presence of water may greatly impact the volatility of the material in the tanks.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
If activated carbon is used for control, this media will need to be stripped of organics or reactivated. Reactivation of carbon is an energy intensive process that may result in emissions of organics as well as NOx and CO from combustion if done on site. Alternatively, carbon disposal or reactivation off site would result in combustion emissions from hauling to a waste or regeneration facility.

Cost:
Activated carbon is readily available at costs between $1,100 and $2,000 per ton. Regeneration of spent carbon may be more costly than purchasing new carbon. The loading capacity for the carbon remains to be determined but is likely to be no more than 50% (by weight) and may be as low as 20% (by weight). Using the high estimate for virgin activated carbon with the low loading rate would result in a cost of $10,000 per ton of TOG reduced

($60,000 per day or $21.9 M per year). This does not take into account the costs of regeneration or disposal of spent carbon, but it does use the highest price for new carbon. Using the lower cost estimate and highest loading rate, costs would equal $2200 per ton TOG reduced ($13,200 per day or $4.8 M per year).

Co-benefits:
Reduction in exposure to toxic air contaminants, depending on what liquid is being collected.

Monitoring Mechanisms:
District Compliance and Enforcement staff will monitor adoption of emissions control through facility inspections. Vacuum trucks could be permitted as portable equipment, although they are not equipment subject to the statewide Portable Equipment Registration Program. Vacuum trucks could also be registered with the District to facilitate monitoring and enforcement.

Issues/Impediments:
Further research will be performed to improve the estimates of costs of control, the number of vacuum trucks in operation, as well as the extent that emissions control is already employed. There may also be other means of control that may prove more effective or less costly than carbon adsorption. If control were by means of combustion, the potential for increases in greenhouse gas emissions would need to be evaluated.

Sources:
1. 1994 Clean Air Plan Control Measure B6: Control of Emissions from Cleaning Up Organic Liquids
2. Bay Area 2005 Ozone Strategy, Further Study Measure FS 11, Vacuum Trucks
3. Steve Sellinger, Senior Engineer, Envent Corporation, personal communication 12 May 2005
4. BAAQMD Regulation 8, Rules 2, 5 and 9.
5. Maintenance/Startup/Shutdown (MSS) Permitting Issues, prepared by Sage Environmental Consulting, LP for The Texas Oil and Gas Association Refinery Environmental Committee, 11 June 2007

SSM 6 - General Particulate Matter Emission Limitation

Brief Summary:
Reduce the District's allowable weight rate limitations for particulate matter.

Purpose:
Reduce particulate matter emissions.

Source Category:
Stationary source.

Regulatory Context and Background:
The District has had a particulate matter emission limitation in Regulation 6, Rule 1 since 1960. Reg. 6-1 contains visible emissions standards, concentration rates in terms of weight per volume of exhaust gas, and an allowable emissions rate expressed in terms of weight per weight of material processed, as well as other limits for specialized operations. Other districts have lower limitations. For example, San Joaquin's Rule 4202 allows less than 15 lbs per hour of particulate matter emission for a process weight rate of 20,000 lbs/hr; the South Coast's Rule 405 allows less than 12 lbs/hr. BAAQMD Rule 6-1 allows 19 lbs/hr for a process weight rate of 20,000 lbs/hr. Particulate matter includes both coarse PM, PM10 or particles with an aerodynamic radius of 10 microns or less, and PM2.5, particles with an aerodynamic radius of 2.5 microns or less.

Implementation Actions:
Amend Regulation 6, Rule 1 to reduce the particulate matter allowable emissions rate.

Emission Reductions:

Pollutants (tons per day)	2012	2020
PM10	0	2.58
PM 2.5	0	0.29

Emission Reduction Methodology:
The 2005 Base Year Emissions Inventory was used to select the potential emissions that might be subject to the particulate emissions rate. Nine categories resulted in 7.79 tpd emissions of total PM. The four largest categories are Concrete Batching, Basic Refining Processes, Stone, Sand, and Gravel (Quarrying) and Other Commercial Industrial Processes. Other categories, such as Cooking and Landfills (fugitive emissions) have not been included although they have significant emissions. If facilities were operating at the current allowable emissions rate and could reduce emissions to the South Coast rate, emissions reductions would be 2.87 tpd. However, it is not known if all facilities are currently operating at close to the allowable rate. It is likely that many facilities, through the installation of more efficient control equipment reflected in their permit conditions, operate at far lower rates.

Reduction in the allowable weight rate of particulate matter would not be expected to reduce total PM, PM10 and PM2.5 equally, because the smaller particles (those that have the greatest health impact) are the lightest. This could be considered during rule development efforts.

Exposure Reduction:
TBD

Emission Reduction Trade-off:
None expected, although a need to increase control equipment could result in greater electricity use, generating more CO2 emissions.

Cost:
TBD

Co-benefits:
Reduced particulate matter is associated with improved visibility.

Issues/Impediments:
Further research is needed to determine if existing sources are operating at or already below the allowable emissions rate.

Sources:
1. BAAQMD Regulation 6, Rule 1: General Particulate Matter
2. South Coast Rule 405: Solid Particulate Matter - Weight
3. San Joaquin Valley Unified APCD Rule 4202: Particulate Matter Emission Rate

SSM 7 - Open Burning

Brief Summary:
Consider further limitations on open burning in Regulation 5: Open Burning.

Purpose:
Reduce particulate matter, NOx and VOC emissions from open burning.

Source Category:
Area source.

Regulatory Context and Background:
The District's Regulation 5 prohibits open burning with some exceptions. These exceptions, to allow certain burning on permissive burn days, include burning for hazardous waste reduction; removal of flood debris; marsh, forest and range management; burning of contraband; fire training; and burning of agricultural debris. Burning of agricultural debris is typically limited to a certain time period depending on what is being burned; e.g., crop stubble, orchard prunings, or crops to be replaced. A permissive burn day is called when air pollution from open burning is not expected to adversely impact ambient air quality or downwind populations according to meteorological criteria established by ARB for the Bay Area. However, Regulation 5 does not limit the quantity of material burned for agricultural operations. As indicated by the level of reported complaints, in some cases, burning of large piles of vineyard prunings have significantly impacted populations on marginally permissive burn days.

In addition, in 2008, the District adopted Regulation 6, Rule 3: Wood-burning Devices, which forbids uses of fireplaces and wood stoves on predicted PM excess nights. On at least one occasion in the winter of 2008, agricultural crops were burned on a permissive burn day prior to a non-burn night. Further limits on open burning would reduce PM emissions, including during periods conducive to high PM levels.

Finally, the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) is required, pursuant to CH&SC 41855.5, to develop alternatives to burning agricultural waste. The San Joaquin District has committed to work with the agricultural industry to investigate the feasibility of reducing burning, and the consequent emissions, by up to 50%. No specific feasible alternatives to burning are identified in SJVUAPCD's 2006 PM10 plan.

Implementation Actions:
Amend Regulation 5 to restrict the amount burned on permissive burn days or under certain meteorological criteria.

Emission Reductions:
The SJVUAPCD 2006 PM10 plan addresses alternatives to burning. Based on their estimates, if alternatives to burning agricultural crop waste were available for the Bay Area, emissions could be reduced by up to 0.04 tons VOC per day, 0.01 tons NOx per day, and 0.09 tons PM2.5 per day. However, as discussed above, the control measure could reduce exposure to PM without reducing total emissions if additional meteorological conditions for burning were considered for Regulation 5.

Emission Reduction Methodology:
The emission reductions are based on San Joaquin Valley estimates and the Bay Area source inventory. Estimates for the Bay Area are based on two source categories, Managed Burning and Disposal – Agricultural Burning – Prunings and Field Crops. Emission reductions are estimated from the percentage reduction estimated in the San Joaquin Valley's PM10 Plans for PM and NOx, and a reduction of 35% reduction for VOC was estimated, consistent with the NOx PM reduction.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
Increased composting of agricultural waste could increase emissions from composting operations, a subject of another control measure. However, a reduction of particulate matter in the atmosphere could reduce the number of days that wood burning is prohibited under Reg. 6-3: Wood Burning Devices.

Cost:
TBD

Co-benefits:
Direct reduction in PM, NOx and VOC from open burning.

Issues/Impediments:
Requiring only a part of agricultural waste to be burned may not reduce the total emissions from this source category because the remainder could be allowed to be burned on another day. However, it could result in a reduction in exposure to nearby residents.

Sources:
1. San Joaquin Valley Unified APCD 2003 PM10 Plan
2. San Joaquin Valley Unified APCD 2006 PM10 Plan
3. District emissions inventory, agricultural burning

SSM 8 - Sulfur Dioxide from Petroleum Coke Calcining

Brief Summary:
Limit emissions of sulfur dioxide from coke calcining by requiring a minimum of 80 percent sulfur capture.

Purpose:
Reduce sulfur dioxide and particulate matter emissions.

Source Category:
Stationary source.

Regulatory Context and Background:
Sulfur dioxide emissions are a precursor to fine particulate. Since the District is not in compliance with the federal ambient air quality standard for PM2.5, reductions are needed in PM2.5 and/or PM2.5 precursors. Combined, the two coke calcining kilns at District Plant 22 (ConocoPhillips Carbon Plant) emit 1232 tons per year of sulfur dioxide. The facility has committed to reducing SO2 emissions by 42 tpy to provide offsets for their Clean Fuels Expansion Project. The plant currently operates an abatement device to periodically trim emissions of sulfur dioxide to maintain compliance with the current sulfur dioxide emission limit in Regulation 9, Rule 1 of 400 ppm by volume or 113 kg (250 pounds) per hour, whichever is more restrictive. However, the South Coast AQMD requires a minimum of 80 percent sulfur capture, which is more restrictive than the current District rule requires. Hence, this control measure is intended to replicate the control measure that is in place in the South Coast.

Abatement technology includes dry scrubbing (injecting dry sodium bicarbonate or lime) into the flue gas stream, semi-dry scrubbing (injection a slurry of aqueous sodium bicarbonate or lime) into the flue gas stream, or wet scrubbing (using a sodium bicarbonate or lime slurry to absorb the SO2) from in the flue gas.

Implementation Actions:
Limit emissions of sulfur dioxide from coke calcining operations by requiring at least 80 percent sulfur reduction. This most likely requires a semi-dry flue gas desulfurization technology that has 80 – 90% SO2 removal efficiency.

Emission Reductions:

Pollutants (tons per day)	2012	2020
SO2	0	2.6

Emission Reduction Methodology:
TBD

Exposure Reduction:
TBD

Emission Reductions Trade-offs:
Use of add-on abatement equipment would be expected to increase power demand, indirectly leading to an increase in GHG emissions, mostly CO2, from power generation.

Cost:
Estimated costs for semi-dry flue gas desulfurization is $9 million capital, with an additional $4 million annual operating costs. Total amortized capital and operating costs are $5.7 million per year. Control efficiency is estimated to be at least 80%, reducing emissions by 950 tons per year. Cost effectiveness is estimated at $6000 per ton of SO2 reduced.

Co-benefits:
Reduction of secondary PM formation.

Monitoring Mechanisms:
Source testing, parametric / CEM.

Issues/Impediments:
No impediments have been identified, because the technology is in place at other similar operations.

Sources:
1. South Coast AQMD Rule 1119: Petroleum Coke Calcining Operations – Oxides of Sulfur.

SSM 9 - Cement Kilns

Brief Summary:
This control measure would reduce NOx and SOx emissions from cement kilns as well as reduce toxic air contaminants. There is one cement manufacturing facility in the Bay Area, Lehigh Southwest Cement (plant #17).

Purpose:
Reduce NOx and SOx emissions, mercury and other toxic air contaminants.

Source Category:
Combustion.

Regulatory Context and Background:
This facility is permitted to produce 1.6 million tons of clinker per year. In 2007, the facility switched from burning coal as its primary fuel to burning green petroleum coke. At the permitted clinker rate, the facility is projected to burn 171,000 tons per year of coke. The District approved the fuel switch based on EPA emission factors that indicated NOx was no greater, and all other criteria pollutants were reduced. However, EPA has recently obtained data from other areas indicating emissions are very dependent on the type of coal being used, and the characteristics of green petroleum coke. EPA has proposed additional source testing to validate that there is not an emissions increase associated with the switch. Hence, there will be source testing in the near future while burning coal and while burning coke.

2008 emissions were 1788 tpy (6.8 tpd for days in operation) of NOx and 181 tpy (0.69 tpd for days in operation) of SO2. This indicates an increase in NOx but a decrease in SO2 from coal burning. Further testing will provide better emissions data.

EPA has proposed to amend their National Emission Standard for Hazardous Air Pollutants for Cement Kilns (40CFR63 subpart LLL) to reduce emissions of mercury, particulate matter, total hydrocarbons and hydrochloric acid. A draft rule was issued and comments have been received through July, 2009. The rule sets standards for these pollutants and requires monitoring equipment and protocols.

Implementation Actions:
Require the use of abatement technology at Lehigh to reduce emissions of NOx, and consider a wet scrubber to reduce emissions of SO2 if any synergies in installing SO2 controls along with NOx controls (or other controls) can be identified.

Emission Reductions:
90% reduction of NOx of 1600 tpy, or 4.38 tpd (6.1 tpd for days in operation).

Pollutants (tons per day)	2012	2020
NOx	0	4.38

In addition to NOX reductions, SSM 9 also has the potential to provide SO2 reductions of 160 tons per year, or 0.44 tpd (0.6 tpd for days in operation). However, because of potential high costs for SO2 controls (see Cost section below), the issue of whether SO2 reductions should be required as part of this measure will be determined during the rule development process. Therefore, SO2 reductions have not been included in evaluating the cost-effectiveness of this measure.

Emission Reductions Methodology:
NOx emissions reductions have been estimated from a 90% emissions factor, consistent with estimates for modern control equipment.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process. The installation of either selective catalytic reduction or scrubbers for SO2 control would require additional power to pull gas through the equipment, indirectly causing more CO2 emissions from power generation.

In some modeling scenarios, reduction of NOx from a significant NOx emitting source with high emission rates has been shown to impact the ozone scavenging effect of NO, resulting in higher ozone concentrations in areas within the source's emission plume.

Cost:
To reduce NOx, the estimated cost to retrofit selective catalytic reduction into the flue gas train of the kiln is from $11.0 million capital expenditure, plus another $1.7 million annual operating costs (total annual costs, including amortization, $2.8 M). Control efficiency is estimated to be 90%, reducing emissions by 1,600 tons per year. Cost effectiveness when including amortized capital is $1750 per ton of NOx reduced. Selective Non-Catalytic Reduction (SNCR) technology may also be effective in this application. SNCR costs are approximately half of SCR costs, but only achieve 40 – 50% NOx reduction. Other technologies may be applicable. To operate NOx reduction equipment, particulate may have to be removed from the flue gas first.

As noted in the emission reduction discussion above, this measure may offer potential SO2 reductions, in addition to NOx. However, since it is not yet known whether SO2 reductions will be required, cost-effectiveness calculations for purposes of the CAP are based on NOx reductions only.

To reduce SO2, estimated costs to retrofit an SO2 scrubber into the flue gas train of the kiln is $140 million capital expenditure, plus another $2.7 million annual operating costs. Control efficiency is estimated to be 90%, reducing emissions by 160 tons per year. Cost effectiveness when including amortized capital would be on the order of $150,000 per ton of SO2 reduced.

Should the final EPA NESHAP for cement kilns require additional control equipment at this facility, some of the control equipment proposed in this measure may be able to be implemented more cost effectively.

Co-benefits:
Reduced secondary PM formation from NOx and SOx emissions.

Monitoring Mechanisms:
Source testing, CEMs and parametric monitoring.

Issues/Impediments:
The cost of SO2 control appears be a significant impediment unless synergies with NOx control or the NESHAP standards can be identified.

Sources:
1. Emissions from District databank files.
2. Alternative Control Techniques Document Update - NOx Emissions from New Cement Kilns, U.S. Environmental Protection Agency, EPA-453/R-07-006, November 2007
3. Best Available Retrofit Control Technology Assessment TXI Riverside Cement, South Coast Air Quality Management District, August 8, 2008
4. NOx Controls Cost Model, Section 4.2, Chapter 1, U.S. Environmental Protection Agency, EPA/452/B-02-001, January 2002
5. NOx Controls Cost Model, Section 4.2, Chapter 2, U.S. Environmental Protection Agency, EPA/452/B-02-001, January 2002

SSM 10 - Refinery Boilers and Heaters

Brief Summary:
Consider options to further reduce NOx emissions from petroleum refinery boilers and heaters.

Purpose:
Reduce NOx emissions.

Source Category:
Stationary source.

Regulatory Context and Background:
BAAQMD Reg. 9, Rule 10 imposes a daily average NOx limit equivalent to 28 ppmv on refinery heaters that were in service at the time the rule was adopted in 1994. Heaters that subsequently went into service were subject to more stringent NOx limits through the BAAQMD permitting process (BACT) and are not regulated under this rule. Reg 9-10 imposes a daily NOx limit of 150 ppmv on each heater classified as a CO boiler because these devices tend to have higher emissions and because their emissions are more difficult to control, compared to non-CO boilers. Only 3 of the Bay Area refineries operate CO boilers, and there are fewer than ten of these devices.

Because Reg 9-10 required final compliance by 2002 and because it does not apply to new heaters (except for new CO boilers), this rule achieved significant emission reductions through 2002, but has had virtually no effect on refinery heaters emissions since then. Because Reg 9-10 allowed refineries to comply on a daily average basis, they installed NOx controls on the largest and highest emitting heaters. Currently, the majority of refinery heaters have advanced NOx controls (ultra low-NOx burners or SCR) and almost all have at least basic low-NOx burners. The few heaters that have no NOx controls typically have one or more factors that appear to make them less-than-ideal candidates for cost-effective NOx control. These factors are being evaluated by staff to verify their validity.

During meetings with refinery personnel and engineering consultants in July 2009, the refineries presented information regarding projected costs to retrofit remaining uncontrolled boilers with low-NOx burners and SCR and to retrofit low-NOx burner-equipped boilers with SCR. In addition, there are a number of refinery projects currently ongoing that will involve retrofits or replacements of refinery heaters. This will result in an overall NOx reduction, the extent of which is currently being evaluated.

Reg 9-10 is not directly comparable to NOx rules in the other air districts with refinery operations (South Coast AQMD and San Joaquin Valley Unified APCD) because other district rules do not allow refinery averaging as Reg 9-10 does for non-CO boilers, and because these other air districts offer compliance options for the NOx limits in their rules (a regional

NOx cap-and-trade program at South Coast, and an emission fee option in San Joaquin) that BAAQMD does not offer. Nonetheless, both South Coast AQMD and San Joaquin Valley Unified APCD have made BARCT determinations that are more stringent than the current requirements of Reg 9-10 including:

South Coast: heaters <40 MM BTU/hr and >110 MM BTU/hr, and CO boilers
San Joaquin: heaters >110 MM BTU/hr

These BARCT determinations are being evaluated by staff, considering the different compliance options in each air district, to determine to what extent they may be applied to Bay Area refinery heaters.

Implementation Actions:
Reduce NOx emissions limits in Reg. 9-10 for the averaged heaters and the CO boilers. Other options that could be considered include requiring improved performance of some existing NOx controls.

Emission Reductions:
Total NOx emissions from heaters currently subject to Reg 9-7 are 12.0 ton/day (8.0 ton/day at averaged heaters and 4.0 ton/day at CO boilers). Because CO boilers represent a disproportionate source of emissions and because they have a significantly higher emission limit than the other refinery heaters, it is likely that most emission reductions will come from CO boilers. If all CO boiler emissions are reduced to the current BACT level for these devices, then NOx emissions would be reduced by about 2.9 ton/day.

Pollutants (tons per day)	2012	2020
NOx	0	2.9

Emission Reduction Methodology:
An amendment of Reg 9-10 will achieve emission reductions by either reducing the average daily NOx limit for pre-1994, non-CO heaters, or by reducing the NOx limit for CO boilers, or both. A reduction in the limit for pre-1994, non-CO heaters will require that refineries install low-NOx burners, ultra low-NOx burners or SCR on uncontrolled heaters, or else upgrade existing controls to more effective controls (e.g., replace low-NOx burners with SCR). These controls may be applied on whichever heaters provide the most-effective reductions, in order to achieve compliance with the new, average limit. CO boilers at different refineries have significantly different operating conditions (fuel mix, operating temperature), so it is unlikely that the current CO boiler limit can simply be reduced, since control costs will probably vary significantly at different refineries. Instead, different NOx limits will probably have to be applied to different fuels and operating conditions.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
The use of SCR could result in an increase in GHG, specifically CO2 due to increased need for electrical power.

Installation of low-NOx and ultra low-NOx burners may increase emissions of CO at the modified heaters, although CO emissions are expected to remain in compliance with the 400 ppmv limit in the rule.

In some modeling scenarios, reduction of NOx from a significant NOx emitting source with high emission rates has been shown to impact the ozone scavenging effect of NO, resulting in higher ozone concentrations in areas within the source's emission plume.

Cost:
This measure is currently going through the rule development process. Cost estimates will be refined by District staff during the course of the rule development process.

Because NOx controls have already been applied to most refinery heaters, and because there have been no cost break-through in NOx controls since Reg 9-10 was first adopted, any additional NOx reductions are expected to have relatively high cost effectiveness. Also, because each refinery has implemented a different NOx control strategy, any reduction in the average daily NOx limit will result in widely different control costs at each refinery. Although it is expected that each CO boiler arrangement will have a different NOx limit, refineries with CO boilers will also face widely different control costs because CO boilers currently operate over a wide NOx emission range.

Because refinery heaters are larger than typical non-refinery boilers and heaters and because of the complicating factors in refinery heater NOx control, control may be less cost-effective than for NOx reductions on natural gas-fired boilers. These complicating factors include: higher heating value of refinery gas and temporal and constituency variations in refinery gas.

Co-benefits: NOx reductions will also reduce secondary particulate formation.

Monitoring Mechanisms:
Initial source tests, ongoing monitoring with CEMs or periodic source tests.

Issues/Impediments:
Internal and external space limitations at uncontrolled heaters may make the installation of low-NOx burners, ultra low-NOx burners or SCR problematic. Where installation of controls is feasible, these factors may increase the cost of control. Poor or variable fuel quality, as well as the use of high-heating value fuel that results in high combustion temperatures will generally prevent refinery heaters from complying with NOx limits consistent with non-refinery heaters using natural gas fuel.

Sources:

1. U.S. EPA. 1994. "Alternative Control Techniques Document - NOx Emissions from Industrial, Commercial, Institutional (ICI) Boilers." EPA document no. EPA-453/R-94-022.
2. BAAQMD, Draft Amendments to Regulation 9, Rule 10: Nitrogen Oxides and Carbon Monoxide from Boilers, Steam Generators and Process Heaters in Petroleum Refineries, Workshop Report, 2010.

SSM 11 – Residential Fan Type Furnaces

Brief Summary:
This control measure would reduce oxides of nitrogen (NOx) emissions from residential fan type central furnaces by reducing allowable NOx emission limits on new and replacement furnace installations. This control measure does not address older homes with simple small floor heaters or larger central furnaces for condominiums, apartment buildings, and commercial space heating.

Purpose:
Reduce emissions of NOx from Residential Central Furnaces.

Source Category:
Combustion.

Regulatory Context and Background:
Natural gas fired fan-type central furnaces are used in residential and commercial buildings to provide comfort heating. Most single-family homes and many multi-unit residences have this type of heating equipment. Many older homes, with below floor furnaces, have been retrofitted with this type of forced air heaters. Typically, residential units have burners rated between 50,000 and 175,000 British thermal units per hour (Btu/hr). District Regulation 9, Rule 4 currently limits NOx emissions from fan type residential central furnaces with heat input less than 175,000 Btu/hr. Regulation 9, Rule 4 is a "point-of-sale" type regulation, requiring that any residential furnace offered for sale, installed, or sold must be certified to meet 40 nanograms (ng) of NOx per joule of delivered heat, which is equivalent to an emission concentration of about 55 ppmv at 3% oxygen. Regulation 9, Rule 4: Nitrogen Oxides from Fan Type Residential Central Furnaces was adopted in December of 1983, and has not been amended since that time. South Coast Rule 1111 includes the same NOx limit as does San Joaquin Rule 4905.

Low NOx burners have since been developed for many types of combustion equipment. These burners have been successfully retrofitted to large process heaters and boilers, and are now being designed for smaller combustion devices like residential water heaters. San Joaquin Control Measure S-COM-10 indicates that burners have been developed that achieve a 50% NOx emission reduction, although these burners are not currently commercially available. These low NOx burners can achieve NOx emission rates of about 10 – 14 ng/joule (15 – 20 ppm) of delivered heat for water heaters. This technology can be further adapted for residential space heating, due to the similar configuration of the appliances.

Implementation Actions:
Current low NOx burner technology is capable of meeting 10 – 14 ng/joule. This represents at least a 65 percent NOx reduction potential. This proposal would continue the "point-of-

sale" approach for residential furnaces to minimize the impact on individual homeowners and landlords. Central furnaces have a life expectancy of about 30 years. Should proposed amendments take a replacement, rather than a retrofit or forced retirement approach, NOx reductions will occur over the 30-year replacement cycle, or approximately a two percent NOx reduction each year.

Implementation timing may be lengthy. Efficiency and safety standards were also incorporated into low NOx residential water heaters, requiring significant redesign to meet all the requirements. There appears to be a three- to five-year period from re-design to marketable product for gas appliances.

Emission Reductions:

Pollutants (tons per day)	2012	2020
NOx	0	TBD

The emission reductions from this measure will be phased in as existing furnaces are replaced over the coming 20-30 years. Emissions reductions will be 4.2 tons per day when the measure is fully implemented.

Emission Reduction Methodology:
NOx emissions from residential space heating are included in the emission inventory as a specific category of emissions: *Category 283- Domestic Natural Gas Space Heating.* Base year 2005 emissions are estimated at 8.62 tons per day (tpd). This includes older homes that just have small floor heater units. This emission estimate includes heating devices for large apartment buildings that are larger than 175,000 Btu/hr. A rough estimate of ten percent (of the emissions inventory for this category) is attributed to these floor heaters, and 15% of the total for very large furnaces leaves 75 percent, or 6.5 tpd NOx emissions attributable to residential fan type central furnaces.

The emission reduction estimates are based on implementation only for new installations, or replacement of residential central furnaces. NOx reduction potential is 65 percent of the current 6.5 tpd NOx, or at least 4.2 tpd cumulative over the 30-year replacement cycle.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process. This is unlikely for this control measure, however, because efficient low-NOx burners have been developed for similar types of appliances. New forced air heaters will probably be more efficient than the ones they replace, reducing GHG emissions.

Cost:
Control costs are based on the costs of power premixed burners used to reduce emissions for large water heaters and small boilers. These burners are estimated to add an additional $100 to $200 to the capital cost of a furnace. Assuming a 30 year replacement cycle, total added capital cost is $150 million based on replacing 750,000 heaters over the 30 year period. Annual costs are $5.0 million.

The cost estimates above exclude potential advantages of probable improved efficiency for the furnace itself, and the opportunity to improve the efficiency of the fan and heated air ductwork, attractive to a homeowner installing a new furnace because of the potential savings in fuel usage. These cost estimates also exclude the potential to improve the thermal efficiency of the home by taking advantage of combined space / water heating or heat pump technology.

Co-benefits:
There are potential positive benefits of reduced greenhouse gases through improved thermal efficiency of space heating, and potential combined efficiency of space and water heating through re-design of the home energy use systems.

Monitoring Mechanisms:
Manufacturers of residential fan-type furnaces would be required to certify the furnace to a NOx limit of 14 ng/joule. Only certified furnaces could be sold in the District.

Issues/Impediments:
No specific issues or impediments have been identified.

Sources:
1. SCAQMD Rule 1111
2. BAAQMD Regulation 9, Rule 4
3. San Joaquin Valley Ozone Plan, Page 405 – 406, Natural Gas-Fired, Fan-Type Residential Central Furnaces (S-COM-10)

SSM 12 - Large Residential and Commercial Space Heating

Brief Summary:
This control measure would reduce oxide of nitrogen (NOx) emissions from large condominium and apartment building central furnaces, and from commercial space heating through retrofit of low NOx burners.

Purpose:
Reduce NOx emissions from large condominium and apartment building central furnaces, and from commercial space heating.

Source Category:
Combustion.

Regulatory Context and Background:
Natural gas fired fan-type central furnaces are used in residential and commercial buildings to provide comfort heating. Most single family homes and many multi-unit residences have this type of heating equipment. Typically, residential units have burners rated between 50,000 and 175,000 British thermal units per hour (Btu/hr). The District Regulation 9, Rule 4: Nitrogen Oxides from Fan Type Residential Central Furnaces (Rule 9-4) currently limits NOx emissions from fan type residential central furnaces with heat input less than 175,000 Btu/hr. There is currently no regulation of larger central furnaces for condominium or apartment complexes, or commercial space heating. Unregulated combustion devices typically generate 75 to 100 ppm or more NOx.

Low NOx burners have been developed for many types of combustion equipment. These burners have been successfully retrofitted to large process heaters and boilers, and are now being designed for smaller combustion devices like residential water heaters. These low NOx burners can achieve NOx emissions of 14 ng/joule (approximately 20 ppm) of delivered heat for large water heaters. It appears this technology can be further developed for large central furnace and commercial space heating applications, due to similar space and size configurations of the affected units.

NOx emissions from residential space heating are included in the emission inventory as a specific category of emissions: *Category 283 - Domestic Natural Gas Space Heating.* Base year 2005 emissions are estimated at 8.62 tons per day (tpd). This emission estimate includes heating devices for large condominiums and apartment buildings that are larger than 175,000 Btu/hr. A rough estimate of 15 percent of the total for these very large furnaces are responsible for 1.3 tpd of NOx emissions.

In addition, *Category 1590 – Other External Combustion Natural Gas (area sources)* has base year 2005 emissions estimated at 7.03 tpd. Analysis of month-to-month gas consumption data indicates that approximately 24 percent of the natural gas use is for commercial

facilities, and 21 percent of the commercial gas use is cyclical from summer to winter. NOx from commercial space heating is estimated to be 0.35 tpd.

Implementation Actions:
Current low NOx burner technology is capable of meeting 14 ng/joule. This represents at least a 70 percent NOx reduction potential. This proposal includes retrofit, and probable registration of large central furnaces for condominium and apartment complexes, and commercial space heaters. These large central furnaces have a life expectancy of about 30 years. This proposal assumes a retrofit strategy for existing large furnace and space heaters. Implementation can take place over a reasonable period of 10 – 15 years, when the furnace reaches half of its potential life span.

Emission Reductions:

Pollutants (tons per day)	2012	2020
NOx	0	TBD

The emission reductions from this measure will be phased in as existing furnaces are replaced over the coming 15-20 years. Emission reductions are expected to be 1.2 tons per day NOx when the measure is fully implemented.

Emission Reduction Methodology:
The emission reduction estimates consider retrofit or replacement of existing large central furnaces and space heaters. NOx reduction potential is 70 percent of the current 1.65 tpd NOx, or at least 1.2 tpd cumulative over the 15-year half life of these devices.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process. However, low-NOx burners of the sort used in similar applications do not tend to reduce the efficiency of the appliance noticeably. New forced air furnaces would likely be more efficient than the ones they replace, reducing GHG emissions.

Cost:
Control costs are based on the costs of power premixed burners used to reduce emissions for large water heaters and small boilers. These low-NOx burners are expected to add $500 to the cost of a large furnace replacement ($3000 - $10,000). There are an estimated 50,000 large forced air furnaces in the District, so based on a 30 year expected lifespan, approximately 1667 would be replaced annually. In 15 years, 25,000 of the furnaces will be retrofited with low NOx burners at a cost of $12.5M, resulting in an annual cost of $833,333 a year and a cost effectiveness of $3800 per ton of NOx reduced.

Approximately half the large furnaces may not be retrofitted with low-NOx burners and need to be replaced within 15 years (half their lifespan), the additional replacement capital costs are estimated at $3000, and would amortize to a total of $6.0 M annually. Cost effectiveness for these heaters is $27,400 per ton of NOx reduced. Overall cost effectiveness for this control measure is $15,600 per ton of NOx reduced.

The cost estimates above exclude potential advantages of any improved efficiency for the furnace itself, and the opportunity to improve the efficiency of the fan and heated air ductwork. These cost estimates also exclude the potential to improve the thermal efficiency of a building by taking advantage of combined space / water heating or heat pump technology.

Co-benefits:
There are potential positive benefits of reduced greenhouse gases through improved thermal efficiency of space heating, and potential combined efficiency of space and water heating through re-design of the building energy use systems.

Monitoring Mechanisms:
Manufacturers of space heaters would be required to certify the heater to a NOx limit of 14 ng/joule. Only certified heaters could be sold in the District.

Issues/Impediments:
No specific issues of impediments have been identified.

Sources:
1. SCAQMD Rule 1111
2. BAAQMD Regulation 9, Rule 4
3. San Joaquin Valley Ozone Plan, Page 405 – 406, Natural Gas-Fired, Fan-Type Residential Central Furnaces (S-COM-10)

SSM 13 - Dryers, Ovens, and Kilns

Brief Summary:
This control measure would reduce oxides of nitrogen (NOx) emissions from combustion devices that are currently exempt from the requirements of Regulation 9, Rule 7: *Nitrogen Oxides and Carbon Monoxide from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters* (Reg 9-7). Reg. 9-7 exempts the following types of combustion devices: kilns, ovens, and furnaces used for drying, baking, heat treating, cooking, calcining, or vitrifying (§9-7-110.6).

Purpose:
Reduce emissions of NOx from kilns, ovens, and furnaces.

Source Category:
Combustion.

Regulatory Context and Background:
The District regulates NOx emissions from a variety of combustion source categories. Reg. 9-7 is a non-industry specific rule that applies to a broad range of combustion devices that heat water or other fluids. Reg. 9-7 includes an exemption for "kilns, ovens and furnaces used for drying, baking, heat treating, cooking, calcining, or vitrifying." Historically, most California air districts that had a general combustion rule similar to Reg. 9-7 also had an exemption similar to that in §9-7-110.6, and did not have a separate rule that applied to these exempt devices. In December 2005 the San Joaquin Valley APCD (SJVUAPCD) adopted Rule 4309 to limit emissions of NOx from dryers, dehydrators and ovens with a rated heat input of 5 MM BTU/hr or more. Rule 4309 was fully implemented in December 2008. In December 2008 the South Coast AQMD (SCAQMD) published a draft of a new rule (Rule 1147) that would limit emissions of NOx from "ovens, dryers, dehydrators, heaters, kilns, calciners, furnaces, crematories, incinerators, heated pots, cookers, roasters, fryers, closed and open heated tanks and evaporators, distillation units, afterburners, degassing units, vapor incinerators, catalytic or thermal oxidizers, soil and water remediation units". This proposed rule has not been adopted.

The draft staff report for proposed SCAQMD Rule 1147 indicates that low-NOx burners are commercially available for all affected devices in the proposed rule.

A database query for permitted combustion devices in this category identified 62 devices with total NOx emissions of 2.1 ton per day (tpd). The cement kiln at Lehigh Southwest Cement (Plant #17) and two coke calciners at the Conoco Phillips Coke Plant (Plant #22) generate approximately 93% of the emissions from this source category. This kiln and calciners are the subject of other proposed control measures. The remaining NOx emissions from this source category are about 0.45 tpd.

Implementation Actions:
Adopt a rule similar to SCAQMD Rule 1147 for this source category.

Emission Reductions:
In the draft staff report for proposed Rule 1147, SCAQMD staff estimated that current, uncontrolled NOx emission rates at devices that would be subject to Rule 1147 range from 110 to 170 ppmv at 3% O2. The proposed NOx limits in this rule range from 30 to 60 ppmv at 3% O2. Small driers, ovens and kilns are assumed to be exempt because NOx reduction would not be cost effective for small devices. If none of these devices in the District has already implemented NOx controls, the emission reduction available by applying the SCAQMD proposed NOx limits ranges from 45% to 80%, or from 0.20 tpd to 0.36 tpd.

Pollutants (tons per day)	2012	2020
NOx	0	0.20

Cost: Low NOx burners are estimated to add $5000 to the cost of a dryer, oven or kiln replacement. Devices of this size and type may not be able to be retrofitted with low-NOx technology. There have been 59 driers, ovens and kilns identified in the Air District, half of which may be exempt because of low fuel usage. For devices unable to be retrofitted, replacement before the end of their useful like may be required. At an estimated cost of $100,000 each, replacement of all devices will cost $3M capital, amortized to $570,000 annually. The SJVUAPCD estimated costs between $7,300 and $22,300 per ton of NOx reduced for Rule 4309. The SCAQMD has estimated costs between $4,000 and $17,000 per ton of NOx reduced for proposed Rule 1147.

Emission Reduction Methodology:
The emissions reductions are derived from South Coast's estimated emissions reductions and the emissions from applicable sources in the Bay Area.

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process.

Co-benefits:
NOx is a precursor to secondary PM formation.

Monitoring Mechanisms:
Source tests, monitoring.

Issues/Impediments:
SJVUAPCD Rule 4309 exempts units used to precondition onions and garlic prior to dehydration. Gilroy Foods, Inc. (Plant #11327) has eight sources that could be controlled. It is not known if the rationale for the San Joaquin exemption would apply to these units. Proposed SCAQMD Rule 1147 does not provide a similar exemption.

Sources:
1. SJVUAPCD Rule 4309: http://www.valleyair.org/rules/currntrules/r4309.pdf
2. SCAQMD Proposed Rule 1147: http://www.aqmd.gov/rules/proposed/1147/PR1147Nov408.pdf
3. SCAQMD Proposed Rule 1147 Draft Staff Report: http://www.aqmd.gov/rules/proposed/1147/PR1147DraftStaffReportNov408.pdf

SSM 14 - Glass Furnaces

Brief Summary:
This control measure would reduce NOx emission from gas-fired glass melting facilities.

Purpose:
Reduce NOx

Source Category:
Stationary source.

Regulatory Context and Background:
SJVUAPCD Rule 4354 imposes NOx limits for several types of glass plants: flat glass, container glass, and fiberglass. The limit went to 4.0 lbs NOx / ton of glass in 2008. In 2008, SJVUAPCD adopted further amendments to Rule 4354 that set a standard for container glass of 1.5 lbs NOx / ton effective in 2014.

BAAQMD Regulation 9, Rule 12: Nitrogen Oxides from Glass Melting Furnaces (Rule 9-12) imposes a NOx limit of 5.5 lbs NOx / ton glass. This limit was based on the South Coast limit but also on differences between Bay Area furnaces and South Coast furnaces. The South Coast furnaces are largely end-port furnaces. The operators of the furnaces used electric boost and flame modifications to reduce emissions to meet the SCAQMD limit. The Bay Area has only one facility (Plant 30) that has three glass melting furnaces. These three furnaces are side port furnaces, and flame modification techniques used in the South Coast cannot be used on these furnaces. In addition, the Bay Area furnaces use electric boost to increase production and, therefore, cannot use it to reduce emissions without decreasing production. Limits lower than 4.0 lbs NOx / ton glass have been achieved by an oxy-fuel system operated by Gallo in Modesto, but this plant manufactures glass for Gallo wines and does not sell to the open market. It is unclear whether oxy-fuel combustion is cost-effective in the current market.

Another relatively new technology, the Pilkington 3R process, has been developed since the SCAQMD and BAAQMD rules were adopted in the early 1990's; but it has been used only in flat glass furnaces. It is unknown whether the process will prove to be suitable for container glass furnaces and whether there is any potential for emission reductions.

Of the three Bay Area glass melting furnaces, two of these (S-11, S-12) have explicit NOx emission rate limits (4.0 lb/ton of glass in a 3-hr period) imposed by permit conditions that are more stringent than the current Tier 2 limit in San Joaquin's Rule 4354. However, the Tier 3 limit effective in 2014 (1.5 lb/ton, 30-day average) is more strict than the permit conditions for these two furnaces.

Because San Joaquin has adopted "Tier 3" NOx emission rate limits that are significantly stricter than those in BAAQMD Rule 9-12 or in the permit conditions applicable to Plant 30, further emission reductions at Plant 30 may be able to be obtained. The 2005 Base Year inventory for the source category "glass melting furnaces - natural gas" included 1.42 ton/day of NOx.

San Joaquin's Tier 3 standard represents a 43 percent reduction in NOx emissions compared to the weighted average emission rate (2.65 lb NOx/ton glass) at the three furnaces at Plant 30.

Implementation Actions:
The control measure will be implemented through amendments to Rule 9-12.

Emission Reductions:

Pollutants (tons per day)	2012	2020
NOx	0	0.38

Emission Reduction Methodology:
TBD

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
Depending on the technology selected, NOx reductions may increase GHG emissions, specifically CO2, by reducing efficiency of the process.

In some modeling scenarios, reduction of NOx from a significant NOx emitting source with high emission rates has been shown to impact the ozone scavenging effect of NO, resulting in higher ozone concentrations in areas within the source's emission plume.

Cost:
An oxy-fuel system or selective catalytic reduction are both viable options to reduce NOx. The capital cost for either option is estimated to be approximately $4 M, amortized to $760,000 per year.

Co-benefits:
Reduction in secondary particulate formation

Monitoring Mechanisms:
Source tests and monitoring equipment will be used to enforce emission standards.

Issues/Impediments:
None identified.

1. **Sources**:
   http://www.valleyair.org/Air_Quality_Plans/docs/AQ_Ozone_2007_Adopted/11%20Chapter%206%20April%202007.pdfhttp://www.valleyair.org/Air_Quality_Plans/docs/AQ_Ozone_2007_Adopted/26%20Appendix%20I%20April%202007.pdf
2. Workgroup Recommendations and Other Potential Control Measures Stationary Combustion Sources Workgroup – Glass/Fiberglass Furnaces, Subhash Shah, New Jersey Department of Environmental Protection, February 22, 2007. http://www.state.nj.us/dep/baqp/rapt/wps/SCS007_fin2.pdf
3. BAAQMD. 1993. Staff Report, Regulation 9, Rule 12, Nitrogen Oxides from Glass Melting Furnaces.
4. SJVUAPCD. 2002. "Final Draft Staff Report, Amendments to Rule 4354 (Glass Melting Furnaces)." SJVUAPCD. Rule 4354.

SSM 15 - Greenhouse Gases in Permitting, Energy Efficiency

Brief Summary:
This control measure would mitigate increases in greenhouse gas (GHG) emissions from new and modified permitted sources, reviewing implementation of energy efficiency measures, where appropriate on new sources subject to the Air District's jurisdiction.

Purpose:
Reduce GHG emissions from new and modified permitted sources.

Source Category:
Stationary source.

Regulatory Context and Background:
Sources that require permits are evaluated according to the District's Permit Handbook and BACT/TBACT Workbook. Projects are ministerial for the purposes of CEQA if the specific procedures, fixed standards and objective measurements established in the Handbook and Workbook apply to the permit application. For larger sources, those for which there is no BACT established in practice for the specific source, the source would not be classified as ministerial and a CEQA evaluation is required.

When reviewing sources for permitting, District staff does not consider GHG emissions. Under existing federal, state and District guidelines, a new source is required to abate criteria pollutants to the maximum extent feasible consistent with other, like sources, or to install the most effective control technology that can be demonstrated to be cost effective.

Implementation Actions:
This control measure could be implemented in two ways. First, some larger projects that are currently considered ministerial could be made to undergo CEQA, specifically to consider mitigation of GHG emissions. This could be accomplished by a change in the Permit Handbook so that some discretion in the evaluation of these permits could be used. Examples of projects that would fall into this category are boilers, steam generators or process heaters with a rated heat input greater than some threshold amount.

Second, some ministerial projects could have certain energy efficiency-related measures imposed as standard permit conditions to minimize the amount of GHGs emitted. As an example, combustion devices such as boilers or internal combustion engines that operate at less than a certain size could be required to have a certain manufacturer's efficiency rating.

Emission Reductions:
Undetermined. This control measure would not reduce existing emissions. It would, like new source review provisions, mitigate increases in GHG emissions from new and modified plants and equipment. As existing equipment ages and is replaced, or new facilities are

built, this control measure could help reduce GHGs that would otherwise be emitted. As the control measure could apply across many of the permitted sources required to obtain District permits, it is impossible to estimate the amount of emissions subject to control.

Emission Reduction Methodology:
TBD

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
None identified.

Cost:
Increased efficiency as a permit condition may add costs to new equipment, but energy efficiency measures often pay for themselves within 5 years. Flexibility in permitting could reduce applicant costs while reducing GHGs.

Co-benefits:
The co-benefits of reducing GHG emissions are myriad, from reducing the likelihood of increased global temperatures, sea level rise, increased frequency and severity of storm activity, to impacts on water quality from increased salinity in the delta and damage to infrastructure from flooding. The development of energy efficiency technologies and equipment that controls criteria pollutant and TACs that does not produce secondary GHG emissions may spur green job creation. One possible means of reducing GHG emissions would be increased energy efficiency resulting in energy savings and reduced consumer costs in the long term. An additional benefit of energy efficiency for combustion equipment is the reduction of other combustion contaminants, such as SO2 and PM.

Monitoring Mechanisms:
The success of this control measure would be monitored by examining the emission inventory for increases in criteria pollutants and TACs from permitted sources above what would be expected if this measure were not in place. GHG emissions from permitted sources are tracked as a result of the May 21, 2008 adoption of the GHG fee in Regulation 3, section 334. Trends in GHG emissions from permitted sources would be examined before and after adoption of this measure.

Issues/Impediments:
None identified.

Sources:
1. BAAQMD Permit Handbook:
   http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
2. BAAQMD Regulations 2-2, and 2-5:
   http://www.baaqmd.gov/dst/regulations/index.htm

SSM 16 - New Source Review Addressing PM2.5

Brief Summary:
This control measure would amend Regulation 2, Rule 2 to address the District's anticipated non-attainment status of the 24-hour PM2.5 National Ambient Air Quality Standard. In addition, more stringent standards will be considered for sources located in areas of sensitive populations as determined by the Community Air Risk Evaluation (CARE) program.

Purpose:
Reduce emissions of PM2.5 from new and modified permitted sources and to address the cumulative air quality impacts of stationary sources on sensitive receptors and impacted communities.

Source Category:
Stationary source.

Regulatory Context and Background:
Existing District rules require that permit applications be submitted for a wide variety of new and modified stationary sources prior to construction so that District staff can complete a review of compliance with applicable air quality requirements. Applicable air quality requirements include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. New Source Review (NSR) rules require that new and modified sources utilize the Best Available Control Technology to minimize air pollution impacts. Additional NSR requirements include emission offsets, air quality impact analysis for criteria air pollutants and their precursors, and health risk screening analysis for toxic air contaminants (TACs). The existing District NSR rules are Regulation 2, Rule 2: New Source Review, and Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants.

The Community Air Risk Evaluation (CARE) Program was initiated in 2004 to evaluate and reduce health risks associated with exposures to outdoor toxic air contaminants (TACs) in the Bay Area. The program examines cumulative TAC emissions from point sources, area sources and on-road and off-road mobile sources. District risk reduction activities will be focused on priority communities that have been identified based on sources of TAC emissions, modeled exposure of sensitive populations, and socioeconomic factors.

US EPA has proposed designating the Bay Area as a non-attainment area for the recently revised 24-hour PM2.5 national ambient air quality standard, but final action is pending. When EPA finalizes the District's non-attainment designation for the 24-hour PM2.5 standard, the District will have a period of time to amend Regulation 2, Rule 2, NSR requirements to address PM2.5. At that time, District staff will consider whether more

stringent permitting requirements should be established for sources of PM2.5 locating in priority communities.

Implementation Actions:
Prepare amendments to Regulation 2, Rule 2: New Source Review pursuant to EPA requirements. During this process, more stringent requirements for sources located in priority communities may be considered. Amendments to Regulation 2, Rule 5 resulting in more stringent permitting requirements for sources of TACs are currently being developed. Lessons learned from this process will help implementation of similar requirements for sources of PM2.5 in Regulation 2, Rule 2.

Emission Reductions:
Undetermined. This control measure would reduce increases in PM 2.5 emissions from new and modified plants and equipment. As existing equipment ages and is replaced, or new facilities are built, this control measure would help reduce PM 2.5 that would otherwise be emitted. As the control measure could apply across many of the permitted sources required to obtain District permits, the amount of emissions subject to control and emission reductions have not been calculated at this time.

Emission Reduction Methodology:
TBD

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
None expected, although a need to increase control equipment could result in greater electricity use, generating slightly more green house gas emissions.

Cost:
TBD

Co-benefits:
PM2.5 can contribute significantly to regional haze and reduction of visibility. A particle of 2.5 microns or less in diameter is also a particle of 10 microns or less in diameter. In other words, PM2.5 is a subset of PM10, so a reduction in the former will result in a reduction in the latter.

Monitoring Mechanisms:
The success of this control measure would be monitored by examining the emission inventory for increases in criteria pollutants and TACs from permitted sources above what would be expected if this measure were not in place. In particular, trends in PM2.5 from permitted sources would be examined before and after adoption of this measure. Ongoing

monitoring of impacted communities as part of the CARE program also will help gauge the success of this measure.

Issues/Impediments:
Amendments to Regulation 2, Rule 2 to address PM2.5 in general are unlikely to face much opposition, however more stringent rules for sources in impacted communities may raise concerns in the regulated community.

Sources:
3. BAAQMD Permit Handbook: http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
4. BAAQMD Regulations 2-2, and 2-5: http://www.baaqmd.gov/dst/regulations/index.htm
5. Update on CARE Program and Associated Regulatory Initiatives, Memo to Stationary Source Committee from Jack Broadbent 6 July 2009
6. Draft Concept Paper, *More Stringent Permitting Requirements for Proposed New/modified Stationary Sources of Air Pollution Located in Impacted Communities or in Proximity to Sensitive Receptors.* February 23, 2009.
7. Brian Bateman, April 2009 Presentation given to the CARE Task Force.

SSM 17 - New Source Review for Toxic Air Contaminants

Brief Summary:
This measure proposes to revise District permitting requirements via amendments to Regulation 2, Rule 5, New Source Review of Toxic Air Contaminants (TACs). For Priority Communities identified in the Air District's Community Risk Evaluation (CARE) Program, cumulative impacts will be addressed by tracking the toxicity-weighted emissions from all sources in the identified communities. Incorporation of revisions to Cal/EPA's Environmental Health Hazard Assessment (OEHHA) methodologies into District Health Risk Screening Analysis Guidelines will result in more stringent standards for new and modified sources.

Purpose:
Reduce the cumulative air quality effects of TACs from new and modified stationary sources in the District and develop a periodic reporting mechanism to track toxic air contaminant emissions in CARE Priority Communities.

Source Category:
Stationary source.

Regulatory Context and Background:
Existing District rules require that permit applications be submitted for a wide variety of new and modified stationary sources prior to construction so that District staff can complete a review of compliance with applicable air quality requirements. Applicable air quality requirements include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. New Source Review (NSR) rules require that new and modified sources utilize the Best Available Control Technology to minimize air pollution impacts. Additional NSR requirements include emission offsets, air quality impact analysis for criteria air pollutants and their precursors, and health risk screening analysis for TACs. The existing District NSR rules are Regulation 2, Rule 2: New Source Review, and Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants.

The requirements of Regulation 2, Rule 5 are based on the results of a site-specific Health Risk Screening Analysis (HRSA), which is an assessment that describes the possible adverse health effects that may result from public exposure to routine and predictable emissions of TACs. All permit applications for new and modified sources are screened for emissions of TACs. Where the predicted health risks from a proposed project exceed specified threshold levels, the new/modified source(s) must use the Best Available Control Technology to minimize TAC emissions (TBACT). The TBACT and Project Risk standards in Regulation 2, Rule 5 are uniformly applied throughout the District's jurisdiction.

Procedures used for completing HRSAs are based on guidelines adopted by Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA) for use in the Air Toxics Hot Spots Program. Procedures for assessing health risks are intended to protect sensitive individuals such as children, and individuals with pre-existing health conditions. The Children's Environmental Health Protection Act (Senate Bill 25) established specific requirements for OEHHA to determine whether existing health risk assessment procedures are adequate to protect infants and children from the harmful effects of air pollution. OEHHA has already acted under SB 25 to revise procedures for assessing non-cancer health risks to provide a greater margin of safety for children. Age Sensitivity Factors (ASFs) were adopted by OEHHA on June 1, 2009 to account for inherent increased susceptibility to carcinogens during infancy and childhood, and exposure assessment procedures are expected to be revised by mid-2010. These changes in exposure assessment procedures, when combined with ASFs, will increase estimates of residential cancer risk by a factor of 2 to 3 relative to existing procedures.

The Community Air Risk Evaluation (CARE) Program was initiated in 2004 to evaluate and reduce health risks associated with exposures to outdoor TACs in the Bay Area. The program examines cumulative TAC emissions from point sources, area sources and on-road and off-road mobile sources. Based on sources of TAC emissions, modeled exposure of sensitive populations, and socioeconomic factors, Priority Communities have been identified where District risk reduction activities will be focused.

Implementation Actions:
Prepare amendments to Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants. District staff proposes to incorporate the latest OEHHA health risk assessment methodologies into Health Risk Screening Analyses completed for proposed new/modified permitted sources. This will effectively increase the stringency of the standards of Regulation 2, Rule 5. Incorporation of ASFs will increase the strigency of cancer risk standards by a factor of 1.7. Incorporation of revised exposure assessment procedures, when combined with the use of ASFs, will further increase the stringency of these standards by a factor of 2 to 3. Staff also proposes that cumulative emissions of toxic air contaminants be tracked in CARE communities on a toxicity-weighted basis and reported periodically.

Emission Reductions:
Undetermined. This control measure would reduce increases of TAC emissions from new and modified plants and equipment. As existing equipment is replaced, or new facilities are built, this control measure would reduce TACs that would otherwise be emitted. As the control measure could apply across many of the permitted sources required to obtain District permits, the amount of emissions subject to control and potential emission reductions have not been calculated at this time. The District will calculate and track emission reductions as the rule is implemented.

Emission Reduction Methodology:
TBD

Exposure Reduction:
TBD

Emission Reduction Trade-offs: None expected, although a need to increase control equipment could result in greater electricity use, generating slightly more green house gas emissions.

Cost:
TBD

Co-benefits:
Reducing TAC emissions will likely result in reduced emissions of TOG, ROG, and possibly particulate matter.

Monitoring Mechanisms:
The District will track cumulative toxicity-weighted risk from affected facilities in Priority Communities along with other sources of emissions. Ongoing ambient monitoring of impacted communities as part of the CARE program also will help gauge the success of this measure.

Issues/Impediments:
On January 6, 2010, the Board of Directors adopted amendments to Regulation 2, Rule 5 including provisions to track cumulative impacts in CARE communities. However, the Board directed staff to consider further setting different standards in the CARE communities for permit issuance under this rule.

Sources:
1. BAAQMD Permit Handbook: http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
2. BAAQMD Regulations 2-5:
3. http://www.baaqmd.gov/dst/regulations/index.htm
4. Update on CARE Program and Associated Regulatory Initiatives, Memo to Stationary Source Committee from Jack Broadbent 6 July 2009
5. Brian Bateman, April 2009 Presentation given to the CARE Task Force.
6. Proposed Amendments to Regulation 2-5, Workshop Report, July 2009.
7. Brian Bateman, October 2009 Presentation given to the CARE Task Force
8. Update on Proposed Amendments to Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants report to the Stationary Source Committee, October 19, 2009

SSM 18 - Revisions to Air Toxics Hotspots Program

Brief Summary:
Revise the District's Air Toxics Hot Spots program focusing on existing sources of toxic air contaminants.

Purpose:
Revise the District's Air Toxic Hotspots program focusing on existing sources of toxic air contaminants (TACs).

Source Category:
Stationary source.

Regulatory Context and Background:
Applicable air quality requirements related to controlling stationary sources include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. In California, air districts have the primary responsibility for controlling air pollution from non-vehicular stationary sources of air pollution. The Air District regulates stationary sources through rulemaking for specific source categories, through its permitting process and New Source Review for new and modified sources, and by administering the Air Toxics "Hot Spots" Program for existing sources.

The Air Toxics "Hot Spots" (ATHS) program is a state program implemented by California air districts. Assembly Bill 2588, the Air Toxics "Hot Spots" Information and Assessment Act, was enacted by the State legislature in 1987. AB 2588 requires companies throughout California to provide information to the public about emissions of TACs, and the impact that those emissions may have on public health. SB 1731, which provided the air districts with the authority to require facilities with significant risks to implement a site-specific risk reduction audit and plan, amended the Act in 1992. Each air district has the authority to establish health risk thresholds for public notification and risk reduction requirements.

The requirements of the ATHS program are based on the results of a site-specific Health Risk Screening Analysis (HRSA), which is an assessment that describes the possible adverse health effects which may result from public exposure to routine and predictable emissions of TACs.

Procedures used for completing HRSAs are based on guidelines adopted by Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA). Procedures for assessing health risks are intended to protect sensitive individuals such as children, and individuals with pre-existing health conditions. The Children's Environmental Health Protection Act (Senate Bill 25) established specific requirements for OEHHA to determine whether existing health risk assessment procedures are adequate to protect infants and children from the harmful

effects of air pollution. OEHHA has already acted under SB 25 to revise certain procedures for assessing non-cancer health risks to provide a greater margin of safety for children, and revisions to cancer risk assessment procedures are expected to be proposed in late 2009.

Implementation Actions:
The District will revise its ATHS program for existing facilities to incorporate more stringent risk reduction requirements than are provided in existing District policy. As was previously described, OEHHA is considering revising cancer risk assessment procedures to provide a greater margin of safety for protecting children. Based on discussions with OEHHA staff, it is possible that these revisions could increase calculated residential cancer risks by a factor of three or more relative to existing risk assessment procedures. Due to the potential significance of these revisions in risk assessment methodologies, the District believes that it is prudent to develop the District risk reduction rule concurrent with the OEHHA guideline revisions. OEHHA does not expect that these risk assessment guideline revisions will be finalized for some time, perhaps late in 2010.

Emission Reductions:
TBD

Emission Reduction Methodology:
TBD

Exposure Reduction:
TBD

Emission Reduction Trade-offs:
None expected.

Cost:
TBD

Co-benefits:
Reducing TAC emissions will likely result in reduced emissions of TOG, ROG, and possibly particulate matter.

Monitoring Mechanisms:
The success of this control measure would be monitored by examining the emission inventory for increases in criteria pollutants and TACs from permitted sources above what would be expected if this measure were not in place. Ongoing monitoring of impacted communities as part of the CARE program will help gauge the success of this measure.

Issues/Impediments:
The regulated community not already subject to the notification and risk reduction requirements of the current ATHS program may oppose more stringent thresholds for these requirements. Those already subject may be opposed to increased restrictions as a results of lowering these thresholds.

Sources:

1. BAAQMD Permit Handbook: http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
2. BAAQMD Regulations 2-5:
3. http://www.baaqmd.gov/dst/regulations/index.htm
4. Update on CARE Program and Associated Regulatory Initiatives, Memo to Stationary Source Committee from Jack Broadbent 6 July 2009
5. Draft Concept Paper, *More Stringent Permitting Requirements for Proposed New/modified Stationary Sources of Air Pollution Located in Impacted Communities or in Proximity to Sensitive Receptors.* February 23, 2009.
6. Brian Bateman, April 2009 Presentation given to the CARE Task Force.

MSM A-1 - Promote Clean, Fuel-Efficient Light and Medium-Duty Vehicles

Brief Summary:
The Air District, in cooperation with local businesses, city and county governments, and state and federal agencies, will expand the use of Super Ultra-low Emission (SULEV) and Partial-Zero (ZEV) emission light-duty passenger vehicles and trucks within the Bay Area. Emphasis will be placed on vehicles capable of using renewable, low-carbon fuels.

Purpose:
This measure will reduce emissions of ozone precursors, ROG and NOx, and CO2, a key greenhouse gas. It will also support the renewable and low carbon fuel policies and rules established by the State of California, and implemented by the California Energy Commission and the California Air Resources Board.

Source Category:
Passenger Vehicles and Light-Duty Trucks.

Regulatory Context and Background:
The California Air Resources Board's Low Emission Vehicle standards require car manufacturers to meet increasingly more stringent emission standards for their vehicles. The Bay Area benefits from the LEV-II emission standards whenever a new vehicle replaces an old vehicle that is then scrapped. This measure will focus on accelerating these benefits by supporting early turn-over of the vehicle fleet.

Specifically, this measure will focus on the purchase of light-duty vehicles certified by CARB as meeting the Super Ultra Low Emission Vehicle or Partial Zero Emission Vehicle standards. The SULEV and PZEV standards represent the two cleanest standards for light duty vehicle using internal combustion engines. The SULEV and PZEV standards were adopted by CARB as part of the LEV-II program, with both standards applying to MY 2004 and newer vehicles. There is no distinct difference in emissions between gasoline and alternative fuel vehicles rated as SULEV or PZEV. In November 2009, CARB staff released a white paper outlining potential changes to the Zero Emission Vehicle regulation. One potential change relevant to this control measure is the establishment of new MY 2014 light-duty vehicle emission standards using PZEVs as the baseline. CARB staff refers to this proposal as "LEV III – Criteria Pollutants." The Air District will follow the development of the proposed LEV III standards, and may modify the goals of this control measure by increasing support for PZEV vehicles.

The State of California has adopted goals to increase the use of renewable transportation fuels, thereby decreasing petroleum importation and greenhouse gases. This measure supports the statewide goals by making support for renewable-fuel vehicles a high priority for the District's grant programs.

On June 24, 2009, the President signed the *Consumer Assistance to Recycle and Save Act of 2009* into law. In response to the Act, the National Highway Traffic Safety Administration (NHTSA) established the Car Allowance Rebate Program (CARS). This is a $3 billion government program that helps consumers buy or lease a more environmentally friendly vehicle from a participating dealer when they trade in a less fuel-efficient car or truck. Consumers receive a $3,500 or $4,500 discount from a car dealer when they trade in their old vehicle and purchase or lease a new one. While the program is designed to energize the economy by boosting auto sales and put safer, cleaner and more fuel-efficient vehicles on the nation's roadways, many of the eligible new vehicles are certified by CARB at either the SULEV or PZEV emissions levels. The program has been successful; however, it is unclear if this program will continue into 2010. If it does continue, it will contribute a strong early start to this measure.

Implementation Actions:
The BAAQMD and partner agencies will collaborate to:

- Provide incentives for the purchase of SULEV/PZEV or other vehicles.
- Target high-mileage vehicles for fleet turnover, such as delivery vehicles and taxis.
- Initiate and support demonstration projects of renewable fuels from 2010 – 2012, with the goal of wide-spread retail availability by 2020.
- Initiate and support demonstration projects for GHG efficient vehicles and PM emission controls for vehicles.
- Encourage participation in the federal CARS incentive program for light duty vehicles.
- Continue public outreach and education on efficient driving habits and importance of vehicle maintenance for emission controls.

Goals for this measure are as follows:

- By 2012, place up to 10,000 renewable fuel SULEVs and up to 10,000 renewable fuel P-ZEVs into service, primarily in fleets;
- By 2020, place up to 100,000 renewable fuel SULEVs and up to 100,000 renewable fuel P-ZEVs into service, largely in fleets.

Emission Reductions:
This measure will result in the following annual emission reductions (in tons per day) by the end of 2012 and the end of 2020:

Emissions Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.05	0.51
NO_x	0.03	0.29
PM_{10}	0.01	0.20
C02-e	0.00	0.18

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
Emission reductions have been estimated by comparing the incremental difference in emissions between a new vehicle meeting the fleet wide average under the LEV-II emissions standards and the zero mile maximum emission allowable emission rate for a new SULEV or PZEV vehicle. There are no appreciable difference in the emission rates of particulate matter between LEV-II compliant vehicles and SULEV or PZEV vehicles. Emission rates developed by CARB were used in this analysis. The new vehicles are assumed to average 12,000 miles of travel per year.

The estimation of reductions in CO2 emissions is highly dependent upon the fuel type of the purchased vehicles. For the purposes of the current plan, it is assumed that 50% of the new vehicles will be fueled by ethanol obtained from a 80%/20% blend of California corn using the dry mill process and from crop and wood waste using cellulosic processes and 50% will be fueled by natural gas recovered from landfills and bio-digesters. Emission factors reflecting the full-fuel cycle developed by CARB for the Low Carbon Fuel Standard were used in this analysis. Vehicles were assumed to achieve an average fuel economy of 30 miles per gasoline gallon equivalent and consume the equivalent of 400 gasoline gallons per year in fuel.

Exposure Reduction:
To the extent that use of more fuel efficient vehicles or combustion of renewable fuels results in lower levels of toxic emissions from light and medium duty vehicles, exposure will be lessened/reduced.

Emission Reduction Trade-offs:
To avoid trade-offs, it will be important to avoid renewable fuels whose full life-cycle impact will result in increased emissions of any criteria pollutant or greenhouse gas.

Cost:
New gasoline and ethanol light duty vehicles certified to the SULEV and PZEV standards generally cost the same as other vehicles on the market. However, vehicles powered by an alternative fuel, such as natural gas, currently sell at a modest price premium. Additionally, an incentive is often required to induce vehicle owners to undertake early replacement of a vehicle. For this measure, it is assumed that an average subsidy of approximately $2,500 per vehicle will be required to accelerate vehicle turnover. The costs of this measure are assumed then to be:

Phase 1: $50 million
Phase 2: $450 million

It is anticipated that the District will provide up to $6 million per year on average towards the accelerated purchase of qualifying vehicles. Additional incentives funds will need to come from state and federal incentive programs, tax refunds and rebates, and private sources.

Because this control measure focuses only on the purchase and deployment of cleaner vehicles, no costs estimates are provide here for necessary infrastructure. The availability of public and private financing for the development of refueling equipment, especially for locally produced, renewable fuels will need to be considered during the implementation phases of this measure.

Monitoring Mechanisms:

- Vehicle registration data from the Department of Motor Vehicles.
- Fuel sales data from the Franchise Tax Board.
- Progress and Final reports from any Air District grants or incentives.
- Progress and Final reports made available from the CEC and CARB for their alternative fuel, technology advancement and climate change programs.

Issues/Impediments:

- Funding for vehicle subsidies.
- Limited availability of SULEV and PZEV vehicles capable of using renewable, low-carbon fuels.
- Limited availability of renewable, low-carbon fuels due to lack of breakthroughs in reducing production costs.
- Local permitting of bio-refineries

Sources:

1. California Air Resources Board, (CARB), Low –Emission Vehicle Program, http://www.arb.ca.gov/msprog/levprog/levprog.htm
2. CARB, Title 17, California Code of Regulations Section 95480 *et seq.*
3. CARB, *Resolution 09-31* (Low Carbon Fuel Standard), April 23, 2009. http://www.arb.ca.gov/regact/2009/lcfs09/res0931.pdf
4. CARB, *Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume 1: Staff Report: Initial Statement of Reason*, March 5, 2009.
5. CARB, *Proposed Environmental Analysis Work plan for the California Low Carbon Fuel Standard*, 2009. http://www.arb.ca.gov/fuels/lcfs/120208lcfs_environ.pdf
6. California Energy Commission, *FINAL Adopted State Alternative Fuels Plan*, December 5, 2007, Publication #CEC-600-2007-011-CMF.
7. California Energy Commission, *Alternative and Renewable Fuel and Vehicle Technology Program Regulations*, May 7, 2008, Publication # CEC-600-2008-013-F.
8. California Energy Commission, Final Regulation Language Alternative and Renewable Fuels and Technologies Program, Title 20, CCR, SECTIONS 3100 – 3108, January 2, 2009.
9. California Energy Commission, *Investment Plan for the Alternative and Renewable Fuels and Technologies Program*, April 2009. Publication #CEC-600-2009-008-CTF.
10. Department of Transportation, National Highway Traffic Safety Administration, *Car Allowance Rebate System (CARS)*, http://www.cars.gov/

MSM A-2 - Zero Emission Vehicles (ZEV) and Plug-in Hybrids

Brief Summary:
The Air District, in cooperation with local businesses, city and county governments, and state and federal agencies, will expand the use of Zero Emission (ZEV) and Plug-in Hybrid (PHEV) passenger vehicles and light-duty trucks within the Bay Area.

Purpose:
This measure will reduce ozone precursors and greenhouse gases.

Source Category:
On-Road Motor Vehicles: Passenger Cars/Light Duty Trucks

Regulatory Context and Background:
In September 1990, ARB adopted a low-emission vehicle regulation whose aim is to drastically reduce pollution from passenger cars and light-duty trucks. As part of the newly created program, the Board included a goal of requiring large auto manufacturers to commercialize vehicles with zero emissions, beginning with 1998 model-year vehicles. The original ZEV program required that 10 percent of new vehicle sales by large manufacturers have zero emissions, starting with 1998 models. The Board modified the program in 1998 and 2001 to allow up to 60 percent of the requirement to be met with vehicles having extremely low emissions and other specific attributes. In 2009 up to 85 percent of the requirements may be met with these vehicles. Vehicles meeting these standards are referred to as "partial zero emission vehicles" (PZEV) and "advanced technology partial zero emission vehicles" (AT-PZEV).

Manufacturers originally planned to meet the ZEV requirements with battery electric vehicles. In 1996, due to cost and performance issues, the ARB eliminated the early (1998) requirements to allow additional time for battery research and development. To ensure a significant market for advanced battery manufacturers, the ARB entered into agreements with manufacturers to place in California roughly 1,800 advanced-battery electric vehicles between 1998 and 2000. The agreements were designed to provide battery developers with the necessary initial production volumes to meet the cost and performance goals needed for commercial production.

CARB's most recent amendments to the ZEV program in 2008 increased the percentage of ZEVs required to 11 percent starting in 2012, with manufacturers being provided additional flexibility to meet their regulatory obligations through sale of plug-in hybrid vehicles and fuel cell vehicles. The ZEV requirement has been implemented by CARB to catalyze efforts to commercialize sustainable transportation. The program has prompted manufacturers to develop extremely clean conventional and alternative fuel and hybrid electric vehicles. There are currently twenty-one auto manufacturers subject to the ZEV regulation. Six are defined as large volume manufacturers: General Motors, Toyota, Ford, Honda, Chrysler and Nissan. The remaining 15 are intermediate volume manufacturers.

In November 2009, CARB staff released a white paper outlining potential changes to the Zero Emission Vehicle regulation that may be considered by the Air Resources Board. One potential change relevant to this control measure is the establishment of new Green House Gas light-duty vehicle emission standards using AT-PZEVs as the baseline. CARB staff refers to this proposal as "LEV III – Green House Gas." The Air District will follow the development of the proposed LEV III standards, and may modify the goals of this control measure by increasing support for battery electric and fuel cell vehicles.

Implementation Actions:

- Commit motor vehicle grant registration funds towards qualifying vehicle purchases and infrastructure development subsidies.
- Partner with private, local, state and federal programs to promote the purchase of battery-electric and plug-in hybrid electric vehicles.
- Partner with private, local, state and federal programs to install and expand public charging infrastructure. Promote existing charging infrastructure.
- Support research programs advancing technology for plug-in hybrid, battery electric and hydrogen-fueled vehicles.
- Advocate for increased government subsidies and research programs with local businesses, non-profits and governments through the Bay Area Electric Vehicle Initiative.
- 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.

Goals for this measure are as follows:

- By 2012, place 1,000 ZEVs and 5,000 PHEVs into service, primarily in fleets;
- By 2012, expand regional recharging network with 500 new charging stations;
- By 2020, place 10,000 ZEVs and 100,000 PHEVs into service;
- By 2020, expand regional recharging network with 2,000 new charging stations.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.18
NO_x	0.01	0.13
PM10	0.01	0.02
$PM_{2.5}$	0.00	0.01
C02-e	0.00	0.30

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
Emission reductions were calculated by assuming that each ZEV and PHEV is 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 2012 and 2020.

For plug-in hybrid vehicles, it is assumed that the vehicles operate in electric mode for 50% of the annual VMT, or 6,000 miles, and that 75% of the electric power derives from grid supplied electricity stored in batteries, while the remaining 25% 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 travelled 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 slightly increase emissions of criteria pollutants and greenhouse gases from power plants that generate the required electricity.

Cost:
Cost for the measure is determined by the marginal cost for the cleaner ZEVs and PHEVs over a standard car, plus infrastructure costs. Based on the Air District's 2009 application for federal stimulus funding from the Department of Energy, the marginal or incremental vehicle costs are $12,000 per vehicle and infrastructure is $19,000 per recharging unit on average. Costs to implement are estimated to be:

Phase 1:	Vehicle Costs	$72 million
	Infrastructure	$9.5 million
Phase 2:	Vehicle Costs	$53 million
	Infrastructure	$19 million

It is anticipated that the District will provide up to $6 million per year on average towards the accelerated purchase of qualifying vehicles. Additional incentives funds will need to come from state and federal incentive programs, tax refunds and rebates, and private sources. It is likely that public fleet orders will comprise the bulk of the purchases during the 2010 to 2012 period.

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.

Monitoring Mechanisms:
This measure can be monitored via annual vehicle registration data compiled by the DMV, as well as tracking any grant contracts for incentive funding paid out by the Air District.

Issues/Impediments:
- Funding for vehicle subsidies
- Limited availability of ZEV and Plug-in Hybrid vehicles.
- Vehicle price and ongoing maintenance costs
- 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. CARB, *Status Report on the California Air Resources Board's Zero Emission Vehicle Program*, April 20, 2007
3. CARB, *Status and Prospects for Zero Emission Vehicle Technology: Report of the ARB Independent Expert Panel 2007*, April 13, 2007.
4. CARB, *California Hydrogen Highway Network: 2008 Report to the Legislature*, January 2009.
5. CARB*, Preliminary Summary of Air Resources Board Action (3/27/08) – Zero Emission Vehicle (ZEV) Program,* April 2008.
6. For a list of existing public EV charging stations in the Bay Area, see http://www.evchargermaps.com/.

MSM A-3 - Green Fleets

Brief Summary:
This control measure consists of three elements: a) development of a green fleet certification as part of the ABAG Green Business Program; b) the promotion of best practices for green fleets through a dedicated website; outreach to local governments; and outreach to business groups and grant applicants to promote best practices; and c) potential revisions to the District's Transportation Fund for Clean Air (TFCA) and other grant programs to ensure funding is directed towards fleets meeting GHG performance standards.

Purpose:
This measure will further reduce ozone precursors and greenhouse gases, as well as particulate matter and PM precursors.

Source Categories/Travel Markets Affected:
On-Road Light, Medium, and Heavy-Duty Vehicles

Regulatory Context and Background:
There has been little experience to-date with regulatory efforts requiring cleaner, greener fleets. The South Coast AQMD adopted a number of fleet regulations including: Less-Polluting Street Sweepers, Clean On-Road Light- and Medium-Duty Public Fleet Vehicles, Clean On-Road Transit Buses, Clean On-Road Residential and Commercial Refuse Collection Vehicles, Commercial Airport Ground Access Vehicles (Taxicabs, Shuttles, etc.), Clean On-Road School Buses, and Clean On-Road Heavy-Duty Public Fleet Vehicles. These regulations apply to public and private fleets and require the purchase of mostly natural gas powered vehicles. ARB has a number of recently adopted regulations targeting fleet turnover, clean-up of heavy duty trucks, and truck hybridization research programs.

With regards to voluntary efforts, the federal EPA has promoted its SmartWay program as means for reducing energy usage from long-haul trucking operations. ABAG has a Bay Area-wide Green Business Program which uses a checklist for businesses/agencies to complete. ABAG has customized checklists for businesses, such as hotels, printers, and offices. San Francisco uses a customized Green Business checklist with several vehicle related requirements for businesses. Puget Sound Clean Air Agency has an entire website, http://www.psgreenfleets.org/, devoted to assisting agencies and businesses in creating a green fleet. The website contains grant/incentives resources, a green fleet calculator, and regulatory updates.

Implementation Actions:
Green Fleet Certification – The Air District will coordinate with the ABAG/Bay Area Green Business program to explore development of a "green fleet" certification. The Air District and ABAG will encourage public agencies and the private sector to contract with certified green fleets, and with other certified businesses that implement green fleet practices.

Promote best practices – Green fleet best practices include purchasing low emission vehicles, properly maintaining vehicles, minimizing fleet size, reducing reliance on petroleum based transportation fuels, increasing use of locally produced renewable fuels, and encouraging efficient driving habits. The green fleet toolkit developed by Sustainable Earth Initiatives with funding from the Air District's Climate Protection Grant Program, and the San Francisco Department of Environment's Green Fleet calculator represent excellent examples of best practices to promote. The District will consider either developing a specific website or dedicating a page on its website to address green fleet best practices, available incentives, and possibly a green fleet calculator, similar to the webpage developed by the Puget Sound Clean Air Agency.

Incentives/Grants Strategy – Track and assist public agencies in "greening" their fleets. Performance standards for cleaner burning and GHG efficient vehicles may be established for the Air District's grant programs based on ARB's GHG vehicle labeling program and green fleet best practices. The Air District and its partners may utilize the EPA SmartWay program as a source for establishing performance standards for heavy-duty trucks.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.02	0.08
NO_x	0.02	0.10
PM10	0.03	0.07
$PM_{2.5}$	0.02	0.05
C02-e	0.00	0.33

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
Overall, the Air District will aim to achieve emission reductions from fleets in three ways: increase the use of alternative fuels, increase the use of fuel efficient light duty vehicles, and reduced VMT.

For the purposes of calculating potential benefits under the measure, the Air District will work towards the following goals:

2012

- 1,000 diesel trucks begin using a 20% biodiesel fuel blend.
- 400,000 gallons of gasoline fuel saved from the use of more fuel efficient light-duty vehicles.
- 12 million fewer miles driven by light-duty vehicles.

2020

- 5,000 diesel trucks begin using a 20% biodiesel fuel blend.
- 2 million gallons of gasoline fuel saved from the use of more fuel efficient light-duty vehicles.
- 60 million fewer miles driven by light-duty vehicles.

The increased use of biodiesel will contribute to the reduction of PM2.5 and CO2, while the use of more efficient vehicles and the reduction in VMT will reduce NOx, ROG, PM2.5, PM10 and CO2. Emission factors are derived from work by CARB on the low carbon fuel standard and LEV-II program. It is assumed that heavy-duty trucks switching to biodiesel on average are driven 25,000 miles per year with a fuel economy of 5 miles per gallon (mpg). It was also assumed that gasoline savings by improving vehicle fuel economy from 20 mpg to 30 mpg.

Exposure Reduction:
The adoption of "green" practices by automotive fleet operators will reduce gasoline and diesel usage, which in turn will lower exposure to toxic compounds emitted by light duty gasoline vehicles and medium- and heavy-duty diesel trucks.

Emission Reduction Trade-offs:
None. Adoption of green fleet practices should lead to the reduction of all emissions.

Cost:
The development of a green fleet certification element to the Bay Area Green Business program is estimated to cost $250,000 in staff and consultant fees. The promotion of the Green Fleets Toolkit is estimated to cost $300,000 annually in staff, material and advertising.

Co-benefits:
Promoting a Green Fleets program will help to reduce water and noise pollution. This measure should also reduce petroleum usage in the Bay Area.

Monitoring Mechanisms:

- The annual level of effort by Air District and ABAG Staff to promote Green Fleet best practices.
- The annual increase in fleets making use of the Green Fleets Toolkit.
- Development of green fleet standards and a checklist of robust green vehicle requirements for the Bay Area Green Business certification program.

Issues/Impediments:
The main issues are the availability of resources to implement a Green Fleet certification component of the ABAG/Bay Area Green Business Program, as well as promote "best practices" to fleet operators; and interest/acceptance by fleet operators in changing from current practices.

Sources:

1. Association of Bay Area Governments, *Bay Area Green Business Program*, online at http://www.greenbiz.ca.gov/
2. The Sustainable Earth Initiative, et al.*, San Francisco Bay Area Green Fleets Toolkit*, February 2009. Available at http://www.sfenvironment.org/downloads/library/clean_fleets_toolkit__greening_commercial_fleet.pdf
3. CARB, *Subarticle 1, sections 95300 to 95312, title 17, California Code of Regulations*
4. CARB, *Heavy Duty Vehicle Greenhouse Gas Emission Reduction Measure,* 2009, http://www.arb.ca.gov/cc/hdghg/hdghg.htm
5. CARB, *Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume 1: Staff Report: Initial Statement of Reason*, March 5, 2009.
6. CARB, *Detailed California-Modified GREET Pathway for Ultra Low Sulfur Diesel (ULSD) from Average Crude Refined in California*, April 22, 2008.
7. CARB, *Detailed California-Modified GREET Pathway for Biodiesel Produced in California from Used Cooking Oil,* July 20, 2009.
8. EPA, SmartWay Program, http://www.epa.gov/smartway/

MSM A-4 - Replacement or Repair of High-Emission Vehicles

Brief Summary:
This control measure proposes enhancements to three long-running programs to control emissions from in-use light-duty motor vehicles: the Air District's Vehicle Buy Back and Smoking Vehicle complaint programs, and the State's Smog Check program.

Purpose:
The purpose of this measure is to reduce ozone precursors, PM, air toxics, and greenhouse gases from high-emitting vehicles by accelerating the replacement or repair of such vehicles.

Source Category/Travel Market Affected:
On-Road Motor Vehicles Passenger Cars & Light-Duty Trucks

Regulatory Context and Background:
Late-model vehicles that are equipped with recent emission control technologies and properly maintained emit very little ozone precursors or PM. By contrast, older vehicles, or vehicles that are not properly maintained, can emit pollutants at a much higher rate. There are approximately 325,000 pre-1989 model year vehicles on the road in the Bay Area. Although they account for only about 7% of the total vehicle fleet, these older vehicles have much higher emission rates, so that they account for a disproportionate share of total vehicle emissions. Accelerating the replacement or repair of high-emitting vehicles offers a cost-effective strategy to reduce emissions of criteria pollutants and air toxics. In addition, removing older vehicles can help to reduce emissions of CO2.

Vehicle Buy-Back: The Air District has operated a Vehicle Buy-Back (VBB), or scrappage, program since 1996. VBB provides cash to vehicle owners to voluntarily retire old vehicles. Payment per vehicle initially was set at $500; it increased in FY 2006/2007 to $650; and again in 2009 to $1,000. Funding has primarily come from the District's Transportation Fund for Clean Air. This program has led to the early retirement of more than 42,000 older, higher emitting vehicles. The average rate of retirement for the first 10 years of the program was 2,700 vehicles per year; this increased to an average of 7,800 vehicles in the most recent two years, the result of an increased budget and the higher per vehicle payout to vehicle owners and expanded model year eligibility. In February 2009, the Air District also expanded the program to cover model years (MY) 1988 and 1989 vehicles.

The District administers the VBB program based upon guidelines issued by the California Air Resources Board for its Voluntary Accelerated Light-Duty Vehicle Retirement (VAVR) Program. The ARB adopted revisions to the VAVR regulation on December 7, 2006, that incorporate the use of remote sensing devises (RSD) and other technologies to identify high emitting vehicles as possible candidates for voluntary retirement to generate additional emission reductions.

In 2007, the South Coast Air Quality Management District launched its High Emitter Repair or Scrap (HEROS) Program. The HEROS program initially explored the potential benefits of using remote sensing devices to identify gross polluting vehicles operating on local roads and highways, and then offering the vehicles owners cash to either repair or scrap their vehicles. The initial experience with the program has been positive, with the program being expanded in 2009.

Smoking Vehicle Program: The Air District's voluntary program for reporting smoking vehicles began in December 1992. Smoking vehicles are identified and reported to the Air District by Bay Area residents through the *1-800-EXHAUST* phone line and website. After a report is made, the Air District contacts the vehicle owner and encourages them to either have the vehicle repaired or retire it through the Vehicle Buy Back Program. Each year an average of 35,000 calls are received complaining about vehicles emitting excessive visible exhaust.

Smog Check: Motor vehicle emissions have been subject to controls since 1961, when California adopted a regulation that required new cars to have positive crankcase ventilation – the recycling of crankcase emissions back into the engine instead of the atmosphere. Since then, progressively tighter limits on exhaust have spurred the development of a variety of abatement equipment and systems.

In recognition that keeping the abatement equipment and systems operating at peak efficiency ensures the best results from the emissions controls, the Air District in 1980 proposed an inspection and maintenance program. This proposal eventually was adopted in modified form by the California State Legislature and Smog Check was begun in 1984. Enhancements to the program were adopted in 1996 and phased in to many parts of California, with the enhanced program begun in the Bay Area in 2003.

The Smog Check program is operated by the California Bureau of Automotive Repair, with advice from the California Air Resources Board. South Coast Air District required biennial test of motor vehicles to assure they meet applicable emission standards. The Inspection and Maintenance Review Committee monitors and recommends enhancements to South Coast's program.

In November 2008, the State of California's Inspection and Maintenance Review Committee published a draft report on the current status of the Smog Check program. In this draft report, the Review Committee has made several useful suggestions for additional modifications and enhancements to the California Smog Check program. The recommendations in the report serve as the basis for the proposed advocacy plan in this control measure.

Implementation Actions:
The Vehicle Buy-Back, Smoking Vehicle, and Smog Check programs have all helped to improve air quality in the Bay Area. Nonetheless, high-emitting vehicles are still a major contributor to air quality problems. The Air District has recently developed a campaign to help strengthen awareness of and responsiveness to the VBB and Smoking Vehicle programs.

Vehicle Buy Back - The Air District will:

- Consider expanding its marketing of the program through targeted outreach in impacted communities defined through the CARE Program, advertising at Smog Check test sites, specialized or supplemental direct mail solicitation and advertising to owners of pre-1975 vehicles and smog-exempt vehicles, and through the District's Smoking Vehicle program.
- Study the potential for including motorcycles in the District's Vehicle Buy Back program.
- Evaluate the possible benefits of offering a higher incentive for vehicles located in priority communities identified through the CARE program.
- Evaluate South Coast Air Quality Management District's experience with a vehicle repair program –$500 for repairs to a vehicle's emission control systems – as an option for the Bay Area.

Smoking Vehicle Program - The Air District will:

- Continue operation of 1-800-EXHAUST phone line and advertisement campaign;
- Conduct an assessment of the program's effectiveness in reducing emissions. The assessment will consist of follow-up surveys of vehicle owners receiving complaint letters from the Air District; amend the program as warranted.
- Propose program enhancements or revisions as appropriate.

California Smog Check - The Air District will:

- Seek and/or support legislation to enhance the smog check program, e.g., require annual inspections of older model year and of high mileage vehicles, include testing for exhaust particulate matter (PM) in the program; add motorcycles to Smog Check;
- Consider offering incentives to encourage newer model and/or lower mileage vehicle owners to submit their vehicles for annual inspections;
- Consider replicating the SCAQMD's high emitter identification and repair program – HEROS.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	4.37	14.60
NO_x	2.06	6.90
PM10	0.03	0.10
$PM_{2.5}$	0.02	0.07
Benzene	0.09	1.30
1,3 Butadiene	0.02	0.28
Formaldehyde	0.06	0.93
Acetaldehyde	0.04	0.65
C02-e	44.14	147.14

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia).

Emission Reduction Methodology:
Emission reduction estimates for this measure are based on past performance of the Vehicle Buy Back and Smoking Vehicle Programs.

Estimates of potential benefits from adding motorcycles to the VBB program and implementing a HEROS style remote sensing and repair program are not included; such estimates will be developed as part of the District's review and consideration of these initiatives.

Exposure Reduction:
In general terms, harmful emissions are at their lowest when abatement equipment on a vehicle is well maintained and operating as designed. Programs that remove the oldest, most-polluting vehicles from operation reduce exposure to toxic air contaminants emitted by gasoline vehicles.

Emission Reduction Trade-offs:
Programs that require the destruction of old vehicles may lead to incremental increases in green house gases; that is, the energy required to destroy the old vehicles may not be offset by the generally higher fuel efficiency of new vehicles. Investigation of this potential trade-off will need to be undertaken during the implementation of this measure.

Cost:
Costs associated with increased frequency of testing under the Inspection & Maintenance program, or inclusion of motorcycles in the program, will be borne by the vehicle owners. There would be some costs to the State of California to update tracking and notification systems.

If the Air District decides to replicate the HEROS program, there will be costs involved in deploying remote sensing equipment to identify gross polluting vehicles, establishing systems for notifying vehicle owners, and the cost of repairing or scrapping vehicles. Costs for this effort will be primarily borne by the Air District, although opportunities exist to utilize funds from private firms or other governmental programs.

The cost for the Vehicle Buy Back Program is $1,000 per vehicle, plus overhead to the car scrapping companies that administer the program. At present, the Vehicle Buy Back Program is funded with Mobile Source Incentive Funds, Carl Moyer Program Funds, and the Air District's Transportation Fund for Clean Air.

The annual budget for the Smoking Vehicle Program is approximately $1 million per year. Funding comes from the Air District's Transportation Fund for Clean Air.

Co-benefits:
Repairing or scrapping gross polluting vehicles will reduce energy consumption, reduce consumer costs, and avoid water pollution (storm water runoff). The expansion of the Smog

Check program to annual inspections and inspections of motorcycles, as well as the implementation of a HEROS type program, may lead to the creation of "green" jobs.

Monitoring Mechanisms:
California Smog Check - The primary means for monitoring progress on this measure will be through the California Legislature, and their effort to expand the Smog Check program.

Vehicle Buy Back and Smoking Vehicles - Monitoring will be accomplished through progress and final reports to the Board of Directors on the initiatives described above, through implementation plans, and budget requests for any expansion of the Vehicle Buy Back and Smoking Vehicle programs.

Expanded use of follow-up surveys for the Smoking Vehicle program will allow the Air District to better assess the on-going need for the complaint line.

Issues/Impediments:
- Changes to the Smog Check program require legislative approval.
- An issue for the Smoking Vehicle program is the declining incidence of vehicles operating with visible exhaust. Tighter emissions controls, higher mileage warranties, advanced engineering, and fleet turnover have all worked to reduce the likelihood for a vehicle to emit visible exhaust, unless there has been a major failure to an engine system.

Sources:
1. State of California, Inspections & Maintenance Review Committee, *IMRC 2008 Smog Check Review Report*, November 18, 2008. http://www.imreview.ca.gov/reports/index_reports.shtml
2. State of California, Bureau of Automotive Repair, http://www.smogcheck.ca.gov/
3. South Coast Air Quality Management District, *High Emitter Repair or Scrap (HEROS) Program*, http://www.aqmd.gov/news1/2007/remotesensingfactsheet.html
4. Bay Area Air Quality Management District, various annual reports & staff reports on the VBB program.
5. South Coast Air Quality Management District, Final 2007 AQMP, Appendix IV-A, pp 148-155, 2007
6. State of California, Air Resources Board, Voluntary Accelerated Vehicle Regulations, http://www.arb.ca.gov/msprog/avrp/avrpfaq.htm

MSM B-1 - Fleet Modernization for Medium- and Heavy-Duty On-Road Vehicles

Brief Summary:
Between 2010 and 2015, the Air District will directly provide, and encourage other organizations to provide, incentives for the purchase of new trucks that meet the California Air Resources Board's 2010 emission standards for heavy-duty engines. This program is designed to assist truck owners/operators to replace pre-2003 heavy-duty diesel trucks (Class 7 and 8) with new diesel-fueled or natural gas-fueled trucks in advance of requirements of CARB's in-use truck regulation.

Purpose:
This measure will reduce ozone precursors and diesel particulate matter emissions.

Source Category/Travel Market Affected:
Medium and Heavy Duty On-Road Vehicles

Regulatory Context and Background:
Emissions from heavy duty trucks account for nearly 24% of NOx emissions in the Bay Area; they are also a significant source of diesel PM. Since 1988, when the first emission standards for trucks came into effect, trucks have become significantly cleaner. Beginning with the model year (MY) 2010 standards adopted by both CARB and the federal EPA, truck emissions for both particulate matter and NOx will be at near-zero levels.

However, because 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 engine standards. In 2008, to accelerate the replacement or retrofit of old trucks, CARB adopted a regulation that requires truck fleets to meet progressively more stringent limits as calculated on a fleet-average basis.

The benefits of the fleet-average regulation can be further accelerated by offering financial incentives to truck owners to replace an existing truck 3-5 years in advance of the regulatory requirements. The Air District currently offers incentives for the purchase of MY 2007 and newer trucks as part of the Carl Moyer Program and other grant programs.

Implementation Actions:
Between 2010 and 2015, the Air District will directly provide and/or work with other entities to provide incentives to accelerate the replacement of up to 5,000 heavy-duty on-road diesel engines in advance of requirements for the ARB in-use heavy-duty truck regulation. In order to maximize reductions in green house gases, priority will be given to the purchase of new trucks fueled by natural gas or locally produced bio-fuels.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.10	0.25
NO_x	5.00	12.5
PM10	0.11	0.28
$PM_{2.5}$	0.03	0.27
Formaldehyde	0.01	0.02
Acetaldehyde	0.02	0.04
C02-e	0.64	233.24

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), Benzene, and 1,3 Butadiene.

Emission Reduction Methodology:
To estimate the emission reductions from the early replacement of heavy-duty diesel trucks, District staff assumed that on average a model year 2000 truck that travels 50,000 miles per year would be replaced by a model year 2010 CARB/EPA compliant truck. The emission reductions represent the difference in emission rates between the old and new trucks. We assumed that of the 5,000 truck replacements targeted under this measure, 3,000 of the new trucks would be fueled by natural gas. We also assumed that 2,000 truck replacements would occur by 2012, with the balance occurring by 2015. Benefits from the early replacement of the trucks would occur over a 3-5 year period.

Exposure Reduction:
This measure will accelerate the health benefits of an adopted CARB 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:
Exhaust controls on diesel trucks meeting the MY 2010 standards may decrease fuel economy, thereby increasing CO2 emissions.

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 CARB truck regulations. The incentive amount will be determined during the development of the program. An existing fleet modernization program operated through the Carl Moyer Program provides approximately $35,000 per heavy-duty truck.

Based on the current incentive levels, this measure will potentially cost $175 million to implement. It is anticipated that the District will make available up to $10 million per year in incentives for the purchase of new trucks between 2010 and 2015.

Co-benefits:
To the extent this measure is successful in replacing diesel trucks with natural gas or other alternative fuel trucks, there will be a reduction in petroleum usage in the Bay Area. Reductions in the use of petroleum will help reduce stationary source pollution and water pollution.

Monitoring Mechanisms:
The benefits of the program will be monitored via the contracts for the financial incentives. The District will track emission reductions.

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, www.baaqmd.gov
2. California Air Resources Board, *2008 Carl Moyer Guidelines*, Chapters III and IV, April 22, 2008

MSM B-2 - Low NOx Retrofits in Heavy-Duty On-Road Vehicles

Brief Summary:
Between 2010 and 2015, the Air District will provide incentives to install CARB-verified abatement equipment to reduce NOx emissions from existing on-road heavy-duty truck engines. Emphasis will be placed on bringing existing engines into early compliance with CARB's in-use truck regulation. The Air District will also continue to require software updates to engine control modules in model year (MY) 1993-1998 diesel trucks to reduce excess NOx emissions as a condition of all heavy-duty vehicle retrofit grants. The Air District will work with CARB to evaluate the feasibility of installing or replacing catalytic convertors on gasoline powered heavy-duty vehicles.

Purpose:
This measure will reduce ozone precursors.

Source Category/Travel Market Affected:
Heavy Duty On-Road Vehicles

Regulatory Context and Background:
Electronic control of the operation of truck engines became commonplace in 1994. Electronics allow for more precise control of engine timing and fuel injection; this has provided significant reductions of NOx and PM emissions. Electronic engine control has also opened up opportunities for integration of exhaust abatement devices, such as lean NOx catalysts, NOx absorbers, exhaust gas recirculation and selective catalytic reduction (SCR) systems. In fact, engine manufacturers will be using SCR systems extensively to comply with ARB's MY 2010 NOx standard for new engines. The increasing availability of retrofit devices to reduce NOx from existing engines provides an opportunity for the Bay Area to achieve benefits in advance of historical fleet turnover rates.

Low NOx software upgrade is computer programming for electronic control modules in certain heavy-duty engines that reduces excess emissions of oxides of nitrogen (NOx). The software upgrades were developed by the engine manufacturers as part of a legal settlement with the federal Environmental Protection Agency and ARB. Installing low NOx software can reduce emissions from most model year 1993-1998 California-registered heavy-duty trucks, school buses, motor homes, and interstate vehicles that visit California, with engines manufactured by Caterpillar, Cummins, Detroit Diesel Corporation, Mack/Renault, Volvo and International. CARB's truck and bus regulation requires replacement of 1994-1999 model engines to reduce NOx emissions by January 1, 2013.

Implementation Actions:
The Air District will either directly provide and/or work with other entities to provide cash incentives for the installation of retrofit devices that reduce NOx emissions from 5,000 MY

1994-2006 engines between 2010 and 2015. Targeted technologies include, but are not limited to, exhaust gas recirculation systems and selective catalytic reduction devices.
As a condition of grant incentives, the Air District will continue to require software upgrades to the engine control modules in any MY 1993-1998 on-road engines to install either diesel PM filters and/or NOx retrofit devices. The Air District will also encourage other providers of incentives to incorporate as similar requirement in their grant programs.
The Air District will work with CARB to evaluate the feasibility of installing or replacing catalytic converters on gasoline powered heavy-duty vehicles.

Emission Reductions:

Pollutants (tons per day)	2012	2020
NO_x	0.99	2.98

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: ROG, PM10, $PM_{2.5}$, NH3 (ammonia), Benzene, Formaldehyde, Acetaldehyde, 1,3 Butadiene and CO2-e.

Emission Reduction Methodology:
To estimate the emission reductions from the retrofit of heavy-duty diesel trucks, District staff assumed that on average a model year 2004 truck that travels 50,000 miles per year would be retrofitted with a CARB verified device that achieves sufficient NOx reductions to bring emission levels on par with a model year 2007 diesel engine. The emission reductions represent the difference in NOx emission rates between a MY 2004 and MY 2007 truck. We also assumed that 1,250 truck retrofits would occur by 2012, with the balance occurring by 2015. Benefits from the retrofit of the trucks would occur over a 3-5 year period.

Exposure Reduction:
Efforts to reduce NOx emissions from existing on-road engines will assist in reducing exposure to ozone and secondary particulate matter. Installation of catalytic converters on heavy-duty gasoline engines, if feasible, may reduce exposure to a number of toxic air pollutants present in the exhaust from gasoline engines.

Emission Reduction Trade-offs:
Both the installation of NOx retrofits and the upgrade of the engine control software may reduce the overall efficiency of existing engines, resulting in increases in greenhouse gases, primarily CO2. Additionally, installation of selective catalytic reduction devices could increase emissions of ammonia.

Cost:
The retrofit of heavy duty diesel engines with NOx abatement equipment is estimated to cost $30,000 per engine. District staff anticipates that about 75% of the retrofits will occur between 2013 and 2015 as fleets prepare to comply with NOx requirements in the ARB in-use truck engine regulation. Costs are estimated to be:

Phase 1: $37.5 million
Phase 2: $75 million

It is anticipated that the District will make available up to $3-5 million per year in incentives for the retrofit of existing trucks between 2010 and 2015.

Co-benefits:
This control measure, by focusing on incentives to install retrofit devices, may result in an increase in "green" jobs in the Bay Area, largely at manufacturers of retrofit devices, local truck repair facilities, and diesel engine distributors.

Monitoring Mechanisms:
Progress and Final reports from any Air District grants or incentives.
Progress and Final reports made available from other incentive programs.
Annual reports submitted to ARB under the in-use, on-road truck regulation.

Issues/Impediments:
The main obstacles for this control measure are: a) durability and availability of NOx retrofit devices, and b) ability of retrofit devices to reduce NOx on existing levels to the EPA/CARB 2007 emissions standards.

Sources:
1. California Air Resources Board, Descriptions of various Level 3 Verified Emission Control Devices, http://www.arb.ca.gov/diesel/verdev/level3/level3.htm
2. California Air Resources Board, *Software Upgrade for Diesel Trucks,* http://www.arb.ca.gov/msprog/hdsoftware/hdsoftware.htm
3. Kubsh, Joe, Manufacturers of Emission Controls Association, *Diesel Retrofit Technologies for Combined Reductions of PM and NOx*, November 2008. Available online at http://www.arb.ca.gov/diesel/verdev/wn/jkubsh.pdf
4. Manufacturers of Emission Controls Association, *Emission Control Technologies for Heavy-Duty Trucks and Buses*, 2009. Available online at http://www.meca.org/page.ww?section=Emission+Control+Technology&name=Trucks+%26+Buses
5. Brodrick, C.J., et al., Urea-SCR System Demonstration and Evaluation for Heavy-Duty Diesel Trucks, UCTC No 493, The University of California Transportation Center, Berkeley, November 15, 1999. Available online at http://www.uctc.net/papers/493.pdf.
6. DieselNet, "Johnson Matthey demonstrating retrofit SCR System," posted online on March 26, 2008: http://www.dieselnet.com/news/2008/03jm.php

MSM B-3 - Efficient Drive Trains

Brief Summary:
The Air District will either directly commit and/or work with partner agencies and companies to provide funding to underwrite development and demonstration of hybrid drive trains for medium- and heavy-duty vehicles.

As technologies become commercially available, the Air District will offer cash incentives to accelerate deployment of more efficient vehicles. The Air District will coordinate this effort with the CalStart Hybrid Truck User Group, the California Air Resources Board, the California Energy Commission and other air districts.

Purpose:
This measure will reduce ozone precursors, particulate matter and greenhouse gases.

Source Category/Travel Market Affected:
On-Road Medium and Heavy Duty Vehicles

Regulatory Context and Background:
Since 1988, heavy-duty truck engines have been progressively regulated to reduce harmful emissions of criteria pollutants, such as NOx, PM and ROG. Until recently, however, little effort has been made to reduce greenhouse gas emissions. In response to higher fuel costs, and growing awareness of the need to reduce emissions of CO2 from transportation sources, truck makers, truck owners, and government agencies have been increasing their efforts to develop more efficient drive-trains and power systems for trucks, focusing on electric vehicles, hybrid-electric and hydraulic systems.

In the Bay Area, the Napa Valley Unified School District has been testing a plug-in electric-diesel hybrid system in a school bus; Pacific Gas & Electric has been testing a diesel electric system in maintenance trucks, and others have proposed hybrid systems for transit buses, delivery vehicles and garbage trucks. Freightliner currently offers a diesel electric hybrid for its medium-heavy-duty chassis.

These promising efforts have been fostered largely through the collaborative Hybrid Truck Users Forum operated by the non-profit CalStart consortium. This control measure proposes to build on the existing work by directing financial incentives toward the various field demonstrations being currently operated or proposed by participants in the HTUF program.

Implementation Actions:
The Air District will either directly provide and/or work with partner agencies and companies to provide funding between 2010 and 2015 to underwrite development and demonstration of hybrid drive trains for medium- and heavy-duty vehicles.

As technologies become commercially available, the Air District will either directly and/or work with partner agencies and companies to offer financial incentives to accelerate deployment of more efficient vehicles. The goals for the measure are to place 1000 efficient medium- and heavy-duty trucks on the region's roadways by 2012 and 4000 additional vehicles by 2020.

The Air District will participate in these efforts with the CalStart Hybrid Truck User Forum, the California Air Resources Board, the California Energy Commission, other air districts, local private and public entities and truck manufacturers.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.05
NO_x	0.29	1.44
PM10	0.01	0.01
$PM_{2.5}$	0.01	0.01
C02-e	0.23	1.14

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), Benzene, Formaldehyde, Acetaldehyde, and 1,3 Butadiene.

Emission Reduction Methodology:
To estimate the emission reductions from this measure, District staff has assumed that the efficient drive trains will result in a 30% reduction in fuel usage per truck. The baseline fuel economy is assumed to be 5.6 mpg. It is assumed that each truck will travel 50,000 miles per year. We also assumed that of the 5,000 truck replacements targeted under this measure, 1,000 will occur by 2012 and 4,000 additional trucks by 2020.

Exposure Reduction:
This control measure is focused on the reduction of greenhouse gases from trucks. However, technologies such as hybrid electric power systems that improve energy efficiency also further reduce criteria pollutants. Reductions in both diesel PM and NOx will reduce exposure to toxic pollutants locally and ozone regionally.

Emission Reduction Trade-offs:
None. Improvements in energy efficiency will reduce all pollutants.

Cost:
There are two parts to the costs for this measure. First, there is an un-estimated amount of costs associated with the development of the hybrid technologies that will go into more efficient drive trains for medium- and heavy-duty vehicles. These costs will be borne by a variety of private firms and federal, state and local government agencies. Second, there will be incremental costs associated with the purchase of the vehicles with the advanced drive trains.

For the purposes of discussion, District staff has assumed the incremental costs will average $20,000 per vehicle between 2010 and 2020.

Phase 1: $20 million
Phase 2: $60 million

The District anticipates making available up to $3 million per year towards both the development and deployment of more efficient drive trains for medium- and heavy-duty vehicles, subject to availability of funding and approval of the District governing board.

Co-benefits:
Development and widespread usage of more energy efficient drive-trains and power systems for trucks will reduce water pollution, save fuel, and increase opportunities for "green" jobs. There is also the potential for reduced business and consumer costs, especially in light of rising petroleum fuel costs.

Monitoring Mechanisms:
Progress and Final reports from any Air District grants or incentives.
Progress and Final reports made available from the CEC and CARB for their alternative fuel, technology advancement and climate change programs.
Reports developed as part of the Calstart Hybrid Trucks Users Group's efforts.
Progress and Final reports made available from the federal EPA, DOT and DOE.

Issues/Impediments:
As with all technology advancement efforts, obstacles for this measure revolve around feasibility, durability and cost of hybrid electric and hybrid hydraulic engine systems. However, since this measure is focused on research and development, any efforts to advance the development of more energy efficient systems will be an advantage.

Sources:
1. CalStart/Weststart, Hybrid Truck Users Forum, http://www.calstart.org/Projects/Hybrid-Truck-Users-Forum.aspx
2. Van Amburg, Bill, CalStart, "Emerging Clean Fuel & Vehicle Technology Options for Fleets: How Fleets Can Pepare and Plan for Change," presented to NAFA Conference, New Orleans, LA, April 27, 2009. Available online at http://www.calstart.org/Libraries/Consulting/Emerging_Clean_Fuel_Vehicle_Technology_Options_for_Fleets.sflb.ashx
3. Lowe, Marcy et al., Center on Globalization Governance & Competitiveness, Manufacturing Climate Solutions, Carbon-Reducing Technologies and U.S. Jobs, Chapter 9, Hybrid Drivetrains for Medium- and Heavy-Duty Trucks, June 10, 2009. Available online at http://www.cggc.duke.edu/environment/climatesolutions/greeneconomy_Ch9_HybridDrivetrainsforTrucks.pdf

4. Kenworth Trucks brochure, "Kenworth T270 Class 6 and T370 class 7 Medium Duty HYBRID CONVENTIONAL," 2008. http://www.kenworth.com/brochures/T270T370Hybrid.pdf
5. Slezak, Lee, *Annual Progress Report for Advanced Vehicle Technology Analysis and Evaluation Activities and Heavy Vehicle Systems Optimization Program*, United States Department of Energy, Vehicle Technologies Program, 2009
6. Department of Energy and 21st Century Truck Partnership, *Roadmap and Technical White Papers*, 21CTP-003, December 2006.
7. ARB, "Hybrid Truck and Bus Incentive Program (HTIP) Development: Concepts for HTIP Implementation," January 13, 2009 AQIP Working Group. http://www.arb.ca.gov/msprog/aqip/meetings/hyip_wg_discussion_paper_01_13_09.pdf

MSM C-1 - Construction and Farming Equipment

Brief Summary:
The Air District will work to reduce emissions from construction and farming equipment by pursuing the following strategies: a) expenditure of cash incentives between 2010 and 2020 to retrofit engines with diesel particulate filters or upgrade to equipment with electric, Tier III or Tier IV off-road engines; b) work with the California Air Resources Board, the California Energy Commission and others to develop more fuel-efficient off-road engines and drive-trains; and c) work with local communities, contractors, 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 ozone precursors, diesel particulate matter, and carbon dioxide.

Source Category/Travel Market Affected:
Farm and Construction Equipment

Regulatory Context and Background:
Construction and farming equipment contribute approximately 15% of the regional inventory of NOx emissions, and 5% of PM2.5 emissions. Construction equipment is also a contributor to local exposure of diesel PM. Criteria pollutant emissions from the engines – which are primarily diesel – in construction and farming equipment are subject to control under regulations adopted by both California Air Resources Board and the federal Environmental Protection Agency.

The ARB's control of criteria pollutant emissions from off-road engines used in construction 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 containing 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 were progressive and phased in through two additional stages which are referred to as Tiers 2 and 3. In 2004, final Tier 4 emission standards were adopted; Tier 4 standards are scheduled to phase in for new engines between 2011 and 2014. The coordinated efforts of ARB, U.S. Environmental Protection Agency, and the 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 and farming equipment are long-lived, with existing

engines remaining in service for many years, ARB adopted in 2007 a regulation to accelerate reductions of NOx and diesel PM from existing off-road engines between 2012 and 2023 by requiring operators to either install abatement equipment, upgrade to Tier 3 and eventually Tier 4 engines, or to retire older equipment with Tier 1 and 2 engines.

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

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

- Between 2010 and 2020 work to either directly and/or encourage partners to provide incentives for the early deployment of 1000 electric, Tier 3 and 4 off-road engines, as well as installation of 500 verified retrofit devices to control diesel PM. The interim goals for 2012 are 200 new engines and 100 retrofits.
- Between 2010 and 2015, 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.
- Between 2010 and 2015, provide support for the field demonstration of off-road equipment that runs on renewable electricity and diesel, with an emphasis placed on fuels that can be developed and produced locally.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.04	0.20
NO_x	0.72	3.60
PM10	0.02	0.09
$PM_{2.5}$	0.02	0.09

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), Benzene, Formaldehyde, Acetaldehyde, and 1,3 Butadiene.

Emission Reduction Methodology:
To estimate emission reductions for this measure, District staff assumed that the typical projects over the next ten years will consist of the replacement of Tier 1 compliant off-road

engines rated at 350 brake horse power-hour with new Tier 4 compliant engines. Each engine is assumed to operate 1,000 hours with an average load factor of 60%. Staff also assumed that for the 2020 goal one-half of the new engines will operate on biodiesel.

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 installation of diesel PM filters and other abatement devices generally reduces fuel economy by approximately 3%, and therefore increases emissions of CO2 by a corresponding amount.

Cost:
District staff assumes that the cost of this measure is equal to the incentive amount offered to get a fleet operator to replace a Tier 1 engine with a Tier 4 engine in advance of the CARB regulation. We estimate the average incentive to be $50,000 per engine. We estimate diesel PM retrofit filters to cost $20,000 per engine. Based on these assumptions, this measure will cost approximately:

Phase 1: $12 million
Phase 2: $41 million

It is anticipated that the District will make available up to $3 million per year in incentives for the purchase of new electric, Tier 3 and Tier 4 engines, as well as the installation of verified diesel PM control devices between 2010 and 2020.

Co-benefits:
New engines for construction 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.

Monitoring Mechanisms:
- Equipment and engine information submitted to CARB as part of the off-road in-use ATCM.
- Progress and Final reports from Air District grants or incentives.
- Progress and Final reports made available from the CEC and CARB for their alternative fuel, technology advancement and climate change programs.

Issues/Impediments:

- Funding for engine subsidies.
- Interest from fleets in early compliance with CARB's off-road in-use engine air toxic control measure.
- Availability of diesel PM retrofit devices for construction and farm equipment.

Sources:

1. BAAQMD, Base Year 2005 Emissions Inventory: Summary Report, December 2008
2. BAAQMD, Base Year 2005 Emissions Inventory: Source Categories, December 2008
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

MSM C-2 - Reduce Emissions from Lawn and Garden Equipment

Brief Summary:
Use of gasoline lawn mowers and leaf blowers contribute to summertime ozone levels primarily through the release of ROG. 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 to warrant Air District efforts to pursue a clean-up program. The Air District will pursue removal of these older engines through voluntary exchange programs that target residential lawn mowers and backpack-style leaf blowers used by professional gardeners and landscapers.

Purpose:
This measure will reduce ozone precursors, particulate matter, toxic air contaminants and greenhouse gases.

Source Category/Travel Market Affected:
Lawn, Garden & Utility Equipment: Gasoline Lawn Mowers and Leaf Blowers

Regulatory Context and Background:
The lawn, garden & utility equipment category is comprised 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 slightly more than 5% of the total ROG 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 gasoline engines on such small equipment were first regulated in 1995 by the Air Resources Board, with the newest, most stringent regulations becoming effective with the MY 2008 equipment. Staff currently estimates there to be 1.16 million lawnmowers and leaf blowers in the Bay Area, of which approximately 70,000 are two stroke lawnmowers and 258,000 are two-stroke leaf blowers. 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 7800 two- and four-stroke lawnmowers for new electrical and mechanical mowers. Estimated emission reductions from the program were 5.3 tons per year of ROG, NOx and PM, at an annualized cost-effectiveness of approximately $7,800 per ton. The Air District expended $780,000 to buy down the cost of the new lawnmowers for the participating homeowners, along with additional funds on administration and advertising by the then Public Information and Outreach Division (now the Communication and Outreach Division).

The South Coast Air Quality Management District periodically conducts exchange programs for "backpack" style leaf blowers used by professional gardeners and landscapers. The program's fourth round of exchanges was conducted in August 2009. Under this program, companies pre-register to exchange up to ten leaf blowers; for each old leaf blower turned in, the company can purchase a new low emission machine at a 50% to 60% discount.

Implementation Actions:
The Air District will:

- Re-establish its exchange program for replacing older gasoline lawnmowers with mechanical push and electrical lawnmowers. The program will target two-stroke engines as an initial priority prior to targeting pre-2008 four-stroke gasoline engines.
- Establish an exchange program for gasoline powered two-stroke "backpack" leaf blowers used by professional gardeners and landscapers.
- Explore options to expand the program to cover chainsaws, trimmers, shredders, stump grinders, commercial turf equipment and other types of lawn mowers. Expansion of the program will depend on the availability of significantly cleaner replacement equipment, costs, equipment turnover rates, and population size.

By 2012: Replace up to 3,000 lawn mowers and up to 5,000 leaf blowers
By 2020: Replace up to 10,000 lawn mowers and up to 50,000 leaf blowers

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.04	0.26
NO_x	0.01	0.01
PM10	0.01	0.07
$PM_{2.5}$	0.01	0.05
C02-e	0.00	0.64

Emission Reduction Methodology:
For this measure, District staff assumed that the typical project would consist of replacing an existing two-stroke 4 hp lawnmower or leaf blower with a new electric or mechanical push lawnmower or an electric or new Tier 3 compliant, four-stroke gasoline leaf blower. Emission factors were taken from the Air Resources Board OFFROAD2007 emissions model.

Exposure Reduction:
Older gasoline engines emit high levels of hydrocarbons, many species of which are listed as air toxics. Exchanging the older equipment with either electric or low-emission new engines 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 replaces a piece of gasoline powered equipment with an 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 main cost of this measure is the discount for the new electric lawn mowers and leaf blowers that are provided to program participants. The cost of this program will be shared by the Air District, vendors and the equipment owner. The cost of an electric lawn mower ranges from $200 to $300; the cost of a mechanical push mower ranges from $80 to $140; the cost of an electric leaf blower ranges from $30 to $70. The Air District anticipates seeking up to $2 million per year to fund this measure. In addition to direct cost for rebates on new equipment, additional costs would be incurred by the Air District to manage and advertise the program, and to ensure appropriate disposal of the older equipment that will be retired through the replacement program.

Co-benefits:
Use of push lawn mowers, electric lawn mowers and low-emission 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.

Monitoring Mechanisms:
Progress will be measured by tracking the number of older gasoline engines that are removed from service in exchange for mechanical and electric powered equipment.

Issues/Impediments:
The main obstacle is the need to secure funding to implement this measure. If funding is secured, then the level of interest from residents and professional gardeners in replacing old equipment with new zero and low-emission equipment could also be a limiting factor.

Experience with the earlier lawn mower exchange program from 1999 to 2006 suggests that a program that focuses on offering rebates through the manufacturers instead of an exchange effort will enhance the program's cost-effectiveness and simplify implementation.

Sources:
1. BAAQMD, Base Year 2005 Emissions Inventory: Summary Report, December 2008
2. BAAQMD, Base Year 2005 Emissions Inventory: Source Categories, December 2008
3. BAAQMD, Source Inventory of Bay Area Greenhouse Emissions, December 2008
4. CARB, *Article 1, Chapter 9, Division 3, Title 13, California Code of Regulations*
5. CARB, Initial Statement of Reasons for Proposed Rulemaking: Exhaust and Evaporative Emission Control Requirements for Small Off-Road Equipment and Engines Less Than or Equal to 19 Kilowatts, August 8, 2003
6. SCAQMD, *Leaf Blower Exchange Program*, http://www.aqmd.gov/tao/leafblowerexchange.htm

MSM C-3 - Reduce Emissions from Recreational Watercraft

Brief Summary:
Use of four-stroke or two-stroke inboard/outboard engines in pleasure craft contribute to summertime ozone levels primarily through the release of ROG. While progressively more stringent emission standards have reduced pollution from these engines, sufficient numbers of older four- and two-stroke engines remain in use in the Bay Area to warrant Air District efforts to pursue a clean-up program. In addition, new inboard/outboard engines are also more fuel efficient.

Purpose:
This measure will reduce ozone precursors, particulate matter and greenhouse gases.

Source Category/Travel Market Affected:
Recreational Watercraft

Regulatory Context and Background:
The recreational vessel category is comprised of relatively small outboard engines that are mounted to the rear or side of small craft and sailboats, as well as larger inboard engines that are mounted within the vessel and connect to propellers via a shaft. This measure focuses on reducing emissions from the small outboard motors.

Outboard gasoline engines were first regulated in 1995 by the Air Resources Board, with the newest, most stringent regulations becoming effective with the MY 2008 equipment. There are currently an estimated 135,500 inboard/outboard engines in the Bay Area, of which approximately 87,000 or 64% are two-stroke, high-emitting outboard engines. Increasingly stringent emission standards and resulting advances in engineering have made four-stroke gasoline inboard/outboard and electric engines readily available.

Implementation Actions:
The Air District will establish a voluntary exchange program to retire older gasoline-powered four-stroke and two-stroke outboard engines used in small pleasure craft. The Air District is focusing on the replacement of outboard engines under this measure because of the lower replacement costs per engines. The goal of the program will be to:

- Replace up to 3,000 outboard motors by 2012.
- Replace up to 10,000 outboard motors by 2020.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.06	0.02
NO_x	0.01	0.01
$PM_{2.5}$	0.01	0.01
C02-e	0.42	1.38

Emission Reduction Methodology:
Emission reductions have been estimated by comparing the incremental difference in emissions between a new four-stroke 50 horsepower (HP) engine meeting the lowest emission standards and an average MY 2000 two-stroke 50 hp engine. Emission factors and usage rates are from CARB's OFFROAD model. The outboard engines were assumed to operate approximately 1100 hours per year.

Exposure Reduction:
Older gasoline engines emit high levels of hydrocarbons, many species of which are listed as air toxics. Exchanging the older equipment with either electric or low-emission new engines will result in reductions in toxic emissions.

Emission Reduction Trade-offs:
To the extent electric motors are purchased as replacements there will be an incremental increase in the production of electricity, which may incrementally increase emissions of particulate matter and greenhouse gases from power plants.

Cost:
Costs for this measure may be borne by government agencies in the form vouchers to buy-down the price of new motors, disposal of old engines, and program administration. The main cost for consumers will be the balance of the purchase price for a new engine. The Air District has not identified possible funding sources for this measure, but anticipates seeking up to $2-3 million in funding per year.

Co-benefits:
Use of four-stroke engines will decrease water pollution: Two-stroke engines use a gasoline and oil fuel mixture, with unburned fuel being exhausted directly into the water. The increase use of more fuel-efficient electric and four-stroke gasoline engines will reduce oil consumption; the improved fuel economy of newer engines will also reduce fuel costs for consumers.

Monitoring Mechanisms:
This measure will be monitored via the vouchers awarded to participants to purchase a cleaner outboard motor.

Issues/Impediments:
The main issues for this measure are:

- Interest in the public in participating in the voluntary buy-down/exchange program for new outboard engines;
- Availability of monetary incentives from government agencies to fund the program.

Sources:

1. BAAQMD, Base Year 2005 Emissions Inventory: Summary Report, December 2008
2. BAAQMD, Base Year 2005 Emissions Inventory: Source Categories, December 2008
3. BAAQMD, Source Inventory of Bay Area Greenhouse Emissions, December 2008
4. Air Resources Board, OFFROAD2007 Emissions Model, http://www.arb.ca.gov/msei/offroad/offroad.htm
5. South Coast Air Quality Management District, "SCOFFRD-06 -- Accelerated Turnover and Catalyst Based Standards for Pleasure Craft [VOC, NOx, PM]," FINAL 2007 Air Quality Management Plan, June 2007.

TCM A-1 – Local and Area-wide Bus Service Improvements

Brief Summary:
TCM A-1 will improve transit by sustaining and improving existing service, including new Express Bus or Bus Rapid Transit on major travel corridors, funding the replacement of older and dirtier buses, and implementing the Transit Priority Measures (TPMs) component of the Transportation Climate Action Campaign.

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

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:
In its Transportation 2035 Plan, MTC estimates that transit operating and capital replacement costs for Bay Area transit providers are projected to total $138 billion over the next 25 years. This includes $98 billion in operating costs plus $40 billion for capital replacement. Revenues available to address these needs total $113 billion, leaving a shortfall of $25 billion ($8 billion for operations and $17 billion for capital replacement). Bus and other bus capital needs total approximately $13 billion; the Transportation 2035 Plan includes $5 billion in committed funds and $2 billion in discretionary funds towards these needs, leaving a remaining shortfall of $6 billion.

In light of the transit operating and capital replacement shortfalls, the Transportation 2035 Plan also sets forth MTC's commitment to proceed with the Transit Sustainability Project. This Project aims to improve transit's core performance and financially stability as well as identify service productivity improvements that will yield more from the region's investment in transit services. Further, it may help transit operators, each of whom are responsible for their own transit operating and capital budgets, to prioritize and make more cost-effective use of limited transit funds.

Adopted as part of the 2001 Regional Transportation Plan, MTC's Resolution 3434 Regional Transit Expansion Program is an $18 billion, long-term, and multifaceted funding strategy for directing local, regional, state and federal dollars to nearly two dozen high-priority bus, rail and ferry expansions. The bus service expansion projects included in Resolution 3434 are as follows:

- AC Transit Berkeley/Oakland/San Leandro Bus Rapid Transit
- AC Transit Enhanced Bus: Hesperian/Foothill/MacArthur corridors

- Regional Express Bus (multiple transit operators)
- SFCTA/SFMTA Van Ness Avenue Bus Rapid Transit
- VTA Downtown to East Valley Bus Rapid Transit

In 2004, voters passed Regional Measure 2 (RM 2), raising the toll on the seven State-owned toll bridges by $1.00. This extra dollar funds various transportation projects within the region, including express buses that reduce congestion or make improvements to travel on the toll bridges, as identified in SB 916 (Chapter 715, Statutes of 2004).

Adding more service and development of new service concepts (such as enhanced bus, Bus Rapid Transit (BRT), and Regional Express Buses) to better serve existing markets and fill in regional transit gaps are determined by the individual transit operators as revenue permits. Decisions on expanding bus service must address both the needs of commuters as well as low-income, elderly, disabled and youth travelers who do not have access to other travel options. During weekday peak hours in 2006, bus transit provided over 1.3 million seat miles per hour in the Bay Area[2].

Diesel bus emissions can be reduced by acquiring new heavy-duty clean air vehicles or installing retrofit devices on existing heavy-duty diesel bus engines. MTC has provided $14 million in Congestion Mitigation Air Quality Improvement (CMAQ) funds to retrofit 1,700 diesel buses operated by 12 transit operators; the Air District contributed the required CMAQ match (11.5%) for this project. In addition, since 2003 the Air District's Lower Emission School Bus Program has replaced 84 school buses at a cost of approximately $11.2 million and retrofitted 204 buses with diesel particulate filters at a cost of $1.3 million. The Air District has also spent $7 million on retrofitting diesel transit buses and purchasing alternative fuel transit buses since 2003. The Air District's Advanced Technology Program provides funding to promote new vehicle technologies, such as hybrid heavy-duty trucks and buses.

MTC's Transportation 2035 Plan launched a new program, the Transportation Climate Action Campaign, to reduce the region's carbon footprint. The $400 million campaign includes new funding for Transit Priority Measures. Transit Priority Measures (TPMs) are operational improvements or road-related infrastructure that preserves and improves bus speed and on-time reliability, and reduces variability in travel times and delay of buses. Case studies indicate significant ridership gains can be realized when TPMs are packaged with improvements in headways and other operations improvements (fewer bus stops, unique branding, all-door boarding and pre-paid fares) typically associated with BRT (Koonce, et al 2006). Note that as of December 2009, MTC approved $80 million in the first programming cycle of the new federal transportation act for four primary climate initatives: 1) Public

[2] Seat miles are a measure of transit capacity and are calculated by multiplying the number of transit vehicle miles travelled by the number of seats in each vehicle. For more information, see Table C-3 in the T2035 Travel Forecast Data Summary (Dec. 2008) available on the MTC website.

Education/Outreach; 2) Safe Routes to Schools, 3) Innovative Grants; and 4) Climate Action Program Evaluation. Funding for TPMs has yet to be identified.

Implementation Actions:
Phase 1 (2012):
MTC to fund:
- The timely replacement of worn-out buses in local transit operator fleets ($900 million)
- Operations of existing services where feasible with available funding ($4 billion)
- Regional Measure 2 Express Bus North and Express Bus South Improvements ($62 million)
- Transit Priority Measures component of the Transportation Climate Action Campaign (includes arterial bus lanes, transit signal priority, queue jumper lanes, and bus bulbs) ($TBD)

BAAQMD to fund:
- Lower Emission School Bus Program (LESBP) to replace and retrofit school buses. ($45 million)
- The Advanced Technology Program to fund hybrid buses and demonstration projects ($1.5 million)

Phase 2 (2020):
MTC to fund:
- Sustain service of Express Buses as identified in Phase 1 and operations of existing services where feasible with available funding ($72 million)
- The timely replacement of worn out buses in local transit operator fleets as funding becomes available ($2.4 billion)
- Bus Rapid Transit Service on the Telegraph Avenue/International Boulevard/E. 14th Street Corridor ($250 million)
- Bus Rapid Transit Service on the Grand-MacArthur Corridor ($41 million)
- Enhanced Rapid Bus Service in Livermore, Dublin, and Pleasanton (includes higher frequencies, new stops and improved stop amenities) ($14 million)
- Bus Rapid Transit project on Van Ness Avenue (includes dedicated transit lanes, signal priority and pedestrian and urban design upgrades) ($88 million)
- Bus Rapid Transit as Phase 1 in the Santa Clara-Alum Rock Corridor with the potential to convert to light-rail in the future (Santa Clara-Alum Rock Phase 1) ($132 million)
- Transit Priority Measures component of the Transportation Climate Action Campaign (includes arterial bus lanes, transit signal priority, queue jumper lanes, and bus bulbs) ($TBD)

BAAQMD to continue to fund Phase 1 programs:
- Lower Emission School Bus Program (LESBP) to replace and retrofit school buses. ($120 million)
- The Advanced Technology Program to fund hybrid buses and demonstration projects ($4 million)

Supporting Actions by Partner Entities:

- Transit agencies and CMAs to work with MTC as appropriate to implement service improvements.
- School Districts, transit agencies and CMAs to work with BAAQMD to implement diesel emission reduction programs.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.03	0.04
NO_x	0.03	0.04
$PM_{2.5}$	0.001	0.001
PM_{10}	0.005	0.01
CO_2	22.53	71.37
C02-e	23.36	72.80

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Implementing Express/BRT Service: This analysis uses Transportation 2035 Travel Forecasts data to estimate future ridership due to the expansion of Regional Express Buses, and it uses existing ridership projections for BRT developed by AC Transit, SFCTA, and VTA. Growth factors, based on increases in each transit operator's ridership modeled as a part of the T2035 travel forecasts, are applied to bring the ridership estimates to analysis years 2012 and 2020. Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access the bus, resulting in the number of vehicle trips reduced. Additional adjustments are made to calculate vehicle miles travelled reduced based on average transit trip lengths and the average distance travelled to the bus stop by non-motorized modes.

Transit Priority Measures: While funding has not yet been identified for TPMs, this emissions analysis assumes a very limited implementation of TPMs in four corridors, specifying an assumed cost of $5 million for two corridors in Phase 1. This analysis uses empirical findings that suggest a 4-7% increase in corridor ridership is reasonable to expect after implementation of TPMs. The average ridership among major bus corridors in the Bay Area is increased by 8-14% in 2012 (assuming TPMs will be implemented on two corridors) and 16-28% in 2020 (assuming TPMs will be implemented on an additional two corridors). Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access the bus, resulting in the number of vehicle trips reduced. Additional adjustments are made to calculate vehicle miles travelled reduced based on average transit trip lengths and the average distance travelled to the bus stop by non-motorized modes.

Advanced Technology Program: Assumes an average project life of 7 years for each project. Emission reductions estimates are based on emission reductions achieved in previous funding years.

Analysis excludes: maintaining bus fleet and operating existing services, Express Bus North and South capital improvements, enhanced rapid bus in Livermore, Dublin, and Pleasanton, and Lower Emissions School Bus Program.

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

Emission Reduction Trade-offs:
Adding diesel retrofit devices to diesel engines may result in a decrease in fuel efficiency. This will thereby cause a modest increase in emissions of carbon dioxide, a greenhouse gas that contributes to climate change. For example, CARB and the EPA estimate that an urban bus with a retrofit device added to reduce emissions of PM and/or NOx would experience a decrease in fuel efficiency of 3.5 percent on average. For an urban bus traveling 20,000 miles per year, this decrease is estimated to result in an additional 4,026 pounds per year of carbon dioxide.

Cost:
Phase 1: $5.0 billion
Phase 2: $3.1 billion

Co-benefits:
- Improved connectivity between transit services and destinations.
- Travel time savings from TPMs and new express/enhanced bus projects that provide faster and/or more direct service between trip origins and destinations.
- Transportation cost savings by providing new bus transit options that may allow some households to own fewer or no cars.
- Community enhancements through creation of more and higher quality transit options and services.
- Provide incentives to jump-start the heavy-duty hybrid bus market and create demonstration projects that increase knowledge about the technological feasibility of hybrid buses.

Monitoring Mechanisms:

- Track capital rehabilitation and replacement using the Regional Transit Capital Inventory (RTCI).
- Track number of diesel buses retrofitted or replaced and emissions benefits associated with these upgrades.
- Track implementation status of express bus or BRT projects.
- Track on-time performance on routes with TPMs.
- Track performance of in-service hybrid buses.

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs. Due to the current economic recession, cuts in State transit funding, including funds for cleaner buses, reductions in sales tax revenue for transit, Bay Area transit operators are facing challenges to maintain and sustain their existing systems and, in light of financial constraints, are cutting their transit budgets, cutting service, increasing fares, and/or delaying or deferring capital maintenance and service expansions. Thus, maintaining the existing fleet, sustaining existing services, restoring service that has been cut, and expanding service will require new funding. New revenues may be available in the future from higher gas taxes, bridge tolls, and voter approved sales tax revenues in individual counties.

Sources:

1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary: http://www.mtc.ca.gov/planning/2035_plan/
2. AC Transit's Strategic Vision: A World Class Transit System for the East Bay 2001-2010, http://www.actransit.org/pdf/planning_focus/planning_focus_121.pdf?PHPSESSID=9
3. SFCTA's Van Ness Avenue Bus Rapid Transit (BRT) Feasibility Study, http://www.sfcta.org/content/view/425/252/
4. VTA's Draft Environmental Impact Report (DEIR) for the Santa Clara-Alum Rock Transit Improvement Project (2008), http://www.vta.org/projects/dtev/eir_draft.html
5. Koonce, Peter, Paul Ryus, David Zagel, Young Park, and Jamie Parks (2006). "An Evaluation of Comprehensive Transit Improvements – TriMet's Streamline Program." Journal of Public Transportation, 2006 BRT Special Edition, pp. 103-115, http://www.nctr.usf.edu/jpt/pdf/JPT%209-3S%20Koonce.pdf

TCM A-2 - Local and Regional Rail Service Improvements

Brief Summary:
TCM A-2 will 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:
This measure will reduce emissions of the key ozone precursors, ROG and NOx by sustaining and improving rail service throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips. In addition, it would affect inter-regional travel.

Regulatory Context and Background:
In its Transportation 2035 Plan, MTC estimates that transit operating and capital replacement costs for Bay Area transit providers are projected to total $138 billion over the next 25 years. This includes $98 billion in operating costs plus $40 billion for capital replacement. Revenues available to address these needs total $113 billion, leaving a remaining shortfall of $25 billion ($8 billion for operations and $17 billion for capital replacement). Rail-car and other rail capital needs total approximately $26 billion; the Transportation 2035 Plan includes $11 billion in committed funds and $4 billion in discretionary funds towards these needs, leaving a remaining shortfall of $11 billion.

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 2006, rail transit provided over 2 million seat miles per hour in the Bay Area[3].

Adopted as part of the 2001 Regional Transportation Plan, MTC's Resolution 3434 Regional Transit Expansion Program is an $18 billion, long-term, and multifaceted funding strategy for directing local, regional, state and federal dollars to nearly two dozen high-priority bus, rail and ferry expansions. The rail service expansion projects included in Resolution 3434 are as follows:

[3] Seat miles are a measure of transit capacity and are calculated by multiplying the number of transit vehicle miles travelled by the number of seats in each vehicle. For more information, see Table C-3 in the T2035 Travel Forecast Data Summary (Dec. 2008) available on the MTC website.

- BART/Oakland Airport Connector
- Tri-Valley Transit Access Improvements to BART
- East Contra Costa BART Extension (eBART)
- BART: Fremont to Warm Springs and Warm Springs to San Jose/Santa Clara
- Caltrain Express: Baby Bullet (Open for service)
- Caltrain Express: Phase 2
- Caltrain Electrification
- Transbay Transit Center (Phases 1 and 2)
- Capitol Corridor Expansion and Enhancements
- MUNI Third Street Light-Rail Central Subway
- ACE Service Expansion
- Sonoma-Marin Rail (SMART)
- Dumbarton Rail
- Downtown to East Valley Light Rail

MTC, in partnership with California High-Speed Rail Authority (CHSRA), Caltrain, and BART, adopted the Regional Rail Plan in September 2007, which included an evaluation of a Bay Area to Central Valley high-speed rail alignment. CHSRA certified the Bay Area to Central Valley Program EIR/EIS in July 2008. The CHSRA is currently proceeding with detailed project-level EIR/EIS for the high-speed train from San Jose to San Francisco. In addition, the CHSRA is currently working with Bay Area and Central Valley transportation agencies (via the Altamont Corridor Partnership Working Group) to implement a joint use regional rail and high-speed rail infrastructure project in the Altamont Corridor.

In November 2008, California voters passed Proposition 1A, the Safe, Reliable High-Speed Passenger Train Bond Act, which includes nearly $10 billion in general obligation rail bond proceeds to help finance construction of a high-speed rail link between San Francisco and San Diego. The Bay Area is slated to receive $408 million for improvements to ACE, BART, Caltrain, SFMTA, and VTA light-rail. In addition, the Bay Area is well-positioned to receive a significant portion of the $8 billion appropriation for high-speed rail included in the American Recovery and Reinvestment Act of 2009 (ARRA).

Seven of the 9 counties have adopted local sales tax measures that fund transportation improvements including rail expansion projects. Most recently, in November 2008, Santa Clara County voters approved the 1/8-cent Measure B to fund operations and maintenance of the BART to San Jose/Santa Clara extension and Sonoma and Marin county voters approved the 1/4-cent Measure Q to fully fund construction and operation of the Sonoma Marin Area Rail Transit (SMART) commuter rail.

Implementation Actions:
Phase 1 (2012)
MTC to fund:

- The timely replacement of worn out rail-cars and other rail capital assets in local transit operator fleets as funding becomes available ($1.8 billion)
- Operations of existing rail services where feasible with available funding ($2 billion)

Phase 2 (2020)
MTC to fund:

- The timely replacement of worn out rail-cars and other rail capital assets in local transit operator fleets as funding becomes available ($4.9 billion)
- Existing rail services where feasible with available funding ($5.3 billion)
- A BART Oakland Airport Connector between Coliseum BART station and Oakland International Airport ($459 million)
- Transit access improvements to BART in the Tri-Valley ($168 million)
- Extension of BART/East Contra Costa Rail (eBART) eastward from the Pittsburg/Bay Point BART station into eastern Contra Costa County ($525 million)
- Extension of BART from Fremont to Warm Springs ($890 million)
- Electrification of Caltrain from Tamien to San Francisco ($626 million)
- Transbay Terminal Phase 1: construct the new Transbay Transit Center Building and rail foundation ($1.2 billion)
- Capitol Corridor intercity rail service (includes increased track capacity, rolling stock and frequency improvements ($108 million)
- Sonoma Marin Area Rail Transit District (SMART) commuter rail project ($1.1 billion)
- Acquisition of right-of-way for ACE rail service between Stockton and Niles Junction, complete track improvements between San Joaquin County and Alameda County, and expand Alameda County station platforms ($150 million)
- Extension of BART from Fremont (Warm Springs) to San Jose/Santa Clara ($7.6 billion)
- Electrification of Caltrain line from Tamien Station to Gilroy ($140 million)
- Extension of Caltrain Express service (Phase 2): design and implement safety elements related to signal communication and positive train control; and implement system-wide level boarding program and terminal improvements ($427 million)
- Transbay Terminal Phase 2: extend Caltrain to the new Transbay Terminal ($3 billion)
- Capitol Corridor: Phase 2 enhancements (includes grade separations at High Street, Davis Street and Hesperian Street) ($89 million)
- Extension of Third Street Light-Rail line from north of King Street to Clay Street in Chinatown via a new Central Subway ($1.6 billion)
- Conversion of Bus Rapid Transit (BRT) to light-rail transit in the Santa Clara-Alum Rock corridor (Santa Clara-Alum Rock Phase 2) ($327 million)
- Commuter rail service on the Dumbarton Bridge ($301 million)
- High-Speed Rail: fund supporting infrastructure for ACE, BART, Caltrain, MUNI and VTA ($408 million)

Supporting Actions by Partner Entities: Transit, CMAs, airports and other agencies to work with MTC as appropriate to implement service improvements.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG		0.15
NO_x		0.15
$PM_{2.5}$		0.03
PM_{10}		0.04
Ammonia (NH3)		0.12
CO_2		506.29
C02-e		516.00

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
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 Transportation 2035 travel forecasts, are applied to bring the ridership estimates to analysis year 2020 (analysis does not assume completion of any rail projects by 2012). 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. Additional adjustments are made to calculate vehicle miles travelled reduced based on average transit trip lengths and the average distance travelled to the rail station by non-motorized modes.
This analysis excludes estimates of emissions reduced from maintaining existing rail services and transit access improvements to transit access improvements to BART in the Tri-Valley, Caltrain electrification, extension of Caltrain to the Transbay Terminal, and supporting infrastructure for high-speed rail.

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:
Phase 1: $3.8 billion
Phase 2: $30.1 billion

Co-benefits:
Improved connectivity between transit services and destinations

- Travel time savings from providing new rail services that provide faster and/or 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 creation of more and higher quality transit options and services.

Monitoring Mechanisms:
Track implementation status of rail projects.

Issues/Impediments:
Implementation of this TCM requires that funding is available for these programs. Due to the current economic recession, cuts in State transit funding, and reductions in sales tax revenue for transit, Bay Area transit operators are facing challenges to maintain and sustain their existing systems and, in light of financial constraints, are cutting their transit budgets, cutting service, increasing fares, and/or delaying or deferring capital maintenance and service expansions. Thus, maintaining the existing fleet, sustaining existing services, restoring service that has been cut, and expanding service will require new funding. New revenues may be available in the future from higher gas taxes, bridge tolls, and voter approved sales tax revenues in individual counties.

Environmental clearance, right-of-way availability and costs, funding for the capital, operating and maintenance costs and level of public support are major impediments to sustain, improve, upgrade, and expand rail services.

Sources:
1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/

TCM B-1 - Freeway and Arterial Operations Strategies

Brief Summary:
TCM B-1 will improve the performance and efficiency of freeway and arterial systems through operational improvements. These improvements include implementing the Freeway Performance Initiative (FPI), the Bay Area Freeway Service Patrol (FSP), and the Arterial Management Program.

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

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:
Caltrans manages freeway operations through a comprehensive system for surveillance (traffic detectors, CCTV cameras), communication with motorists (traffic advisory signs) and system control (ramp meters, incident management). Through its Transportation Management Center (TMC), Caltrans is able to collect and process traffic information; to detect incidents as reported by freeway cameras, loop detectors in the freeway pavement, motorist calls and other sources; and to respond to incidents.

The Freeway Performance Initiative (FPI) aims to maximize the efficiency and improve the management and reliability of the existing freeway infrastructure, while limiting traditional expansion of the system to only the most essential locations. FPI addresses both recurrent daily traffic that comes from the surge of commuters using the freeways during rush hours and nonrecurrent congestion that results from unanticipated incidents and blockages of highway lanes. In fact, half of the total congestion experienced in the Bay Area is caused by vehicle breakdowns, vehicular accidents, material spills and other incidents. In performance assessments of infrastructure packages evaluated during the development of Transportation 2035 Plan, MTC found that FPI is the most cost-effective means to deal with traffic congestion in the region.

In its Transportation 2035 Plan, MTC set-aside $1.6 billion over the next 25 years to implement FPI. FPI includes (a) Traffic Operations Systems (TOS): full deployment of monitoring and surveillance systems and implementation of ramp metering on the region's entire freeway network to improve efficiency and maximize use of the freeway system's available capacity; (b) TOS replacement: consistent maintenance and periodic replacement of infrastructure to ensure a fully functioning system; (c) Arterial coordination and

management: coordination with and optimization of major arterials to maximize efficiency of the freeway system; and (d) Performance monitoring: monitoring to measure progress in freeway performance.

Arterial management includes traffic signals, signing and pavement marking, access management, parking management, and traffic calming. Over 3,500 of the Bay Area's 7,000+ traffic signals are part of coordinated systems. An additional 1,700 signals are close enough to be included in coordinated systems, but most local agencies cannot afford to interconnect their signals. Based on feedback from local traffic engineers, their greatest unmet needs involve resources and expertise for traffic signal timing and funding for the operation and maintenance of Smart Corridors. Most cities have not been able to meet these needs since the dot.com bust in 2001.

MTC has been investing in arterial management for over 20 years through the Traffic Engineering Technical Assistance Program (TETAP) and the Regional Signal Timing Program (RSTP). Between 2004 and 2009, over 3,500 traffic signals have been retimed, yielding 10 percent savings in travel time and fuel consumption, 7 percent reductions in mobile source emissions, and a benefit: cost ratio of 34:1. Similarly, since its inception in 1993, TETAP has funded over 250 operations and safety studies.

The Bay Area FSP is a joint project of the Metropolitan Transportation Commission Service Authority for Freeways and Expressways (MTC SAFE), the California Highway Patrol (CHP) and Caltrans. The service is provided by private tow truck companies, and during the hours of operation, the vehicles and drivers are exclusively dedicated to patrolling their freeway beat. Currently, a fleet of 83 trucks patrols some 550 miles of the Bay Area's freeways. Patrol routes are selected based on several factors, including a high rate of traffic and congestion, frequent accidents or stalls, and lack of shoulder space for disabled vehicles. The program is intended to augment the MTC SAFE network of motorist-aid call boxes in the nine Bay Area counties.

Implementation Actions:
Phase 1 (2012)
MTC to implement the following actions ($155 million):

- Through FPI, fill gaps in TOS infrastructure.
- Through FPI, install ramp meters at entrance ramps.
- Through the RSTP, coordinate traffic signals and continue to update timing plans. Arterial management strategies will consider and prioritize transit needs.
- Maintain the current level of FSP service which involves patrolling 540 miles of the Bay Area freeways. By 2012, FSP anticipates a reduction of up to ten trucks from the FSP fleet. Note that the FSP service levels are subject to change though the freeway miles covered are unlikely to be significantly affected.

Phase 2 (2020)
MTC to implement the following actions ($TBD):

- Through FPI, conduct routine replacement of TOS infrastructure at the end of its useful life
- Through FPI, install additional TOS infrastructure.
- Through FPI, install additional ramp meters at entrance ramps and monitor and adjust meter timing as appropriate.
- Through the RSTP, coordinate additional traffic signals and continue to update timing plans.
- Expand FSP on I-280 from SR 92 to SR 85 in San Mateo and Santa Clara counties.

Supporting Actions by Partner Entities: Local governments, Caltrans, CMAs and transit agencies to work with MTC as appropriate to implement service improvements.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.99	1.06
NO_x	3.25	3.83
$PM_{2.5}$	0.12	0.16
PM_{10}	0.18	0.24
Ammonia (NH3)	0.07	0.09
Benzene	0.02	0.02
Formaldehyde	0.01	0.01
Acetaldehyde	0.01	0.01
CO_2	2,403.08	3,303.24
C02-e	2,451.00	3,369.30

Emission Reduction Methodology:
This analysis includes emissions reductions associated with implementation of the Freeway Performance Initiative (FPI), the Freeway Service Patrol (FSP), and the Regional Signal Timing Program (RSTP). These three components are calculated separately. The Freeway Performance Initiative uses model output from the Transportation 2035 Vision Analysis which compared four different investment scenarios on a range of performance objectives: 1) Baseline, 2) Freeway Performance (Freeway Operational Improvement) 3), High-Occupancy/Toll (HOT) Lanes Network And Express + Local Bus, and 4) Regional Rail and Water Transit. The net difference between air quality emissions associated with the Baseline and the Freeway Performance scenarios are used to determine emissions reductions associated with the project. Emissions reductions are estimated for year 2012 and 2020 based on 2035 model output. The Freeway Service Patrol uses a benefit-cost model developed by Caltrans with the cooperation of the 13 local agencies that operate the FSP programs around the state. Emission reductions were last calculated for the 2004-05 fiscal year. Similarly, estimates for the regional signal timing program use a benefit-cost model in which the general methodology, fuel consumption factors, and health costs of motor vehicle emissions are based on Caltrans' California Life-Cycle Benefit/Cost Analysis

Model; estimates are calculated using the average benefits from 64 projects involving 1975 retimed traffic signals. For both FSP and RSTP, the 2004-05 emissions reductions are used to estimate 2012 and 2020 emissions reductions.

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

Emission Trade-offs:
ARB's motor vehicle emissions factors indicate that tailpipe emission rates for ROG, NOx, PM, and CO2 are lowest when vehicles travel in the 30-50 mph speed range. The estimated emission reduction benefits for this measure are based on the anticipated improvement in average vehicle speed due to expected reduction in congestion in the affected corridors. While the regional travel model estimates transportation emissions due to temporal, spatial and mode shifts resulting from increased roadway capacity, the potential emission reduction benefits of this measure may be eroded if reduced travel time in these corridors encourages additional vehicle travel or changes in land uses that would result in longer vehicle trips. To address this issue, the Air District will perform an independent analysis to evaluate the long-term impacts of this measure on vehicle travel and emissions.

Cost:
Phase 1: $ 155 million
Phase 2: $ TBD million

Co-benefits:
- Health and economic savings for both businesses and travelers from reduced congestion.
- Improved travel times, reduced fuel consumption and fewer collisions from retiming signals.
- Reductions in fuel usage, improved safety for stranded motorists, reductions in secondary accidents and improved motorist travel times from FSP services.

Monitoring Mechanisms:
- Track mobility (how well the corridor moves people and freight), reliability (the predictability of travel times), and safety as part of the comprehensive FPI corridor studies.
- Track savings in travel time, fuel consumption, and air emissions on a project-by-project and on an annual basis for Arterial Management Program.
- Collect detailed assist data and motorist experience information for Freeway Service Patrol services. The assist data is used by Caltrans to calculate benefit-cost ratios, fuel-savings, and pollutant reductions.

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. However, ramp-metering may provide a greater travel time savings for vehicles making longer trips. Levinson and Zhang (2006) found that: "Ramp meters are particularly helpful for long trips relative to short trips… trips longer than three exits in length benefit, while many trips 3 exits or less are hurt by ramp meters." 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.

Installation and replacement of TOS infrastructure, retiming traffic signals, and expansion of FSP is constrained by the availability of funding.

Sources:
1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Arterial Management Program: http://www.mtc.ca.gov/services/arterial_operations/
3. MTC's Transportation 2035 Vision Analysis: http://www.mtc.ca.gov/planning/2035_plan/tech_data_summary_report.pdf
4. SAFE's Freeway Service Patrol Program: http://www.mtc.ca.gov/services/fsp/
5. Levinson, David and Lei Zhang (2006). "Ramp Meters on Trial: Evidence from the Twin Cities Metering Holiday" *Transportation Research Part A: Policy and Practice*, Volume 40, Issue 10, pp. 810-828.
6. Levinson, David and Lei Zhang (2003). "Relationships between Ramp Metering and Sprawl" Draft working paper available through the University of Minnesota Http://nexus.umn.edu/Papers/RampMetersSprawl.pdf.

TCM B-2 - Transit Efficiency and Use Strategies

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

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

Travel Market Affected:
This measure would affect intraregional travel on transit, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:
Public transit services in the Bay Area are operated by 26 agencies, each with its own budget, policies, procedures, service plan and operating practices tailored to its immediate service area. The agencies do not always coordinate effectively with neighboring service areas for purposes of facilitating seamless regional travel and customer service.

Since 2002, the Bay Area's telephone and Web-based 511 traveler information service provides up-to-the-minute, on-demand transportation-related information that supports transit riders throughout the nine-county region. On the phone, 511 provides direct transfers to over two dozen transit agencies and various paratransit providers as well as real-time transit departure predictions for SF Muni and BART. It will expand to cover other agencies that develop real-time capabilities. On the web, 511 offers a transit trip planner which allows users to create itineraries for their trips, including trips requiring transfers between transit agencies. The project also has a call center interface used by transit agencies to provide trip-planning information to customers over the phone. The 511 web service also provides schedules, route maps, information on fares and passes, and service announcements. In the near future, a personalized MY 511 service on the phone and the web will allow users to save trips for real-time departure predictions. The Bay Area system has received nearly 25 million calls since 2002, and averages 100,000 transit-related calls and over 1.3 million transit itinerary requests each month. In light of a planned 50 percent decrease in 511 Transit project funding starting in FY 2014, as well as potential project impacts due to recent State Transit Assistance budget reductions, the project will assess possible approaches to reduce ongoing operational costs such as further automating

data transfer/processing from the region's over two dozen transit agencies and/or scaling back project functionality/features provided to the public.

TransLink® offers transit riders a convenient and secure way to pay fares on multiple transit systems. The TransLink® system reduces the hassle associated with paying transit fares using exact change, multiple tickets and paper transfers. The reloadable TransLink® card stores value in the form of electronic cash (e-cash), which is accepted by all participating agencies, and transit passes. TransLink® has been available on all AC Transit and Dumbarton Express buses and on all Golden Gate Transit and Ferry routes since November 2006. TransLink® is currently operating on all San Francisco Muni routes, but Muni is encouraging only limited use of the system by the public in order to closely monitor the system's performance and customer response. Furthermore, TransLink® is fully installed on the Caltrain system, and Caltrain will begin encouraging the public to use the system once an employee testing phase is complete. TransLink® use by BART customers began in August 2009, and use by Santa Clara VTA and SamTrans customers will begin in 2010. TransLink® will also be available for use at a limited number of San Francisco Municipal Transportation Agency (SFMTA) parking garages on a pilot basis in 2010. When fully implemented, TransLink® will serve more than 600,000 transit riders every day.

A number of programs provide services to Bay Area employers to facilitate use of pre-tax purchases of transit tickets and other transit benefits. (See discussion re: transit benefit ordinances in TCM C-1.) Transit riders can apply their transit benefits directly to their TransLink® card. The TransLink® program is also working with AC Transit and a number of housing developers to offer transit benefits to residents of new transit-oriented housing developments.

MTC prepared the Transit Connectivity Plan to improve passenger transfers between connecting transit systems. Aside from reinforcing the importance of 511 Transit and TransLink® to improve transit system-wide, several key issues emerged, including (a) lack of wayfinding signage to guide transit riders between systems and to their final destinations; (b) lack of information about connecting services such as schedules, fares and routes; (c) lack of real-time transit departure information; (d) disconnects in schedule coordination; (e) lack of "last mile" services for riders to get to/from mainline transit service such as shuttles, pedestrian access, bicycle parking or taxis; and (f) few hub amenities such as weather protection, restrooms and security measures. MTC, in partnership with transit operators, will implement the Hub Signage Program to address wayfinding signage, transit information and real-time transit information recommendations at 21 transit hubs and 3 airports. Transit operators will lead implementation of other Plan recommendations over time (no cost assumption in TCM).

Implementation Actions:
Phase 1 (2012)
MTC to:

- Operate and maintain 511 Transit ($10 million)

- Deploy, operate and maintain TransLink® on Bay Area transit agencies ($59 million)
- Provide pre-tax and other transit benefits through TransLink® ($5 million)
- Implement, operate and maintain Transit Hub Signage Program ($3 million)

Phase 2 (2020)
MTC to:
- Operate and maintain 511 Transit ($18 million)
- Operate and maintain TransLink® on Bay Area transit agencies ($117 million)
- Provide pre-tax and other transit benefits through TransLink® (assume cost is absorbed in TransLink® budget)
- Operate and maintain Transit Hub Signage Program ($10 million)

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 TransLink® 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.

Pollutants (tons per day)	2012	2020
ROG	0.004	0.006
NO_x	0.005	0.007
$PM_{2.5}$	0.00	0.00
PM_{10}	0.00	0.00
CO_2	6.01	10.01
C02-e	6.12	10.21

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: PM2.5, PM10, NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emissions Reduction Methodology:
This analysis uses a "transit efficiency" elasticity of 0.651; that is, every 1% increase in "transit efficiency" will result in a 0.651% increase in ridership. This elasticity was selected based on an analysis of output from the Transportation 2035 travel forecasts that examined change in mode share given a reduction of in-vehicle travel time by transit and wait time for transit, both by 20%. Reductions of this magnitude were selected based on review of empirical studies that examined how information improvements affect passengers' perceived and actual wait time and travel time (Litman 2008). This elasticity was then applied to a share of the entire transit market (ranging from 2.7% to 3.4% in Phase 1 and 3.4% to 5.4% in Phase 2), which was estimated based on the current share of transit riders that use the 511 Transit Trip Planner 3.4%; and scaling by 100-125% in Phase 1 and by 125%

to 200% in Phase 2 to assume additional impact from the other elements of the TCM beyond the 511 transit trip planner. Using local data, estimated new ridership is reduced to factor in new riders that are transit dependent and those who drive to access the bus, resulting in the number of vehicle trips reduced. Additional adjustments are made to calculate vehicle miles travelled reduced based on average transit trip lengths and the average distance travelled to the bus stop by non-motorized modes. Note: this analysis excludes impact and costs associated with TransLink® as there is insufficient empirical research regarding the travel impacts associated with implementation of universal fare card payment systems.

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

Emission Trade-offs:
None identified.

Cost:
Phase 1: $77 million
Phase 2: $145 million

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

Monitoring Mechanisms:
- Monitor customer use of 511 web and phone features to obtain transit schedule, route and fare information as well as real-time transit departure times. Monitor use of 511 Transit data by third party Information Service Providers
- Monitor customer use of TransLink® card and TransLink® market penetration
- Track number of people receiving transit benefits through TransLink®
- Track completion of sign installation (wayfinding, transit information displays, real-time transit) at each of 21 hubs and 3 airports

Issues/Impediments:
Implementation of this TCM 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, TransLink® and other transit connectivity improvements.

Sources:
1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/

2. Litman, Todd (2008). "Valuing Transit Service Quality Improvements." *Journal of Public Transportation*, Vol. 11, No. 2, pp. 43-63. http://www.nctr.usf.edu/jpt/pdf/JPT11-2Litman.pdf.

TCM B-3 - Bay Area Express Lane Network

Brief Summary:
TCM B-3 will seek to price travel demand on Bay Area highways by developing and implementing a seamless, regionally-managed Express Lane Network throughout the Bay Area and improving regional transit service. This system will offer free-flowing conditions for carpools, buses and toll payers by adjusting tolls based upon the level of congestion.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, by improving the efficiency of and managing congestion on existing freeways throughout the Bay Area through the use of express lanes, and by generating revenues to make corridor improvements such as improved regional transit. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:
Bay Area highway congestion is the second-worst in the nation; regional travel is slow and unreliable. The carpool lane system, which has been under construction for over 30 years, is fragmented by gaps. If we rely on traditional funding sources, these gaps will not be fully closed for many decades due to the lack of funds, making carpools and transit less effective.

Currently, the Bay Area is authorized to develop and implement only a handful of express lane projects in Alameda and Santa Clara counties. The first such projects, on Interstates 580 and 680, are now under construction and are scheduled to open in 2010/2011.

MTC is seeking legislation via AB 744 (Torrico) in the 2009 and 2010 legislative sessions to authorize the Bay Area Toll Authority (BATA) to finance, develop and operate a complete, seamless, regionally managed Express Lane Network. Key features will include:

- A management and operations structure involving the BATA, the county Congestion Management Agencies, Caltrans, and the California Highway Patrol.
- Conversion of 500 miles of existing or fully funded HOV lanes to express lanes.
- Construction of 300 miles of new express lanes, including 200 miles of gap closure and 100 miles of outward expansion. The outward expansion segments are:
  - I-80 SOL: I-505 to Yolo County Line – 28 miles
  - I-80 SOL: Air Base to I-505 – 18 miles
  - I-580 ALA: Greenville to San Joaquin County Line – 17 miles
  - US 101 SCL: Cochrane to SR 25 – 30 miles

- Qualifying carpools and public transit use network free of charge; non-carpoolers pay toll (collected electronically).
- Free-flowing traffic for carpools, buses and toll payers maintained by adjusting tolls as congestion rises and falls.
- Toll revenue pays for construction, operation, maintenance and enforcement of the Express Lane Network, with remaining net revenue available for additional transportation improvements, including public transit, in network corridors.

The Express Lane Network will be built in phases; the first phase will likely include primarily HOV conversions, followed by gap closures, with the last segments being the outward extensions.

MTC expects that the express lanes will be operated on a full-time (24/7) basis when tolling is introduced in a corridor, subject to further evaluation.

Implementation Actions:
Phase 1 (2012)
MTC will implement the following express lane projects ($2.7 billion)[4]:
- Existing Express Lane projects under development on I-680 (Sunol), I-580, SR 85 and US 101, including the SR 237/I-880 direct connector
- I-680 corridor from the I-680/SR 24 interchange south
- I-880 corridor in Alameda and Santa Clara counties
- I-80 in Alameda and Contra Costa
- Portions of US 101 in Marin and Sonoma County
- SR 87 in Santa Clara County
- I-280 in Santa Clara County
- Bridge approaches (SR 84, SR 92, and on I-680 and I-80)
- SR 237 in Santa Clara
- I-80 between Air Base and I-680
- I-80 between I-680 and the Carquinez Bridge

As proposed in recent amendments to AB 744, at least 95% of net revenues from the express lane network will be allocated to fund corridor improvements determined by Corridor Working Groups in Corridor Investment Plans, with priority given to public transit improvements.

Phase 2 (2020)
The outward expansion projects (see list in Regulatory Context and Background section above) identified in Phase 2 are included subject to additional air quality analysis to determine if they will be beneficial for air quality.
MTC to implement the following express lane projects ($1 billion):

[4] Assumes project implementation during Phase 1/Phase 2 time horizons. The actual implementation year is subject to change based on the Bay Area Express Lane implementation plan.

- SR 4 in Contra Costa County
- US 101 North (Novato Narrows) in Marin and Sonoma counties
- US 101 SM: Millbrae to Whipple – 22 miles
- I-80 SOL: I-505 to Yolo County Line – 28 miles
- I-80 SOL: Air Base to I-505 – 18 miles
- I-580 ALA: Greenville to San Joaquin County Line – 17 miles
- US 101 SCL: Cochrane to SR 25 – 30 miles
- I-680 in Solano County
- I-580 between 238 and I-680

As proposed in recent amendments to AB 744 at least 95% of net revenues from the express lane network will be allocated to fund corridor improvements determined by Corridor Working Groups (CWGs) in Corridor Investment Plans, with priority given to public transit improvements.

Supporting Actions by Partner Entities: Local governments, transit agencies, Caltrans, and CMAs to work with MTC as appropriate to implement express lane projects while implementing or maintaining express bus service and land uses supportive of transit.

Pollutants (tons per day)	2012	2020
ROG	0.86	0.82
NO_x	1.34	1.11
$PM_{2.5}$	0.28	0.37
PM_{10}	0.66	0.9
Ammonia (NH3)	0.11	
Benzene	0.02	
Formaldehyde	0.01	
Acetaldehyde	0.01	
CO_2	1855.00	2551.50
C02-e	1892	2602.53

Emission Reduction Methodology:
This analysis uses model output from the Transportation 2035 Vision Analysis which compared four different investment scenarios on a range of performance objectives: 1) Baseline, 2) Freeway Performance (Freeway Operational Improvement 3), High-Occupancy/Toll (HOT) Lanes Network And Express + Local Bus, and 4) Regional Rail and Water Transit. The net difference between air quality emissions associated with the Baseline and the High-Occupancy/Toll and Express/Local Bus scenarios are used to determine emissions reductions associated with the project. Emissions reductions are reduced to factor out the emissions reductions associated with expanded transit service (which is modeled in TCMs A-1 and A-2). The estimated emissions reductions are interpolated for year 2012 and 2020 from 2006 and 2015 estimates.

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

Emission Reduction Trade-offs:
Implementing the express lane network and providing express bus service in these corridors should reduce freeway congestion and decrease motor vehicle emissions in the near term. ARB's motor vehicle emissions factors indicate that tailpipe emission rates for ROG, NOx, PM, and CO2 are lowest when vehicles travel in the 30-50 mph speed range. The estimated emission reduction benefits for this measure are based on the anticipated improvement in average vehicle speed due to expected reduction in congestion in the affected corridors. However, this measure will also increase vehicle capacity on segments within some of these corridors. While the regional travel model estimates transportation emissions due to temporal, spatial and mode shifts resulting from increased roadway capacity, the potential emission reduction benefits of this measure may be eroded if the increased capacity in these corridors encourages additional vehicle travel or changes in land uses that would result in longer vehicle trips. To address this issue, the Air District will perform an independent analysis to evaluate the long-term impacts of this measure on vehicle travel and emissions.

Cost:
Phase 1: $2.7 billion
Phase 2: $1 billion

Co-benefits:
- Travel time savings.
- Generation of net toll revenue for corridor improvements.

Monitoring Mechanisms:
- Track miles of express lanes implemented.

- Track average vehicle speeds in both express lanes and general travel lanes (changes in congestion).
- Track changes in Vehicle Hours of Delay.

Issues/Impediments:
Implementation of this TCM requires that funding is available for these programs.
In addition, legislation is required to give BATA the authority to finance, develop and operate the Bay Area Express Lane Network. AB 744 (Torrico) is currently being considered by the State Legislature.
The network includes a variety of design challenges due to both environmental, geographic, and development constraints.

There is mixed public opinion regarding value pricing, with concerns about the impact on existing carpoolers, potential environmental impacts, the use of network net revenues, and charging for the use of the highway.

The program calls for rapid implementation of a large network of managed lanes, which will require significant resources and institutional support from a number of agencies.

Sources:
1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Bay Area Express Lane page: http://mtc.ca.gov/planning/hov/
3. MTC's Transportation 2035 Vision Analysis: http://www.mtc.ca.gov/planning/2035_plan/tech_data_summary_report.pdf

TCM B-4 - Goods Movement Improvements and Emission Reduction Strategies

Brief Summary:
Goods movement is a critical component of the Bay Area's economic and transportation system, and a significant contributor to air quality issues. Exposure to diesel pollution from goods movement greatly 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 and continuing to offer incentives for diesel engine owners to reduce emissions will address existing air quality issues as well as help the region to prepare for continued growth in this important sector of our economy.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, and diesel particulate matter associated with goods movement by investing in the Bay Area's trade corridors and by providing incentive funding for diesel equipment owners to purchase cleaner-than-required vehicles and equipment. In addition, some projects implemented through this measure will reduce emissions of greenhouse gases. The District will endeavor to meet the California Air Resources Board (ARB) 2007 Goods Movement Action Plan goal to reduce goods movement emissions to the greatest extent possible and at least back to 2001 levels by year 2010.

Travel Market Affected:
This measure would affect all 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 pollution 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 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. This population is exposed to approximately 20 percent or 5.6 tons per day of the total PM and 20 percent of 124 tons per day of the total NOx emission from goods statewide.

Nearly 40 percent of the region's economic output is in manufacturing, freight transportation, and the warehouse and distribution businesses. For example, the Port of Oakland is one of the nation's busiest container ports, and although cargo volumes are

currently down due to the economic recession, projections show cargo volumes at the Port and throughout the region and state will grow significantly over the next 20 years. The Port of Oakland plays a particularly important role in supporting the state's agricultural sector, providing the primary means of transporting produce from the Central Valley to the Pacific Rim. Goods movement businesses create over 10 percent of regional employment. More than 80 percent of the goods movement in the Bay Area involves trucking in several major corridors: Interstates 80, 580, and 880 and U.S. Highway 101.

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 program to nearly $2.5 billion and programmed just over $3 billion for high-priority goods movement projects. A coalition of regional agencies in Northern California, representing 23 counties and the three major ports, was able to secure $825 million for 14 Northern California transportation projects that are to be in construction by 2013. Nearly $585 million of this total will fund seven key Bay Area goods movement projects.

Proposition 1B also included $1 billion for a Goods Movement Emissions Reduction program. The BAAQMD is responsible for developing various programs for the bond, including a diesel truck replacement program.

In addition, the California Air Resources Board (ARB) 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."

In the Transportation 2035 Plan, MTC allocated $45 million toward the District's Goods Movement Emission Reduction Program, which aims to reduce particulate matter emissions and health risks by replacing and/or retrofitting up to 800 port and general regional goods movement trucks currently operating along the Bay Area's priority trade corridors.

Since 2003, the District has spent approximately $55.6 million on projects through the Carl Moyer Program. These funds purchased cleaner-than-required on-road, off-road, marine, rail, and agricultural equipment.

In addition, since 2003, the District has spent approximately $18 million on projects through the Transportation Fund for Clean Air (TFCA) that reduce pollution from on-road trucks that move goods, including port trucks, garbage and street sweepers, and construction dump trucks. Beginning in 2009, the District will set aside $1.5 million in TFCA funds a year. These dollars will fund the Advanced Technology Program, which will provide grants for heavy-duty hybrid trucks and demonstration projects.

The California Air Resources Board (CARB) has adopted rules that require owners of diesel trucks and equipment, including those associated with goods movement, such as on-road trucks and harbor craft, to limit emissions from their fleets. The federal government has also taken action to limit emissions from locomotive engines. Although these regulations will require that equipment meets stringent standards, anticipated growth in goods movement over the next 20 years may offset much of the benefits that these regulations will achieve. Thus, incentive programs offered through the District are designed to provide emission reductions that go beyond reductions required by CARB. For example, regulations require upgrades to equipment in future years; the District incentive programs offer funds for engine owners to upgrade equipment in advance of these regulations, thereby funding emission reductions that are not yet mandated. Incentive programs can also offer funds for reduction of pollutants that are not required, for example, NOx and ROG reductions, when only PM reductions are required. In sum, although CARB (and federal) requirements will result in substantial emission reductions from the goods movement sector, incentive funding can be used to speed up these reductions or generate additional emission reductions that would otherwise not occur.

Implementation Actions:

Phase 1 (2012)

BAAQMD to implement:

- State-funded diesel emission reduction incentive programs, including the Carl Moyer Program and Proposition 1B Goods Movement program ($144 million)
- Replacement or retrofit of port and general goods movement trucks operating in the region via Goods Movement Emission Reduction Program, (subject to availability of funding)
- The TFCA-funded Advanced Technology Program to fund hybrid heavy-duty trucks and demonstration projects ($1.5 million a year).

Phase 2 (2020)

MTC to implement the following seven Proposition 1B Trade Corridors Improvement Fund (TCIF) projects ($585 million):

- 7th Street Grade Separation
- I-80 Eastbound Cordelia Truck Scales Relocation
- Martinez Subdivision Rail Corridor Improvements
- San Francisco Bay to Port of Stockton Channel Dredging
- I-580 Eastbound Truck Climbing Lane
- I-880 Improvements at 23rd and 29th Avenues
- Outer Harbor Intermodal Terminals

BAAQMD to continue implementation of:

- Goods Movement Emissions Reduction Program to replace or retrofit up to 800 port and general goods movement trucks operating in the region ($45 million)
- State-funded diesel emission reduction incentive programs ($384 million)

Supporting Actions by Partner Entities:

- Local governments, Ports, goods movement businesses and other agencies to work with the District to implement grant programs that fund diesel emission reduction programs.
- Local government, Ports, Caltrans and other agencies to work with MTC as appropriate to implement TCIF projects.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG		0.59
NO_x		4.81
$PM_{2.5}$		0.06
PM_{10}		0.28
Diesel PM		0.12
Benzene		0.01
Formaldehyde		0.05
Acetaldehyde		0.09
CO_2		3966.08
C02-e		4045.00

Emission Reduction Methodology:

Diesel emission reduction program emission reduction estimates are based on emission reductions achieved in past funding years.

Proposition 1B TCIF Projects: Emissions reductions were estimated as a part of the project application for TCIF funds. Growth factors were applied to emissions reduction estimates to bring them to analysis year 2020.

Exposure Reduction:

The District and California Air Resources Board (CARB) studies show that 80% of the risk from toxic air contaminants in the Bay Area comes from diesel particulate emissions. This measure addresses this air quality problem by reducing emissions from vehicles and equipment used in goods movement. This measure directly addresses air quality in impacted communities.

Emission Reduction Trade-offs:

Adding diesel retrofit devices to diesel engines may result in a decrease in fuel efficiency, thereby increasing emissions of carbon dioxide. For example, CARB and the EPA estimate that a heavy-heavy duty (HHD) diesel truck with a retrofit device added would experience a decrease in fuel efficiency of 3.5 percent on average. By District staff computations, for a

HHD truck traveling 30,000 miles per year, this decrease is estimated to result in an additional 4,382 pounds per year of carbon dioxide.

Cost:
Phase 1: $146 million
Phase 2: $1 billion

Co-benefits:
- Energy/fuel cost savings from more efficient and reliable engines.
- Economic benefits from faster, more efficient goods movement.

Monitoring Mechanisms:
- Completion of major project milestones for TCIF projects.
- Changes in Vehicle Hours of Delay (VHD) on TCIF corridors.
- Number of goods movement trucks retrofitted or replaced through the Goods Movement Emission Reduction program, and amount of emissions reduced through these retrofits/replacements.
- Number of grants and amount of money awarded through Carl Moyer Program and the Alternative Technology Program, emissions reduced through these grants.

Issues/Impediments:
High costs to reduce emissions from aging goods movement equipment and infrastructure (such as large diesel trucks that tend to stay on the road much longer, replace at a very slow rate, and operate on the smallest margin of profits) may be cost-prohibitive for the private sector.

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.

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.

It will be difficult to achieve the same amount of emission reductions through the existing incentive programs. However, since diesel engine owners will be required to reduce emissions by CARB regulations, the Bay Area will still benefit from cleaner diesel operations.

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.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Goods Movement Initiatives 2009 Update: http://www.mtc.ca.gov/planning/2035_plan/Supplementary/T2035_Goods_movement_update.pdf
3. ARB's Goods Movement Emission Reduction Program: http://www.arb.ca.gov/bonds/gmbond/gmbond.htm
4. BAAQMD's Strategic Initiatives: http://www.baaqmd.gov/Divisions/Strategic-Incentives.aspx
5. ARB's Carl Moyer Memorial Air Quality Standards Attainment Program: http://www.baaqmd.gov/Divisions/Strategic-Incentives/Carl-Moyer-Program.aspx

TCM C-1 - Voluntary Employer-Based Trip Reduction Programs

Brief Summary:
This measure will support voluntary efforts by Bay Area employers to encourage their employees to use alternative commute modes, such as transit, ridesharing, bicycling, walking, telecommuting, etc.

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

Travel Market Affected:
This measure would primarily affect commute trips, which were 23% of total weekday person-trips and about 40% of weekday vehicle miles traveled for personal (non-commercial) travel in 2006 in the Bay Area.

Regulatory Context and Background:
While commute trips make up only about one-quarter of person trips they tend to be longer distance trips and they make up most peak hour trips when traffic congestion is worse. For these reasons, reducing commute vehicle trips can have a significant impact on reducing congestion and improving air quality.

Employees may choose to drive to work for a variety of reasons:

- Workplaces that are not near transit.
- Barriers to ridesharing (see TCM C-3).
- 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.
- Lack of information regarding other travel options.
- Availability of free (or underpriced) vehicle parking.

Since 1996, Senate Bill 437 has prohibited mandatory employer trip reduction programs. However, many employers participate in these types of program on a voluntary basis.

511 Rideshare is one component of 511, MTC’s regional transportation information program, which provides a suite of services to facilitate carpooling, vanpooling, taking transit and bicycling. These programs are designed to remove some barriers identified above. 511 Rideshare and congestion management agencies (CMAs) conduct outreach to employers, providing information and encouragement to implement programs that will influence employees to use alternate modes of transportation. 511 Rideshare services and tools include: consultations, marketing and outreach, work site events, employee surveys,

density maps, relocation assistance, online ridematching, vanpool formation and support, commute incentives, and employer referrals. (For additional elements of 511 Rideshare, see TCM C-3).

MTC, through 511 Rideshare, provides funds to each of the 9 county CMAs to conduct outreach to employers in their county. Employer outreach focuses on describing and marketing each of the rideshare services and tools provided by 511 (described above), encouraging implementation of trip reduction programs, as well as informing employers of county-level incentives (see TCM C-3).

BAAQMD administers the Spare the Air program, encouraging individuals to take actions to improve air quality on days when air quality is forecasted to be unhealthy. On summer days with unhealthy levels of ground-level ozone forecast, individuals are encouraged to take transit, carpool, and/or curb driving. As a part of this program, employers participating in the Spare the Air Employer Network designate coordinators to 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. BAAQMD provides educational information, incentives and support to participating employers.

Since 2003, BAAQMD's Transportation Fund for Clean Air (TFCA) program has allocated $117 million for local projects that reduce motor vehicle emissions in the Bay Area. TFCA is funded by a surcharge on motor vehicle registration fees paid within BAAQMD's jurisdiction. The surcharge revenues are to be used to implement specific transportation control measures that are developed and adopted in BAAQMD's Clean Air Plans and are pursuant to the requirements of the 1988 California Clean Air Act. Programs funded by TFCA include regional and local rideshare programs, vanpool/buspool programs, bicycle lockers, rack and parking stations, bicycle paths and lanes.

The Bay Area Clean Air Partnership (BayCAP) ran a shuttles project from 2001 - 2006. The major employer and business organizations involved in BayCAP saw untapped potential for shuttle expansions in the Bay Area. Private sector entities saw the project as an opportunity for a public/private partnership to improve air quality. The shuttles project was funded by BAAQMD with the goals of increasing the Bay Area shuttle ridership, improving partnerships among public agencies, providing technical support and networking information, and improving policy-maker understanding of Bay Area shuttle programs. As Bay Area population grows and public transportation agencies expand service, we will need new shuttles to serve new stations and handle increased overall passenger loads.

Federal law and IRS regulations allow employers to provide transit passes to their employees on a pre-tax basis up to $230 per month; this substantially reduces the out-of-pocket cost of transit to employees. Many employers already make this benefit available to their employees, either by providing free or subsidized passes to their employees, or by allowing the employee to purchase a transit pass with pre-tax dollars. The employer also benefits by not having to pay payroll taxes on the cost of the transit pass. In fall 2008 the

City of San Francisco adopted a Commute Benefits Ordinance which requires employers with 20 or more employees to offer employees the opportunity to purchase transit passes with pre-tax dollars. By expanding the number of employers who offer transit benefits, the ordinance should help to retain and increase transit use for commute trips. This is especially important in the current economic environment in which transit agencies have been forced to impose significant fare increases to compensate for cuts in public funding and reduced farebox revenues.

Implementation Actions:

Phase 1 (2012)

- MTC to continue to implement employer elements of 511 Rideshare ($2 million).

BAAQMD to:

- Continue to implement employer elements of the Spare the Air program, evaluate program effectiveness, and implement new ideas to expand the scope and improve the effectiveness of the program at workplaces ($6 million). Note that the costs associated with this program are accounted for under TCM C-3.
- Continue to provide TFCA funding for shuttle/feeder buses ($9 million).
- Support legislation to maintain and expand incentives for employer programs, such as tax deductions and credits.
- Encourage local cities to adopt transit benefit ordinances, similar to the ordinances that have been adopted by the cities of San Francisco, Richmond, and Berkeley.
- Support legislation to empower air districts and/or local governments to adopt employer-based trip reduction requirements. (This item is also addressed in the CAP Leadership Platform.)
- Encourage employers and other entities to utilize webcasting and related technologies to reduce travel for business meetings.
- Consider implementing a program similar to the (2001-2006) BayCAP shuttle program. The new program could include any or all of the following elements:
  - Encourage coordination between the private and public sector.
  - Study and implement a consistent regional shuttle program.
  - Encourage the integration of shuttles in regional rail plans and in the planning process.
  - Encourage the expansion of current shuttle operations.
  - Promote the benefits of shuttles to employers, employees, transit operators, and regional agencies.
  - Study alternative access modes to regional transportation stations/hubs, specifically frequent shuttle/feeder buses, from under used parking lots.
  - Study and promote the concept of rapid shuttles using park and ride parking capacity to meet the same need as transit hub parking structures.
  - Work with large housing developments to provide guidance and implement rapid shuttles as an alternative to driving.

Phase 2 (2020)

- MTC to sustain employer elements of 511 Rideshare and CMA programs ($17 million).
- BAAQMD to sustain other Phase 1 actions ($40 million).

Supporting Actions by Partner Entities:

- Congestion Management Agencies will continue to implement employer element of CMA programs.
- Local governments are encouraged to require mitigation of vehicle travel as part of new development approval, adopt transit benefits ordinances in order to reduce out-of-pocket transit costs to employees, and develop innovative ways to encourage rideshare, transit, cycling and walking for work trips.
- Transit agencies and shuttle providers should continue to implement and expand shuttle and feeder bus service to complement fixed routes transit service and reduce the demand for parking at transit stations.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.08	0.07
NO_x	0.10	0.07
$PM_{2.5}$	0.00	0.00
PM_{10}	0.03	0.04
Ammonia (NH3)	0.01	0.01
CO_2	94.73	103.82
C02-e	97.00	105.90

In addition to the pollutants shown above, this measure will reduce emissions of the following air toxics by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:

Employer elements of 511 Rideshare: This analysis uses a calculation of vehicle trips and vehicle miles travelled reduced through outreach to employers as a part of a previous analysis conducted by 511 Rideshare staff to estimate the combined impacts of travel demand management programs, both for those implemented by MTC and by local partners such as CMAs without double counting any impacts at both the county and regional level. The ratio of trips reduced to total employment in FY 2006-07 (the year the analysis was carried out) is then applied to projected employment levels in 2012 and 2020.

This measure also includes emission reductions based on TFCA funding for shuttle buses. The estimate from this program is based on emission reductions from previous years of the program.

Note that the emission reductions associated with the Spare the Air program are accounted for under TCM C-3.

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:
Phase 1: $ 17 million
Phase 2: $ 57 million

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

Monitoring Mechanism:
- Track number of employers contacting 511 Rideshare for employer services offered.
- Track number of employees served by BayCAP and regional shuttle programs and emission reduced.
- Number of grants and amount of money awarded through TFCA Program and emissions reduced through grants.
- Track municipalities implementing commute benefit ordinances.

Issues/Impediments:
BAAQMD's lack of regulatory authority to mandate employer-based trip reduction programs limits the ability to expand employer participation.

Implementation of this TCM requires that funding is available for this program. Potential lack of funding would preclude MTC, CMAs, county transportation authorities, cities, etc., from delivering this TCM as scoped.

The current economic downturn and cost of implementing trip reduction programs may limit employer's willingness to participate. However, future legislation may repeal SB 437 or provide new incentives for employer-based trip reduction programs.

The BayCAP Shuttles Project identified key barriers that must be addressed if the region is to expand its shuttle system and increase transit ridership, including:
- No consistent regional shuttle program.
- Shuttles are not yet seen as an integral part of the regional rail network.
- Lack of on-going regional funding (TFCA funding is only regional funding available for shuttles).
- Most shuttles are at the work-end; very little experimentation with home end shuttles.

- With certain notable exceptions such as Caltrain/SamTrans/VTA, shuttles are not high priority and shuttles programs are not institutionalized at most transit agencies.
- Some transit agencies see shuttles as competition for fixed route services.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. South Hayward BART Development, Design and Access Plan: http://www.bart.gov/docs/planning/SouthHaywardDevelopDesignAccessPlanpartA.pdf
3. Bay Area 2005 Ozone Strategy: http://www.baaqmd.gov/Divisions/Planning-and-Research/Plans/Bay-Area-Ozone-Strategy/2005-Bay-Area-Ozone-Strategy.aspx
4. San Francisco County Transportation Authority. Draft Strategic Analysis Report: "The Role of Shuttle Services in San Francisco's Transportation System." November 17, 2009. http://www.sfcta.org/images/stories/Planning/Shuttles/ShuttleSAR_Draft_PnP111709.pdf.

TCM C-2 - Safe Routes to Schools and Safe Routes to Transit Programs

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 bicycle facilities, such as lanes, routes, paths, and parking, and improvements to pedestrian facilities, such as sidewalks/paths, benches, reduced street width, reduced intersection turning radii, crosswalks with activated signals, curb extensions/bulbs, buffers between sidewalks and traffic lanes and streets trees.

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

Travel Market Affected:
The Safe Routes to School component of this measure would affect school trips, which were 6% of total person trips in 2006, and trips to transit stops. The Safe Routes to Transit component of this measure would affect transit trips, which were 5.2% of total person trips in 2006.

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 such as 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. In 2006, home-based grade school trips in the Bay Area accounted for nearly 1.3 million trips/day, or 6 percent of total personal trips. Safe Routes to School reduces vehicle trips to school and parents' vehicle trips to work, who may be able to switch to another mode if they do not need to drop their children off at school.

The State of California's Safe Routes to School program was established in 1999 by Assembly Bill 1475, and in 2007, legislation was passed (Assembly Bill 57) to extend the program indefinitely. Project funding has been issued for 7 two-year funding cycles, the selection of Cycle 8 projects for FY 2008-09 and FY 2009-10 is underway, and the program will continue to issue calls for projects on a bi-annual basis. Examples of Bay Area projects funded in Cycle 7 include:

- New traffic signals with countdown pedestrian heads, crosswalks, radar speed feedback signs and education activities near Ocean View Elementary School in Alameda County;
- Construction of a segment of the Lions Creek Trail for bicyclists and pedestrians, outreach and education activities near Antonio Del Buono Elementary School in Santa Clara County; and

- Installation of in-pavement lighted crosswalk, curb ramps, safety lighting, signing and striping near Windsor High School in Sonoma County.

SAFETEA established a federal Safe Routes to School program between 2005 and 2009. The federal program advises Safe Routes to School projects to include five components, "the Five Es" – engineering, education, enforcement, encouragement and evaluation. Two cycles of federal funding were issued. Examples of Bay Area projected funded include:

- Installation traffic calming features by extending curbs, narrowing an intersection, and installing a pedestrian crossing signal near Mill Valley Middle School in Marin County; and
- Funding to conduct walkability audits/workshops, focus groups, meetings with teacher and parent groups, assemblies, outreach, on-site technical assistance with local bicycle/pedestrian champions, and pedestrian educational presentations at schools in Western Contra Costa County.

In 2004, voters passed Regional Measure 2, raising the toll on the seven State-owned toll bridges by $1.00. This extra dollar funds various transportation projects within the region, including the Safe Routes to Transit program.

Safe Routes to Transit 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. While removing vehicle trips to transit may have only small impacts on reducing vehicle miles travelled, these reductions have more significant impacts in reducing vehicle engine starts, which are a significant source of total vehicle emissions. The Safe Routes to Transit program is funded by MTC and administered by TransForm and the East Bay Bicycle Coalition. To date nearly $8 million has been awarded to over 20 capital and planning projects. Example projects funded include:

- Planning for Balboa Park Ocean Avenue pedestrian/bicycle connections in San Francisco;
- Capital improvements to provide safe pedestrian/bicycle routes to Ed Roberts Campus/Ashby Bart in Berkeley; and
- Capital funds to provide electronic bicycle lockers at BART stations.

MTC's Transportation 2035 Plan launched a new program, the Transportation Climate Action Campaign, to reduce the region's carbon footprint. The $400 million campaign includes new funding for Safe Routes to School and Safe Routes to Transit. These funds will supplement the available federal, state, regional and local sources committed to these sources, which are currently oversubscribed, to meet the high demand for funding for these types of projects. Note that as of December 2009, MTC approved $80 million in the first programming cycle from the new federal transportation act for four primary climate initiatives: 1) Public Education/Outreach; 2) Safe Routes to Schools, 3) Innovative Grants; and 4) Climate Action Program Evaluation. Of the $80 million, the Safe Routes to Schools program received $17 million in funding. Funding has not yet been identified for the Safe Routes to Transit program.

Implementation Actions:
Phase 1 (2012)
MTC to:

- Continue to award Regional Measure 2-funded Safe Routes to Transit Program funds ($23 million)
- Implement the Safe Routes to Schools Program component of the Transportation Climate Action Campaign ($17 million)

Phase 2 (2020)

- MTC to pursue additional funding for Safe Routes to School and Safe Routes to Transit ($ TBD)

Supporting Actions by Partner Entities: CMAs, transit agencies, local governments, schools, and communities to work with MTC to implement safe access for pedestrians and cyclists to schools and transit.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.01
NO_x	0.01	0.01
$PM_{2.5}$	0.00	0.00
PM_{10}	0.00	0.00
CO_2	8.02	17.51
C02-e	8.18	17.86

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: PM10, PM2.5, NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
Safe Routes to School: This analysis assumes increases in home-based grade school walk trips by 25-35% and increases in home-based grade school bicycle trips by 60-70%, ranges based on previous analyses of Safe Routes to School travel outcomes from the State of California's Safe Routes to School programs. Because the amount of funding expected to be available for Safe Routes to School programs will not be sufficient to fund programs at all the elementary and middle schools in the Bay Area, the 25-35% increase in walk trips and the 60-70% increase in bike trips are only applied to 2.7% of grade school trips in 2012 and 5.3% of grade school trips in 2020. VMT reduced is then calculated based on an assumed average walk-to-school distance of 0.5 miles and an assumed bike-to-school distance of 2 miles.

Safe Routes to Transit: Because there is very little empirical research estimating the impacts of Safe Routes to Transit-type improvements on travel outcomes, this analysis is grounded in findings of one empirical study (Cervero 2001) that presents "walk-to-transit" elasticities ranging from .161-.230 for increases in sidewalk miles; that is, a 1% increase in the ratio of sidewalk miles to road miles results in a .16% to .23% increase in the probability of walking to transit. This analysis assumes a 0.5% increase in this ratio in 2012 and a 1% increase in this ratio in 2020. It also assumes a comparable increase in bicycle infrastructure and anticipated increase in the probability of bicycling to transit; although the relationship documented in the study is only for walk trips, the analysis extends the relationship to bicycle trips as results from any more suitable studies were not found. These changes in walk-to-transit and bicycle-to-transit trips are then multiplied by a 2 mile bicycle access/egress distance and a 0.7 mile walk access/egress distance to calculate vehicle miles reduced.

This analysis assumes $17 million in SRTS and $10 million SR2T funds available in Phase 1 (though no funding has yet been identified for SR2T), and an additional $10 million for each program in Phase 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:
Phase 1: $ 40 million
Phase 2: $ TBD

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

- Reduced travel costs.

Monitoring Mechanisms:

- Track the number of new Safe Routes to School programs and the change in number of bicycle and walk trips to school at schools with Safe Routes to School programs
- Track the number of new Safe Routes to Transit Projects

Issues/Impediments:

Implementation of this TCM 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 have been identified in the short-term, many of these sources will sunset in the future. However, the new federal transportation bill 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.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. Safe Routes to School Safety & Mobility Analysis: Report to the California Legislature: http://www.saferoutespartnership.org/media/file/SR2S_Final_Report_3_1_07.pdf
3. Cervero, Robert (2001). "Walk-and-Ride: Factors Influencing Pedestrian Access to Transit." *Journal of Public Transportation,* Vol. 3, No. 4, pp. 1-23.

TCM C-3 - Ridesharing Services and Incentives

Brief Summary:
This 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 the rideshare information call center and website, and providing vanpool support services. In addition, this measure includes provisions for encouraging car-sharing programs where appropriate.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx by reducing single occupancy vehicle trips through the promotion of rideshare services and incentives throughout the Bay Area, and car sharing programs where feasible. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
The ridesharing component of this measure would primarily affect commute trips, which were 23% of total weekday person-trips and approximately 40% of weekday vehicle miles traveled for personal travel in 2006 in the Bay Area. Car-sharing programs are more likely to affect discretionary trips for shopping, errands, business and recreational purposes.

Regulatory Context and Background:

Ridesharing
While commute trips make up only about one-quarter of person trips, they tend to be longer distance trips and they make up most peak hour trips when traffic congestion is worse. For these reasons, reducing vehicle trips to workplaces can have a significant impact on reducing congestion and improving air quality.

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, etc.).
- Needing to factor in travel time to pick-up other carpoolers.
- Needing flexibility to change travel schedule due to emergencies.

511 Rideshare is MTC's regional rideshare program, providing 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, provide additional incentives for ridesharing, and include:
- A regional ridematching system which connects commuters who live and work near one another (for employer elements of 511 Rideshare see TCM C-1).

- Information and incentives for carpools and vanpools, including gas cards for carpoolers, seat subsidies for vanpoolers, and prizes for both types of ridesharing.
- CMAs, county transportation authorities, cities and counties provide a range of different incentives to encourage non-single occupant vehicle commute trips. Eligibility requirements and types of incentives available vary and include (or will include) the following[5]:
- Alameda County: guaranteed ride home in emergencies.
- ACE Rail: guaranteed ride home in emergencies for those who hold monthly ACE Rail passes
- 511 Contra Costa: guaranteed ride home in emergencies, discounted vanpool fare for new vanpoolers, cash incentives for vanpool drivers who sustain a vanpool for one year, gift card incentives for carpool participants, complimentary transit tickets for commuters who currently drive alone.
- Marin County: incentives for new vanpools and guaranteed ride home.
- Napa County: guaranteed ride home in emergencies, gas cards for new back-up vanpool drivers, gas cards for new vanpools.
- San Francisco County: preferential vanpool parking, guaranteed ride home in emergencies, carpool parking permits.
- San Mateo County: guaranteed ride home in emergencies, gas cards for carpool participants, discounted vanpool fare for new vanpoolers, discounted purchase and installation costs for employers to provide bike racks/lockers, free transit coupons for new riders, free lunchtime taxi service.
- Santa Clara County: EcoPass Transit annual transit pass on South Bay transit systems (for participating employers), preferential parking for 4+ carpools.
- Solano County: guaranteed ride home in emergencies, gas cards for new back-up vanpool drivers, gas cards for new vanpools, discounted bicycle purchase.
- Sonoma: guaranteed ride home in emergencies, free 2+ carpool parking in downtown garages, reduce cost transit passes.

Car-Sharing

Carsharing allows people to forgo or reduce the number of cars in their household and rely on other modes for most of their trips, but still have convenient access to a car when needed for occasion use. There are currently two car-sharing organizations in the Bay Area: City Carshare is a nonprofit organization and Zipcar, (which merged with Flexcar in 2007) is a for profit corporation. Members join for a monthly fee, pay an hourly use fee that includes gasoline, and can schedule use of a car over the internet. Car-sharing has been available in the Bay Area since 2001, but has a longer history in Europe. Members can pick up cars at locations around San Francisco and the east bay, including Oakland, Alameda, Berkeley, Albany, El Cerrito, and in Palo Alto at Stanford University. The advantages to car-sharing include:

[5] See 511 Rideshare's Commute Rewards and Incentives: County Incentives webpage at http://rideshare.511.org/rideshare_rewards/county.asp.

- Fixed costs are lower than owning a car. Zipcar members report an average savings of approximately $500 a month when they join Zipcar compared to owning their own car. These fixed costs include car payments, licensing, garage fees, insurance, and maintenance.
- Regardless of how often an owner uses a car, there are high fixed costs to owning a car and lower marginal costs, such as fuel and parking charges. Because of the ratio of fixed costs to marginal costs, car owners tend to use their private auto for trips that could be served by other less polluting transportation modes, including transit, walking and biking. In contrast, car sharing has lower fixed costs and higher marginal costs. This encourages members to use other transportation modes when available and convenient. Overall, car-sharing encourages members to reduce their total number of vehicle trips by taking advantage of other modes of travel.
- For low income people, car-sharing can augment transit, walking and bicycle trips to make occasional trips carrying cargo or outside the transit system's service area.
- Car-sharing service is also available to businesses. This can help Bay Area businesses save money otherwise spent on maintaining, insuring and garaging a fleet of cars.

Implementation Actions:
Phase 1 (2012)
MTC to implement the following actions ($17 million):

- Continue to provide 511 RideMatch service and implement website enhancements including a trip-tracking tool, functionality for administration of employer-based and local agency-based incentives, a quick search matching tool, and improved interface functionality for employers.
- Continue to provide rideshare support services, including call center services, program marketing and materials and vanpool support services.
- Continue administration of 511 Rideshare Rewards annual campaign and provision of incentives for carpools and vanpools.
- Implement incentive programs sponsored by congestion management agencies, county transportation authorities, cities and counties, and transit agencies.
- Encourage the expansion of car-sharing services.

BAAQMD will encourage car-sharing, as appropriate, as a potential CEQA and ISR mitigation measure.

Phase 2 (2020)
Sustain Phase 1 programs ($47 million)

Supporting Actions by Partner Entities:

- Local governments, CMAs, and employers to encourage ridesharing and create incentives to promote ridesharing.
- CMAs that support existing local rideshare programs to continue to fund these programs.
- Caltrans to identify and develop new Park and Ride sites as needed.
- Explore the option to encourage or require new projects to include dedicated car-sharing parking spaces and car-sharing services in-lieu of required parking spaces.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.09	0.06
NO_x	0.10	0.05
$PM_{2.5}$	0.01	0.01
PM_{10}	0.01	0.02
Ammonia (NH3)	0.03	0.03
CO_2	150.03	170.03
C02-e	153.00	173.43

In addition to the pollutants shown above, this measure will reduce emissions of the following air toxics by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
This analysis uses a calculation of vehicle trips and vehicle miles travelled reduced through rideshare services and incentives as a part of a previous analysis conducted by 511 Rideshare staff to estimate the combined impacts of travel demand management programs, both for those implemented by MTC and by local partners such as CMAs without double counting any impacts at both the county and regional level. The ratio of trips reduced to total employment in FY 2006-07 is then applied to projected employment levels in 2012 and 2020.

The estimated emission reductions do not include any reductions from car-sharing programs.

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:
Phase 1: $17 million

Phase 2: $47 million

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 parking for employers.
- Support additional options for residents who seek to reduce their dependence on private vehicles for environmental and financial reasons.

Monitoring Mechanisms:

- Track number of carpools and vanpools matched through the 511 RideMatch service
- Track number of carpools and vanpools participating in 511 Rideshare Rewards program

Issues/Impediments:

Ridesharing
Surveys and focus groups indicate that many commuters need flexibility in their daily trips to conduct errands, or pick-up and drop-off children. This reduces the market for carpooling and vanpooling as traditional participation requires fixed schedules among participants. Incentive programs such as guaranteed ride home programs, which are available to most Bay Area employees, and/or encouraging participants to try carpooling once or more a week can alleviate this impediment.

Potential lack of funding would preclude MTC, CMAs, county transportation authorities, cities, etc., from delivering this TCM as scoped.

Employer support of ridesharing programs, which complement the regional services and incentives, are limited by the economic downturn.

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

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. http://www.citycarshare.org/
3. http://www.zipcar.com/

TCM C-4 - Conduct Public Outreach & Education

Brief Summary:
This measure will encourage Bay Area residents to make choices that benefit air quality by educating the public about the health effects of air pollution and the air quality benefits of choosing transportation modes that reduce motor vehicle use, such as carpooling, vanpooling, taking public transit, biking, walking, and telecommuting. BAAQMD will implement this measure through the Spare the Air (STA) Every Day campaign and the Spare the Air episodic program ("STA Alerts"). In addition, MTC and BAAQMD in partnership will implement the outreach component of the Transportation Climate Action Campaign. Implementation actions include marketing and incentive programs to alert the public to the connection between air pollution and motor vehicle usage, and promoting the benefits of reducing single-occupant motor vehicle use every day, and in particular on poor air quality days when BAAQMD issues a STA Alert.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, by educating the public about air quality in the Bay Area and encourage residents, employers and local governments to make choices that have a positive effect on air quality, particularly regarding transportation and consumer activities. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would target all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips. The Spare the Air program emphasizes reduction in morning commute trips. In addition, this measure may help to reduce emissions from the use of consumer products, lawn and garden equipment, recreational watercraft, etc.

Regulatory Context and Background:
Public education and outreach are an important part of the overall strategy to reduce motor vehicle travel and emissions. The BAAQMD administers several public education programs, including Spare the Air (STA) Every Day and the Spare the Air Alert programs. The BAAQMD encourages voluntary actions that reduce air pollution throughout the year.

The STA Every Day Program is the backbone of the BAAQMD'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 exceedances 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 (see TCM C-1)
- 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 BAAQMD support, are responsible for developing and carrying out local projects.
  - Currently there are nine STA Resource Teams meeting and working together within the Bay Area's nine counties.
- Youth Programs
  - Protect Your Climate Curriculum which includes 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 student.
  - Development of the eCO2 Commute Challenge Project Manual, a tool to help high schools 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.
  - Air District staff make presentations in the classroom as requested by teachers.

MTC's Transportation 2035 Plan launched a new program, the Transportation Climate Action Campaign (TCAC), to reduce the region's carbon footprint. The campaign, which will be implemented by MTC and the BAAQMD in partnership, includes funding for outreach activities to educate Bay Area residents about how they can reduce emissions of greenhouse gases (and criteria air pollutants) on an everyday basis. The outreach campaign will feature multiple outreach messages directly linked to action programs, incentives, projects, policies and advocacy focused on two complementary themes: 1) Smart Driving/Vehicles: actions to reduce emissions of greenhouse gases on a per-mile basis via driving behaviors and vehicle improvements as discussed above, and 2) Smart Traveling: actions to reduce emissions of greenhouse gases by promoting alternatives to driving: e.g., transit, biking, walking, carpooling and telecommute. Note that as of December 2009, MTC approved $80 million in the first programming cycle of the new federal transportation act for four primary climate initiatives: 1) Public Education/Outreach; 2) Safe Routes to Schools, 3) Innovative Grants;

and 4) Climate Action Program Evaluation. Of the $80 million, the public education/outreach element received $10 million in funding.

Implementation Actions:
Phase 1 (2012)

- MTC and BAAQMD to implement outreach component of Transportation Climate Action Campaign ($10 million).
- BAAQMD to implement Spare the Air Every Day Campaign including STA Alerts, employer program, community resources team, and youth programs ($6 million).

Phase 2 (2020)

- MTC and BAAQMD to continue implementing outreach component of Transportation Climate Action Campaign ($TBD).
- BAAQMD to continue implementing Spare the Air Every Day Campaign including STA Alerts, employer program, community resources team, and youth programs ($16 million).

Supporting Actions by Partner Entities: Local governments, transit agencies, CMAs, schools, media outlets, and businesses are encouraged to participate in the campaign.

Emission Reductions:
The STA Every Day and TCAC programs will result in the following emission reductions, expressed in tons per day.

Pollutants (tons per day)	2012	2020
ROG	0.02	0.01
NO_x	0.02	0.01
$PM_{2.5}$	0.00	0.00
PM_{10}	0.00	0.00
CO_2	38.99	46.96
C02-e	40.42	47.90

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
Emission reductions estimates are based on aggregated survey information collected after STA Alerts. The STA Alert data shows that 5 percent of the surveyed population changed travel behavior due to the alert. These individuals were more likely to forgo discretionary (non-work) vehicle trips than work trips. This travel behavior data was then applied to STA Every Day and TCAC programs based on the assumption that the STA Every Day program would result in a behavior change at one-tenth the rate (0.5%) of the episodic Spare the Air

program. This is a conservative assumption: the program may provide greater 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:
Phase 1: $13 million
Phase 2: $16 million

Note that 3 million of the funds available for the TCAC Program are accounted for under TCM C-5.

Co-benefits:
This measure raises the awareness of the public about the causes of and solutions to the air pollution problem. 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 TCAC programs.

Monitoring Mechanisms:
BAAQMD will continue to conduct surveys of travel behavior in response to STA Alerts, possibly expanding this activity to include STA Every Day and the TCAC programs.

Issues/Impediments:
Implementation of this TCM 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. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan
2. BAAQMD's Spare the Air Program: http://www.sparetheair.org/

TCM C-5 - Smart Driving

Brief Summary:
Pollutant emissions rates vary based on the speed a vehicle is traveling. The emission/speed relationship varies for each pollutant, but emission rates generally are lowest in the 30-45 mile per hour mph range. Vehicles traveling on Bay Area freeways at speeds above 65 mph emit significantly more ROG, NOx and greenhouse gases (GHGs) than cars and trucks traveling at speeds between 35 and 55 mph. This measure focuses on public education to encourage drivers to observe posted speed limits and adopt other fuel efficient driving practices, supplemented by more rigorous enforcement of speed limits, especially to reduce high-speed driving on freeways.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, by reducing high speed driving. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips. In addition, this measure would primarily address freeway travel within the Bay Area.

Regulatory Context and Background:
Further Study Measure 3 in the Bay Area 2001 Ozone Attainment Plan provides a foundation for this control measure. In response to FSM 3, MTC conducted an analysis on emissions created by vehicles traveling over 65 mph on freeways. This analysis shows that by limiting passenger car travel to 65 mph, there is a potential to reduce VOC by 1 to 2.8 tons per day and NOx by 0.9 to 1.9 tons per day, if applied throughout the Bay Area. Approximately 60% of Bay Area driving (VMT) takes place on the freeway system and, based on Caltrans speed monitoring data, 34% of freeway driving occurs at speeds over 65 mph. Therefore, by addressing over-the-limit freeway driving, this measure could achieve a significant amount of emission reductions. A vehicle driven at 75 mph consumes approximately 40% more fuel and emits 35% 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 (e.g. golf clubs)
- Properly maintaining vehicles including maintaining optimal tire pressure

Outreach to encourage these types of smart driving behaviors are included in the outreach component of the Transportation Climate Action Campaign (see TCM C-4).

In Europe there have been several measures that address the relationship between travel speed and traffic safety, climate effects and air quality. Some of the measures that have been undertaken addressed speed reduction, improved speed enforcement, speed alerts, and driver education. A program to promote "ecodriving" has been implemented by several European countries. Program details vary among countries, but generally the focus is on driving school curriculums, fuel saving devices in vehicles, purchasing behavior, and vehicle maintenance. Evaluation of this program has shown positive benefits in traffic safety, GHG reductions and improved air quality.

Implementation Actions:
Phase 1 (2012)

- BAAQMD and MTC to encourage smart driving as a part of the outreach component of the Transportation Climate Action Campaign (see TCM C-4).

As resources permit, BAAQMD will:

- Coordinate and implement programs with business (e.g., tire companies, insurance companies, driving schools, and vehicle manufacturers) and public agencies.
- Implement and coordinate curriculum with High Schools (Driver's Ed) and driving schools.
- Promote/implement a voluntary certification program with fleet operators that could be used as a marketing tool, utilizing the Sustainable Earth Initiative's Green Fleets Toolkit, which was produced with a grant from the BAAQMD.
- Evaluate and potentially promote and implement a program to purchase and install fuel consumption feedback devices in vehicles for a nominal price. Devices are available now for various vehicle models and allow drivers to get real-time information about fuel consumption. Access to this information may influence drivers to practice fuel-saving behavior, such as driving the speed limit, maintaining a steady speed, and avoiding unnecessary acceleration and braking.
- Explore and potentially establish with CHP and others agencies such as MTC and/or ARB a partnership to 1) enhance enforcement of freeway speed limits on an on-going daily basis and 2) emphasize the importance of complying with posted speed limits on Spare The Air days, including use of variable message boards on roadways and public outreach messaging.

Phase 2 (2020)

- MTC and BAAQMD to continue Phase 1 activities

Supporting Actions by Partner Entities:
Local governments, transit agencies, CMAs, school districts, other agencies, media outlets and businesses will be encouraged to join BAAQMD and other partners to create an innovative campaign to connect smart driving with climate protection.

Pollutants (tons per day)	2012	2020*
ROG	0.08	
NO_x	0.17	
$PM_{2.5}$	0.01	
PM_{10}	0.01	
CO_2	176.00	
C02-e	180.00	

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

* 2020 emission reductions are not available at this time.

Emission Reduction Methodology:
The emissions reduction estimate for this measure is based on the following assumptions:

- 35% o freeway travel occurs at speeds over 65 mph
- Of the 65 mph + driving, 50% occurs at 70 mph and 50% at 75 mph
- Speed would be reduced to 65 mph
- The actions described in this measure would reduce five percent of over-the-limit speeding (65 mph for light vehicles and 55 mph for heavy-duty vehicles).

The appropriate emission/speed factors were applied to the above assumptions to calculate the emissions reductions.

It should be pointed out that these assumptions are very conservative. The portion of high-speed driving on freeways may well exceed 35% and many drivers may exceed 75 mph. Using the same assumptions described above, if we assume that all freeway driving in excess of 65 mph were reduced to the 65 mph limit, the reductions would be on the order of 1.6 tpd of ROG, 3.3 tpd of NOX, and 3500 tpd of CO2.

Exposure Reduction:
To the extent that freeway corridors are a major source of emissions in many impacted communities, reducing high speed driving should help to reduce emissions of ROG, NOx, PM, and CO2 in these corridors and throughout the Bay Area.

Emission Reduction Trade-offs:
None identified.

Cost:
Phase 1: $ 3 million ($1 million per year)
Phase 2: $ TBD

Implementation of this measure will be funded as part of the public outreach campaign described in TCM C-4. It is not yet known how much of this funding will be used to promote speed moderation. However, for purposes of estimating the cost-effectiveness of this measure, we estimate $1 million per year.

Co-benefits:
- Economic benefits from fuel savings to individual drivers and to the Bay Area economy as whole. If all high-speed freeway driving were eliminated, based on the conservative assumptions described above, this would save approximately 360,000 gallons of gasoline and diesel per day in the Bay Area, yielding a cost savings greater than $1 million per day.
- 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. According to the National Highway Traffic Safety Administration (NHTSA) speeding is a significant contributing factor to traffic crashes. Based on 2007 data, the NHTSA estimates that nationally speeding related crashes have a $40.4 billion cost to society. In a 2008 Bay Area study, the American Automobile Association estimated that the total cost of car crashes (fatalities and injuries) is $2.7 billion.

Monitoring Mechanisms:
- While monitoring changes in behavior can be difficult, voluntary programs may be monitored by participation rates.

Issues/Impediments:
Implementation of this TCM requires that funding is available for this program. In addition, this program requires collaboration between multiple agencies. Finally, at present the public is accepting of high-speed driving. This TCM requires that the public begin to recognize the consequences of high-speed driving.

Sources:

1. American Automobile Association. Crashes vs. Congestion: http://www.aaaexchange.com/Assets/Files/2008107142430.CrashesVs.Congestionl.pdf
2. BAAQMD. 2001 Ozone Attainment Plan: http://www.baaqmd.gov/Divisions/Planning-and-Research/Plans/Ozone-Attainment-Plans/2001-Ozone-Attainment-Plan.aspx
3. European Transport Conference 2007: The effects of speed measures on air pollution and traffic safety: http://www.etcproceedings.org/paper/the-effects-of-speed-measures-on-air-pollution-and-traffic-safety.
4. Dijkema, et al. 2008. Air Quality Effects of an urban highway speed limit reduction: http://www.sciencedirect.com.
5. Gauderman, et al. 2007. Effect of exposure to traffic on lung development from 10 to 18 years of age. www.thelancet.com.
6. http://www.ecodrive.org/. Ecodriven Campaign Catalogue for European Ecodriving & Traffic Safety Campaigns.
7. UK Safe and Efficient Driving. http://www.safed.org.uk/About.htm

TCM D-1 - Bicycle Access and Facilities Improvements

Brief Summary:
TCM D-1 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. This TCM also includes improving bicycle access to transit and supporting the annual Bike to Work event.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx by sustaining and improving bicycle access and facilities throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to the airport; and school trips.

Regulatory Context and Background:
Bicycles are an inexpensive and widely available type of zero emissions vehicle. Bicycles are well-suited to a wide range of trips in urban settings. 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. Cities such as Palo Alto, Davis, Seattle, and Portland have demonstrated that bicycle use can be integrated into local transportation networks.

Improved bicycling facilities increase perceived and actual safety of travel by bicycle as well as its overall attractiveness, encouraging more travel by this mode. The average trip length for all personal trips in the Bay Area is just under 3 miles, a distance short enough for travel by bicycle. In addition, improved bicycle facilities can encourage park-and-ride users to shift modes to bike-and-ride. Bicycle improvements encourage mode shift for shorter trips, which are a majority of total personal trips. The average weekday trip length for all personal travel in the Bay Area in 2006 was 2.95 miles. Of total personal trips in 2006, 21% of trips were less than one mile, 18% were between 1 and 2 miles, 12% were between 2 and 3 miles, and 8% were between 3 and 4 miles.

Many barriers exist that prevent more bicycle trips. In particular, parts of the Bay Area lack bicycling routes that include features such as lower speed limits, bicycle lanes or other facilities, loop detectors that detect bicyclists waiting at red lights, and other complete street features.

MTC's Regional Bicycle Plan for the San Francisco Bay Area, 2009 Update was created to focus regional bicycle-related funding on high-priority bicycle facilities that serve regional

trips. The Plan defines a Regional Bicycle Network made up of key routes in each county. The Plan was updated in 2009 and was adopted as a part of MTC's Transportation 2035 Plan. MTC created the Regional Bicycle Working Group to implement the Regional Bicycle Plan. The Working Group's activities include data collection and analysis; collaboration with transit operators to provide bike parking at stations; and marketing and outreach.

In July 2006, MTC adopted Resolution 3765 to encourage the routine accommodation of bicyclists and pedestrians in projects that are funded by MTC regional discretionary funds. To implement the resolution, MTC developed a Routine Accommodation Checklist Policy, requiring project sponsors to consider the needs of bicyclists and pedestrians in project design.

In its Transportation 2035 Plan, MTC committed $1 billion in funding over the next 25 years for the Regional Bicycle Program.

The Bicycle Facility Program (BFP) is a component of BAAQMD's Transportation Fund for Clean Air (TFCA) grant program that provides funding to reduce motor vehicle emissions through the implementation of new bicycle facilities in the San Francisco Bay Area. Since 2003, BAAQMD has awarded approximately $14.6 million towards bicycle facility projects in the Bay Area.

MTC has created the Safety Toolbox, a website that provides tools for preventing collisions, injuries and fatalities, and encouraging walking and bicycling through partnerships between multiple disciplines, multiple jurisdictions, and the public. The site includes information on engineering and maintenance (e.g. design standards and review), law enforcement (e.g. police stings or photo enforcement to identify motorists who violate pedestrian right-of-way crossing streets), planning (e.g. pedestrian- and bicycle-friendly local policies), community involvement (e.g. local jurisdiction pedestrian and bicycle advisory committees), school districts (e.g. Safe Routes to School), and public health (e.g. health promotion).

The Transportation Development Act (TDA) is a quarter-cent sales tax that is imposed statewide in California for transportation purposes. A share of this money, TDA Article 3, goes to fund pedestrian and bicycle projects. To obtain TDA funding from MTC, local jurisdictions must have Bicycle Advisory Committee to plan and prioritize funding for bike projects.

A special issue in the bicycle community is the provision of bike lanes on the Bay bridges. Bay bridges with bicycle lanes currently include the Golden Gate, Carquinez, Antioch, and Dumbarton Bridges. The New East Span of the San Francisco-Oakland Bay Bridge and the new Benicia Bridge will also have bicycle lanes. Caltrans completed a feasibility study to install bicycle lanes on the west span of the Bay Bridge in 2001 and Bridge and Toll Authority (BATA) is currently preparing a Project Study Report (PSR) to update this analysis. In particular, it will identify a new cost estimate and update the engineering and design for the touchdown points on Yerba Buena Island and on Rincon Hill in San Francisco.

Bicycle projects are also funded as a part of MTC's Transportation for Livable Communities (TLC) program (see TCM D-3).

The regional FOCUS program (described in TCM D-3) also seeks to create communities that meet the day-to-day needs of residents in a bicycle-friendly environment.

The State of California also funds bicycle projects through its Bicycle Transportation Account (BTA) which is expected to allocate $7.2 million statewide in FY 2009-10.

Many Bay Area counties also fund bicycle projects though their local option sales tax expenditure plans. These counties include:

- Alameda: 5% of revenues, measure sunsets in 2022
- Contra Costa: 1.5% of revenues, measure sunsets in 2025
- Marin: 3.5%, measure sunsets in 2025
- San Mateo: 3%, measure sunsets in 2033
- Sonoma: 4%, measure sunsets in 2025

Implementation of bike sharing programs is on the rise around the globe. A number of cities, such as Paris and Montreal, have successfully implemented bike sharing programs.

Implementation Actions:

Phase 1 (2012)

To improve bicycle access and facilities, MTC will:

- Fund bicycle improvements through the Regional Bicycle Program that are a part of the Regional Bikeway Network ($19.5 million – Note: As of December 2009, MTC approved $19.5 million in the first programming cycle of the new federal transportation act for the Regional Bicycle Program).
- Apply the Routine Accommodations Checklist Policy to projects funded by regional discretionary sources.
- Continue to fund bicycle projects with TDA Article 3 funds ($0.4 million).
- Continue to fund and promote annual Bike to Work event ($0.5 million).
- Continue to provide bicycle education and information dissemination via 511 Bicycle website, including the BikeMapper tool ($0.3 million).

BAAQMD will:

- Continue to fund bicycle projects with TFCA funds through the Bicycle Facilities Program (BFP) ($1.8 million).

ABAG will:

- Continue to work with local jurisdictions and special districts to advocate for the completion of the 500-mile Bay Trail, a planned recreational and commute corridor that, when complete, will encircle San Francisco and San Pablo Bays with a continuous

network of bicycling and hiking trails. The Bay Trail provides easily accessible recreational opportunities, as well as key transportation linkages.

Phase 2 (2020)
MTC will:

- Pursue additional funding for the Regional Bikeway Network ($TBD million).
- Continue to fund bicycle projects with TDA Article 3 funds ($1.4 million).
- Continue to fund and promote annual Bike To Work event ($1.2 million).
- Continue to provide bicycle education and information dissemination via 511 Bicycle website, including the BikeMapper tool. ($0.9 million).

BAAQMD will:

- Continue to fund bicycle projects with TFCA funds through the Bicycle Facilities Program (BFP) ($4.8 million).
- BAAQMD will encourage MTC to meets its T2035 commitment to provide $1 billion in funding for the Regional Bicycle Program.
- MTC, BAAQMD and ABAG will sustain other Phase 1 programs.

Supporting Actions by Partner Entities**:**

- Cities and counties should implement their bicycle plans, provide a comprehensive network of bicycle lanes, routes, and pathways, and provide secure bicycle parking.
- Local governments, including park districts and other special districts, should continue to build, operate, and maintain bicycle facilities.
- Local governments are encouraged to require bicycle access and amenities as a condition of approval of new development projects, and to require secure bicycle parking in existing public and private parking lots and office buildings.
- Local governments should consider using a broader approach to measure roadway performance that considers cyclists and pedestrians as well as motor vehicles, rather than relying on Level of Service (LOS) that is solely based on motor vehicle throughput.
- Caltrans, Congestion Management Agencies and local governments should implement “complete streets” policies to ensure that cyclists and pedestrians are safely accommodated on all streets and roads.
- Transit agencies should implement policies and maintain and expand facilities to accommodate bicycles on rail transit, buses and ferries.
- Local governments should consider implementing bicycle-sharing programs.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.00	0.01
NO_x	0.00	0.00
$PM_{2.5}$	0.00	0.00
PM_{10}	0.00	0.00
CO_2	4.36	9.93
C02-e	4.44	10.13

This measure will also reduce emissions of the following pollutants by less than 0.01 tons per day: ROG, NOX, PM2.5, PM10, NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
This analysis uses a methodology developed using data collected around cycling facilities in the cities of Minneapolis and Saint Paul, Minnesota, to estimate use of a new cycling facility, as well as to estimate how much use is generated by the new facility versus how much is generated by existing cyclists changing routes (see Krizek et al 2006). Because the funds expected to be available to fund the RBN will not be sufficient to build the whole network, this analysis assumes 3% of the unbuilt network will be built by 2012 and 6% will be built by 2020. Using the estimated number of employed residents within ¼ mile, ½ mile, and 1 mile buffers around the unbuilt portion of the RBN and the regional bicycle commute share, the existing number of cycling commuters is estimated. The number of new commuter cyclists is then estimated based on multipliers applied to the number of existing bicycle commuters in each buffer. New cycling trips for non-work purposes are estimated based on the ratio of bike commute trips to bike non-work trips. Vehicle trips reduced is then estimated by assuming 63% of all new cycling trips will replace car trips, and vehicle miles travelled reduced is estimated by assuming a 4.54 mile average bicycle commute distance and a 2 mile average bicycle non-work trip distance. This analysis excludes emissions reductions associated with funding via TFCA, TDA Article 3, Bike to Work Day, and the provision of bicycling information via 511.org.

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:
2012: $22.5 million
2020: $8 million

Co-benefits:

- Improved safety/reduced bicycle-motor vehicle accidents.
- Improved public health/reduced obesity.
- Reduced travel costs.

Monitoring Mechanisms:

- Track new miles of the Regional Bikeway Network constructed and projects funded through the BFP.

Issues/Impediments:

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. Improving bicycle facilities and public education for bicyclists and drivers can increase perceived and actual safety.

Implementation of this TCM requires that funding is available for these programs.
At present, funds for bicycle improvements are limited and funds to implement the bridge portion of the Regional Bikeway Network have not been identified.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Regional Bicycle Plan for the San Francisco Bay Area 2009 Update: http://www.mtc.ca.gov/planning/bicyclespedestrians/MTC_Regional_Bicycle_Plan_Update_FINAL.pdf
3. MTC's Safety Toolbox at http://mtc.ca.gov/planning/bicyclespedestrians/
4. Krizek, Kevin, et al 2006. *NCHRP Report 552: Guidelines for Analysis of Investments in Bicycle Facilities.* Washington D.C.: Transportation Research Board.: http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_552.pdf.
5. League of American Bicyclists report on the City of Davis Bicycle Plan: http://www.bikeleague.org/programs/bicyclefriendlyamerica/communities/bfc_davis.php
6. League of American Bicyclists report on the City of Portland Bicycle Plan: http://www.bikeleague.org/programs/bicyclefriendlyamerica/communities/bfc_portland.php.

TCM D-2 - Pedestrian Access and Facilities Improvements

Brief Summary:
TCM D-2 will improve pedestrian facilities and encourage walking by funding projects that improve pedestrian access to transit, employment and major activity centers. Improvements may include sidewalks/paths, benches, reduced street width, reduced intersection turning radii, crosswalks with activated signals, curb extensions/bulbs, buffers between sidewalks and traffic lanes, and street trees.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx by encouraging walking throughout the Bay Area. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

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

Regulatory Context and Background:
Improved pedestrian facilities increase perceived and actual safety of walking on trips as well as the overall attractiveness of walking, encouraging more travel by this mode. About one-fifth of all personal trips are less than a mile, a short enough distance to walk. In addition, improved pedestrian facilities can encourage park-and-ride users to shift modes to walk-and-ride.

Many barriers exist that prevent people from taking more walk trips. In particular, low levels of pedestrian travel can be attributed to low density, single-use land use patterns and development of streets, roads and development projects that lack adequate attention to the pedestrian environment.

Pedestrian improvements encourage mode shift for shorter trips, especially those less than a mile. In 2006, 21% of total weekday personal trips were less than one mile. In addition, for longer trips pedestrian improvements encourage transit users who access transit by car to switch to accessing transit by walking.

These types of barriers can be overcome through a variety of techniques, including:

- Ensuring the design and placement of buildings in new developments provide amenities such as sidewalks/paths, benches, and landscaping; minimize setbacks from street; and provide entrances near sidewalks and transit stops (as well as retrofitting existing developments/streets to include these features).
- Providing an integrated street network with direct routes for pedestrians and ensuring easy pedestrian access between neighboring developments, as well as downtowns, commercial areas and community centers.

- Locating and designing parking so pedestrians have direct, attractive access (see TCM E-2)
- Promoting pedestrian-friendly land uses (see TCM D-3).
- Using street design standards that enhance pedestrian safety and comfort through measures such as reduced street width, reduced turning radii, crosswalks with activated signals, curb extensions/bulbs, buffers between sidewalks and traffic lanes, streets trees, etc.

MTC's Regional Pedestrian Committee was created in 2001. The Pedestrian Program works at the regional and community level to make walking a safe, convenient, and healthy activity by using the best engineering, public education, and law enforcement practices to minimize pedestrian injuries and fatalities.

MTC has created the Safety Toolbox, a website that provides tools for preventing collisions, injuries and fatalities, and encouraging walking and bicycling through partnerships between multiple disciplines, multiple jurisdictions, and the public. The site includes information on engineering and maintenance (e.g. design standards and review), law enforcement (e.g. police stings or photo enforcement to identify motorists who violate pedestrian right-of-way crossing streets), planning (e.g. pedestrian- and bicycle-friendly local policies), community involvement (e.g. local jurisdiction pedestrian and bicycle advisory committees), school districts (e.g. Safe Routes to School), and public health (e.g. health promotion).

Pedestrian projects are funded as a part of MTC's Transportation for Livable Communities (TLC) program (see TCM D-3).

The Transportation Development Act (TDA) is a quarter-cent sales tax that is imposed statewide in California for transportation purposes. A share of this money, TDA Article 3, goes to fund pedestrian and bicycle projects.

Since 2003, BAAQMD has awarded smart growth projects that improve conditions for pedestrians with approximately $6 million in funds (see TCM D-3).

In 2006, MTC prepared the Bay Area Pedestrian Districts Study to encourage and improve pedestrian planning in the Bay Area. The Pedestrian Districts Study advances the use of pedestrian districts as a concept for creating better pedestrian environments in the Bay Area. Through the development of the pedestrian district typologies and real-life case studies, the study identifies the types and costs of pedestrian facilities that have the greatest impact on improving the pedestrian environment. This study is one tool that cities and counties can use in planning for pedestrian improvements.

Pedestrian projects are also subject to MTC's Routine Accommodation Checklist Policy (see TCM D-1).

The regional FOCUS program (described in TCM D-3) also seeks to create communities that meet the day-to-day needs of residents in a pedestrian-friendly environment.

Implementation Actions:
Phase 1 (2012)
MTC to:

- Continue to fund pedestrian safety and facility improvements with TLC funds (see TCM D-3) and through Safe Routes to School and Safe Routes to Transit (see TCM C-2).
- Continue to fund pedestrian projects with TDA Article 3 funds ($0.6 million).

BAAQMD to:

- Continue to fund projects that enhance pedestrian facilities through TFCA funds (referred to as Smart Growth and traffic calming in TFCA guidelines, see TCM D-3).

ABAG to:

- Continue to work with local jurisdictions and special districts to advocate for the completion of the 500-mile Bay Trail, a planned recreational and commute corridor that, when complete, will encircle San Francisco and San Pablo Bays with a continuous network of bicycling and hiking trails. The Bay Trail provides easily accessible recreational opportunities, as well as key transportation linkages.

Phase 2 (2020)

- MTC to continue to fund pedestrian projects with TDA Article 3 funds ($1.8 million).
- BAAQMD to continue to fund projects that enhance pedestrian facilities through TFCA funds (referred to as Smart Growth and traffic calming in TFCA guidelines, see TCM D-3).

Supporting Actions by Partner Entities:

- Cities and counties should provide a comprehensive network of facilities, including sidewalks, pathways and provide for pedestrian access in their development plans.
- Local governments are encouraged to require pedestrian access and amenities as a condition of approval of new development projects, such as street trees, furniture, lighting, shelter for transit patrons and inviting environments for walking.
- Local governments should consider using a broader approach to measure roadway performance that considers cyclists and pedestrians as well as motor vehicles, rather than relying on Level of Service (LOS) that is solely based on motor vehicle throughput.
- Local governments should adopt land use policies that support more compact, infill development to make neighborhoods more walkable.
- Caltrans, Congestion Management Agencies and local governments should implement “complete streets” (aka “routine accommodation”) policies to ensure that cyclists and pedestrians are safely accommodated on all streets and roads.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.00	0.01
NO_x	0.00	0.00
$PM_{2.5}$	0.00	0.00
PM_{10}	0.00	0.00
CO_2	1.72	4.26
C02-e	1.79	4.35

This measure will also reduce emissions of the following pollutants by less than 0.01 tons per day: ROG, NOX, PM2.5, PM10, NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
By providing safer and more connected walking routes, funding new pedestrian infrastructure will encourage additional walk trips which would previously have been made by car. Because the location and type of pedestrian improvements that will be made with anticipated future TDA Article 3 and TFCA funds are undefined, the expected travel outcome impact is difficult to quantify. This analysis uses outputs from the more defined RBN investment and anticipated outcomes as a proxy to estimate changes in pedestrian travel. The ratio of the amount of money invested in the RBN relative to the percentage increase in cycling trips expected is applied to the amount of funds anticipated to be spent on pedestrian infrastructure to estimate the percent increase in pedestrian trips. An average walk distance of 0.7 miles is applied to determine the number of vehicle miles reduced.

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:
Phase 1: $0.6 million
Phase 2: $1.8 million

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

Monitoring Mechanisms:

- Track number of pedestrian projects funded through TLC and TDA.

Issues/Impediments:

Implementation of this TCM requires that funding is available for these programs.
In addition, long distances, inclement weather, and concerns with safety may all reduce the desirability of pedestrian travel.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. MTC's Safety Toolbox:
   http://www.mtc.ca.gov/planning/bicyclespedestrians/safety/policies.htm

TCM D-3 - Local Land Use Strategies

Brief Summary:
TCM D-3 will support and promote land use patterns, policies, and infrastructure investments that support higher density mixed-use, residential and employment development near transit in order to facilitate walking, bicycling and transit use.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx by promoting land use patterns, policies, and infrastructure investments that support higher densities and job creation near transit that facilitate walking, bicycling and transit use. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:
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; and that are proximate to transit service have distinctly different travel behavior. They take more transit, bicycle, and walk trips and drive shorter distances, resulting in reduced vehicle miles travelled per household. For example, key findings from MTC's Station Area Residents Survey (STARS) Report include the following:

- People who live within ½ mile of a rail or ferry station are four times as likely to use transit as people living farther than ½ mile from a rail/ferry stop.
- Individuals living and working within ½ mile of a rail/ferry stop use transit for 42% of their work commute trips, whereas those who neither live nor work within ½ mile of a station use transit for only 4% of their work commute trips.
- Households within ½ mile of rail stations/ferry generate about half of the vehicle miles travelled of their suburban and rural counterparts.
- People who live within ½ mile of rail or ferry walk about half the time for all short trips (less than one mile), whereas residents who live greater than ½ mile away walk for only about one quarter of short trips.

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."

Land use is directly regulated at the local level by local governments. Cities and counties adopt local general plans, specific plans and zoning ordinances. As local governments support focused growth, these documents will be updated to promote land use patterns with increased densities and mixed land uses, focus development around transit stops, strengthen downtowns and community centers, and promote infill development and reuse/redevelopment of underutilized land.

Since 2003, BAAQMD has awarded smart growth and arterial management projects with approximately $17.5 million in funds.

Local parking policies also impact travel behavior and offer an opportunity to encourage non-auto trips (see TCM E-2).

In July 2005, MTC adopted a landmark Transit-Oriented Development (TOD) Policy. The TOD Policy ties regional discretionary funds for new transit extension projects (funded via Resolution 3434) to supportive land uses. This policy establishes targets for new housing units in each transit corridor and calls for station area plans and corridor working groups to help achieve the housing targets. Station area plans to meet the housing targets must be adopted by local municipalities prior to receiving MTC discretionary funding for construction of Resolution 3434 funds. MTC has provided over $10 million in funding to date to Station Area Planning grant recipients.

ABAG, MTC, BAAQMD and BCDC administer FOCUS, a voluntary, local jurisdiction-led effort to identify future locations for infill development and for the preservation of critical habitat and open space. Through this process over 60 local government entities have identified well over 100 Priority Development Areas (PDAs). PDAs are areas near transit with a mix of housing, jobs, services, and stores to meet the day-to-day needs of residents in a pedestrian- and bicycle-friendly environment. The adopted PDAs offer the chance to house over 50% of the region's 25-year housing needs on 3% of the land within the existing built environment. In addition, 98 Priority Conservation Areas have been designated as areas for protection and preservation.

Furthermore, regional agencies are committed to securing financial incentives and providing technical assistance to designated PDAs and PCAs. A few examples of funding opportunities made available to PDAs to date are the Transportation for Livable Communities Program (described below), $229 million in Proposition 1C funds award by the Department of Housing and Community Development to 21 Bay Area communities (20 of the 21 communities are PDAs), $7.5 million in Station Area Planning grants were awarded to PDAs, and $100,000 from an Environmental Justice grant was awarded to PDAs seeking to engage community members on the topic of displacement due to development in their community. In addition, the BAAQMD's grant program, Transportation Fund for Clean Air, offers additional points to proposed projects that are located in PDAs and Potential PDAs.

MTC's Transportation for Livable Communities (TLC) program offers capital grants to cities, counties, and transit agencies to construct projects that support compact development near transit. Since the inception of the TLC program in 1998, MTC has funded 67 planning projects totaling $2.5 million and 84 capital projects totaling $85 million.

In its Transportation 2035 Plan, MTC allocated $2.2 billion to TLC over the next 25 years. MTC has developed new TLC program guidelines that direct funding to PDAs and allow a broader set of eligible expenditures that are focused on providing the best possible incentives for TOD. As of December 2009, MTC approved $85 million in the first programming cycle of the new federal transportation act for the Transportation for Livable Communities Program.

Senate Bill 375, signed into law in September 2008, requires the Air Resources Board (ARB) to adopt by September 30, 2010, regional greenhouse gas (GHG) reduction targets for emissions associated with the automobile and light truck sector. Metropolitan planning organizations are required to develop a Sustainable Communities Strategy (SCS) element in their long-range transportation plans to reach the GHG reduction targets. The SCS adds three new elements to the plan: 1) a land-use component that identifies areas within the region to house all of the population in the region; 2) a resource and farmland protection component; and 3) a demonstration of how the development pattern and the transportation network can work together to reduce GHG emissions. In the Bay Area, the provisions of Senate Bill 375 will apply to the successor plan to Transportation 2035, scheduled for adoption in 2013. MTC and ABAG will need to work closely with local and regional agency partners to begin implementation of SB 375.

MTC distributes funds to each of the 9 county congestion management agencies (CMAs) for transportation planning, programming and transportation/land use coordination. The interagency funding agreements for FY 2010-12 will include language that encourages county planning activities to support climate protection and reduce VMT.

Implementation Actions:
Phase 1 (2012)
MTC to:

- Award funds through new TLC program to support transit-supportive land uses in FOCUS PDAs ($85 million).
- Implement the TOD Policy for Resolution 3434 Regional Transit Expansion Program.
- Award Station Area Planning Grants to fund city-sponsored planning efforts for areas around future stations of Resolution 3434 projects and for other transit projects in PDAs.

BAAQMD to:

- Continue to fund smart growth projects through TFCA program ($3 million).
- Issue updated CEQA guidelines; the guidelines will establish thresholds of significance for GHGs (see LUM 2 - Updated CEQA Guidelines and Enhanced CEQA Review).

- Issue guidance for local general plan updates, as well as guidelines to help local jurisdictions address air quality and population exposure issues related to infill development.

Regional agencies to :
- Continue to collaborate with local agencies to implement the FOCUS program and Priority Development Areas under the leadership of the Joint Policy Committee and ABAG.
- Begin developing the SCS pursuant to the requirements of SB 375.

Phase 2 (2020)
Sustain Phase 1 programs ($TBD)

Supporting Actions by Partner Entities:
- Local governments are encouraged to update general plans and area plans to encourage infill and support land use that allows residents and workers to walk, bicycle, and take transit to reach destinations, instead of relying on private automobiles.
- Local governments are encouraged to revise parking standards required for new development and update parking policies. (See TCM E-2)
- Transit agencies are encouraged to work with local governments and developers to create mixed-use transit-oriented developments in proximity to transit stations and key bus routes.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.26	0.60
NO_x	0.31	0.72
$PM_{2.5}$	0.15	0.35
PM_{10}	0.58	1.35
Ammonia (NH3)	0.16	0.00
Benzene	0.01	0.00
CO_2	856.50	1998.94
C02-e	873.63	2038.92

Emission Reduction Methodology:
As a part of the Transportation 2035 travel forecast process, MTC evaluated the impact that pricing and land use policies would have on achieving regional performance objectives, including improving air quality. In order to evaluate the impact that a more compact development pattern would have on regional travel, MTC used an alternative growth scenario developed by ABAG that goes beyond the Projections 2007 demographic forecast to balance jobs and housing and target growth in existing communities near transit. This land use alternative reflects considerable shifts in regional growth to existing employment and housing centers, areas projected to have either household or employment growth, and areas with existing and/or planned transit. The alternative scenario also assumes fewer in-

commuters from neighboring regions by accommodating approximately 37,000 more households within the Bay Area. The emissions reductions estimated as a part of the travel forecasts are interpolated for year 2012 from 2010 and 2015 estimates. ABAG's alternative growth forecast is a good proxy to examine transportation impacts from land use changes; however, the provisions described in this TCM are not expected to result in the precise population/employment distribution used for this analysis. Because the alternative forecast houses an additional 37,000 households within the Bay Area, additional air quality benefits are anticipated from households that would otherwise have located in the Central Valley, but work in the Bay Area. However, because these forecasts are at a regional level, the additional benefits associated with housing this portion of the population regionally are not taken into account in this emissions reduction estimate.

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:
Phase 1: $ 88 million
Phase 2: $ TBD

Co-benefits:
- Reduced travel costs.
- Reduced greenhouse gases, particulate matter, and toxic air containments.
- 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.

Monitoring Mechanisms:
- Track funds awarded to and completion of station area plans, TLC projects, projects within PDAs, and TFCA and other grant dollars spent to support and promote land use patterns, policies, and infrastructure investments that support higher density mixed-use, residential and employment development near transit.

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 impacts. However, FOCUS, TLC, and MTC's TOD Policy all provide incentives that help overcome some of these challenges. In addition, as Senate Bill 375 implementation begins,

CEQA-relief incentives for projects consistent with the region's land use strategy to reduce greenhouse gas reductions may also reduce both the time and costs associated with this type of development.

Sources:

1. MTC's Transportation 2035 Plan and Travel Forecasts Data Summary: http://www.mtc.ca.gov/planning/2035_plan/
2. FOCUS: http://www.bayareavision.org/
3. Station Area Residents Survey (STARS) Report (September 2006) http://www.mtc.ca.gov/planning/smart_growth/stars/index.htm.
4. National Research Council. "Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions," (August 2009).

TCM E-1 - Value Pricing Strategies

Brief Summary:
TCM E-1 will pursue implementation of value pricing strategies such as tolling on trans-bay bridges and cordon pricing recommendations from San Francisco County's Mobility, Access, and Pricing Study.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx, by managing travel demand during congested conditions and improving regional bus service through value pricing on the Bay bridges and in San Francisco. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:
Value pricing (which is also known as congestion pricing) refers to varying road tolls wherein higher prices are set at congested times and locations and lower prices are set at less congested times and locations for purposes of reducing peak-period traffic volumes to optimal levels. Tolls can vary based on a fixed schedule, or they can be dynamic, meaning that rates change depending on the level of congestion that exists at a particular time. Value pricing serves as a demand management strategy on existing roadways to avoid the need to add capacity. In addition, value pricing can raise needed revenues for a wide-range of transportation improvements, including public transit.

The Federal Highway Administration's (FHWA) Value Pricing Pilot (VPP) program, which was initially authorized in the Intermodal Surface Transportation Efficiency Act (ISTEA) and most recently renewed under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), encourages implementation and evaluation of value pricing pilot projects to manage congestion on highways through tolling and other pricing mechanisms. Three Bay Area transportation agencies have received VPP funding to study value pricing, including area road charging and parking pricing in San Francisco, express lanes on I-580 and I-680 in Alameda County, and pricing strategies in Santa Clara County.

The San Francisco County Transportation Authority (SFCTA) is currently conducting a Mobility, Access, and Pricing Study (MAPS) to examine the feasibility of value pricing in San Francisco, following receipt of a $1 million VPP study grant from the FHWA. Refined pricing scenarios under evaluation include combining fees on gateway crossings with additional fees on downtown cordon and fees on crossings in the northeast corner of San Francisco. The SFCTA expects to present the final study recommendations in winter 2010.

MTC is pursuing legislation in the 2009 and 2010 state sessions via AB 744 (Torrico) to authorize a Bay Area Express Lane Network to deliver congestion relief and public transit funding. Because of this, the HOV (high occupancy vehicle) occupancy requirements on Bay Area bridges must be made consistent with HOV occupancy requirements on adjacent freeways so that the region's bridges and express lane network form a unified system (see TCM B-3).

In January 2010, the Bay Area Toll Authority (BATA) increased the toll on the seven state-owned toll bridges in the Bay Area to pay for the completion of the Toll Bridge Seismic Retrofit Program. This toll increase included value pricing on the Bay Bridge, where motorists would pay $6 toll during peak hours, $4 toll during non-peak hours, and $5 toll on weekends. The toll increases will go into effect on July 1, 2010. BATA staff will evaluate the value pricing on the Bay Bridge and provide a report to the BATA Oversight Committee on an annual basis after value pricing is implemented.

Implementation Actions:

Phase 1 (2012)

- MTC will assist SFCTA in implementing recommendations of the Mobility, Access, and Pricing Study in San Francisco (if applicable and feasible).

Phase 2 (2020)

- MTC will consider time-of-day pricing on trans-Bay bridges as a part of future bridge toll increases. If the value pricing on the Bay Bridge is successful, value pricing may be considered for application to other bridges in the region, if feasible.
- MTC will continue to assist SFCTA in implementing recommendations of the Mobility, Access, and Pricing Study in San Francisco (if applicable and feasible).

Supporting Actions by Partner Entities:

- Local governments, CMAs and transit agencies are encouraged to partner with MTC to implement value pricing.
- SFCTA will implement recommendations of the Mobility, Access, and Pricing Study in San Francisco (if applicable and feasible).

Emission Reduction:

Pollutants (tons per day)	2012
NO_x	0.02
CO_2	9.68
C02-e	9.87

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: PM10, PM2.5 and NH3 (ammonia). Emission reduction estimates for year 2020 will be determined at a later date, depending upon whether value pricing is extended to include other trans-Bay bridges.

Emission Reduction Methodology:
The emissions reduction methodology is based on the 2009 study, "San Francisco-Oakland Bay Bridge Congestion Pricing – Phase 1" prepared for the Bay Area Toll Authority. This analysis examines the effect of congestion pricing on traffic demand, mode shift and time-of-day shift.
The study determines that the most likely scenario is a 4.7% mode shift from single occupancy travel to other modes, during both the AM and PM peak periods, resulting in the emission reductions reported above.

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:
Phase 1: $26 million per year
Phase 2: TBD.

The cost of $26 million per year is based on the estimated number of vehicles that will pay the additional $2 per vehicle congestion surcharge during AM & PM peak periods on weekdays.

Co-benefits:
- Generation of new funds for multi-modal transportation improvements.
- Travel time savings.

Monitoring Mechanisms:
- Track whether new legislative authority is granted SFCTA to implement its MAPS strategies.
- Track implementation status of SFCTA's MAPS strategies.

Issues/Impediments:
There is mixed public opinion regarding value pricing, with concerns about the impact on existing carpoolers, potential environmental impacts, the use of net revenues, and charging for the use of the highway and bridges.

Sources:

1. FHWA's Value Pricing Program, http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/index.htm
2. San Francisco County Transportation Authority: www.sfmobility.org
3. BATA: http://apps.mtc.ca.gov/meeting_packet_documents/agenda_1433/5a_tollincreasereco mmendationmemo.pdf
4. Cambridge Systematics. "San Francisco-Oakland Bay Bridge Congestion Pricing – Phase 1 Final Report." October 7, 2009.

TCM E-2 - Promote Parking Policies to Reduce Motor Vehicle Travel

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 the Air District, in cooperation with its 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 by implementing parking policies that support in-fill and transit-oriented development and reduce vehicles miles traveled and vehicle emissions through increased transit use, walking and bicycling. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

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 sprawl-like growth 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. 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.

Many cities base their minimum parking requirements on guidelines in the *Parking Generation* manual published by the Institute of Transportation Engineers with little consideration to the location of the land use. The recommended parking ratios in the guidelines are geared toward meeting peak demand for parking in single-use suburban locations with little transit access. Applying these same parking guidelines to more dense, mixed-use areas well served by transit leads to an oversupply of parking, which in turn serves as a disincentive for people to choose other transportation modes over private

vehicles.

An oversupply of parking and ineffective parking management policies creates a number of adverse impacts. For example, parking in dense areas requires using high-value land for parking lots and structures. The high cost of land and construction to build parking drives up development costs. Construction costs for structured parking can range from $30,000 to $60,000 per parking spot. These costs are typically hidden in purchase prices and rents. This exacerbates the shortfall of affordable housing in the Bay Area, creates obstacles to transit-oriented development, and reduces the land available for other uses.

Second, parking supply and the quality of design both influence streetscapes and walk-ability. For example, the pedestrian friendliness of a commercial main street compared to a strip mall depends in part on parking design. In a typical big box strip mall, large stores are surrounded by sprawling parking lots and people tend to drive and re-park from store to store rather than walk. In contrast, a commercial main street with street parking, or parking behind stores, creates a more pedestrian-friendly environment where people are more likely to park once and walk from store to store. Areas where stores are oriented to the street and parking does not dominate the streetscape are also more accessible to bicyclists, and helps reduce motor vehicle travel.

Paved parking areas also contribute to local urban heat island effects, which raises local temperatures. Higher temperatures lead to higher levels of ozone and particulate matter, increase energy use for cooling, and can create health risks for sensitive populations. Paved, impermeable parking surfaces also add to water quality problems including storm water pollution run-off, flooding vulnerability, and reduced groundwater recharge.

Effective parking management can encourage alternative transportation modes, support carpooling and car-sharing, and improve vehicle travel efficiency, thus reducing vehicle miles traveled and emissions. Best practice parking policies and strategies include:

- Coordinated parking policies within jurisdictions and on a regional scale
- Coordinated parking pricing that encourages shorter-term curb parking and longer-term off-street parking
- Parking design guidelines to promote walk-ability
- Unbundled parking from residential and commercial rents
- Parking cash-out by employers
- Parking technologies such as real-time parking information and parking payment devices
- Parking financing such as a parking tax or fee and incentives or rebates
- Parking assessment districts
- Reduced parking requirements in coordination with requirements for transit passes and other transportation demand management strategies (TDMs), such as shuttles, for new developments and/or implementation of parking maximums
- Shared parking between land uses with different patterns of demand

Donald Shoup's book, *The High Cost of Free Parking* describes the consequences of non-

market rate parking pricing and strategies to reform parking policy in much greater detail.

Examples of effective parking policies can be found in Bay Area cities. The San Francisco Metropolitan Transportation Agency (SFMTA) is implementing SFPark, a variable rate parking pricing strategy to effectively manage curb, lot, and structured parking spaces. The variable rate will be determined by location, time of day, and day of week. This project is funded through a U.S. Department of Transportation program grant. Prices will be adjusted to direct short-term parking to street parking and longer-term parking to lots and garages.

The City of Redwood City adopted a downtown parking plan and a parking ordinance to allow for periodic adjustment of downtown meter rates. Rates are based on achieving a parking utilization rate of 85 percent.

A number of local governments have reduced parking requirements for new development in conjunction with TDMs, including the cities of San Jose, Berkeley, and San Mateo.

MTC has provided technical information on parking to local agencies. In 2007, MTC conducted a parking policy study with the purpose of developing best practices and modeling tools. The study resulted in several key products including:

- Toolbox/handbook for parking best practices and strategies that support transit oriented development for local governments.
- Parking demand model that can be customized for local conditions.
- Detailed case studies of parking policies for 10 Bay Area cities.
- Parking training seminar for local governments hosted by MTC.

The Joint Policy Committee (JPC) has identified regional parking policies as a priority area in its climate action strategy. MTC, in leading this effort, is preparing a report, "Regional Parking Strategies for Climate Protection," to outline a set of regional parking reform strategies and actions to reduce greenhouse gas emissions. The JPC is in the process of developing regional parking policies. Strategies may include: leading by example, incorporating parking policies into current and conditions for forthcoming regional grants to local jurisdictions (e.g. TLC, Climate Change, Station Area Plans) with regional monitoring, engaging congestion management agencies as partners for climate protection, using or extending existing regulations to parking, conditioning distribution of regional discretionary transportation funding to local jurisdictions on implementation of specified parking management policies/practices, funding parking programs with a regional gas tax, and advocating for elimination of federal tax subsidy for employee parking.

Implementation Actions:

Phase 1 (2012)

- Regional agencies will participate in the Joint Policy Committee (JPC) consideration and adoption of regional parking strategies.
- Regional parking strategies will consider using parking fees to improve transit and other alternative modes of travel, such as biking and walking.

MTC will:

- Provide technical assistance to local jurisdictions such as consultant assistance for individual cities through the TOD Technical Assistance Program (TOD TAP) and offering best practices workshops
- Develop Transportation 2035 Climate Change guidelines regarding capital support for innovative parking strategies.
- Incorporate parking issues into the broader public outreach program for climate action.
- Continue support for State and Federal bills to reduce subsidies for parking.
- Support other BAAQMD efforts described below as relevant and feasible.

BAAQMD will:

- Work with partners to explore ways to provide financial incentives to cities and counties to implement parking policies.
- Work with partners to consider the air quality impacts associated with free parking as part of the District's Indirect Source Review (ISR) Rule development. The District is currently developing an ISR and anticipates rule adoption in 2011. Parking supply and policies may be considered as performance standards in the ISR development.
- Identify appropriate grant opportunities that can be applied to implementing parking policies.
- Make implementation of such policies a condition for receiving certain funds that are awarded at the regional agencies' discretion.
- Integrate parking best practices into the update of its guidelines for evaluating air quality impacts in CEQA analyses. The District's CEQA Guidelines are currently being updated and are scheduled to be adopted in 2010. Parking best practices will be included in the guidance document as recommended mitigation measures. In addition, in providing comment on CEQA analyses to lead agencies, the Air District recommends for cities to include parking best practices as a condition of project approval.
- Highlight parking best practices in its best practices web portal. The District has partnered with the Institute for Local Government to develop a best practices web portal to serve as an information clearinghouse for Bay Area local governments seeking to implement climate protection actions.
- Working with partners, will consider funding a parking technology demonstration projects. Demonstration projects may include providing real-time parking information, pay-by-phone parking, a parking hotline program where people call in advance for automated information on available parking, or related car-sharing or bike-sharing technology project. The goal would be to better understand the potential for these projects to create mode shifts and therefore reduce emissions.
- With its partners promote implementation of parking cash-out programs and advocate for legislation to strengthen and expand the reach of the California parking cash-out law enacted in 1992, including advocating appropriate legislative actions to improve the parking cash-out program, such as identifying potential financial incentives for parking cash-out programs, and recommending that parking cash-out programs be required as a condition of approval in environmental review processes.

ABAG will:

- Integrating parking best practices into its FOCUS program, through technical assistance and other resources provided to local governments.
- ABAG and MTC to administer Station Area Planning grants to FOCUS Priority Development Areas and Resolution 3434 stations that encourage adoption of TOD-oriented parking management strategies in final area plans.

Phase 2 (2020)

- MTC, BAAQMD, and ABAG will continue Phase 1 actions.

Supporting Actions by Partner Entities:

- SFMTA will implement SFpark.
- Local agencies are encouraged 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 and consider residential permit programs to alleviate spillover concerns.
  - Implement performance-based pricing for curb 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.

Employer-Based Actions:

- Employers, in partnership with regional agencies and in particular BAAQMD, can work to reduce motor vehicle travel by promoting and implementing parking cash-out programs.
- Business groups can work with regional partners to encourage employers to voluntarily implement parking cash out programs, and/or develop other parking best practices.

Emission Reduction:

Pollutants (tons per day)	2012	2020
ROG	0.18	0.16
NO_x	0.19	0.16
$PM_{2.5}$	0.02	0.03
PM_{10}	0.02	0.05
Ammonia (NH3)	0.05	0.15
CO_2	288.00	553.00

CO_2-e	294.00	564.06

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
This measure encompasses a wide range of potential actions by various regional and local agencies, to promote parking policies to reduce motor vehicle travel. The specific combination of strategies and actions that will be implemented has not yet been determined, so the potential emission reductions for this measure cannot be predicted with any degree of confidence as yet. For purposes of estimating potential emission reductions from parking measures we have analyzed the potential emission reductions that might be achieved if parking fees were to be imposed at Bay Area worksites. However, it should be emphasized that employer parking fees are not proposed as part of this measure. Rather, this is used as an example for purposes of estimating potential emission reductions, because analysis of employer parking fees was previously performed and therefore available.

The employee parking fee emission reduction methodology uses empirical findings that support a relationship between employee parking prices and vehicle work trip rates for the Bay Area (Harvey and Deakin, 1997). This data suggests that a $3.18 employee parking fee will result in a 1.65% decline in vehicle work trips. Based on Transportation 2035 Travel Forecast data, BAAQMD estimated that this charge has the potential to eliminate approximately 62,400 vehicle trips in 2012, and approximately 120,600 vehicle trips in 2020.

This analysis does not take into account that funds raised by parking pricing can be re-invested into the transportation system to improve access to transit and other alternative modes of travel, such as bicycle and pedestrian travel to further promote transit use.

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:
Phase 1: $1.4 billion/year. If a fee as described above were imposed on all employer-provided parking in the region, this would result in costs of approximately $1.4 billion to employees who continue to park in employer-provided lots. However, as noted above, such a fee is not proposed as part of this measure.
Phase 2: $1.4 billion/year

Co-benefits:

- Generation of parking revenues.
- 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 cruising and associated congestion and vehicle 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.

Monitoring Mechanisms:

- A panel of academic researchers, including Donald Shoup, will conduct a program evaluation of SFpark.
- MTC will track legislative actions related to parking policies.

Issues/Impediments:

Local government parking reform can be impeded by limited resources and technical expertise, especially in small municipalities. These jurisdictions can seek technical assistance from MTC. Technical assistance may include: training seminars, sharing of best practices across municipalities, and development of outreach and education materials for developers and the public.

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 will; fear that businesses will protest; fear that their city will be at a disadvantage with competitors in neighboring cities without similar parking reforms; and concern that the process will be stalled due to protests from businesses and residents. 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. MTC Parking Study including presentations and resource documents: http://www.mtc.ca.gov/planning/smart_growth/parking_study.htm
2. MTC Regional Parking Strategies for Climate Protection by Nelson\Nygaard Consulting Associates, May 2009
3. SFMTA's SFpark program: http://www.sfmta.com/cms/psfpark/sfparkindx.htm
4. Shoup, Donald. *The High Cost of Free Parking.* Washington D.C.: APA Planners Press,

2005.

TCM E-3 - Implement Transportation Pricing Reform

Brief Summary:
Motor vehicle travel imposes a variety of costs on society, including air pollution, that are not fully reflected in the price that drivers currently pay to own and operate a vehicle. Transportation pricing strategies can provide a powerful mechanism to reduce motor vehicle travel, traffic congestion, and tailpipe emissions of criteria pollutants and greenhouse gases. This control measure proposes that the Air District and its regional agency partners collaborate to develop and implement a regional transportation pricing policy strategy.

Purpose:
This measure will reduce emissions of the key ozone precursors, ROG and NOx by implementing transportation pricing policies in the Bay Area through establishment of a regional pricing task force to evaluate transportation pricing policy options and coordinated implementation of a regional transportation pricing strategy. In addition, the measure will reduce emissions of particulate matter, air toxics and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel; passenger and commute trips to airports; and school trips.

Regulatory Context and Background:
Transportation pricing, if well conceived and implemented, can help to achieve some or all of the following objectives:

- Reduce total vehicle trips and VMT.
- Reduce traffic congestion.
- Reduce emissions of criteria pollutants and greenhouse gases.
- Generate revenues that can be used for a variety of purposes, including support for public transit and alternative modes of transportation.
- Increase use of alternative transportation modes, such as transit, rideshare, walking and biking.

In its Transportation 2035 (T2035) Plan adopted in April 2009, MTC highlighted the importance of transportation pricing to help achieve the performance objectives defined in the Plan.

Transportation pricing mechanisms that may be available at the regional or local level include:

- High-occupancy toll (HOT) lanes – see TCM B-3.
- Value pricing, including variable bridge tolls, congestion pricing of roadways, or zone pricing (e.g. downtown tolls) – see TCM E-1.

- Parking pricing – see TCM E-2.
- Gas tax or fee: This could include imposing a gasoline tax or fee at the regional level (MTC has existing authority to place a regional gas tax measure on the ballot in Bay Area), and/or helping to build support for higher gas taxes at the state and federal levels.
- Diesel tax or fee: Revenues from higher diesel fuel taxes could be used to reduce NOx and particulate matter emissions from older heavy duty diesel trucks, which may stay on the road for many years due to the durability of their engines. Funds could go to help offset the cost of purchasing new vehicles, repowering existing vehicles with cleaner engines, or retrofitting trucks with aftermarket devices that significantly reduce NOx and particulate matter.
- VMT fee: As an alternative to gas or diesel taxes, a fee could be levied based on vehicles miles traveled, i.e., the annual miles that a vehicle is driven.
- Pay-as-you-drive vehicle insurance: Pay-as-you-drive insurance premiums would be more sensitive to the number of miles an individual drives, thereby offering vehicle owners an incentive to cut back on miles driven.
- Emission-based vehicle registration fees: Vehicle registration fees could be used to influence the purchase choices of new vehicles. Annual fees would be based on vehicle emission characteristics and the amount of annual driving that is conducted (which would be assessed at the time the vehicle undergoes a Smog Check). The fees would be used in turn to pay for various air quality programs, such as Voluntary Accelerated Vehicle Retirement programs (VAVR), fixing emission controls on mid-aged vehicles, incentives to tune up vehicles prior to the next smog season, financial assistance to low income families that would face hardships with costly tune-ups, and other programs.
- Feebates: Feebates, incentives for purchasing fuel efficient vehicles, could be offered to consumers for choosing fuel efficient vehicles over other vehicles. Funding from feebates could come from the emission-based vehicle registration fee noted above.

Implementing transportation pricing policies will require political leadership, public support, and coordination among the Bay Area's regional agencies and local jurisdictions. Although the potential benefits of transportation pricing are significant, there are major obstacles as well. The technical means are available to implement several value pricing strategies; the constraints are primarily political. The universe of potential pricing mechanisms is well defined, and pricing measures have been included in Bay Area air quality plans since 1991. The real challenge is how to develop and execute a clear strategy to implement transportation pricing in the Bay Area.

Transportation pricing policies must identify and address equity concerns, specifically those that disproportionally affect low-income drivers and impacted communities. These concerns should be addressed early in the development process. Effective pricing modeling, measures to minimize disproportionate impacts, public outreach, and monitoring of pricing policies equity issues should be incorporated into pricing strategies.

Implementation Actions:
The Air District and MTC will collaborate with their regional agency partners under the auspices of the Joint Policy Committee to establish a regional transportation pricing task force. The task force will be charged with:

- Developing a public engagement and input process, and coordinating with key stakeholders.
- Defining goals and outcomes.
- Developing evaluation criteria based upon those goals.
- Analyzing the various pricing options based upon the criteria.
- Identifying and advocating for any necessary enabling legislation.
- Recommending a regional transportation pricing strategy and an action plan to implement the strategy, including policies regarding reinvesting transportation fees to improve transit service and other alternative modes, such as biking and walking.

A regional transportation pricing strategy can help to feed into and inform the Sustainable Communities Strategy that will be developed as part of the next update of the Regional Transportation Plan in 2013.

Supporting Actions by Partner Entities:
Local governments, businesses, insurance providers, and other public and private entities are encouraged to develop and implement policies to ensure that user costs to own and operate motor vehicles reflect the full environmental and social costs related to vehicle use. This can be pursued via value pricing of the roadway network (see TCM E-1), parking policies (see TCM E-2), and other pricing measures, such as those described in the "Background" section above.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.12	0.06
NO_x	0.12	0.06
$PM_{2.5}$	0.01	0.01
PM_{10}	0.02	0.02
Ammonia (NH3)	0.07	0.07
CO_2	184.00	200.00
C02-e	188.00	204.00

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emission Reduction Methodology:
This measure describes a variety of potential pricing policies and strategies to reduce motor vehicle emissions. The specific combination of strategies and actions that will be endorsed by the proposed regional transportation pricing task force cannot be predicted with any

degree of confidence at this time. For purposes of estimating potential emission reductions from this measure, we have analyzed the potential emission reductions that might be achieved by means of a regional gas tax increase, as described below. We use the regional gas tax as an example because studies have been performed that demonstrate the relationship between higher gas fees and a reduction in vehicle trips and therefore vehicle miles traveled. However, it should be emphasized that such a fee is only one pricing option that may be evaluated by a regional task force and is not explicitly being proposed as part of this measure; rather, it is provided here as an example to illustrate the potential impact of pricing measures in reducing motor vehicle travel and emissions.

The regional gas tax emission reduction methodology uses empirical findings that support a relationship between a gasoline tax increase and decreased trip rates (US EPA). This data suggests that a 1% increase in tax would result in a 0.9% decrease in vehicle trips. At a cost of $3.01 a gallon, an increase of $0.30 per gallon was assumed. This is a 10% increase in tax.

Based on Transportation 2035 Travel Forecast data, we estimate that this charge has the potential to eliminate approximately 127,100 vehicle trips in 2012, and approximately 138,300 vehicle trips in 2020. The vehicle trips eliminated include work and non-work trips and it is assumed that 25% percent would be work trips, and 75% percent would be non-work trips. Based on these assumptions, the number of miles and emissions reduced was then estimated.

This analysis does not take into account that funds raised by a gasoline tax can be re-invested into the transportation system to improve access to transit and other alternative modes of travel, such as bicycle and pedestrian travel.

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:
Phase 1: $470 million/year. If gas taxes were increased by $0.30 per gallon as described above, this would result in costs of approximately $470 million per year to Bay Area residents, based on current gasoline consumption data. However, as noted above, such a fee is not proposed as part of this measure.
Phase 2: $500 million/year

Co-benefits:
- Generate revenues that could be invested in supporting transit, other alternative modes of travel, and transit-oriented development.
- Increase transit ridership, walking, and cycling.
- Reduce health risks from vehicle emissions and enhanced walk-ability.

Monitoring Mechanisms:
Progress will be monitored by tracking the progress and outcomes of the Regional Pricing Task Force. An initial work product of the Task Force will be to identify milestones and schedule for their process.

Issues/Impediments:
Transportation pricing reform may be controversial. Any proposal will need to consider equity impacts.

Sources:
1. ICLEI, January 2006. Changing the Pricing Signal. http://www.iclei.org/
2. Victoria Transport Policy Institute, http://www.vtpi.org/
3. Rand Corporation, 2009. "Equity and Congestion Pricing." http://www.rand.org/pubs/technical_reports/TR680/.
4. U.S. Environmental Protection Agency, "Technical Methods for Analyzing Pricing Measures to Reduce Transportation Emissions," Table 2.2. August 1998. http://www.epa.gov/OMS/stateresources/policy/transp/tcms/anpricng.pdf

LUM 1 - Goods Movement

Brief Summary:
This control measure aims to reduce emissions and population exposure related to movement of freight in the Bay Area by means of incentives, enforcement, research, strategic partnerships, and outreach. Regional components of this measure will focus on reducing truck use by encouraging a shift to other modes of freight transport by supporting pilot projects and research, as well as working with partner agencies to promote land uses patterns and distribution systems (roadways, logistic systems) that result in less vehicle miles traveled. At the local level, this measure includes targeted enforcement of ARB diesel regulations, outreach to businesses and fleets operating in goods movement corridors to encourage turnover to cleaner engines, and installation of signage to indicate trucks routes and anti-idling regulations. This measure also calls for advocating for container fees to be imposed on goods transported through Bay Area ports to fund strategies to offset goods movement emissions.

Purpose:
The purpose of this measure is to 1) reduce human exposure to diesel emissions from goods movement in the near term and 2) develop and support long-range strategies and partnerships to reduce emissions from the movement of freight in the Bay Area.

Source Category/Travel Market Affected:
Heavy and medium duty diesel trucks, locomotives and rail, dockside emissions from ships.

Regulatory Context and Background:
The Bay Area is home to a robust and varied economy, including the nation's fourth largest Port and five refineries, and serves as a major gateway for Pacific Rim trade. I-880, I-101, and I-80 freeways are heavily used to transport goods and intersect major metropolitan areas of Western Contra Costa/Richmond, East San Francisco, parts of the South Bay and Alameda County/West and East Oakland. Sensitive receptors and vulnerable populations near these goods movement corridors have been identified through the District's Community Air Risk Evaluation Program as being disproportionally impacted by elevated concentrations of toxic air contaminants, when compared to other areas of the Bay Area. The District has an important role to play in addressing these goods movement corridors as part of fulfilling its mission to protect the public's health and the environment.

The delivery of raw materials and finished products to factories, distribution centers and stores represents a significant segment of the Bay Area's emissions inventory. An extensive State and federal regulatory program will reduce criteria and toxic emissions from these sources down to very low levels per engine over the next 5-10 years. Over the past few years, ARB has adopted regulations consistent with their Goods Movement Emissions Reduction Plan (GMERP) goal of reducing diesel emission by 85% by 2020. These regulations have addressed: on road drayage trucks, locomotives, harbor craft, ocean going vessels, and off-road equipment.

In addition, regional plans which address the Bay Area's goods movement infrastructure and air pollutant emissions include the Regional Transportation Plan 2035 (RTP), Goods Movement Initiative 2009, and the Port of Oakland's Maritime Air Quality Improvement Plan (MAQIP). Projects identified in these plans will soon be implemented to address numerous impacts associated with the projected increase in goods movement (See TCM B-4).

However, the rate and extent of the decline in goods movement related emissions in the Bay Area will be dictated by how quickly the region can turn over the heavy/medium duty diesel fleet with new technologies and low emission engines. This will in part depend on the Bay Area's growth in population, economic activity, and local development patterns.

Despite the recent economic slump, the volume of goods movement in the region is expected to increase rapidly in the next several decades. The Port of Oakland's Maritime Air Quality Improvement Plan projects a 100% increase in volume of trade by 2020 under its low growth scenario. Notwithstanding uncertainty around economic trends and localized effectiveness of impending state diesel regulations and local plans, this increase will have implications for regional air quality.

This measure is intended to complement ARB's diesel emission reduction regulations as well as Bay Area plans to ensure that the region develops a comprehensive strategy to reduce emissions from the goods movement sector, and protect and improve public health in communities that are disproportionally impacted by goods movement emissions.

Implementation Actions:
Regional Implementation Actions:

- Lead a Collaborative Regional Effort – Continue working with regional partner agencies and transportation stakeholders in a collaborative regional process to articulate and advance a regional strategy for goods movement in the Bay Area, with a focus on air quality, health, and climate protection. This will include activities already underway, such as the Air District's Green Ports Initiative and the Port of Oakland's Maritime Air Quality Improvement Plan (MAQIP).

- Identify Strategies for Mode Shift – Examine opportunities to shift freight transport from truck to rail and barge in order to reduce emissions and exposure associated with movement of freight in the Bay Area. The District will consider participating in projects where mode shift can be beneficial to local and regional air quality, such as the "marine highway," a project to move freight by barge and tugboat between the Port of Oakland and the Port of Stockton.

- Efficiencies in Distribution Systems (roadways, logistic systems) – Assess current freight distribution systems and routes for major transport modes, and make recommendations for increasing travel efficiencies to reduce emissions. Areas of evaluation may include truck movements on regional highways between seaports, airports and warehousing/distribution

centers, and operational and/or design improvements to facilitate more efficient goods movement.

- Best Practices for Goods Movement Land Uses – Warehousing and Distribution Centers. MTC's *Goods Movement Initiatives 2009* highlights a need to preserve land within the Bay Area core for goods movement businesses such as warehousing and distribution in order to decrease trip lengths and emissions associated with goods movement distribution. This may have implications for areas identified as impacted communities by the Air District, because many of these communities are located along the Bay Area's major trade corridors. In order to avoid or mitigate population exposure to emissions from goods movement, the District will work with regional partners to identify and disseminate best practices to promote good air quality, and public health and safety in neighborhoods where goods movement facilities are situated adjacent to residential land uses. Best practices may include site design, zoning, industry operating practices and technological innovations. Best practices will be evaluated based on their ability to promote public health while encouraging infill development, particularly in FOCUS Priority Development Areas. This work will complement efforts by the FOCUS program to address the role of employment centers in smart growth.

- Container Fees – The District will advocate for container fees to be imposed on goods passing through Bay Area ports to be used for environmental mitigation. Fees should be assessed to reflect the air quality impacts that result from goods movement activities, including PM, ozone precursors, air toxics and greenhouse gases. Funds will be used to improve air quality in areas most impacted by goods movement activities.

- Partnerships and Demonstration Projects – The District will work with regional partners and stakeholders to identify, evaluate, and implement innovative projects that reduce emissions and exposure associated with goods movement. Demonstration projects are intended to spark long-range changes in freight movement and technology use that will result in reduced vehicle miles traveled, emissions, and human exposure to harmful emissions. Such projects may include implementing cold- ironing (shorepower) infrastructure at Bay Area ports in advance of ARB regulations in order to eliminate ship idling while docked, utilizing liquefied natural gas (LNG) to provide shorepower, promoting the use of LNG to power drayage fleets, funding new switcher engines at Bay Area railyards, and continuing to work in partnerships such as the Green Ports initiative.

Local Implementation Actions:

- Collaborative enforcement - The Air District is developing a diesel enforcement program whereby inspectors may enforce ARB's diesel air toxics control measures (ATCMs) specifically targeting impacted areas identified by the CARE program along two major Bay Area trade corridors. Initial enforcement activity will be focused on diesel truck idling and drayage trucks and will expand to include other ATCMs as they become applicable, including cargo handling equipment, truck refrigeration unit (TRU) enforcement, Gen Set

enforcement, and off-road construction equipment. The District will also encourage local jurisdictions to enforce ARB's anti- idling regulation.

- Systematic outreach and incentives program for independent and fleet truck operators – The District will continue and enhance outreach efforts to independent and fleet truck operators regarding available funds for installing retrofit devices on and/or replacing their trucks. The Air District will continue to operate a trailer at the Port of Oakland to inform truck drivers about ARB's applicable anti–idling ATCMs, emission reducing technologies and fuels, and targeted incentives program in efforts to reduce emissions from the Port and along the I-880 corridor.

- Signage and truck routes – Air District staff will facilitate discussions with county planning departments, county public health departments, and local businesses and industries to assist in the planning process to identify suitable truck routes in and around impacted communities. Signage will then be placed to discourage idling and promote truck movements along non-residential arterial roads to reduce human exposure.

- Centralizing truck services and overnight parking – Support the Port of Oakland and Alameda County Congestion Management Agency (ACCMA) efforts to move essential truck services from within the impacted communities on to or near Port property or away from residential areas. In a recent survey conducted by the ACCMA, most truck driver access residential areas to repair their truck, to access the public scales, to obtain food or fuel, or to park until their next delivery. By having these services available at a centralized location away from residents, trucks will reduce vehicle miles traveled to these services and also drive less in residential communities thereby reducing emissions and exposure to residents.

Emissions Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.01	0.36
NO_x	1.71	6.00
$PM_{2.5}$	0.22	0.48
PM_{10}	0.02	0.20
SO_2	0.00	0.02
CO_2	2511	4116
C02-e	2561	4198

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: NH3 (ammonia), benzene, 1,3 butadiene, formaldehyde, and acetaldehyde.

Emissions Reduction Methodology:

This measure encompasses a range of potential actions by various regional agencies to address emissions from goods movement. The specific combination of strategies and actions that will be implemented has not yet been determined, so the potential emission reductions for this

measure cannot be predicted with any degree of confidence as of yet. For purposes of estimating potential emission reductions we have analyzed the reductions that might be achieved by 2020 if the region successfully implements programs that address mode shift, distribution system efficiencies, container fees, and enhanced regulation enforcement.

For example, if implemented by 2020 we estimated that:

- Shifting from trucking to cleaner goods movement modes could lead to a 25% decrease in pollution from estimates for 2020 based on projected goods movement by truck.
- Increased distribution system efficiencies could lead to a 2% decrease in pollution.
- A container fee program could raise funds for clean technology grants, resulting in additional pollution reductions similar to those associated with current BAAQMD grant programs.
- A combined regulation enforcement effort between CARB and the District could increase truck regulation compliance and decrease pollution.

Exposure Reduction:
The District and California Air Resources Board (CARB) studies show that 80% of the risk from toxic air contaminants in the Bay Area comes from diesel particulate emissions. This measure addresses this air quality problem by reducing emissions from vehicles and equipment used in goods movement. This measure directly addresses air quality in impacted communities.

Emission Reduction Trade-offs:
Adding diesel retrofit devices to diesel engines may result in a decrease in fuel efficiency, thereby increasing emissions of carbon dioxide. For example, CARB and the EPA estimate that a heavy-heavy duty (HHD) diesel truck with a retrofit device added would experience a decrease in fuel efficiency of 3.5% on average. By Air District staff computations, for a HHD truck traveling 30,000 miles per year, this decrease is estimated to result in an additional 4,382 pounds per year of carbon dioxide.

Cost:
Phase 1: $14.5 million/year
Phase 2: $14.5 million/year

Co-benefits:
- Energy/fuel cost savings from more efficient and reliable engines.
- Economic benefits from faster, more efficient goods movement.

Monitoring Mechanisms:
Regional Initiative Outcomes and Benchmarks:
- Progress in continued regional collaborative process focused on goods movement and clean air: stakeholders convened, meetings, outcomes.
- Evaluation of efforts and results to promote shifts in freight transport mode, and infrastructure needed to support mode shift.

- Analysis of air quality exposure impacts associated with current highway truck routes along trade corridors compared to alternative routes.
- Survey of existing best practices in areas where goods movement impacts residential communities to reduce health risks (as well as noise and safety impacts).
- Legislation for container fees for Bay Area ports.
- Annual report on emissions reduction resulting from innovative technologies and projects implemented through partnerships and demonstration projects.
- Summarize and highlight project successes and promote further adoption in the freight movement industry.

Local Initiative Outcomes and Benchmarks:

- Record of violations issued by District staff under collaborative enforcement agreement with ARB.
- Status reports on collaborative enforcement.
- Annual report listing applications for retrofit replacement submitted, funds awarded, and projects implemented.
- Report on needs assessment for signage and number of signs installed.
- Report from community planning process for San Jose, East Oakland, and San Leandro truck routes.

Issues/Impediments:

- Staffing and resources.
- Determining emissions reductions from cooperative enforcement of ARB's regulations.
- Developing regional buy-in for a regional task force for goods movement.

Sources:

1. East Bay Alliance for a Sustainable Economy and Pacific Institute, Taking A Toll: The High Cost of Health, Environment, and Worker Impacts of the Oakland Port Trucking System, http://www.pacinst.org/reports/taking_a_toll/index.htm
2. Southern California Association of Governments, Analysis of Goods Movement Emission Reduction Strategies, Task 1 Final Report, January 2008 http://www.scag.ca.gov/goodsmove/
3. Southern California Association of Governments, Reports : Project 99-130 Goods Movement Truck and Rail Study http://www.scag.ca.gov/goodsmove/truckrail.htm
4. MTC's Transportation 2035 Plan, http://www.mtc.ca.gov/planning/2035_plan/
5. MTC's Goods Movement Initiatives 2009 Update, http://www.mtc.ca.gov/planning/2035_plan/Supplementary/T2035_Goods_movement_update.pdf
6. Goods Movement Plan ARB, http://www.arb.ca.gov/gmp/docs/gmap-1-11-07.pdf
7. CARE Report on TAC, http://www.baaqmd.gov/CARE/documents/care_p1_findings_recommendations_v2.pdf
8. ATCM to Limit Diesel-Fueled Commercial Motor Vehicle Idling, http://www.arb.ca.gov/msprog/truck-idling/truck-idling.htm

9. New Regulation to Significantly Reduce Emissions From Existing On-Road Diesel Vehicles, http://www.arb.ca.gov/msprog/onrdiesel/onrdiesel.htm
10. Mobile Cargo Handling Equipment at Ports and Intermodal Rail, http://www.arb.ca.gov/ports/cargo/cargo.htm
11. ARB's PERP Regulation, http://www.arb.ca.gov/portable/perpact/perpactarchive.htm
12. ARB's Harborcraft Regulation, http://www.arb.ca.gov/ports/marinevess/harborcraft.htm
13. ARB's Drayage Truck Regulation, http://www.arb.ca.gov/msprog/onroad/porttruck/porttruck.htm
14. ARB's TRU Regulation, http://www.arb.ca.gov/diesel/tru/documents/faq121708.pdf
15. Ocean Going Vessels Regulation, http://www.arb.ca.gov/ports/marinevess/marinevess.htm
16. Railyard MOU, http://www.arb.ca.gov/railyard/railyard.htm
17. Smartway Transport Partnership, http://epa.gov/smartway/
18. Cooperative Enforcement Document, February 17, 2009 California Air Resources Board

LUM 2 - Indirect Source Review

Brief Summary:
The Air District will develop an indirect source review (ISR) rule to reduce construction and operating emissions associated with new or modified land uses in the Bay Area. Indirect sources are development projects that generate or attract motor vehicle trips and area source emissions. The rule may also address other sources of emissions, such as fireplaces, home heating and cooling and landscape maintenance equipment. Air pollutant emissions from these sources can adversely affect local and regional air quality. The District will consider the legal issues, political acceptability, local government acceptability, enforceability, staffing or other resources needed when defining the scope of the ISR.

Purpose:
The purpose of the Indirect Source Rule is to reduce emissions associated with new or modified land use development to attain health based ambient air quality standards. The rule may also achieve co-benefits by reducing emissions of greenhouse gas. The measure is intended to address increases in air pollutant emissions from economic and population growth in the region by encouraging new or modified development projects to be designed, sited and constructed so as to reduce motor vehicle and area source emissions.

Source Category/Travel Market Affected:
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 and that air districts can require the use of measures which reduce the number or 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 supercede local land use authority of cities and counties. Other relevant ISR sections in the CCAA include: 40717(g), 40918(a)(4), and 42311(g).

The federal Clean Air Act authorizes states to include ISR programs in their state implementation plan under the federal Clean Air Act ((Section 110(a)(5)(42 USC 7410)).

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,

Placer County, Sacramento, 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.

In 2005, the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) 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 PM_{10} through onsite mitigation or pay an off-site mitigation fees. The fee formula is structured to encourage on-site mitigation measures. SJVUAPCD uses the fees to fund off-site mitigation projects that reduce NOx and PM_{10} emissions. To date, the air district 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 4 units at the point of application for a building permit. 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 PM_{10}.

Sacramento Metropolitan Air Quality Management District and South Coast Air Quality Management District are each currently developing ISR rules for their jurisdictions. The two air districts committed to adopting an ISR rule as part of their state implementation plan to reduce ozone precursors.

The Air District identified the potential for an ISR rule as a further study measure in the *Bay Area 2005 Ozone Strategy*. Further Study Measure 18: Indirect Source Mitigation Program (FS-18) states that the Air District will evaluate ways to reduce emissions from new and existing land uses. Air District staff has determined that due to EPA's adoption of new health based national ambient air quality standards, the successful implementation of the San Joaquin APCD's ISR and Imperial County APCD's ISR, an Indirect Source Review Rule should be brought to the Air District's Board of Directors for consideration.

Implementation Actions:

- The District could adopt a rule that sets air quality performance standards for new and modified development.
- Fees could be assessed for projects that exceed thresholds.
- Standards and fees would be structured to provide incentives for projects located and designed to minimize emissions.
- To initiate the ISR rulemaking process, the Air District has convened a broad-based stakeholder workgroup comprised of representatives from local governments, the building

industry, developers, realtors, other business representatives, and environmental/community members.

- District staff will consult with the stakeholder group regarding the scope, structure, and applicability of the ISR rule, and the basis for any fees associated with the rule.
- Details regarding administration of the rule will be determined via the rule-making process.

Emission Reduction:

Pollutants (tons per day)	2012	2020
ROG	0.30	0.30
NO_x	0.24	0.24
$PM_{2.5}$	0.11	0.11
PM_{10}	0.47	0.47
Diesel PM	0.18	0.18
Benzene	0.01	0.01
Formaldehyde	0.01	0.01
CO_2	333.43	333.43
$C0_2$-e	340.00	340.00

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: SO_2 (sulfur dioxide), benzene, 1,3 butadiene, and acetaldehyde.

Emission Reductions Methodology:
The emissions reduction methodology for this measure is based on methodology developed and reported by the San Joaquin Valley APCD (SJVAPCD) Indirect Source Review (ISR) program. The SJVAPCD methodology requires the payment of mitigation fees for projects that will result in 2 tons NOx or 2 tons of PM emissions a year or more. This District, based on our CEQA database, estimated for years 2010 through 2020 the number of projects that may be subject to the ISR program. The emission reductions above estimate the results if 15% 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.

Emission Reduction Trade-offs:
None identified.

Cost:
Phase 1: $1.4 million/year
Phase 2: $1.4 million/year

These costs represent only those associated with the payment of off-site mitigation fees, not the costs developers may incur implementing on-site measure to reduce their project's

emissions.

Co-benefits:

- Improved project design and planning.
- Public health benefits from reduced emissions, improved pedestrian access, and use of green building elements.
- Reduced GHG emissions from motor vehicles, building energy use, and other sources.

Monitoring Mechanisms:

Air District staff will work with the stakeholder group and the public through workshops to identify the most efficient mechanism to monitor implementation of the ISR.

Issues/Impediments:

The ISR needs to be developed to encourage less auto dependent development, to reduce regional VMT and not create an administrative burden on local land use planning. The ISR will need to take into consideration the implementation of measures for AB32 and SB375.

Sources:

1. 2005 Ozone Strategy, Volume II, Appendix E, Further Study Measure 18
2. Memo to Mobile Source Committee, September 11, 2007: *2005 Ozone Strategy Further Study Measure 18: Indirect Source Mitigation Program*
3. SCAQMD ISR: http://www.aqmd.gov/rules/proposed/2301/index.html
4. SJVAPCD ISR Web site http://www.valleyair.org/ISR/ISRHome.htm
5. SMAQMD 2009 Ozone Plan, page 7-21, IS-1 IS-2 http://www.arb.ca.gov/planning/sip/planarea/sacsip/sacplanozone2009.pdf
6. Larry Robinson, Joe Carl, SMAQMD, personal communication
7. Imperial Valley Rule 310 Operational Development Fee - http://www.co.imperial.ca.us/ag/Departments/Air%20Pollution/Forms%20&%20Documents/Rule%20310%20Mitigation%20Project%20Report%20Package.pdf http://www.imperialcounty.net/ag/Departments/Air%20Pollution/WORKSHOPS/Past%20Workshops/Rule%20310/Rule%20310%20Public%20Committee%20Nomination%20Ad.doc
8. 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
9. Socioeconomic analysis SJVUAPCD http://www.valleyair.org/ISR/Documents/RULE_9510_AppendixF.pdf
10. Survey of ISRs from SCAQMD http://www.aqmd.gov/rules/proposed/2301/pr2301_is_program_matrix_20090224.pdf

LUM 3 - Updated CEQA Guidelines and Enhanced CEQA Review

Brief Summary:
The District will develop and issue updated California Environmental Quality Act (CEQA) guidelines to provide guidance on evaluating air quality impacts of development projects and local plans, determining whether an impact is significant, and mitigating significant air quality impacts related to new or modified projects. The updated guidelines will provide revised thresholds of significance for criteria pollutants and toxic air contaminants, and newly-adopted thresholds for greenhouse gas emissions. In addition to issuing revised CEQA guidelines, the District will also strengthen its existing CEQA review program, as resources permit, by increasing the number of CEQA documents that the District reviews and by quantifying estimated reductions in emissions of criteria pollutants, air toxics, and greenhouse gases from the District's CEQA program.

Purpose:
The purpose of this measure is to reduce emissions associated with new development in order for the region to attain state and national ambient air quality standards, reduce local impacts, reduce greenhouse gases, and improve health outcomes in the region.

Source Category/Travel Market Affected:
This measure would affect new development in the Bay Area subject to the environmental review process as defined by the California Environmental Quality Act.

Regulatory Context and Background:
The California Environmental Quality Act (CEQA) was adopted in 1970 and intended to inform policy-makers and the public about potential environmental effects of a project; identify ways to reduce adverse impacts; offer alternatives to the project; and enhance public participation in the planning process. The District participates in the CEQA review process in several capacities. The District provides guidance to Lead Agencies, consultants, and other parties regarding air quality analyses of project and plans conducted pursuant to CEQA. The District acts as a Lead Agency when it has the primary authority to implement or approve a project, such as a District Clean Air Plan or Rule. The District acts as a Responsible Agency when it has discretionary authority over a project, but does not have the primary decision-making authority of a Lead Agency. In this capacity, the District consults with the Lead Agency regarding potential impacts and may recommend project alternatives or mitigation measures to lessen any potentially significant air quality impacts. As a Commenting Agency, the District reviews environmental documents prepared for development proposals and plans in the Bay Area and provides comments to Lead Agencies regarding the adequacy of the air quality analysis and mitigation measures.

Implementation Actions:
Key implementation actions include the following:

- Update CEQA guidelines; provide revised thresholds of significance and mitigation measures, including new thresholds that address particulate matter and greenhouse gases
- Conduct outreach to local jurisdictions, consultants, developers, and community members to introduce updated CEQA guidelines and environmental review process and provide technical assistance to lead agencies.
- As described in LUM 4, the District will encourage local jurisdictions to develop Community Risk Reduction Plans to reduce public exposure to air toxics and PM, and provide technical assistance in developing these plans.
- Expand CEQA commenting by the Air District:
  - Review CEQA documents prepared for Bay Area projects, evaluate their consistency with the District's Guidelines, and recommend mitigation measures as appropriate.
  - Estimate the emission reductions achieved based on the implementation of mitigation measures recommended by the District.
  - Provide on District's CEQA website a log of CEQA comment letters accessible to the public.
- Develop and implement a monitoring plan for the District's CEQA review program:
  - Develop a database of projects that have been commented on and track implementation of mitigation measures.
  - Conduct regular reviews to evaluate CEQA program performance in achieving its goals and to recommend potential improvements to the program.
  - Review Mitigation Monitoring and Reporting Plans of CEQA documents prepared in the Bay Area.

Emission Reduction:

Pollutants (tons per day)	2012	2020
ROG		0.44
NO_x		0.35
$PM_{2.5}$		0.16
PM_{10}		0.67
Diesel PM		0.26
Benzene		0.01
1,3 Butadiene		0.01
Formaldehyde		0.01
CO_2		438.50
CO_2-e		447.00

No emission reductions are estimated for 2012. In addition to the pollutants shown above for year 2020, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: Ammonia (NH3) and acetaldehyde.

Emissions Reductions Methodology:

The emissions reduction methodology for this measure is based on the District's CEQA database and new development projections for years 2010 through 2020. We estimated the unmitigated emissions for the new land use projects expected over this time period that would be subject to

CEQA. We then assumed that the enhanced CEQA program would result in approximately 20% of the total unmitigated emissions from new land development would be reduced through the implementation of feasible mitigation measures on projects that would not have otherwise mitigated their project's emissions.

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:
Lead agencies currently prepare air quality analyses in CEQA documents. Air District staff does, and will continue to, provide technical assistance. This measure is not expected to significantly increase or decrease these review costs. However, this analysis does not consider the costs developers may incur preparing environmental analyses or implementing mitigation measures to reduce their project's emissions.

Co-benefits:
This control measure will result in long term adoption of cleaner, greener building practices in the Bay Area, as municipalities, developers, and their consultants adopt green building practices, build closer to transit nodes and job centers, and incorporate travel demand management into their projects and plans.

Monitoring Mechanisms:
Annual performance reviews of program.

Issues/Impediments:
The updated guidelines will include revised and adopted thresholds for criteria pollutants, toxic air contaminants, and greenhouse gas emissions associated with new or modified projects. It is anticipated that new or revised thresholds of significance will be more stringent than current thresholds which may be of concern to certain stakeholders, while supported by others.

Sources:
1. Draft CEQA Thresholds Options Paper
2. Survey of CEQA Thresholds

LUM 4 - Land Use Guidance

Brief Summary:
Local land use decisions have direct impacts on air quality and population exposure to air pollutants. This measure summarizes programs and resources that the Air District will make available to local agencies to help them develop goals, policies and implementation measures that will benefit air quality and reduce motor vehicle travel and emissions. With its regional partners, the Air District is committed to assisting local governments to include smart growth principles and climate protection elements in their general plans to reduce criteria pollutants and greenhouse gas emissions.

Purpose:
The purpose of this measure is to provide resources to local governments that support local land use patterns to reduce mobile source emissions and human exposure to airborne toxic contaminants and reduce emissions related to energy use and waste disposal.

Source Category:
Emissions related to land use patterns and vehicle miles traveled: heavy, medium, and light duty vehicles. Emissions related to energy use and waste disposal.

Regulatory Context and Background:
Local land use strategies and decisions will play a key role in determining whether the Bay Area can achieve our air quality and climate protection goals as our population and economy continue to grow. Because general plans prescribe land use patterns that shape growth in cities and counties for 20 years or more, they represent the most effective mechanisms to reduce vehicle miles traveled, vehicle emissions, and population exposure to toxic air contaminants.

California's Office of Planning and Research recommends for local governments to update their general plans every ten years. Approximately ten Bay Area local governments are currently in the process of updating their general plans. The majority of these local governments are integrating smart growth principles and climate protection strategies into their update.

Within the Bay Area, there are approximately 50 cities that have not updated their general plan since 2000. Therefore, within the next several years, nearly half of the Bay Area's 110 local governments can be expected to update their general plan. This presents an opportunity for Bay Area local governments to incorporate into their general plans smart growth and climate protection policies that will reduce emissions from motor vehicle travel over the long-term, while also reducing population exposure to toxic emissions.

Implementation Actions:
Link with District Functions: The Air District is implementing a number of programs and projects that can help to inform general plan updates.

- CEQA Guidelines: The Air District is currently updating its CEQA Guidelines to assist lead agencies in analyzing air quality impacts. The update contains numerous mitigation measures and general plan policies to implement smart growth principles, minimize construction emissions, and reduce population exposure. The updated CEQA Guidelines are scheduled for release in 2010.

- CARE Program: The Community Air Risk Evaluation (CARE) program, initiated in 2004, evaluates and reduces health risks associated with exposures to toxic air contaminants (TACs) in the Bay Area. The program's main objectives are to: identify health risks from exposure to TACS, assess population exposures; identify TAC sources and impacted communities; and develop and implement mitigation measures.

- Clean Air Communities Initiative (CACI): This initiative is a multifaceted approach to address health concerns in communities disproportionally impacted with poor air quality and to minimize the effects of land use decisions on cumulative air impacts. CACI will bring to bear regulations, incentives, enforcement, public education, and technical studies to improve air quality.

- The District will work with cities and counties to develop Community Risk Reduction Plans (CRRPs) to reduce population exposure to air toxics and PM, particularly in impacted communities identified through the CARE program. The District will provide technical assistance in preparing these plans. The CRRPs should provide comprehensive plans for defined areas, including public engagement processes, emission inventories, numerical goals or targets, risk modeling, emission reduction measures, and monitoring mechanisms.

- Indirect Source Review Rule: The Air District is in the early phases of developing an Indirect Source Review (ISR) regulation to reduce air pollutant emissions from new or modified development. It is anticipated that the ISR will provide incentives to design and locate new and modified development to minimize associated emissions.

- Climate Protection Grants: The District's climate protection grant program provided funding to local governments developing climate action plans or integrating climate protection strategies into general plans.

- Provide Best Practice Guidance: The Air District has, and will continue, to provide general plan guidance and best practices resources to local governments. In addition, where appropriate the Air District encourages local jurisdictions to consult with the "Air Quality and Land Use Handbook: A Community Health Perspective," published by the California Air Resources Board (ARB)

- Best Practices Web Portal: In partnership with the Institute for Local Government, the Air District has developed a web portal highlighting best practices for local governments to use for their own climate action plans and general plans. The portal enables local governments to search for a wide variety of best practices and upload information on their own success stories. This tool is available at http://www.ca-ilg.org/SFBayClimate.

- CAPCOA Resource Documents: CAPCOA (California Air Pollution Control Officers Association) published two separate documents useful to local governments updating their general plans: 1) "Model Policies for Greenhouse Gases in General Plans (May 2009)," a resource for local governments to incorporate general plan policies to reduce greenhouse gas emissions; 2) "CEQA & Climate Change (January 2008)," a resource for evaluating and addressing greenhouse gas emission in CEQA review. CAPCOA is currently preparing a greenhouse gas mitigation strategy and quantification resource document.

- Regional Agency Collaboration: The Air District's regional agency partners provide a number of resources to help local governments implement smart growth principles. Resource tools include MTC's parking toolkit, Transportation for Livable Communities (TLC) capital grants; and the multi-agency FOCUS program that directs incentives, including funds for land use planning and capital infrastructure, to Priority Development Areas (PDAs), which are locally-identified infill development opportunity areas near transit.

Expand Assistance to Local Governments: To further enhance its support to local governments, the Air District may implement some or all of the following actions.

- Present Workshops: The Air District will consider conducting a number of workshops to assist local governments in addressing air quality and climate change in their general plan updates.

- Identify Innovative Funding Mechanisms: Lack of financial resources is a major constraint on the ability of local jurisdictions to conduct comprehensive long-range planning. Therefore, the Air District will collaborate with its regional partners to identify innovative funding mechanisms to help jurisdictions address air quality and climate change in their general plans.

- Tailor Best Practices to Local Needs: Guidance for general plans must recognize that our communities are diverse and that no single policy prescription would be appropriate in all cases. Communities that lack transit infrastructure have different challenges than cities with strong transit and/or the potential for transit-oriented development. The Air District will consider developing tools catered to a variety of community types to reform their development patterns and reduce emissions.

- Track Local Government Progress: The Air District will consider monitoring and tracking progress of general plan updates and climate action plans. Monitoring mechanisms may include: tracking the number of climate action plans and emission reduction targets integrated in general plans; and assisting local governments in developing biennial GHG emission inventories to encourage them to track local progress.

Emission Reductions:

Pollutants (tons per day)	2012	2020
ROG	0.08	0.09
NO_x	0.08	0.10
$PM_{2.5}$	0.01	0.02
PM_{10}	0.01	0.03
CO_2	136.27	346.58
$C0_2$-e	139.00	353.51

In addition to the pollutants shown above, this measure will reduce emissions of the following pollutants by less than 0.01 tons per day: Diesel PM, sulfur dioxide (SO_2), ammonia (NH3), benzene, 1,3 butadiene, formaldehyde and acetaldehyde.

Emissions Reductions Methodology:
The emissions reduction methodology is based on methodology in ABAG's report *Projections 2009: What If?* The District estimated that if all General Plan updates in the Bay Area over the next five years emphasized compact development, there would be a 1% reduction in light-duty vehicle miles traveled (VMT) due to changes in land use patterns and increased use of transit. This decline in VMT translates into reductions in emissions, as documented in the table above.

Exposure Reduction:
This measure will provide guidance to local jurisdictions in assessing health impacts associated with new development and in implementing mitigations to reduce human exposure to harmful air contaminants due to land use projects that generate toxic emissions and land use projects that are impacted from existing toxic sources.

Emission Reduction Trade-offs:
None identified.

Cost:
Costs would vary. Available resources would be determined through the District's budget process.

Co-benefits:
This measure will 1) foster collaboration with local governments, resulting in more wide spread and effective implementation of this and other District programs, and 2) provide public health benefits, since focused development is more conducive to walking and bicycling.

Monitoring Mechanisms:
Program success will be monitored using:

- Database tracking Bay Area general plan updates including air quality / climate friendly policies and/or elements and emissions reductions quantified in environmental review process, number of climate action plans and emission reduction targets integrated in general plans.

- Tracking local government participation in and satisfaction with land use and air quality web or workshop resources offered by the District.
- Monitoring of ISR and CEQA programs as stated in LUM 2 and LUM 3.

Issues/Impediments:
Resources for long range planning.

Sources:
1. Governor's Office of Planning and Research, California Planners' Book of Lists, http://opr.ca.gov/index.php?a=planning/publications.html#pubs-C
2. CEQA Guidelines and Greenhouse Gases, http://opr.ca.gov/index.php?a=ceqa/index.html
3. California Air Pollution Control Officers (CAPCOA) CEQA and Climate Change White Paper, http://www.capcoa.org/CEQA/CAPCOA%20White%20Paper.pdf
4. 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. Air Quality and Land Use Handbook: A Community Health Perspective, (April 2005), http://www.arb.ca.gov/ch/handbook.pdf
6. ABAG 2009 Projections: What If? http://www.abag.ca.gov/rss/pdfs/whatif.pdf

LUM 5 – Reduce Health Risk in Impacted Communities

Brief Summary:
This measure describes a set of complementary actions and programs that comprise key elements of the Air District's strategy to reduce emissions and population exposure in impacted communities as identified by the Air District's Community Air Risk Evaluation (CARE) Program. Key elements of this measure include:

- The District will establish a system to track cumulative health risks associated with emissions from stationary, mobile, and area sources in order to help monitor progress in reducing population exposure in impacted communities.
- The District will revise rules to tighten requirements in order to reduce emissions of air toxics and particulate matter from existing sources via its Air Toxics "Hot Spots" Program and from new sources via its New Source Review rules. See SSM 16, 17, and 18 for additional description of these rule revisions.

Purpose:
The purpose of this measure is to address the cumulative air quality impacts of emissions from stationary, mobile, and area sources in impacted communities.

Source Category/Travel Market Affected:
Stationary sources subject to the District's permitting regulations, as well as mobile sources and area sources.

Regulatory Context and Background:
Applicable air quality requirements related to controlling stationary sources include rules and regulations adopted by the District, the California Air Resources Board, and the U.S. Environmental Protection Agency. In California, air districts have the primary responsibility for controlling air pollution from non-vehicular stationary sources of air pollution. The Air District regulates stationary sources through rulemaking for specific source categories, through its permitting process and New Source Review process for new and modified sources, and by administering the Air Toxics "Hot Spots" Program for existing sources.

New Source Review (NSR) requires that new/modified sources utilize the Best Available Control Technology to minimize air pollution impacts. The existing District NSR rules are Regulation 2, Rule 2: New Source Review, and Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants. Additional Air District NSR requirements include emission offsets, air quality impact analysis for criteria air pollutants and their precursors, and health risk screening analysis for toxic air contaminants (TACs).

The Air Toxics "Hot Spots" (ATHS) program is a state program implemented by California air districts. Assembly Bill 2588, the Air Toxics "Hot Spots" Information and Assessment Act, was enacted by the State legislature in 1987. AB 2588 requires facilities throughout California to

provide information to the public about emissions of TACs, and the impact that those emissions may have on public health. The Act was amended in 1992 by SB 1731, which provided air districts with the authority to require facilities with significant risks to implement a site-specific risk reduction audit and plan. Each air district has the authority to establish health risk thresholds for public notification and risk reduction requirements.

Regulation 2, Rule 5 and the ATHS program in many cases require the preparation of a site-specific Health Risk Screening Analysis (HRSA), which is an assessment that describes the possible adverse health effects which may result from public exposure to routine and predictable emissions of TACs. All permit applications for new and modified sources are screened for emissions of TACs. Where the predicted health risks from a proposed project exceed specified threshold levels, the new/modified source(s) must use the Best Available Control Technology to minimize TAC emissions (TBACT). The TBACT and Project Risk standards in Regulation 2, Rule 5, are uniformly applied throughout the District's jurisdiction.

Procedures used for completing HRSAs are based on guidelines adopted by Cal/EPA's Office of Environmental Health Hazard Assessment (OEHHA) for use in the Air Toxics Hot Spots Program. Procedures for assessing health risks are intended to protect sensitive individuals such as children, and individuals with pre-existing health conditions. The Children's Environmental Health Protection Act (Senate Bill 25) established specific requirements for OEHHA to determine whether existing health risk assessment procedures are adequate to protect infants and children from the harmful effects of air pollution. OEHHA has already acted under SB 25 to revise certain procedures for assessing non-cancer health risks to provide a greater margin of safety for children, and revisions to cancer risk assessment procedures are expected to be proposed in late 2009, with final action anticipated in 2010.

Implementation Actions:
While recognizing that stationary sources regulated by the Air District are only a portion of the sources that contribute to differential population exposure and risk levels, this measure describes the District's strategy for reducing emissions and exposure from stationary sources in impacted communities. Specific components of this measure are described below.

• The District will track the maximum cumulative health risks associated with new and modified permitted stationary source projects over time. The results will be reported on the District website as follows: (a) list of projects including project location and emission rates, (b) location and magnitude of maximum incremental project health risks, and (c) location and magnitude of maximum cumulative health risks for all projects from the date the requirement is established.

• District staff will propose amendments to Regulation 2, Rule 2: New Source Review to address PM2.5, as described in Stationary Source Measure 16, and Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants, as described in Stationary Source Measure 17.

• The District will consider revising the District's Air Toxics "Hot Spots" Program for existing facilities to incorporate more stringent risk reduction requirements than are provided in

existing District policy. See description of Stationary Source Measure 18. As discussed above, OEHHA is considering revising cancer risk assessment procedures to provide a greater margin of safety for protecting children. Based on discussions with OEHHA staff, it is possible that these revisions could increase calculated residential cancer risks by a factor of three or more relative to existing risk assessment procedures. Due to the potential significance of these revisions in risk assessment methodologies, the District believes that it is prudent to develop potential revisions to the District's Hot Spots program concurrent with the OEHHA guideline revisions. OEHHA does not expect that these risk assessment guideline revisions will be finalized for some time, perhaps late in 2010.

• District staff will continue developing and implementing source-category-specific rules to reduce emissions and risk in impacted communities. An example is SSM1: Metal-Melting Facilities, a control measure contained in this draft control strategy which will further control emissions from foundries and metal forging facilities. District staff will assess other source types and facilities throughout the region as candidates for source-category-specific rules.

• As described in LUM 4, the District will encourage local jurisdictions to develop Community Risk Reduction Plans to reduce public exposure to air toxics and PM, and provide technical assistance in developing these plans.

Emissions Reductions:
Emission reductions are not directly attributed to this measure. The cumulative impacts tracking system described above will not provide any direct emission reductions. The emission reductions for rules described above will be calculated for each of those rules. See the applicable stationary source measure descriptions for emission reduction estimates.

Emissions Reductions Methodology:
BAAQMD is unable to estimate the emission reductions from measure LUM 5.

Exposure Reduction:
This measure has been specifically developed with the objective of reducing population exposure to emissions of air toxics and PM from stationary, mobile, and area sources of emissions.

Emission Reduction Trade-offs:
No trade-offs are anticipated for this measure.

Cost:
- Monetary costs to industry to install BACT to achieve reduced emissions and risk levels.
- Monetary costs to District to develop regulations, track cumulative risk levels in impacted communities, inform and educate the regulated community and to enforce.

Co-benefits:

- Since many TACs are also reactive organic gases (ROG), any localized reductions in TACs will provide co-benefits by helping to reduce ambient ozone levels. Also, reductions in emissions of diesel PM will help to reduce ambient levels of PM2.5 and PM 10.

Monitoring Mechanisms:

- Ongoing monitoring in impacted communities to measure changes in air quality, pollutant concentrations, and exposure.
- Cumulative toxics emissions risk-tracking requirement with results posted on District website.

Issues/ Impediments:

- The District will need to allocate resources to track changes in emissions of TACs in impacted communities.

Sources:

1. July 6, Memo to Stationary Source Committee from Brian Bateman, Update on CARE Program and Associated Regulatory Initiatives.
2. Draft Concept Paper, *More Stringent Permitting Requirements for Proposed New/modified Stationary Sources of Air Pollution Located in Impacted Communities or in Proximity to Sensitive Receptors.* February 23, 2009.
3. Bateman, April Presentation given to the CARE Task Force.

LUM 6 - Enhanced Air Quality Monitoring

Brief Summary:
The Air District will evaluate and enhance its capabilities, as resources permit, to monitor air quality on a region-wide basis, as well as on a localized basis in the impacted communities identified under the District's Community Air Risk Evaluation (CARE) program.

Purpose:
The purpose of this measure is to provide the Air District with sufficient ambient air quality monitoring data needed to inform 1) its efforts to improve air quality in impacted communities and 2) its air quality planning and modeling programs.

Source Category/Travel Market Affected:
Not applicable.

Regulatory Context and Background:
The Air District's Air Monitoring Program operates a network of 28 air monitoring stations, consistent with state and federal air monitoring requirements, designed to 1) provide the data required to determine the Bay Area's attainment status for both National and State ambient air quality standards; 2) provide air quality data to the public in a timely manner; and 3) support air pollution research and modeling studies. Additionally, a network of air toxic monitors collects data to ensure permit conditions are met at stationary sources and for State and National regulatory programs. The *BAAQMD 2008 Air Monitoring Network Plan* describes recent and planned changes and improvements to the District's air monitoring network.

In recent years the Air District has undertaken initiatives, such as the Community Air Risk Evaluation (CARE) program and the Clean Air Communities Initiative, to analyze pollution exposure at a more localized level and identify communities that are disproportionately impacted by air pollution. In many cases, these communities correspond to areas identified as priority development areas (PDAs) under FOCUS—the region's development and conservation strategy. The FOCUS strategy encourages infill development in PDAs to promote smart growth and reduce sprawl. The data and information generated from these new initiatives allows the District to implement more targeted policies and programs to reduce emissions and exposures in these communities.

The Air District has developed limited enhanced monitoring capabilities of key pollutants to gather more complete data to better assess local air quality conditions based upon the resources available. As an example, the Air District recently located a portable monitoring trailer in West Berkeley and Benicia to measure local air quality, and launched a mobile air monitoring van to assist in developing local pollutant concentrations across the West Oakland community to help identify local sources. Such efforts generally require a minimum of one year of data collection to effectively characterize an area's air quality. These efforts are resource

intensive, requiring expensive instrumentation, specialized operators, coordination among many Air District staff, and long site-development and set-up times.

Implementation Actions:
Depending on available resources, specific components of expanded monitoring would include:

- Ensure representative air quality data is being collected in the impacted communities identified under the CARE program. This effort would require review of the existing monitoring network with respect to the impacted communities to ensure that appropriate long term air quality data is being collected.
- Enhance monitoring of local air quality by collecting more information about pollutant concentrations and exposure at localized levels. This effort would be focused around microenvironments that may have significant local emission sources that could be assessed through the use of temporary monitors.
- Partner with County Health Departments to identify areas of poor air quality and collaborate with the community on ways to potentially measure and reduce exposure and emissions from local and regional sources.
- Perform on-going diagnostic analysis of the monitoring network, surveying the utility and effectiveness of monitoring locations and pollutants monitored while ensuring that the existing network continues to meet all federal and state requirements. This could help to verify air quality modeling inputs and predicted concentrations, which in turn would provide a more comprehensive and representative air quality profile of the Bay Area.

Emission Reductions:
Control measure does not directly reduce emission but supports emissions reduction programs.

Emission Reduction Methodology:
Not applicable.

Exposure Reduction:
Control measure does not directly reduce exposure but supports exposure reduction efforts.

Emission Reduction Trade-offs:
None.

Cost:
Costs would vary depending on the extent of enhanced monitoring implemented. Available resources would be determined through the District's budget process.

Co-benefits:
Not applicable.

Monitoring Mechanisms:
Track enhancements to local and regional air monitoring capabilities.

Issues/ Impediments:
Enhanced air quality modeling will require additional resources, including purchase of new instrumentation, equipment maintenance, and additional staff with technical expertise in atmospheric chemistry, and background and familiarity with monitoring equipment.

Sources:
1. BAAQMD 2008 Air Monitoring Network Plan

ECM 1 - Energy Efficiency

Brief Summary:
This control measure consists of three components: 1) provide education and outreach to increase energy efficiency in residential and commercial buildings and industrial facilities, 2) provide technical assistance to local governments to adopt and enforce energy efficiency building codes, and 3) provide incentives for increasing energy efficiency at schools.

Purpose:
Decreasing the amount of energy consumed in the Bay Area through increased efficiency and conservation will reduce the amount of fossil fuels, such as natural gas, needed to produce the electricity that the region uses. This will, in turn, decrease the production of greenhouse gases and criteria pollutants emitted by combustion of fossil fuels.

Source Category Affected:
The emission source affected by this measure is primarily electricity production for commercial and residential buildings and industrial facilities.

Regulatory Context and Background:
The California Global Warming Solutions Act, or AB32, signed into law in 2006, requires the State of California to reduce greenhouse gas emissions to 1990 levels by 2020. In support of this goal, the California Air Resources Board "encourages local governments to adopt a reduction goal for municipal operations emissions and move toward establishing similar goals for community emissions that parallel the State in commitment to reduce greenhouse gas emissions by approximately 15 percent from current levels by 2020." According to the Air District's 2008 Source Inventory of Bay Area Greenhouse Gas Emissions, approximately fifty percent of the region's greenhouse gas emissions are produced through energy used in residential and commercial building, industrial facilities and electricity generation. The Bay Area cannot meet the challenge of AB32 without reducing energy use in buildings and industry.

Energy production at and for residential, commercial, industrial and other buildings is also a significant source of criteria pollutants such as NOx and PM. Improved energy efficiency can reduce these emissions from power plants, boilers, furnaces, etc.

PUC Strategic Plan: In September 2008, the California Public Utilities Commission (CPUC) adopted the state's first Long Term Energy Efficiency Strategic Plan, presenting an integrated framework of goals and strategies for saving energy from government, utilities and the private sector in the 2009 to 2020 period. Goals in the Strategic Plan include:

- All new residential construction in California will be zero net energy by 2020;
- All new commercial construction in California will be zero net energy by 2030;
- The Heating, Ventilation, and Air Conditioning (HVAC) industry will be reshaped to ensure optimal equipment performance; and
- All eligible low-income homes will be energy efficient by 2020.

Title 24: In California, energy efficiency requirements for new construction are addressed through Title 24 of the California Code of Regulations. Part 6 of Title 24, the California Energy Code, contains energy conservation standards applicable to all residential and non-residential buildings throughout California. In April of 2008, the California Energy Commission adopted new standards for Title 24, with the intent of decreasing energy use and greenhouse gas emissions throughout the state. The 2008 update is expected to achieve 13-15% energy savings in residential buildings and 8% savings in commercial buildings compared to the 2005 standards. The 2008 standards will take effect on January 1, 2010.

Progress in energy efficiency will be essential to achieve our greenhouse gas reductions goals. Comprehensive green building programs that include standards for energy efficiency and third party verification of building performance are critical to this objective. The most effective role for the District is to complement and build on the requirements embedded in the 2008 update of the Title 24 standards. One such gap is in the enforcement of Title 24. A study conducted by EDAW on behalf of the City of Seattle concludes that, as building codes and standards become more complex, there is a critical need for education and outreach to ensure that the codes are properly implemented and enforced.

In general, it is difficult for schools and school districts to access governmental funding resources to upgrade their facilities because, unlike city and county governments, schools and school districts have very little capital with which to leverage financing, and very limited resources to navigate the paperwork and research needed to develop effective proposals. The 2009 American Recovery and Renewal Act has provided funding and financing for building upgrades, however this funding is not available for schools to add solar power, as photovoltaic systems are not considered part of a school facility.

Implementation Actions:
This control measure consists of three components:

- Provide education and outreach, as resources permit, to increase energy efficiency in residential and commercial buildings and industrial facilities, including distributing information on state and local energy programs to permitted sources, and researching the newest methodologies and tools for quantifying GHG emissions from building energy use;
- Provide technical assistance to local governments to adopt and enforce energy efficiency building codes and green building ordinances, including distribution of model ordinances and collaboration with the California Energy Commission to convene building inspector trainings on new Title 24 regulations;
- Provide information and incentives, as resources permit, to increasing energy efficiency at schools, through the District's existing outreach and community grant programs.

Emission Reductions:
It is estimated that all actions in this control measure will result in a 1% reduction in electricity use in the Bay Area which draws from the results to date from local green building ordinances.

The Air District's *2008 Source Inventory of Greenhouse Gas Emissions* provides current levels of energy use and resulting CO2 emissions.

ABAG projects an approximately 28% increase in Bay Area population from 2005 – 2035. From 2005 – 2020, this increase will be approximately 14%. Using the District's *Source Inventory,* the total electricity use is first expanded to incorporate this estimated growth, and then an estimated savings from the control measure implementation actions is applied. The *Source Inventory* uses 2007 data, so instead of applying the full 14% increase (representing an increase from 2005 – 2020), an adjusted increase of 12% has been applied.

After applying the increase due to population growth, a 1% decrease is calculated.

Emissions are in short tons/day (metric tons/day for CO_2):

Daily Energy Use	CO2	PM 10	PM 2.5	ROG	NOx	SO2	CO
149,474 MWh	43,099	28	28	4.2	46	40	57
2020 Projection*	48,270	32	32	4.7	52	44	64
1% Reduction	483	0.32	0.32	0.05	0.52	0.44	0.64

*12% increase over 2007 data

How Emissions Reductions Were Estimated:
Factors for greenhouse gas emissions from electricity use are based solely on the amount of energy used. Factors for criteria air pollutant emissions, on the other hand, are based not just on the amount of energy used, but also on the specific technology being utilized. Therefore, it is far more complicated to develop an emissions factor for criteria pollutants, and the numbers in the table above should be treated as general estimations and not specific projections.

Coefficients to translate electricity into CO2 emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1. Electricity coefficients for PM, ROG, NOx, SO2 and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Exposure Reduction:
This measure could help to reduce exposure in impacted communities that are located near power plants, particularly "peaker plants", due to the reduction in electricity use.

Emission Reduction Trade-offs:
This control measure is designed purely to reduce energy consumption, so there would be no direct emission trade-offs. There might be indirect emissions associated with the production and delivery of some energy efficient technologies.

Cost:
Investing in energy efficiency is almost always cost-effective because there is a direct return on the investment in the form a reduction in energy expenditures. Numerous state- and utility-sponsored incentive programs exist which provide rebates or financing for purchasing and

installing energy efficient technologies. In addition, innovative financing strategies such as the Berkeley FIRST model, have emerged which negate the need for upfront capital investments on the part of building owners.

According to the CEC's Energy Consumption Data Management System, residential electricity use represents approximately 29% of all electricity use in the Bay Area. The table below outlines the net savings to building owners from investing in energy efficiency. The per household cost and savings numbers reflect averages between the cost estimates of new green building policies in San Francisco and Sonoma County, as reported to the CEC.

	Per Household	Total
Incremental annual cost*	$96	$27,945,600
Annual savings	$165	$48,031,500
Net Savings	$69	$20,085,900

*Total incremental cost of $1,929 amortized over 20 years

Co-Benefits:
Reducing the use of fossil fuels in grid-tied electricity production brings a number of co-benefits to a community, including:

- improved air quality near power plants (due to reduced production)
- Increased reliability of power supply and cost
- energy savings
- financial savings through reduced energy usage
- green job creation (local manufacturers/suppliers/contractors for installing technologies)

Monitoring Mechanisms:
The overall goal of the measure is to reduce fossil fuel use through the direct use of grid-tied electricity. Monitoring and evaluating progress will be measured by:

- Reduction in electricity use (information from PG&E)
- Number of businesses and residents reached, in site visits, meetings, through mailings and other methods of information distribution (tracked by District)
- Number of building inspectors and operators receiving enforcement training on Title 24 (reported to District by CEC)
- Number of permitted sources seeking technical assistance, funding or other assistance from state and federal agencies for energy efficiency as a result of District's information provision (will be tracked through a response survey included in the information packets)
- Reduction in electricity use from permitted sources (reported through permitting process)

Issues/Impediments:
It is not anticipated that there would be significant impediment due to the voluntary nature of this control measure.

Sources:
1) *"'Re-commissioning' Leans on Education",* A. Lee Chichester, NEMI Research Report

2) "Source Inventory of Greenhouse Gas Emissions" Bay Area Air Quality Management District, December 2008
3) *Seattle New Building Energy Efficiency Policy Analysis: Case Study California Title 24 Energy Code*; EDAW (11/2004); http://www.seattle.gov/environment/documents/GBTF_NewBldg_Title24_Case_Study.pdf
4) http://www.dsa.dgs.ca.gov/Code/title24.htm
5) http://www.seattle.gov/environment/documents/GBTF_NewBldg_Title24_Case_Study.pdf
6) http://ag.ca.gov/globalwarming/pdf/green_building.pdf
7) http://www.energystar.gov/index.cfm?c=heat_cool.pr_hvac
8) http://www.cpfund.ca/pdf/the-jobs-connection.pdf

ECM 2 - Renewable Energy

Brief Summary:
This control measure consists of two components: 1) promote incorporation of renewable energy sources into new developments and redevelopment projects, and 2) foster innovative renewable energy projects through provision of incentives. Note: In addition, as part of the Further Study Measure entitled "Enhancement to Energy Measures," the District will evaluate the cost-effectiveness of solar thermal technology for consideration as a potential solar hot water heating rule.

Purpose:
Promoting the production and use of renewable energy in the Bay Area will reduce the portion of fossil fuel-based energy needed to produce the electricity that the region consumes. This will, in turn, decrease the greenhouse gases and criteria pollutants emitted by combustion of fossil fuels.

Source Category Affected:
The emission sources affected by this measure are primarily natural gas combustion associated with electricity production for commercial and residential buildings and industrial facilities.

Regulatory Context and Background:
The California Global Warming Solutions Act, or AB32, signed into law in 2006, requires the State of California to reduce greenhouse gas emissions to 1990 levels by 2020. In support of this goal, the California Air Resources Board "encourages local governments to adopt a reduction goal for municipal operations emissions and move toward establishing similar goals for community emissions that parallel the State in commitment to reduce greenhouse gas emissions by approximately 15 percent from current levels by 2020." According to the Air District's 2008 Source Inventory of Bay Area Greenhouse Gas Emissions, approximately fifty percent of the region's greenhouse gas emissions are produced through energy used in residential and commercial building, industrial facilities and electricity generation. The Bay Area can not meet the challenge of AB32 without reducing energy use and/or using renewable energy in buildings and industry.

There are two primary approaches to increasing renewable energy: change the fuel mix from which grid-tied electricity is produced; or replace grid-tied electricity with 100% renewable electricity produced through distributed generation such as solar panels, micro wind turbines, or onsite cogeneration.

Changes to the electricity fuel mix are most efficiently made upstream, at the utility level. The State of California has an aggressive "renewable portfolio standard" that requires publicly-held electric utilities to provide electricity that is produced from 20% renewable energy sources by 2010. The AB32 Scoping Plan adopted by the California Air Resources Board calls for this renewable energy target to increase to 33% by 2030.

A downstream approach to increasing the use of renewable energy is to promote non-fossil fuel-based energy technologies, such as solar thermal panels, solar photovoltaic (PV) panels, cogeneration systems that use waste heat or waste methane, micro-sized wind turbines, etc.

Implementation Actions:
Control measure consists of two components:

- Promote renewable energy sources in new developments and redevelopment projects as an emissions offset option included in both the District's new Indirect Source Review Rule, and as a mitigation measure within the CEQA process (promoted, in part, through the District's CEQA Guidelines)
- Foster innovative renewable energy projects and approaches through existing and new incentive programs (e.g. expand the Berkeley FIRST program, replicate Solar Sonoma County's streamlining of incentives policies)

Emission Reductions:
Currently, the Bay Area has 132 megawatts (MW) of installed solar power. The California Public Utilities Commission oversees the California Solar Initiative, which has a statewide program goal of installing 3,000 MW of new solar power by 2020. Current statewide capacity is 515 MW, reflecting a 482% increase over current capacity. Applying this increase to current Bay Area capacity would indicate that by 2020, installed capacity in the Bay Area would be in the neighborhood of 636 MW.

It is estimated that the implementation actions in this control measure would increase installed solar capacity in the Bay Area by approximately 1-5% above and beyond the goals set by the California Solar Initiative. This would result in additional installed capacity of 64 MW, which would offset grid-tied electricity.

Emission reductions are in short tons/day (metric tons/day for CO2)

Solar Capacity Increase	Annual MW	MT CO2	PM10	PM2.5	ROG	NOx	SO2	CO
10% by 2020	64	0.05	<.01	<.01	<.01	<.01	<.01	<.01

How Emission Reductions were Estimated:
Factors for greenhouse gas emissions from electricity use are based solely on the amount of electricity used. Factors for criteria air pollutant emissions, on the other hand, are based not just on the amount of energy used, but also on the specific technology being utilized at the power plant. Therefore, it is far more complicated to develop an emissions factor for criteria pollutants, and the numbers in the table above should be treated as general estimations and not specific projections.

Coefficients to translate electricity use into CO2 emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1. Electricity coefficients for PM, ROG, NOx, SO2 and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

The 10% estimate for increased solar capacity is a conservative estimate which draws from the results to date from local solar promotion programs.

Exposure Reduction:
This measure could help to reduce exposure in impacted communities that are located near power plants, particularly "peaker plants", due to the switch in electric load from grid-tied to distributed electricity generation.

Emission Reduction Trade-offs:
Emissions are created through the production and transport of renewable energy technologies (solar PV panels, etc.). Life-cycle criteria pollutant and other emissions, such as sulfur dioxide, nitrogen oxide and lead, associated with solar panels are due primarily to raw material extraction and energy consumption in the manufacturing process.

Cost:
The cost of renewable energy can vary widely, depending on available rebates, tax credits and other incentives, the energy needs of the building, and other factors. The payback period for solar PV systems is long (approximately 15-20 years), but may decrease if net metering laws change (see discussion on AB 560 below). In addition, innovative financing strategies such as the Berkeley FIRST model, have emerged which can reduce or negate the need for upfront capital investments on the part of building owners.

The cost of including onsite renewable energy generation in buildings would be born by building and property owners. Potential long-term savings would accrue to property owners as well. In the example below outlining the cost and savings of a typical 2.5 kW PV system, the payback period is approximately 19 years.

Net cost of solar 2.5 kW PV system

	Costs/Credits	Balance	10% increase (25,600 systems)	Annual cost over 10 years
Up-front capital cost	$20,000	$20,000	$512,000,000	
State rebate	-$6,500	$13,500		
Federal tax credit	-$4,050	$9,450		
Final cost		$9,450	$241,920,000	$24,192,000

Savings

	2.5 kW system	10% increase (25,600 systems)
Annual electricity savings	4,000 kWh	102,400 MWh
Average cost per kW	12.5 cents	
Annual cost savings	$500	$12,800,000
Annual cost (over 10 years)	$945	$24,192,000
Annual net cost	$445	$11,392,000

Applying these cost and savings figures to the region-wide program outlined in this control measure would result in a total net cost of $11,392,000.

Co-benefits:
Replacing grid-tied electricity with renewable energy brings a number of co-benefits to a community, including:

- improved air quality near power plants (due to reduced production)
- Increased reliability of power supply and cost
- energy savings, including savings by reducing distribution losses between power plants and the end user
- financial savings through reduced energy usage
- green job creation (local manufacturers/suppliers/contractors for installing technologies – e.g., the world's largest solar cell manufacturer is in Palo Alto)

Monitoring Mechanisms:
The Air District will use existing staff resources to track the amount of solar PV and solar thermal capacity installed in the Bay Area by monitoring organizations which report on these statistics, such as the PUC and the California Solar Initiative.

Issues/Impediments:
It is not anticipated that there would be significant impediment to the voluntary approach described in component (1). Significant impediments to implementation of the incentive-based component to this control measure (2) are not anticipated, however, provision of financial incentives would be dependent upon the availability of adequate financial resources.

AB 560 and Net Metering: Under net-metering, the electric utility is required to "buy back" any electricity generated by a customer-owned generator as measured by an electric meter that can measure the flow of electricity in both directions. At the end of the year, the electric utility calculates the amount of electricity distributed to the grid by the customer and reduces the customer's annual bill by the amount of electricity generated by the customer. In California, utilities currently only have to offer net metering until the load served by net metering represents 2.5% of the utilities' total load. This limitation creates a general impediment to widespread installation of solar power by limiting its cost-effectiveness. Pending legislation in the State Assembly, AB 560, would increase the current cap on the amount of electricity that

can be generated under net metering from 2.5% to 10% of each utility's aggregate peak demand.

Sources:

1. "Source Inventory of Bay Area Greenhouse Gas Emissions", Bay Area Air Quality Management District, December 2008.
2. "Emissions from Photovoltaic Life Cycles", V.M. Fthenakis, H.C. Kim, and E.A. Alsema, *Environmental Science and Technology*, 2008.
3. AB560 Bill Analysis, California State Legislative Council
4. http://www.cpuc.ca.gov/PUC/energy/Renewables/
5. http://www.oregon.gov/ODOT/HWY/OIPP/docs/solar_panel_lifecycle.pdf
   http://www.leginfo.ca.gov/pub/09-10/bill/asm/ab_0551-0600/ab_560_cfa_20090508_122502_asm_floor.html

ECM 3 - Urban Heat Island Mitigation

Brief Summary:
The control measure includes regulatory and educational approaches to reduce the "urban heat island" (UHI) phenomenon by increasing the application of "cool roofing" and "cool paving" technologies.

Purpose:
The purpose of this control measure is to mitigate the urban heat island phenomenon. Reducing UHI effects can help to reduce ozone levels, as well as emissions of particulate matter (PM), air toxics and greenhouse gases related to energy consumption for air conditioning and cooling. In addition, it can help to offset temperature increases related to global warming.

Source Category Affected:
The sources of emissions affected by this control measure are primarily associated with electricity generation for buildings and evaporative emissions from automobiles.

Regulatory Context and Background:
As urban areas develop, natural, permeable surfaces and vegetation are replaced by impermeable structures and paved surfaces. This development transforms the area into a drier micro-environment, which absorbs, rather than reflects, the heat of the sun. Thus, urban heat islands are created, which can be up to 10^0 F hotter than natural background temperatures. Factors that contribute to UHI formation include the following:

- Many man-made surfaces are composed of dark materials that absorb and store the sun's heat.
- Buildings, industrial processes, motor vehicles and people produce anthropogenic heat.
- Loss of trees and vegetation due to urbanization causes a reduction in cooling from evapo-transpiration.
- Urban structures can form canyons that reduce ventilation and trap heat.

Elevated temperatures caused by UHIs can accelerate the formation of ground level ozone, or smog, and can contribute to adverse health impacts, such as respiratory and heat-related ailments. Higher temperatures can also result in increased electricity use to cool buildings. Mitigation methods include increasing the reflectivity of built surfaces, such as roads, parking lots and rooftops, increasing tree-cover and natural vegetation (for shading and the cooling effect of evapo-transpiration), and increasing ventilation.

Cool Paving: On average, about 12% of an urban city's land area is devoted to parking lots. This number can be even higher in suburban communities.

Many parking lots are resurfaced every 5-10 years. The amount of parking lot construction and re-surfacing that occurs in the Bay Area provides a significant opportunity to substantially

increase albedo (reflectivity) while providing ancillary benefits such as an extended life of the paved surface and storm water benefits associated with use of porous paving.

The hottest pavements tend to be impermeable and dark in color, with solar reflectance values (albedo) under 25%. These pavements can heat to 150°F or more on hot days. Utilizing cool paving techniques can reduce this temperature by 30°F or more. There are two ways to make pavements cooler: 1) by increasing albedo, and 2) by increasing their ability to store and evaporate water.

Cool Roofs: Most existing flat roofs have an albedo (reflectivity) of only 10 to 20 percent of sunlight. These roofs absorb much of the remaining solar radiation and heat up the buildings they cover. Cool roofing technologies, such as lighter or more reflective paint, coatings, membranes, shingles or tiles, can increase a roof's albedo, on average, to about 50-60%. A 2000 study by Lawrence Berkeley National Laboratory revealed a 13-18% reduction in air conditioning-related electricity use in residential and commercial buildings in San Jose due to the application of cool roof strategies.

While cool roofing reduces the need for air conditioning during periods of heat, it can have an opposite impact during periods of cold by reflecting solar radiation away from the buildings, requiring an increase in heating during winter months. In most locations, the balance of these two effects results in a net reduction in energy use. However, in some locations, there may not be an energy reduction benefit from the application of cool roof technologies. Air District staff will continue to follow research efforts in this area.

Implementation Actions:
Control measure consists of the following components:

- Promote building code requirements for new construction or re-roofing/roofing upgrading for commercial and residential multi-family housing to meet specific "cool roof" standards.
- Include minimum "cool roof" standards for new commercial and residential multi-family housing construction and re-roofing or roofing upgrades in specified areas as mitigation measures under the District's CEQA Guidelines and ISR rule.
- Develop and promote adoption of a model zoning ordinance for "cool paving" standards to be met when existing parking lots undergo re-surfacing.
- Provide training for public works staff and private construction/paving companies on benefits of and how to meet new cool paving standards.
- Encourage construction of new and re-surfacing of existing parking lots and other paved surfaces to meet minimum reflective and permeable surface standards by including this as a mitigation measure under the District's CEQA Guidelines and ISR rule.
- Perform outreach to cities and counties to make them aware of the benefits of cool roofing and cool paving, and of new tools available.
- Provide training for building inspectors on benefits of and how to meet new cool roofing standards.

Emission Reductions:
Lawrence Berkeley National Laboratory's (LBNL) Heat Island Group conducted a study of the impacts that surface lightening of rooftops and pavement, combined with tree shading, might have on the Los Angeles air basin. The study found that the widespread application of these combined activities could achieve a decrease in ambient air temperature of 3°C (5.4°F). Half of this temperature reduction is due to albedo (roofs and pavement) and half to trees.

While no similar study has been conducted for the Bay Area, the results can be applied to similar temperature zones, such as San Jose and the Diablo Valley. This reduction in ambient air temperature would result in a reduction in electricity use to cool buildings. While no empirical studies have been conducted for the Bay Area, studies of individual buildings by LBNL, the Florida Solar Energy Center, and others have shown that energy savings on the order of 20% to 30% are commonly achieved with a cool roof surface.

Contra Costa County, Napa County, Santa Clara County and approximately half of Solano County are expected to be the most appropriate locations for applications of cool roofs in the Bay Area Air Quality Management District's jurisdiction due to their warmer temperatures and higher use of air conditioning. It is assumed that cool roofs in these counties would reduce air conditioning-related electricity use by 20%.

Emission reductions are in short tons/day (metric tons/day for CO2)

Source Category	MWh	CO2 (MT)	PM10	PM2.5	ROG	Nox	SO2	CO
Electricity	80	23	0.015	0.15	<0.01	0.03	0.02	0.03

Emission Reduction Methodology:
Factors for greenhouse gas emissions from electricity use are based solely on the amount of electricity used. Factors for criteria air pollutant emissions, on the other hand, are based not just on the amount of energy used, but also on the specific technology being utilized at the power plant. Therefore, it is far more complicated to develop an emissions factor for criteria pollutants, and the numbers in the table above should be treated as general estimations and not specific projections.

Coefficients to translate electricity use into CO2 emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1, using the most recently CCAR-approved coefficient for PG&E (for year 2007). Electricity coefficients for PM, ROG, NOx, SO2 and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Estimations for electricity used for air conditioning in the selected counties was taken from the Energy Information Administration's (EIA) 2001 Residential Buildings Energy Consumption Survey and the California Energy Commission's (CEC) 2006 California Commercial End-Use Survey. Data on energy consumption by county and by sector from the CEC's Energy

Consumption Data Management System was used to estimate the amount of electricity used for air conditioning that occurred in these counties.

Exposure Reduction:
This measure would help reduce smog formation by reducing the ambient air temperature, particularly in areas that experience excessive heat. It would be especially effective in reducing population exposure in those areas of the Bay Area that experience higher daily ambient temperatures, like San Jose, Concord, and San Leandro/East Oakland.

Emission Reduction Trade-offs:
It is unlikely that this measure would increase any emissions appreciably. However, caution would have to be taken in compiling the technology specifications to ensure that products that could produce toxic emissions during their use are not recommended.

Cost:
Cool roofs deflect some desired heat gain during the winter. In general, though, cool roofs result in net energy savings, especially in areas where electricity prices are high.

Although costs will vary greatly depending on location and local circumstances, the cost premium for cool roofs versus conventional roofing materials ranges from zero to 5 or 10 cents per square foot for most products, or from 10–20 cents for a built-up roof with a cool coating used in place of smooth asphalt or aluminum coating.

A California study found that cool roofs provide an average yearly net savings of almost 50 cents per square foot. This number includes the price premium for cool roofing products and increased heating costs in the winter as well as summertime energy savings, savings from downsizing cooling equipment, and reduced labor and material costs over time due to the longer life of cool roofs compared with conventional roofs.

A 2007 study titled "California Rooftop Photovoltaic (PV) Resource Assessment and Growth Potential by County," conducted by Navigant Consulting for the CEC's PIER program provided estimated roof space for the residential and commercial sectors within the selected counties. An estimated cost of 10 cents per square foot was used to calculate the cost of applying cool roof technologies to this potential roof space. Assuming a cool roof penetration program rate of 10%, we estimated upfront capital cost of $7,600,637 for the residential sector and $2,311,504 for the commercial sector.

	Residential	Commercial	Total
Upfront Capital Costs	$7,600,637	$2,311,504	$9,912141
Annual Savings	$38,003,185	$11,557,521	$49,560,706
Net Annual Savings	$30,402,548	$9,246,017	$39,648,565

To estimate the electricity cost savings that would be achieved in the residential sector, we again reference the California Energy Commission's Energy Consumption Data Management

System for the amount of expenditures in California for electric Air Conditioning in 2007. This was then scaled down based on the share of statewide electricity used by the selected counties, and reduced by 80% to arrive at the amount of electricity use that would be avoided by cool roofs. We largely used the same methodology for the commercial sector, except that we did not have actual expenditure data. Instead, we consulted the Energy Information Administration's Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State report to find the average retail price of electricity. This was then applied to the scaled down air-conditioning electricity consumption data.

Co-Benefits:
Heat island mitigation measures bring a number of co-benefits to a community, including:

- improved air quality
- improved public health (lower risk of respiratory and heat-related ailments)
- energy savings
- financial savings through reduced energy usage
- green job creation (local suppliers/contractors for installing technologies)

Monitoring Mechanisms:
Monitoring and evaluating progress could include:

- Tracking how many cool roof building codes are adopted
- Measuring increases in square footage of cool roofs, both in new construction and existing buildings
- Measuring increases in square footage of cool parking lots

Issues / Impediments:
Advocating for building code requirements that include "cool roof" standards for re-roofing/roofing upgrades may raise concerns about a potential increase in up-front costs among some stakeholders, such as the construction and development industries or local governments. Similar requirements for "cool paving" may also raise concerns due to a lack of information on the availability and sourcing of these technologies and products. By promoting and encouraging adoption of these types of policies, the Air District will facilitate demonstration of the actual cost benefits of such policies and work toward overcoming these barriers.

Sources:
1) Cool Houston: A Plan for Cooling the Region (2004)
2) Heat Islands: Understanding and Mitigating Heat in Urban Areas; Gartland (2008)
3) California Energy Commission, http://www.energy.ca.gov/title24/coolroofs/
4) http://www.energy.ca.gov/title24/coolroofs/documents/QUESTIONS-ANSWERS_BUILDING-OWNERS.PDF
5) USEPA, http://www.epa.gov/heatisland/
6) Consumer Energy Center, http://www.consumerenergycenter.org/coolroof/faq.html#faqs-04

7) Cool Roof Rating Counsel, http://www.coolroofs.org/coolroofing.html; http://www.autolife.umd.umich.edu/Environment/E_Casestudy/E_casestudy2.htm; http://www.concretenetwork.com/pervious/environ_benefits.html
8) California Energy Commission. Energy Consumption Data Management System. Available online: http://ecdms.energy.ca.gov/elecbycounty.aspx
9) Energy Information Administration, 2001. Residential Buildings Energy Consumption Survey (RECS), Consumption and Expenditure Data Tables. Available online: http://www.eia.doe.gov/emeu/recs/recs2001_ce/2001tblce.html
10) California Energy Commission, March 2006. California Commercial End-Use Survey. Publication # CEC-400-2006-005, Table 8-2, p.153. Available online: http://www.energy.ca.gov/ceus/
11) Navigant Consulting, Inc. 2007. California Rooftop Photovoltaic (PV) Resource Assessment and Growth Potential by County, California Energy Commission, PIER Program. CEC-500-2007-048. Available online: https://norman.baaqmd.gov/exchweb/bin/redir.asp?URL=http://www.energy.ca.gov/2007publications/CEC-500-2007-048/CEC-500-2007-048.PDF
12) Energy Information Administration, November 2009. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Available online: http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html

ECM 4 - Shade Tree Planting

Brief Summary:
The control measure includes voluntary approaches to reduce the "urban heat island" phenomenon by increasing shading in urban and suburban communities through planting of (low VOC-emitting) trees and preservation of natural vegetation and ground cover.

Purpose:
The purpose of this control measure is to reduce ozone precursors, criteria pollutants (ozone, NO_2, PM10, SO_2) and greenhouse gases by mitigating the urban heat island phenomenon.

Source Category Affected:
The sources affected by this control measure include electricity generation as well as evaporative emissions from mobile sources.

Regulatory Context and Background:
As discussed in the Urban Heat Island control measure, due to their impermeable structures and paved surfaces, as well as a lack of vegetation, urban areas tend to absorb, rather than reflect, the sun's heat. These urban heat islands can be up to 10^0 F hotter than natural background temperatures. These elevated temperatures can accelerate the formation of ground level ozone, or smog. They can also result in increased electricity use to cool buildings. In addition, parked cars can release emissions from the vehicle's carburetor or fuel system. These "evaporative emissions" increase as ambient temperatures rise.

Planting trees through a comprehensive urban forestry program that includes goal-setting and ongoing management of the urban tree canopy can mitigate the urban heat island phenomenon and conserve energy use in three principal ways:

- Shading reduces the amount of the sun's energy absorbed and stored by built surfaces
- Transpiration converts moisture to water vapor and thus cools by using solar energy that would otherwise result in heating of the air
- Wind-speed reduction reduces the movement of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g., glass windows)

In addition, urban trees provide the following air quality and climate protection benefits:

- Absorbing gaseous pollutants (ozone, nitrogen oxides) through leaf surfaces
- Absorbing CO2 (carbon sequestration)
- Intercepting particulate matter (e.g., dust, ash, dirt, pollen, smoke)
- Reducing emissions (GHGs and criteria pollutants) from power generation by reducing energy consumption

- Releasing oxygen through photosynthesis
- Reduce evaporative emissions in parking lots
- Street trees also enhance conditions for pedestrians and cyclists, thus supporting alternatives to the automobile.

The Sacramento Municipal Utility District (SMUD) shade tree program has a goal to plant 500,000 trees in Sacramento. The tree planting program was found to produce net benefits from air conditioning savings. Three scenarios were assumed (base, highest, and lowest benefits) based on the SMUD program and a Best Available Control Technology cost analysis was performed to determine if shade trees planted in residential yards can be a cost effective means to improve air quality. Annual planting and maintenance costs, pollutant deposition, and biogenic hydrocarbon emissions were estimated over a 30-year period with existing models.

Some tree species emit volatile organic compounds, or VOCs, which contribute to the formation of ground level ozone, particularly in hot weather. It is important for tree planting programs to carefully select the species to be planted, opting for low VOC-emitting species.

Implementation Actions:
Control measure consists of the following components:
- Include tree planting standards for new developments in specified areas as mitigation measures under the District's CEQA Guidelines and ISR rule
- Promote adoption of a model municipal tree planting ordinance, including tree planting in parking lots
- Provide information via outreach materials, presentations and workshops to local government planning and public works department staff on how to maximize air quality, GHG and public health benefits of municipal tree planting programs, including promoting the Bay-Friendly Landscape Guidelines
- Provide information on and encourage the use of low VOC-emitting tree species for new planting and, as appropriate, replanting
- Monitor the outcomes and findings of current tree planting programs, such as the Air District Climate Protection Grant to Urban ReLeaf for tree planting and air quality monitoring in West Oakland.

Emission Reductions:
Implementation actions #1 (include as mitigation options under CEQA and ISR) and #2 (promote municipal tree planting ordinances) are estimated to increase the Bay Area's tree canopy by 1% over the next 10 years, from the current 29% of land cover to 30%.

Increase in Canopy cover (%)	Canopy cover (%)	# of Trees	Increase in # of Trees
Baseline = 0	29	41,172,735	0
Ten year goal = 1	30	42,593,715	1,420,980

The table below illustrates the annual energy savings and emission reduction benefits of planting an average medium sized deciduous tree, in this case a Cherry Plum tree, in a residential neighborhood. Benefits are given for 1,420,980 ten year old trees (representing a 1% increase in existing tree canopy).

Emission reductions are in short tons/day (metric tons/day for CO2)

	MWh	CO2 (MT)	PM10	PM2.5	ROG	NOx	SO2	CO	BVOCs
Benefits for 1,420,980 trees	85,259	67.56	0.04	0.04	<0.01	0.07	0.062	0.09	-0.002

Emission Reduction Methodology:
Even low-voc trees will result in some release of biogenic VOC. This has been factored into the emission reduction estimates, and these emissions are listed as BVOCs in the table above.

The 1% target for increasing tree canopy is a more conservative, reduced target taken from the report, *"State of the Urban Forest: San Francisco Bay Area Progress Report"*, published by the Center for Urban Forest Research in 2007. This report examines a 3% increase in tree cover. Estimated energy savings were also taken from this report. In quantifying the emission reductions from this measure, coefficients to translate electricity into CO2 emissions were taken from the California Climate Action Reserve General Reporting Protocol, version 3.1. Electricity coefficients for PM, ROG, NOx, SO2 and CO were derived by Air District staff based on regional averages of emissions factors from power plants in the region.

Exposure Reduction:
This measure would reduce smog formation by reducing the ambient air temperature, particularly in areas that experience excessive heat. The measure would also reduce local air pollution by decreasing the accumulation of ozone precursors and PM due to the absorptive ability of trees.

Emission Reduction Trade-offs:
Caution must be taken in compiling the list of recommended species for planting to ensure that only low-VOC emitting trees are recommended. Planting deciduous trees ensures that there is no cooling dis-benefit in cooler months.

Cost:
According to the report, "*City of Berkeley, California Municipal Tree Resource Analysis"*, prepared by the Center for Urban Forest Research in 2005, the energy reduction benefits of the City of Berkeley's tree planting program are approximately $15 per tree. Applying these benefits and costs to the Bay Area as a whole (and planting a total of 1,420,980 trees) creates the following results:

	Per Tree	Total(1)
Total benefits	$15	$21,314,700
Total costs	$65	$92,363,700
Net cost	$50	$71,049,000
Cost-benefit ratio	4.3	

1. This table represents the benefits and costs of planting 1,420,980 trees in the Bay Area.

In this analysis, benefits come from reduced net energy use due to shading.

Co-Benefits:
Tree planting brings a number of co-benefits to a community and the region.

Regional benefits:
- reduced urban heat island effect
- improved air quality
- improved public health (lower risk of respiratory and heat-related ailments)
- green job creation (tree planting and maintenance)

Local benefits:
- reduced energy use in buildings
- financial savings through reduced energy usage
- reduced storm water run-off
- increased community livability/quality of life
- enhanced bike and pedestrian environments
- increased property values

In the *"State of the Urban Forest: San Francisco Bay Area Progress Report"*, the Center for Urban Forest Research estimates that approximately 90% of the monetary benefits achieved by urban tree planting programs are due to increased property values.

Monitoring Mechanisms:
Monitoring and evaluating progress will be done by:
- Tracking local tree planting ordinances and tree planting programs

Issues/Impediments:
Due to the voluntary nature of this measure, significant impediments to implementation are not anticipated.

Sources:
1) *Cool Houston: A Plan for Cooling the Region* (2004)
2) *Heat Islands: Understanding and Mitigating Heat in Urban Areas*; Gartland (2008)

3) "Estimating Cost Effectiveness of Residential Yard Trees for Improving Air Quality in Sacramento, California, Using Existing Models," E. Gregory McPherson, Klaus I. Scott, James R. Simpson, USDA Forest Service, Pacific Southwest Research Station, Davis, CA, October 1997.
4) "City of Berkeley, California, Municipal Tree Resource Analysis," Scott E. Maco, E. Gregory McPherson, James R. Simpson, Paula J. Peper, Qingfu Xiao, USDA Forest Service, Pacific Southwest Research Station, Davis, CA, March 2005.
5) *"State of the Urban Forest: San Francisco Bay Area Progress Report,"* Jim Simpson, Greg McPherson, Chad Delany, Center for Urban Forest Research, USDA Forest Service, PSW Research Station, Davis, CA; June 20, 2005.
6) *"Actualizing microclimate and air quality benefits with parking lot tree shade ordinances,"* McPherson, E.G., J.R. Simpson and K.I. Scott. 2001.
7) *Parking Lot Shading Guidelines*, City of Davis Municipal Code, Section 40.25.100,
8) California Energy Commission, http://www.energy.ca.gov/title24/coolroofs/; http://www.energy.ca.gov/title24/coolroofs/documents/QUESTIONS-ANSWERS_BUILDING-OWNERS.PDF
9) USEPA, http://www.epa.gov/heatisland/
10) Consumer Energy Center, http://www.consumerenergycenter.org/coolroof/faq.html#faqs-04
11) Cool Roof Rating Counsel, http://www.coolroofs.org/coolroofing.html
12) http://www.autolife.umd.umich.edu/Environment/E_Casestudy/E_casestudy2.htm
13) http://www.concretenetwork.com/pervious/environ_benefits.html

FSM 1 - Adhesives and Sealants

Brief Summary:
This further study measure would research the emission inventory for this source category and seek to reconcile discrepancies with the inventories of other districts in the State and to determine if VOC limits found in South Coast AQMD rules are feasible and effective in the Bay Area.

Purpose:
Reduce emissions of VOC from the use of some categories of adhesives and sealants.

Source Category:
Area Source.

Further Study Measure Description:
In 2003 and early 2004, the ARB, San Joaquin, Sacramento and Bay Area districts jointly undertook a rule comparison project for a number of source categories, including adhesives and sealants. The South Coast AQMD rule for adhesives appears to be the most stringent, particularly for architectural adhesives. Architectural adhesives encompass a wide variety of adhesives used in residential and commercial construction: carpet adhesives, flooring adhesives, subfloor adhesives, tile adhesives, drywall adhesives, and multipurpose construction adhesives. The South Coast VOC limits range from 50 to 150 grams per liter (g/l) for various categories of architectural adhesives.

In 1998, the ARB and California districts developed Reasonably Available Control Technology/Best Available Retrofit Control Technology (RACT/BARCT) VOC limits for adhesives and sealants. RACT/BARCT VOC limits range from 100 to 250 g/l for various categories of architectural adhesives. The Bay Area rule, Regulation 8, Rule 51: Adhesive and Sealant Products, meets the BARCT limits in the ARB document.

In the rule comparison discussions, significant differences in inventory between the districts emerged. Specifically, the San Joaquin District has almost no area source adhesive emissions, which includes the architectural adhesives, whereas the Bay Area inventory has over 9 tons organic emissions per day from area source adhesives. When Bay Area staff developed Regulation 8, Rule 51: Adhesives and Sealants, the area source inventory was derived from the Rauch Guide to the US Adhesives and Sealants Industry, by the Rauch Associates, Inc., originally the 1990 edition. This should be updated.

Since Reg. 8-51 was last amended, in 2002, the comparable South Coast rule, Rule 1168, has been amended twice. Consequently, the South Coast has a number of VOC limits for adhesives and sealants that are lower than the Bay Area's. Some VOC limits that are appropriate for southern California, such as subfloor adhesives, may not be feasible for the Bay Area. However, lower limits should be investigated for feasibility.

Sources:

1. California Air Resources Board. 1998. "Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology for Adhesives and Sealants."
2. South Coast AQMD, Rule 1168
3. South Coast AQMD. 2002. "Final Staff Report: Proposed Amended Rule 1168-Adhesives and Sealants"
4. South Coast AQMD. 2000. "Staff Report: Proposed Amended Rule 1168-Adhesives and Sealant Applications"
5. TIAX. 2003. Sacramento Regional Clean Air Plan Update: Control Measure D3.
6. Walnut, F., TACC International. 2003. Personal Communication.

FSM 2 - Reactivity in Coatings and Solvents

Brief Summary:
Consider photochemical reactivity for the architectural coatings or other coatings categories. This approach targets volatile organic compounds (VOCs) with the greatest ozone forming potential, rather than treating all VOCs equally. Reformulation options may be greater and potential ozone formation less with a reactivity-based strategy, because there is a wide range of reactivity between VOC species.

Purpose:
Reduce emissions of VOCs with the greatest ozone-forming potential from various coatings operations and solvents.

Source Category:
Area source.

Further Study Measure Description:
The District regulates coating operations and solvent use in over 20 district regulations through VOC limits and operational requirements. Because coatings and solvents are manufactured in a consistent manner, it is possible to regulate the amount of VOCs and other compounds that are used to formulate these products. This is the rationale behind developing mass-based VOC limits for coatings and solvents.

When coatings are applied they release organic compounds. Different organic compound species react in the atmosphere to produce different amounts of ozone. The ozone forming potential is called reactivity. A coating containing small amounts of a highly reactive compound could form more ozone than a coating with a greater amount of low-reactive compounds. The relative difference in ozone forming ability is called the "relative reactivity."

EPA deems organic compounds that form no more ozone than ethane to be "negligibly reactive." Since that original listing, EPA has designated about 50 compounds as negligibly reactive, many of which are chlorinated or fluorinated compounds, and has excluded these compounds from the federal regulatory definition of VOC. In fact, there is a scale of ozone reactivity among compounds, with some creating many times the amount of ozone as others for each gram of the compound that is emitted. Since the initiation of mass-based VOC limits in the 1970's, considerable research has gone into characterizing the relative reactivity of organic compounds commonly used in paints and as solvents.

The traditional mass-based approach has led to significant reductions in VOC emissions, and improvements in air quality. However, the ability to get further reductions on a mass basis may be limited, as technological limits inherent in coating and solvent formulation are approached. Consequently, a reactivity-based approach may be a better option and may allow coating

formulators more flexibility to reduce ozone-forming impacts of their products and ultimately, progress towards attainment with state and federal ozone standards.

Sources:

1. Staff Report: BAAQMD Regulation 8, Rule 3: Architectural Coatings, May 2009.
2. Workshop Report: BAAQMD Regulation 8, Rule 45: Motor Vehicle and Mobile Equipment Coating Operations, June 2008.
3. Final Approved Suggested Control Measure for Architectural Coatings, ARB, February 2008.
4. Technical Support Document for the Proposed Suggested Control Measure for Architectural Coatings, ARB, September 2007.
5. 2005 Architectural Coatings Survey, Final Report, ARB, December 2007.

FSM 3 - Solvent Cleaning and Degreasing Operations

Brief Summary:
Reduce emissions of VOCs from solvent cleaning and degreasing operations by implementing control measures based on ARB's statewide study.

Purpose:
Reduce VOC emissions.

Source Category:
Area Source.

Further Study Measure Description:
Cold cleaning describes the use of a cleaning solution in a tank or container into which a part to be cleaned is immersed, or a remote reservoir cleaner that pumps some cleaning solution over a part to be cleaned that then drains back into the reservoir. Wipe cleaning involves wetting a rag, cloth or paper with a cleaning solution and wiping grease or soils from a part by hand. California Districts have either a 25 g/l or a 50 g/l VOC standard for solvent used in cold cleaners and for wipe cleaning. The BAAQMD standard in Regulation 8, Rule 16 is 50 g/l, and wipe cleaning standards in various surface coating rules (Reg. 8, Rules 4, 14, 19 and 31) have a 50 g/l standard. More recently amended rules (Reg. 8, Rules 20, 32 and 45) have incorporated a 25 g/l wipe cleaning standard. This further study measure would investigate whether a 25 g/l VOC standard in Reg. 8-16 and in 50 g/l limit surface coating rules would significantly reduce emissions.

Based on work conducted in 2002, when Reg. 8-16 was last amended, a 25 g/l VOC standard would only result in 0.022 tons/day emissions reductions, and only 0.023 tons/day for wipe cleaning. This is in part due to differences in how emissions are calculated between districts.

In 2007, ARB initiated a research project, conducted by Professor Bill Welch and researchers at the University of California at Riverside, to develop a statewide emissions inventory for solvent and wipe cleaning. The final report of that project, originally scheduled for completion in spring, 2009, has not yet been released.

Sources:
1. Staff report, Proposed Amendments to Regulation 8, Rules 4, 14, 19, 31, 43, BAAQMD, Oct. 2002
2. Staff Report, Proposed Amendments to Reg. 8, Rule 16: Solvent Cleaning Operations, BAAQMD, Sept. 2002
3. Welch, Bill, University of California at Riverside, College of Engineering – Center for Environmental Research and Technology, e-mails and survey drafts, Sept. 2007 through June, 2008.

FSM 4 - Emissions from Cooling Towers

Brief Summary:
Research ways to reduce VOC emissions from cooling towers in refineries.

Purpose:
Reduce VOC emissions.

Source Category:
Stationary source.

Further Study Measure Description:
The emission inventory for refinery cooling towers shows 0.45 tons/day organic emissions, based on cooling water throughput from cooling towers with District permits. AP-42 emission factors of 6 lbs organic emissions per million gallons water throughput were used in this calculation. This assumes organic compound leaks into the cooling water system are not minimized. However, if leaks are minimized, the AP-42 emission factor is 0.7 lb organic emissions per million gallons water. Further study is needed to determine whether leaks from cooling towers are currently minimized and whether there is any potential for emission reductions from regulations.

This further study measure has been initiated. The Texas Commission on Environmental Quality has adopted a regulation requiring monitoring of and limiting emissions from cooling towers at refineries and chemical plants in the Houston – Galveston area. This rule, including a test method, limits emissions of highly reactive VOC's (HRVOC). HRVOC is the basis for the SIP in the Houston – Galveston area. District staff developed a test method to replicate cooling tower emissions and has sought feedback on the method from the refinery representatives. The next step will be to establish a correlation between EPA test method 8015, which quantifies non-halogenated organic compounds in water. From there, the need for further action can be assessed.

Sources:
1. 30 TAC Chapter 115, Subchapter B and H, Cooling Towers, Texas Commission on Environmental Quality
2. BAAQMD 2005 Final Adopted Ozone Strategy, Vol. 2, January 2006
3. Compilation of Air Pollution Emission Factors (AP-42), US EPA, 1995

FSM 5 - Equipment Leaks

Brief Summary:
Research ways to reduce VOC emissions from equipment leaks through remote sensing technologies and other methods.

Purpose:
Reduce VOC emissions.

Source Category:
Stationary Source

Further Study Measure Description:
In 2003 and early 2004, ARB, San Joaquin, Sacramento and Bay Area districts jointly undertook a rule comparison project for a number of source categories, including valves and flanges. Valves and flanges are typically found at refineries and chemical plants, but are also found in other petroleum and gas production facilities. The review found that the Bay Area's existing Regulation 8, Rule 18: Equipment Leaks, is the most stringent regulation in the state. Reg. 8, Rule 18 was amended on January 21, 2004 to fulfill the provisions of control measure SS-16 from the 2001 Ozone Attainment Plan. During that rule development process, staff identified a number of different areas for potential future study to further reduce emissions from valves and flanges. One area recommended for further review was incorporating remote sensing technologies to identify the largest leaking components in the leak detection and repair (LDAR) program. Remote sensing could enhance the effectiveness of existing LDAR programs by identifying leaks sooner and in a manner that is less time consuming and labor intensive. Remote sensing could also expand the applicability of LDAR programs to areas currently not covered by existing rules, such as pipelines. Remote sensing technology is currently not able to detect the low levels required for compliance with Regulation 8, Rule 18, but it could supplement or enhance existing programs or allow more frequent compliance screening of remote valves.

Sources:
1. BAAQMD 2005 Final Adopted Ozone Strategy, Vol. 2, January 2006
2. Staff Report, Proposed Amendments to Regulation 8, Rule 18: Equipment Leaks, January, 2004, BAAQMD

FSM 6 - Wastewater from Coke Cutting

Brief Summary:
Review coke cutting operations to determine if emissions reductions can be achieved from the resulting wastewater.

Purpose:
Reduce VOC emissions.

Source Category:
Stationary source.

Further Study Measure Description:
Refineries operate high pressure water pumps to remove or "cut" coke from coking drums. During the investigation of Further Study Measure FS 9: Refinery Wastewater Systems in the 2001 Ozone Plan, it was noted that coke cutting operations at some facilities generated significant quantities of wastewater. This wastewater, at elevated temperatures, is often recycled. The wastewater from coke cutting is not part of the refinery wastewater collection and treatment system. One possible method of control would be to include coke cutting wastewater in the existing collection and treatment system. Additional research needs to be conducted to determine whether coke cutting wastewater contains significant quantities of VOC and whether there is any potential for emissions reductions from these operations. Because of these uncertainties, it is recommended that coke cutting operations be studied.

This further study measure is currently under way. In addition to the two refineries that have traditionally used this coke cutting operation, Tesoro has added a delayed coker and is now also using this process.

Sources:
1. BAAQMD 2005 Final Adopted Ozone Strategy, Vol. 2, January 2006
2. Draft Technical Assessment Document: Potential Control Strategies to Reduce Emissions from Refinery Wastewater Collection and Treatment Systems, CARB and BAAQMD, Jan., 2003

FSM 7- SO2 from Refinery Processes

Brief Summary:
Review refinery processes to identify opportunities to reduce SO2 emissions.

Purpose:
Reduce SO2 emissions.

Source Category:
Stationary source.

Further Study Measure Description:
The District's emissions inventory indicates that significant quantities of SO2 are emitted from refinery processes. In 2007, Basic Refining Processes (Category 10) emitted 23.8 tons SO2 per day. Other refinery combustion processes (categories 298, 299 and 301) emitted an additional 9.4 tons per day. This is roughly half of the SO2 emissions in the District, and by far the majority of those from stationary sources.

SO2 is a precursor to secondary fine particulate matter formation, and the District is not in attainment for the federal and state PM2.5 standards. Consequently, a reduction in SO2 emissions would help the District toward attainment of PM2.5 standards.

The basic process used in refineries to remove sulfur from oil has not changed in many years. Hydrogen is added to oil (hydrotreating) which converts the sulfur to hydrogen sulfide (H2S), which is then absorbed from the oil with diethanolamine or monoethanolamine. It is then stripped out of the DEA or MEA and combusted to produce elemental sulfur. Regulation 9, Rule 1: Sulfur Dioxide, limits SO2 emissions from fluid catalytic cracking units and fluid cokers to 1000 ppm, limits SO2 emissions from sulfur recovery plants to 250 ppm, and requires 95% removal of H2S from refinery fuel gas. Reg. 9-1 and the various refinery units could be examined to see if additional reductions are feasible.

Sources:
1. BAAQMD Emissions Inventory

FSM 8 - Reduce Emission from LPG, Propane, Butane, and other Pressurized Gases

Brief Summary:
Reduce emissions of LPG, propane, butane and other pressurized organic gases by requiring tanks and relief valves to be gas tight, prohibiting venting during tank filling, and establishing a leakage allowance for hoses.

Purpose:
Reduce VOC emissions.

Source Category:
Area source.

Further Study Measure Description:
The Air District already enforces gas tight requirements at stationary sources for a variety of operations, including refineries and bulk terminals. This control measure would apply similar standards to LPG, propane and butane tanks, prohibit venting from filling of such tanks, and would set a leakage allowance for hoses used in these operations.

Typically, liquid pressurized gases should occupy no more than 80 to 85 percent of the volume of a tank to allow for liquid expansion if a tank gets heated (such as by sunlight). These containers have a bleed valve, which is sometimes used to indicate to the person filling the container when the level of liquid in the tank is at the "full" level (80 to 85 percent full by volume). Containers can be safely refilled without venting by filling to a final weight or by filling to a final liquid volume using a tank gage.

California propane demand is estimated to be about 120,000 barrels per day. If Bay Area demand is 20% of that (although it may be less due to the availability of natural gas) and losses average 1%, losses equal 240 barrels per day. This is equivalent to 21.4 tons per day of propane losses. In addition, it has been estimated that up to 10 tons per day of LPG may be vented in the Bay Area.

A report on a research project at CARB in March, 2009 indicated that technological solutions were available and cost effective.

A further study measure would consider a gas tight standard for propane and other tanks; a prohibition on the filling of a container where the pressure differential for refilling is generated by venting the receiving container; a prohibition on venting to determine if the container is adequately filled; and a leakage allowance for new hoses sold in conjunction with pressurized gas containers.

Such a measure could impact:

- standard containers, such as 20# cylinders and forklift fuel tanks, refilled at high volume central locations
- fleet refueling at large facilities (i.e., forklift tank refueling)
- large stationary pressurized gas containers

Sources:

1. Maximus™ SFI – Measurement and Reduction of Gas Outage Gauge Emissions, the ADEPT Group, Inc. California Air Resources Board, Chair's Air Pollution Seminar, March 19, 2009

FSM 9 - Greenhouse Gas Mitigation in BACT and BACT Determinations

Brief Summary:
Consider flexibility in BACT/TBACT determinations in order to reduce secondary green house gas (GHG) emissions from abatement devices.

Purpose:
Reduce GHG emissions.

Source Category:
Stationary source.

Further Study Measure Description:
New source review regulations, including BAAQMD Regulation 2, Rule 2, mitigate increases from new and modified permitted sources of air pollution for criteria pollutants by making applicants install Best Available Control Technology (BACT) and/or obtain offsets for the emissions increases. In addition, the District's toxic new source review rule, Regulation 2, Rule 5, requires installation of toxic best available control technology (TBACT) for new and modified sources of toxic air contaminants (TACs) where the source risk exceeds a certain health risk level, and denies a permit where the source risk exceeds a greater health risk level.

Currently, District Regulations do not consider GHG emissions. Under existing federal, state and District guidelines, a source required to abate organic emissions can be required to install a highly efficient incinerator to abate those emissions to the maximum extent feasible, even if a relatively large amount of supplemental fuel is required to achieve a high organic destruction efficiency.

The District could advocate for flexibility in BACT/TBACT determinations when a permit application triggered BACT/TBACT and was not ministerial. In these determinations, discretion is allowed on implementation of control equipment, but implementation must be consistent with a maximum reduction in criteria pollutants. With the agreement of EPA and ARB, a lower level of emissions control could be considered if the alternative would emit large amounts of GHGs. Flexibility in BACT/TBACT determinations would require agreement of EPA and ARB, and potentially changes in regulations.

Sources:
8. BAAQMD Permit Handbook:
   http://www.baaqmd.gov/pmt/handbook/rev02/permit_handbook.htm
9. BAAQMD Regulations 2-2, and 2-5:
   http://www.baaqmd.gov/dst/regulations/index.htm

FSM 10 - Further Reductions from Commercial Cooking Equipment

Brief Summary:
Consider reducing emissions from commercial wok cooking, and solid fueled cooking devices such as wood fired pizza ovens.

Purpose:
Reduce PM emissions.

Source Category:
Area source.

Further Study Measure Description:
In 2007, the District adopted a rule to limit emissions from commercial conveyorized and under-fired charbroilers, Regulation 6, Rule 2: Commercial Cooking Equipment. The rule requires the use of control equipment on these cooking devices if certain amounts of beef are cooked. In 2008, the Association of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) tested and developed emissions factors for a number of appliances. The greatest amount of particulate matter came from a solid fueled broiler cooking hamburger and a Chinese wok cooking chicken breast in peanut oil.

The ASHRAE study indicated that the wok cooking emitted the greatest amount of particulate matter, as measured below the ventilation hood, but a breakdown of particle sizes indicated that most of the particulate weight was PM greater than 10 microns in diameter, it is likely that much of this large particulate matter is deposited on the grease filter, in the exhaust stack on the roof. For wok cooking, however, particles in the smaller size ranges (PM10 to PM2.5, PM2.5 and condensable vapors) were still significant. They total 51.7 lbs particulate matter per 1000 lbs food cooked, the second highest of the cooking appliances tested.

In addition, concern has been expressed about the use of wood fired pizza ovens and other cooking devices that are not underfired broilers. Typically, pizza in a wood-fueled oven is placed on a floor or platform, the pizza does not generate particulate matter or organic emissions from contact with the flame. The particulate matter of concern is generated directly by burning wood.

The number of commercial wok cooking appliances in the District has not been determined. Control equipment similar to those used for underfired charbroilers could control the emissions, but the cost effectiveness for wok cooking has not been investigated. For pizza ovens, and other solid-fueled cooking devices, an inventory needs to be established. A broader range of control equipment may be available, but cost effectiveness needs to be determined.

Sources:
1. ASHRAE Study 745-RP, 2008

2. BAAQMD Regulation 6, Rule 2: Commercial Cooking Equipment

FSM 11 - Magnet Source Rule

Brief Summary:
The District will explore as a further study measure the viability of developing a magnet source rule to reduce mobile source emissions from some or all of the types of facilities described below. Emphasis would be given to facilities in impacted communities as identified though the District's CARE program.

Purpose:
The purpose of this measure would be to reduce emissions and population exposure associated with magnet sources.

Source Category:
Transportation emissions.

Further Study Measure Description:
The term "magnet sources" refers to new and existing facilities that attract or generate a high volume of activity or usage of mobile sources of emissions, such as cars, trucks, off-road equipment, etc. Magnet sources can include airports, seaports, warehouses, distribution centers, shopping centers, and other facilities that generate mobile source emissions of criteria air pollutants, toxic air contaminants and greenhouse gases.

District staff are currently developing an indirect source review (ISR) regulation to mitigate the impacts of growth and new development in the Bay Area – see control measure LUM-2. A magnet source rule would be designed so as to complement the ISR regulation.

The District will evaluate the feasibility of developing a magnet source rule. Potential requirements could include calculating and reporting of emissions, estimating health risks and local impacts, developing plans to comply with ARB mobile source regulations, and development of additional emission reduction strategies. Issues to be considered include how to define a "magnet source," which types of sources and pollutants to focus on, specific emission reduction and other requirements, how a magnet source rule would be implemented and enforced, how to quantify emissions produced by magnet sources, potential mechanisms to reduce emissions and population exposure, and how a magnet source rule could supplement the emission reductions expected from ARB's diesel air toxics control measures over the next 5 to 10 years.

FSM 12 - Wood Smoke

Brief Summary:
The Air District will continue to study the impacts of its existing rules regarding wood burning and open burning, in order to develop more effective methods to implement, promote, enforce, and possibly expand, existing rules.

Purpose:
Reduce particulate matter emissions from wood smoke.

Source Category:
Area source.

Further Study Measure Description:
Fine particulate matter (PM) is a serious health concern; these particles can pass through the nose and throat, lodge deep within the lungs, and enter the bloodstream. Residential wood-burning represents the largest source of fine PM in the Bay Area, accounting for up to 30-40% of fine PM during peak pollution days. The Bay Area is home to 1.4 million fireplaces and woodstoves.

In order to protect Bay Area residents from the public health impacts of wood smoke pollution, on July 9, 2008 the Air District adopted a wood-burning rule (Regulation 6, Rule 3) that prohibits the use of wood-burning devices such as fireplaces, woodstoves, or pellet stoves, when air quality is forecast to be unhealthy and a *Winter Spare the Air Alert* is in effect. As defined in the rule, the *Winter Spare the Air* season runs from November 1 through the end of February.

The primary focus during the first year of rule implementation was to educate the public about the new rule, how to comply and the rule's relevance to public health. The *Winter Spare the Air Alert* advertising and outreach campaign utilized TV, print, billboard, radio, direct mail, public events, door-to-door canvassing and the Air District website. The District's No Burn phone line received over 500,000 calls. Enforcement focused on providing information to residents on how to comply with the rule, issuing warning letters to first-time violators who did not comply, and developing enforcement action for repeat violators.

For the 2008/2009 season, eleven *Winter Spare the Air Alerts* were issued. Data indicates that household wood burning was reduced by approximately 50% throughout the entire season[6]. Nevertheless, the national 24-hour ambient air quality standard (35 ug/m^3) was exceeded at one or more air monitoring site on 13 days during the winter of 2008/09. Seven of the alert days still exceeded the standard. It should also be noted that although the District's wood burning rule and the Winter Spare the Air program are focused on reducing exceedances of the

[6] *Winter Spare the Air Study: 2008-2009 Winter Wood Smoke Season*, Bay Area Air Quality Management District, March 2009, p. 30.

35 ug/m^3, some individuals may suffer health effects even when PM concentrations are below PM air quality standards.

In addition to residential wood burning, the District has limited agricultural burning in order to control emissions of fine particulate matter. The District will continue to study its current rules regarding wood and agricultural burning to develop rules and strategies to better protect public health. The District's PM emission inventory also indicates that PM emissions from commercial cooking are a significant source of PM emissions (see FSM #10 re: cooking).

Potential actions that the District will evaluate and may implement in future years include:

- Continue to work with local governments to adopt the District's model wood smoke ordinance (40 local governments in the Bay Area have adopted an ordinance as of February 2010);
- Evaluate the trigger level for declaring a *Winter Spare the Air Alert (*the threshold is currently 35 ug/m^3);
- Expand the *Winter Spare the Air Alert* education and outreach campaign;
- Continue to analyze monitoring data and refine models on PM2.5;
- Evaluate and modify enforcement response with increasing penalties for repeat violators for enhanced effectiveness;
- Evaluate and potentially revise current exemptions in Regulation 5: Open Burning, and Regulation 6: Particulate Matter;
- Consider revising Regulation 6, Rule 3 to incorporate any new changes to the federal New Source Performance Standard, Subpart AAA for new residential wood heaters;
- Evaluate the feasibility of requiring an upgrade or replacement of existing fireplaces and/or wood stoves when an existing home is sold or changes ownership;
- Evaluate the impact of modified definitions and exemptions in Regulation 6, Rule 3;
- Consider amending Regulation 6, Rule 3 to reduce unnecessary solid-fuel burning; and
- Consider amending Regulation 6, Rule 3 to apply to outdoor as well as indoor wood-burning devices.

FSM 13 - Energy Efficiency and Renewable Energy

Brief Summary:
Many agencies are already involved in issuing building standards and promoting energy efficiency and renewable energy. It is important to determine the proper role and added value that the District could bring to energy use in the buildings sector in light of constraints related to legal authority, potential enforcement mechanisms, in-house experience and expertise, available resources, and existing regulatory structures.

Purpose:
The purpose of this Further Study Measure is to determine whether and how the Air District can play a constructive role in energy efficiency and renewable energy.

Source Category:
Area source.

Further Study Measure Description:
It will be increasingly important to curb fossil fuel use in order to stem the threat of climate change. The Air District has not traditionally addressed energy use in buildings via regional air quality plans or its rule-making authority. However, given the growing threat of local impacts from climate change, including the threat that higher temperatures will degrade our air quality, the District is now exploring how it can use its existing authority to help reduce fossil fuel use by the buildings sector. In many cases the use of fossil fuels is indirect; for example, through the use of electricity produced by burning fossil fuels. Fossil fuel combustion is a major source of criteria air pollutant emissions as well as greenhouse gases.

Potential actions that the District will evaluate and may implement in future years include:

- Research the existing regulatory structure to determine the extent of District authority over building energy use, such as requiring energy audits of commercial and/or industrial buildings;
- Research the interface between Air District authority and implementation measures in the AB32 Scoping Plan;
- Adopt a rule to require installation of solar hot water heating systems in all new residential construction;
- Adopt a rule to require new commercial and residential swimming pools to be heated with solar power;
- Consider additional actions, such as discouraging the sale or use of “vampire appliances” that consume energy even when not in use.

Sources:
1. http://www.cpuc.ca.gov/PUC/energy/DistGen/solarhotwater.htm

FSM 14 – Winery Fermentation

Brief Summary:
Review emissions generated by fermentation at wineries to determine if reductions can be achieved.

Purpose:
Reduce VOC emissions.

Source Category:
Stationary source.

Further Study Measure Description:
In 2005, the San Joaquin district adopted a rule to control emissions from wineries. The rule applies to wineries that emit over 10 tons/year of organic emissions (primarily ethanol) based on formulae in the rule. The rule requires a reduction of fermentation emissions of 35%, which may include payment of an emission mitigation fee. The rule also requires that storage tanks of 5000 gallon size or greater be equipped with a pressure/vacuum valve and kept at a temperature of no greater than 75° F. San Joaquin staff estimated that 18 wineries would be subject to the rule, 14 of which were major stationary sources subject to federal Title V permits. The rule is anticipated to reduce emissions from wineries by 0.6 to 0.7 tons per day from a total inventory of 2.1 tons per day ROG.

The BAAQMD inventory for winery emissions is 0.78 tons ROG per day. The San Joaquin estimates 109 wineries in the San Joaquin district. In the Bay Area, there are over 300 wineries in Napa County alone that collectively account for about 60% of the Bay Area winery emissions. Further research will have to be done to determine whether any of the Bay Area wineries meet the San Joaquin threshold of 10 tons ROG emissions per year, or whether cost-effective controls could be applied to Bay Area facilities.

Sources:
3. Rule 4694: Wine Fermentation and Storage Tanks, San Joaquin Valley Unified Air Pollution Control District, December 15, 2005.
4. Memorandum to Governing Board re: Rule 4694, Crow, David L., San Joaquin Unified Air Pollution Control District, December 15, 2005.

FSM 15 - Composting Operations

Summary:
This measure would consider reductions in organic emissions from Composting Operations.

Purpose:
Reduce emissions of organic compounds from composting operations.

Source Category:
Area source.

Further Study Measure Description:
This measure will consider whether it is feasible to reduce emissions, both ROG and GHG, from composting operations, in cooperation with the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD), South Coast Air Quality Management District (SCAQMD) and Mojave Desert Air Quality Management District. In addition, feasible reductions in ammonia and particulate matter will be explored. In 2003, the SCAQMD adopted Rule 1133.2: Emission Reductions from Co-composting Operations, to limit emissions of both ROG and ammonia. As part of its 2005 Extreme Ozone Attainment Demonstration Plan, SJVUAPCD identified composting and biosolids operations as a source category for emission reductions (Control Measure J). SJVUAPCD adopted Rule 4565, Biosolids, Animal Manure, and Poultry Litter Operations on March 15, 2007 to limit ROG emissions from operations involving the management of biosolids, animal manure, or poultry litter, similar to SCAQMD's Co-composting Rule 1133.2. In 2008, SJVUAPCD initiated a field study to determine emissions factors from a variety of composting methodologies. A final report is due to be issued in the spring of 2010.

Emission mitigation measures may be proposed based on SJVUAPCD Rule 4566 and SCAQMD Rule 1133. These measures, combined with the results of the San Joaquin field study will determine if it is feasible to control composting emissions. In addition, objectives of the Regional Water Quality Control Board and the Integrated Waste Management Board will be integrated into the study measure.

Sources:
1. Mojave Desert Air Quality Management District Technical Report, Feasibility Analysis for Composting and Related Operations, dated 10/22/2007
2. San Joaquin Valley Unified Air Pollution Control District, Preliminary Draft Staff Report for Rule 4566, Composting Green Waste, dated 1/10/2008
3. SJVUAPCD, Final Draft Staff Report for Rule 4566, Organic Waste Operations, dated 12/18/2008
4. The Policy Committee for the Central California Ozone Study, and SJVUAPCD, Request for Proposal for the Organic Waste Composting Study, dated 12/16/2008
5. South Coast Air Quality Management District, Final 2007 Air Quality Management Plan, Control Measure CM # 2007MCS-04, dated 6/1/2007

SCAQMD Technology Assessment for Proposed Rule 1133, Emission

FSM 16 - Vanishing oils and rust inhibitors

Brief Summary:
Research VOC reductions from vanishing oils and rust inhibitors.

Purpose:
Reduce VOC emissions.

Source Category:
Stationary Source

Further Study Measure Description:
The South Coast AQMD adopted a rule in 2009 to reduce emissions from vanishing oils and rust inhibitors. Vanishing oils are lubricants metal working fluid (such as cutting oil) or other oil used manufacturing. Rust inhibitors are fluids used to inhibit, protect or prevent corrosion on metal surfaces. The South Coast rule, 1144, does not apply to oils and inhibitors that have a flash point of less than 200°F. It sets an interim VOC limit for rust inhibitor at 300 grams VOC per liter of material, and a final limit for both inhibitor and oil at 50 grams VOC per liter of material. The staff report projects emissions reductions of 2.7 tons per day from a 3.2 ton per day inventory. The businesses likely to be affected include machine shops (job shops), aerospace facilities, steel mills, auto part rebuilders, screw machine shops, steel tube (pipe) manufacturers, steel spring manufacturers and captive machine shops located inside of others type of businesses.

Sources:
South Coast AQMD Rule 1144, Staff Report, SCAQMD, March 6, 2009

FSM 17 - Ferry System Expansion

Brief Summary:
MTC, the Air District, and the Water Emergency Transportation Authority (WETA) will collaborate to ensure that expansion of the regional ferry network will provide the greatest possible air quality benefit.

Purpose:
To reduce emissions of criteria pollutants and greenhouse gases.

Travel Market Affected:
This measure would affect all intraregional travel, including commute travel; shopping, personal business, social and recreational travel, including tourism. In particular, expansion of ferry service will affect peak period commute travel, when congestion on bridges is greatest.

Further Study Measure Description:
Because expansion of the ferry system does not show a clear-cut benefit for air quality based on current analytical methodologies, as explained below, TCM 7 (Improve Ferry Service) in the 2005 Ozone Strategy has been reclassified as a Further Study Measure for purposes of the 2009 Clean Air Plan.

Ferry service in the Bay Area is provided by the Golden Gate Bridge, Highway, and Transportation District (GGBHTD) and the Water Emergency Transportation Authority (WETA). GGBHTD provides ferry service from Larkspur and Sausalito to San Francisco. WETA was created by Senate Bill 976, resulting in the consolidation of Alameda, Oakland, and Vallejo ferry services under one authority. WETA issued a final transition plan for consolidation of services in June 2009. This plan also includes expansion projects envisioned over the next five years including new ferry routes from South San Francisco, Berkeley, Treasure Island, and Alameda Point, as well as pre-construction planning for longer term expansion of ferry service to Hercules, Redwood City, Richmond, Martinez, and Antioch. MTC's Resolution 3434 Regional Transit Expansion Program includes new or expanded ferry service to: Berkeley, Alameda/Oakland/Harbor Bay, Hercules, Richmond, and South San Francisco.

All ferry vessels purchased after January 1, 2009 must meet the emission limits set forth in Section 93118.5(e)(5), Title 17, California Code of Regulations, and WETA expansion vessels must comply with the mitigation measures adopted by the Water Transit Authority (now WETA) as part of the Implementation and Operations Plan (IOP) adopted by the California State Legislature in 2003. These measures effectively require that all new ferry vessels reduce emissions of NOx and PM by 85% below EPA Tier 2 emissions standards.

The use of engines that meet the emission standards described above will reduce overall emissions produced by ferry vessels, even as service is expanded. However, analysis of the ferry expansion plan indicates that emissions produced by the ferry vessels will likely outweigh

the benefit of reduced emissions from decreased motor vehicle trips by new ferry riders. This is because, on average, ferry vessels require more horsepower per passenger-mile than bus, rail, or private vehicles and motor vehicle emission technology advances for these other transportation modes will continue to reduce emission rates for on-road vehicles in future years.

Ferry service provides a variety of benefits to the region including increased transbay transportation capacity, enhanced mobility, improved connectivity, tourism and recreation, back-up to the regional transportation system in the event of natural or man-made disruptions to the region's transit systems and road and bridge infrastructure, and emergency evacuation.

MTC, the Air District, and WETA will work together to maximize potential air quality benefits of ferry system expansion. Potential measures to improve the air quality outcome include maximizing ridership, promoting non-motorized modes of access to and from ferry terminals, prioritizing routes that would provide the greatest air quality benefit, and exploring how to further reduce emissions from ferry engines by means of operational efficiencies and/or advanced technologies such as hybrid designs. In particular, WETA will evaluate the option of consolidating future projected ridership onto fewer routes. Service consolidation will likely increase ridership demand for individual routes, resulting in a greater number of passengers per vessel trip and an improvement in net emissions reductions.

The three agencies will also work together to thoroughly analyze all assumptions regarding the new routes that will be created, the schedule as to when new routes will be brought into service, ridership projections, assumptions regarding prior mode of ferry riders and transportation mode that ferry patrons will use to access the ferry terminals, and actual emission rates for new ferry vessels. Additionally, WETA will evaluate scenarios on new routes where ridership can be maximized at reduced levels of service during peak and/or off-peak periods. Such scenarios would require fewer ferry operating hours and trips, resulting in a reduction of gross ferry emissions.

Expansion of the ferry network may be included as a transportation control measure in future air quality plans if MTC, the Air District, and WETA agree that expansion of the network would provide a clear air quality benefit.

Sources:

1. MTC's Transportation 2035 Plan: http://www.mtc.ca.gov/planning/2035_plan/
2. Water Emergency Transportation Authority: http://www.watertransit.org
3. Water Transit Authority (now WETA) Ridership Model Sensitivity Analysis: http://www.watertransit.org/files/pubs/techPubPresentations/CS_Sensitivity_analysis.pdf