DRAFT FOR REVIEW

Compendium of 8 Hour Ozone State Implementation Plan (SIP) Mobile Source Control Strategies

Task 0905
Transportation Air Quality Policy Analysis

Prepared for

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Prepared by

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Introduction

Wide arrays of mobile source reduction strategies are being used throughout Texas and elsewhere. However, these are not widely or uniformly known to Texas MPOs and others responsible for ozone reduction measure development. This task obtained and compiled mobile source emissions reduction strategies used in ozone SIPs in Texas and other states, and also used interviews with responsible officials to determine factors leading them to select those strategies. Information was also gathered on the methods used to evaluate or estimate emission reductions. Finally, information was collected regarding control measure implementation experiences and "lessons learned."

Ozone SIPs were reviewed from the following areas, classified as marginal to severe nonattainment areas for 8-hour ozone.

Severe

- Los Angeles South Coast Air Basin, California

Serious

- Riverside County, California
- Sacramento, California
- San Joaquin Valley, California
- Ventura County, California,

Moderate

- Baltimore, Maryland
- Baton Rouge, Louisiana
- Beaumont-Port Arthur, Texas
- Boston-Lawrence-Worcester (Eastern) and Springfield (Western) Massachusetts
- Charlotte-Gastonia-Rock Hill, North Carolina
- Chicago-Gary-Lake County, Illinois
- Cleveland-Akron-Lorain, Ohio
- North Central Texas (Dallas-Fort Worth)
- Greater Connecticut
- Houston-Galveston, Texas
- Los Angeles-San Bernardino (W. Mojave), California
- New York-New Jersey-Long Island Metropolitan Area
- Philadelphia-Wilmington-Atlantic City (SIP documents from State of New Jersey and Commonwealth of Pennsylvania)
- Poughkeepsie, New York
- Rhode Island
- St. Louis, Missouri
- Washington, D.C.

Marginal

- San Francisco Bay Area, California

Most of the measures included in this report have been adopted as SIP measures or are being held in reserve as contingency measures. Exceptions include several of the San Francisco Bay Area's transportation control measures and some measures from the Metropolitan Washington, D.C. "Gold Book." These measures, explained below, are marked and footnoted where they appear to distinguish them from measures that have been adopted for the California and Washington DC SIPs.

The Bay Area submits an ozone plan to the California Air Resources Board (CARB) every three years to comply with California's state air quality laws. San Francisco's only "official" SIP measures are the vehicle and fuel standards implemented throughout the state, but the other measures contained in its state-supervised ozone plan play a significant role in the area's ongoing work toward attainment.

The "Gold Book" was developed in 2003 and revised in 2006 during the development of the SIP documents for the Washington D.C. nonattainment area. The Gold Book documents measures and programs that are (a) in place in the region but not being claimed for SIP credit, (b) planned for future implementation, or (c) proposed as future projects that could reduce emissions in the region. The Gold Book measures are potential contingency measures and/or potential measures for a future SIP for the Washington D.C. area.

Selection of SIP Measures

The nonattainment areas and state environmental agencies surveyed generally used similar criteria for selecting ozone control measures for inclusion in state and local SIPs. Criteria named by various agencies included the following:

- Type (NOx, VOC, PM or other) and rate/amount of emission reductions,
- Practical and/or technical feasibility of the measure,
- Ease of implementation,
- Cost-effectiveness,
- Efficiency (the positive effects of the measure compared to any negative effects),
- Enforceability of the measure/legal authority to implement the measure,
- Equity (fairness of the distribution of positive and negative effects among different socioeconomic groups), and
- Acceptability of the measure to the public, to stakeholders, and/or to other local agencies.

These criteria are not always absolute. Air quality public outreach programs, for example, are strategies that are generally not quantifiable and usable for credit for emissions reduced, but are included as part of some SIPs and other local plans because they support and promote implementation of other emission control measures.

Many of the 8-hour ozone nonattainment areas were former nonattainment areas under the 1-hour ozone standard; because of this, several of the strategies in the 8-hour SIPs may have been in use for a number of years, with updates made to the measures as needed to improve their effectiveness and/or conform to new federal standards.

The North Central Texas Council of Governments (NCTCOG) and the Houston-Galveston Area Council (H-GAC) assembled master lists consisting of hundreds of potential emission control measures. Consultants were hired to assist with assembling the master lists and then prioritizing and qualitatively evaluating the measures on the master lists. Measures on the Dallas-Fort Worth area's master list were initially evaluated according to the following criteria:

- Practicality of implementation,
- Likely acceptance by public and regulated entities,
- Emissions benefit, and
- Cost effectiveness.

Each potential control measure was given a score from 1 (low) to 4 (high) for each of above criteria. The maximum possible score for any measure was 16; 14 out of 16 was the minimum total score for a measure to be classified as "high-ranking."

A second ranking was calculated using only two of the above criteria: public/regulated entity acceptance and emissions benefit. "High-ranking" measures scored at least 7 out of a possible 8.

High-ranking measures, based on at least one of the two total scores, moved on to the next selection phase as the "short list." These measures were further evaluated according to the following:

- Relative ranking (from the scores received in the first phase),
- Available information to quantify the measure's emissions benefit,
- Potential NOx reductions (more important in the Dallas-Fort Worth area than potential VOC reductions), and
- Comments received from stakeholders.

Following this second, more detailed evaluation, a finalized list of measures was presented to TCEQ for possible inclusion in NCTCOG's 8-hour ozone SIP.

A similar process is underway in the Houston-Galveston area as of the summer of 2008. A master list of potential control measures will be presented to the H-GAC Board of Directors in August, and the selection process to determine the "short list" of measures is beginning.

Evaluation Methods

Most of the agencies researched use MOBILE6 where possible to calculate emission inventories and emission reductions; agencies in California use the calculation software

EMFAC (the most recent version is EMFAC2007). Estimations of reductions from voluntary programs (such as incentive programs) require further assumptions or estimations about vehicle miles traveled and participation levels. This information is usually collected by the interviewed agencies from state DOTs (VMT estimates), employers, and/or from individuals participating in a particular program.

Most Successful Measures

Agency staff interviewed generally agreed that the most effective measures are the ones that affect the largest number of vehicles across a region or state: vehicle/engine standards, fuel standards, I/M and retrofit/replacement programs (if widespread enough). Other comments about the effectiveness of mobile sources measures:

- Benefits from most mobile source measures (other than vehicle and fuel standards) are fairly small; for many areas, reductions from local measures are measured in pounds instead of tons per day. Measures that affect limited numbers of vehicles will by their nature create smaller net reductions.
- For many of the smaller/regional measures, greatest success in implementation has come from empowering stakeholders (local governments, private sector) with information, technical assistance, and advice so that they can make informed decisions and choose what's best for their community. North Carolina's initial attempt to mandate private-sector employee alternate commute programs failed, but alternate commute programs were successfully implemented as a voluntary measure. The state's environmental agency provided information, technical assistance, and advice, but didn't try to dictate how the programs would be run.
- Locally, land use and pricing mechanisms have a lot of potential to reduce emissions, but these are the most difficult to implement. Local governments do not want to be told how to develop and pricing is viewed as being too negative; the air quality agencies have to approach these issues in partnership with other local governments and stakeholders rather than issue decrees.
- Control measures that cover larger geographical regions (sometimes requiring cooperation among multiple local and/or state jurisdictions) can be important factors in overall success, as these help to address the problem of transported pollution.
- Additional mobile source measures may become more valuable in the future as regions begin to place greater emphasis on climate change and greenhouse gases. Some measures that are not currently considered effective (or cost-effective) when only NOx and/or VOC are considered can be more significant to overall air quality efforts if greenhouse-gas pollutants are also being significantly reduced.

Implementation of SIP Measures – General Lessons Learned

Collaboration among various local and state agencies is very helpful. In the experiences of several interview respondents, having a good partnering relationship among transportation providers, environmental agencies, and MPOs is a good way for an agency to in effect increase its "staff" by having additional people working on a common problem.

For measures requiring legislation and/or significant public buy-in, much of the work to implement those measures must be done early. North Carolina's Department of Natural Resources (DNR), for instance, began working on the implementation of its vehicle inspection and maintenance (I/M) program years before it would be needed. The 8-hour ozone standard was issued in 1997; though the standard was not officially implemented until 2004, the DNR started work with the North Carolina General Assembly in 1998. Implementation of the I/M program and its fee structure required a legislative change, which can take up to two years in North Carolina. If the DNR had waited until the 8-hour ozone nonattainment designations were issued, there would not have been time to get that measure implemented before the first of the attainment dates arrived. Because of the early start, North Carolina's I/M program was implemented in 2002, before nonattainment designations were even made by the EPA.

Vehicle, Engine, and Fuel Standards

While many of the areas surveyed are subject to the required federal EPA standards for new engine emission ratings and fuels, some states and regions have adopted the more stringent California standards for certain categories of vehicles and/or equipment. It is currently legal for areas outside of California to "pick and choose" the categories of vehicles/engines for which they adopt the California standards. However, for any given engine class, the California standard must be adopted in full – that is, an area cannot adopt a California standard for a vehicle's emissions of one pollutant and the federal standard for that vehicle's emissions of another pollutant. Table 1 lists federal vehicles standards that have been included in 8-hour ozone SIPs. Table 2 lists SIPs in which California vehicle standards have been adopted to provide more stringent controls. Table 3 lists fuel standards (federal and state-specific).

Table 1. Federal Engine Standards.

SIP Measure	SIPs That Include the Measure
Federal Tier 1/NLEV/Tier 2 Federal Motor Vehicle Control Program (FMVCP)	Charlotte, North Carolina Washington, D.C. Baltimore, Maryland Dallas/Fort Worth Houston-Galveston Beaumont/Port Arthur Baton Rouge, Louisiana Chicago, Illinois St. Louis, Missouri Cleveland, Ohio
Federal 2007 Heavy Duty Diesel FMVCP standards, including not-to-exceed standards	Charlotte, North Carolina Baltimore, Maryland Eastern Massachusetts Western Massachusetts Washington, D.C. Chicago, Illinois Connecticut

SIP Measure	SIPs That Include the Measure
Federal Tier I and Tier II Locomotive NOX standards	Washington, D.C Baton Rouge, Louisiana Chicago, Illinois Connecticut
Federal New Non-road Spark Ignition Engines rule	New Jersey Washington, D.C Baton Rouge, Louisiana Rhode Island Chicago, Illinois Connecticut
Federal Tier 1, 2, 3, and 4 Non-road Diesel Engines rule	Philadelphia-Wilmington-Atlantic City Washington, D.C. Eastern Massachusetts Western Massachusetts Baton Rouge, Louisiana Rhode Island Chicago, Illinois St. Louis, Missouri Connecticut
Federal Small Non-road Spark Ignition Engines rule	Philadelphia-Wilmington-Atlantic City Washington, D.C. Eastern Massachusetts Western Massachusetts Baton Rouge, Louisiana Rhode Island Connecticut
Federal Large Non-road Spark Ignition Engines and Recreational Marine rule	Philadelphia-Wilmington-Atlantic City Washington, D.C. Eastern Massachusetts Western Massachusetts Baton Rouge, Louisiana Rhode Island Dallas/Fort Worth Houston-Galveston Beaumont/Port Arthur Connecticut
Federal Nonroad Recreational Engines and Vehicles	Philadelphia-Wilmington-Atlantic City Rhode Island Chicago, Illinois Connecticut
Federal Marine diesel engine rule	Eastern Massachusetts Western Massachusetts Philadelphia-Wilmington-Atlantic City Baton Rouge, Louisiana Rhode Island Connecticut

Table 2. California Vehicle/Engine Standards.

SIP Measure	SIPs That Include the Measure
California LEV and LEVII	California (all regions) Eastern Massachusetts Western Massachusetts New York Metropolitan Area New York Poughkeepsie Area Philadelphia-Wilmington-Atlantic City Rhode Island Connecticut Chicago, Illinois †
NTE Heavy-Duty Diesel Engines	California (all regions) Dallas-Fort Worth Houston-Galveston Beaumont/Port Arthur Philadelphia-Wilmington-Atlantic City
Small Spark-Ignition Off-Road Engines and Equipment Less Than 25 Horsepower (Including Lawn and Garden Equipment, and Small Industrial Equipment)	California (all regions)
Off-Road Recreational Vehicles (Including Motorcycles and All-Terrain Vehicles)	California (all regions)
Off-Road Compression Ignition (Diesel) Engines and Equipment	California (all regions)
Off-Road Large Spark Ignition (Gasoline and LPG) Engines and Equipment 25 Horsepower and Greater (Including Industrial Equipment, Forklifts, and Portable Generators)	California (all regions)
Airport Ground Support Equipment	California (all regions)
Cargo Handling Equipment (Diesel) at Ports and Intermodal Rail Yards	California (all regions)
Locomotives	California (all regions)
Commercial Marine Vessels	California (all regions)
Commercial Harbor Craft	California (all regions)
Recreational Marine (Including personal water craft, ski boats, inboards, and outboards)	California (all regions) New York Metropolitan Region New York Poughkeepsie Region

†Contingency measure.

Table 3. Fuel Standards.

SIP Measure	SIPs That Include the Measure
Federal/EPA Low Sulfur Diesel	New York Metropolitan Area New York Poughkeepsie Area Eastern Massachusetts Western Massachusetts Philadelphia-Wilmington-Atlantic City Dallas-Fort Worth
Low Reid Vapor Pressure Gasoline	New York Metropolitan Area New York Poughkeepsie Area Dallas-Fort Worth Cleveland, Ohio †

Texas Low Emission Diesel (TxLED) • Marine fuel • Locomotive engines (locally operated)	Houston-Galveston Dallas-Fort Worth Beaumont/Port Arthur
Federal Reformulated Gasoline for On-road Applications (Phase I and II)	Washington, D.C Philadelphia-Wilmington-Atlantic City Houston-Galveston Dallas-Fort Worth Beaumont/Port Arthur Chicago, Illinois New York Metropolitan Area New York Poughkeepsie Area St. Louis, Missouri Connecticut
Federal Reformulated Gasoline for Off-Road Applications	Washington, D.C
California Reformulated Gasoline	California (all regions)

†Contingency measure.

Implementation Experiences and Lessons Learned for Vehicle, Engine, and Fuel Standards

A strategy for faster motor vehicle replacement is currently being developed in the state of California. Fleets of a particular size will need to meet overall/average fleet emissions standards (progressively lower average emissions) in coming years. Expected emission reductions from the proposed rule, as described in the 2007 proposed SIP measure document, "would be equivalent to replacing by 2014 approximately 30 percent of the oldest trucks with 2010 models year or newer trucks."[1] The specifics of the rule are still under discussion by the California Air Resources Board (CARB) and stakeholders. This proposed rule will put more pressure on fleet owners to retire their oldest, least efficient vehicles and help to accelerate the benefits realized from new-vehicle standards.

Vehicle or fuel standards and other technology requirements, once the necessary legislation/authority is obtained, produce greater overall reductions than measures that rely on changing driver behavior. Commuter options, transit programs, and other similar trip-reducing measures rely on individual participation, which is hard to obtain, and benefits from those measures are smaller.

Rhode Island is one of the states that has adopted the California-LEV vehicle standards. The benefits of adopting this strategy have been estimated, but actual benefits will not start to accrue until this year, as the adopted standard applies to 2008-9 and newer vehicle models. The rule change was implemented three years ago by the state's Department of Environmental Management (DEM) without significant legal difficulty. However, when the rule was amended two years ago to include restrictions on greenhouse gases, the DEM was sued in federal court; that suit is still pending.

[1] Air Resources Board's Proposed State Strategy for California's 2007 State Implementation Plan, p. 104

I/M Programs and Emission Reduction Technologies

Several areas have expanded existing inspection/maintenance (I/M) programs to new counties and/or to new categories of vehicles (diesel, older vehicles, high-mileage vehicles). Onboard diagnostic systems, required on all gasoline and alternate-fuel passenger vehicles manufactured since 1996 are the most commonly specified technical enhancement to I/M programs in recent SIPs. Table 4 lists I/M program enhancements and expansions listed in the selected SIPs. Table 5 lists in-use compliance standards and emission control technologies. Table 6 lists re-fueling controls.

Table 4. I/M Program Enhancements and Expansions.

SIP Measure	SIPs That Include the Measure
High-emitter identification program • Pilot program using remote sensing; owners of high emitters offered ability to repair or scrap vehicles for light-duty (up to 8,500 lbs) and medium-duty (8,501 to 14,000 lbs) vehicles	South Coast, California (2007 SIP)
Remote sensing device program • Uses remote sensing to identify high emitting vehicles in the Commonwealth of Virginia. High-emitting vehicles must complete out-of-cycle emissions testing and repair.	Washington, D.C. (part of voluntary bundle, implemented by Commonwealth of Virginia)
Augment truck and bus highway inspections with community-based inspections (doubling the total number of inspections performed each month)	South Coast, California (2003 SIP)
I/M improvements (enhancements to CA's Smog Check Program) • Require low pressure evaporative system testing and repair of leaks • Set more stringent pass/fail requirements to ensure more complete repairs • Annual inspections for vehicles 15 years or older • Annual inspections for vehicles driven 25,000+ miles/year • Add visible smoke test • Inspection of light and medium-duty diesel vehicles • Inspection of motorcycles *South Coast Area 2003 changes:* • Direct more vehicles to "test-only" stations • Require loaded-mode testing of heavy-duty gas trucks between 8,500 and 9,999 GVWR **Require a low-pressure evaporative test to identify excess reactive organic gases (ROG) emissions from leaks in the fuel system and help facilitate necessary repairs**	South Coast, California (2007 SIP) San Joaquin Valley, California (2007 SIP) Antelope Valley, California Western Mojave Desert, California[†]

SIP Measure	SIPs That Include the Measure
I/M for diesel vehicles	Philadelphia-Wilmington-Atlantic City (NJ only) Eastern and Western Massachusetts Charlotte, North Carolina (under consideration as RACM) South Coast, California San Joaquin Valley, California Sacramento, California St. Louis, Missouri
Enhanced I/M for gasoline vehicles • Tailpipe test, dynamometer, OBD (depending on vehicle model year) • OBDII	New York Metropolitan Area New York Poughkeepsie Area Charlotte, North Carolina Washington, D.C. Eastern and Western Massachusetts Baltimore, Maryland Dallas-Fort Worth Houston-Galveston Beaumont/Port Arthur Philadelphia-Wilmington-Atlantic City Rhode Island Chicago, Illinois St. Louis, Missouri Baton Rouge, Louisiana Connecticut

[†]Contingency measure.

Table 5. In-use Compliance Standards and Emission Control Technologies.

SIP Measure	SIPs That Include the Measure
Cleaner in-use off-road equipment (over 25 hp)	California (all regions)
Cleaner in-use agricultural equipment	California (all regions)
Replace or upgrade emission control systems on existing passenger vehicles – pilot program	South Coast, California (2003 SIP)
Pursue approaches to clean up the existing and new truck/bus fleet • PM in-use emission control • Engine software upgrade for model years 1993-1998 • On-board diagnostics • Manufacturer's in-use compliance • Reduced idling	South Coast, California (2003 SIP)
HDDV defeat device settlement/vehicle anti-tampering restrictions • Penalized seven major diesel engine manufacturers for installing software on 1993-1998 HDD engines that disengaged the emission control system during highway driving; also required manufacturers to offer software updates to truck owners at no cost	Philadelphia-Wilmington-Atlantic City (NJ only) Dallas/Fort Worth Houston-Galveston Beaumont/Port Arthur
Statewide emissions standards for all in-use non-diesel and non-electric vehicles statewide; also requires on-board diagnostic systems.	New York Metropolitan Area New York Poughkeepsie Area

Requirements for clean diesel technology for all construction equip. on large construction projects	Charlotte, North Carolina (under consideration as RACMs)
Green contracting model ordinance	San Francisco Bay Area *
Use of ultra-low sulfur diesel and CRT filters on buses	Washington, D.C.
Voluntary diesel retrofits, expanding to other types of public and private fleet vehicles • Diesel oxidation catalysts and/or diesel particulate filters (plus ultra low sulfur diesel fuel)	Washington, D.C. (Gold Book**)

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).
** Measures in place, planned, or proposed; potential future SIP measures.

Table 6. Re-fueling Emissions Controls.

SIP Measure	SIPs That Include the Measure
Onboard refueling vapor recovery (ORVR) beyond Stage II	Philadelphia-Wilmington-Atlantic City (NJ only) Eastern and Western Massachusetts
Capture and control vapors from gasoline cargo tankers (various maintenance techniques)	South Coast, California (2007 SIP)
Stage I and/or Stage II vapor capture at gasoline stations.	New York Metropolitan Area New York Poughkeepsie Area Baltimore, Maryland Eastern and Western Massachusetts Washington, D.C Philadelphia-Wilmington-Atlantic City Dallas-Fort Worth Houston-Galveston Beaumont-Port Arthur Rhode Island St. Louis, Missouri

Implementation Experiences and Lessons Learned for I/M Programs and Emission Reduction Technologies

The state of Maryland found its expanded I/M program difficult to implement, politically and technically. The change from the tailpipe test to dynamometers was a hard sell to Maryland citizens, partially due to the unfamiliar technology and procedure. This public resistance may change with the shift to onboard diagnostic systems. Other states have experienced less resistance to I/M programs, although not all vehicles are being inspected.

Fifteen cents from each vehicle inspection in North Carolina goes to outreach education. Nine counties in the state had been using a tailpipe I/M test under the previous 1-hour SIP. Under the 8-hour SIP, the I/M program expanded to 48 counties using onboard diagnostics. As each new county was brought on board, the state environmental agency held a clinic in that county demonstrating the new I/M technology. Thanks to this outreach education, the implementation of the enhanced and expanded I/M program was "fairly painless."

The onboard diagnostic (OBD) emissions testing technology available on newer-model vehicles has made I/M requirements much more convenient for vehicle owners and for inspectors. However, states must decide how to address older-model vehicles that do not have OBD technology. Rhode Island and Massachusetts have adopted two different approaches for addressing older (pre-OBD) vehicles. Rhode Island still performs tailpipe tests on older model cars, which is not popular among the state's I/M inspectors. However, the state plans to continue the tailpipe testing component until the number of pre-OBD cars registered in the state is low enough to be an insignificant emissions concern. Massachusetts opted to drop tailpipe testing of older vehicles, shifting to OBD testing only. As a compensating measure, the state made other changes to its I/M program, including establishing a annual inspection requirement (Rhode Island tests vehicles every two years).

To increase the effectiveness and minimize costs associated with Stage II vapor recovery systems, the state of Missouri has instituted regular inspections of in-use systems, as well as performance testing of various Stage II systems using the Missouri Performance Evaluation Testing Procedures. These testing procedures help to identify the most efficient and durable systems for use in Missouri gas stations.

Transportation Control Measures

Several of the areas surveyed include transportation control measures (TCM) in local transportation plans, but not all of these areas submit TCMs as part of the SIP. The San Joaquin Valley in California, for example, evaluated the potential emission reductions from the TCMs planned for the region and determined that the reductions were not sufficient to justify inclusion in the SIP. (One San Joaquin Valley project is listed below as a proposed measure, not defined specifically as a TCM in that region's plan.) Tables 7 through 14 list TCMs being used by some nonattainment areas.

Table 7. Traffic Flow Improvements.

SIP Measure	SIPs That Include the Measure
84 grade separations planned for 2009	Dallas-Fort Worth
655 intersection improvements for 2009	Dallas-Fort Worth
Grade separations, traffic signalization, intersection improvements	South Coast, California (2007 SIP)
Grade separations, access management projects, interchange and intersection improvements, traffic signal improvements, turn lanes	Houston-Galveston (1997 SIP)
Arterial traffic management measures	San Francisco Bay Area *
Promote traffic calming	San Francisco Bay Area *
Local land use planning and development strategies	San Francisco Bay Area *
Freeway Service Patrol: provides motorist assistance and towing of disabled vehicles during peak commute periods on various highways in Sacramento County and a portion of I-80 in Yolo County	Sacramento, California (2008 draft SIP)

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).

Table 8. ITS/Telecommunications.

ITS/Telecommunications	
Transportation management systems/control centers	South Coast, California (2007 SIP) Sacramento, California (2008 draft SIP) Houston-Galveston (1997 SIP) San Francisco Bay Area *
Telecommuting programs, satellite work centers	South Coast, California (2007 SIP)
Real-time rail, bus, freeway information systems	South Coast, California (2007 SIP)
Arden Way "Smart Corridor"	Sacramento, California (2008 draft SIP)
Watt Avenue Phase 3 Smart Corridor	Sacramento, California (2008 draft SIP)
Sacramento Transportation Area Network (STARNET) connecting 18 traffic and emergency centers	Sacramento, California (2008 draft SIP)

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).

Table 9. HOV/Managed Lane Projects.

Measure	SIPs that Include the Measure
HOV lane extensions, new facilities, improvements, connectors, bypasses, ramp-metered interchanges, HOT lanes and pricing	South Coast, California (2007 SIP)
New or expanded high occupancy vehicle lanes • 70 lane miles for 2009 (Dallas/Fort Worth)	Dallas-Fort Worth Eastern Massachusetts San Francisco Bay Area *
Transportation pricing reform	San Francisco Bay Area *
High-occupancy toll (HOT) lanes on D.C. Beltway and Inter County Connector	Washington, D.C. (Gold Book**)

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).
** Measures in place, planned, or proposed; potential future SIP measures.

Table 10. Fleet Replacements.

Measure	SIPs that Include the Measure
Transit bus replacements • Purchase of new transit buses (WMATA) • Purchase of 25 hybrid light duty buses (Fairfax County, VA) • 11 CNG buses to replace diesel buses (Arlington County, VA)	Washington, D.C.
Purchase replacement buses ($250m total through 2018)	Sacramento, California (2008 draft SIP)
Purchase 4 CNG replacement buses	Houston-Galveston
Hybrid light duty vehicles added to city fleets	Washington, D.C.
Trash collection trucks replaced with CNG trash trucks	Washington, D.C.
Alternative fuel (LP, CNG) and diesel retrofit programs for fleet vehicles	Cleveland, Ohio †

†Contingency measure.

Table 11. Transit/Park and Ride Projects.

Measure	SIPs that Include the Measure
Expanded or improved local and areawide bus service • Bus service/operational improvements • Bus passenger initiatives • Express bus or BRT service	South Coast, California (2007 SIP) Eastern Massachusetts
New or expanded rail service • Light rail • Commuter rail • Regional rail	Dallas-Fort Worth Houston-Galveston San Francisco Bay Area *
Transfer, multimodal, and park-and-ride (P&R) facilities • New and/or improved bus, rail, multimodal facilities • New transit/rail parking spaces • New P&R parking spaces and facilities. • Improved access to rail service	Dallas-Fort Worth Sacramento, California (2008 draft SIP) South Coast, California (2007 SIP) Washington, D.C. Houston-Galveston San Francisco Bay Area *
Ferry service • Improved ferry service • Improved access to ferry service • Improved ferry facilities • Ferry/airport/train shuttle service	San Francisco Bay Area *
Youth transportation services	San Francisco Bay Area *
Maintain transit operations at existing funding levels	Sacramento, California (2008 draft SIP)
Pedestrian improvements/connections to transit centers	Houston-Galveston

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).

Table 12. Bicycle/Pedestrian Projects.

Measure	SIPs that Include the Measure
"Veloweb" for fast-moving bicyclists; also accommodates pedestrians; 15.4 miles planned for 2009	Dallas-Fort Worth
Bike/ped facilities and programs • New or expanded facilities • Improved access to facilities	South Coast, California (2007 SIP) San Francisco Bay Area *
Bicycle facilities • Bicycle lane in D.C. (8 miles) • Bicycle racks in D.C. (150) • Bicycle facilities in Maryland • Bicycle lanes/trails in Northern Virginia (41 miles) • Bicycle lockers in Northern Virginia	Washington, D.C.
Bicycle racks on buses (1458 racks)	Washington, D.C.
Sidewalk and pedestrian access improvements	Washington, D.C. San Francisco Bay Area *
Bicycle/pedestrian bridges, trails and paths, shelters, bike lanes	Houston-Galveston

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).

Table 13. Speed Limit Reduction, Parking Restrictions, Idling Restrictions.

Measure	SIPs that Include the Measure
Speed limit reduction • 70 mph roads reduced to 65 mph • 65 mph roads reduced to 60 mph	Dallas-Fort Worth Houston-Galveston
Parking freeze regulations (no new spaces in selected areas) in City of Boston, City of Cambridge, Logan Airport, East Boston, South Boston	Eastern Massachusetts
Locally enforced idling restriction	Dallas-Fort Worth Washington, D.C. (Gold Book**)
Diesel freight idling reduction	Dallas-Fort Worth
Anti-idling program for heavy-duty engines (on-road and non-road) Proposed draft (expected in October) rule limiting idling on-road to 5 minutes in every 60-minute period.	Charlotte, North Carolina (under consideration as reasonably available control measure - RACM)
Diesel equipment idling model ordinance	San Francisco Bay Area *
Idling reduction for locomotives • Expand use of auxiliary power units on locomotives to operate on-board systems without engine idling	Washington, D.C. (Gold Book**)
Parking management programs • Parking impact fee on commuter parking spaces • Employer parking cash-out (voluntary) • Commuter parking tax	Washington, D.C. (Gold Book**)

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).
** Measures in place, planned, or proposed; potential future SIP measures.

Table 14. Employer-based Trip Reduction Programs.

Measure	SIPs that Include the Measure
• Proposed measure to adopt a rule requiring businesses with 100+ employees to establish rideshare programs • Strengthen state laws governing parking payout programs	San Joaquin Valley (CA) 2007 ozone plan
Mandatory VMT reduction on ozone episode days (changed to voluntary program)	Charlotte, North Carolina
Support voluntary employer based trip reduction programs	San Francisco Bay Area *

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).

Implementation Experiences and Lessons Learned for Transportation Control Measures

North Carolina's employee VMT reduction program began as a mandatory rule targeting 20 percent reduction in VMT for all employers with 25 or more employees, which proved impossible to implement due to outcry from the Charlotte Chamber of Commerce. The rule might have been more successful if it had been implemented gradually, e.g., starting with employers of 150 or more employees and then phasing in smaller employers over subsequent years. Instead, employee trip reduction was implemented as part of a voluntary program called "Clean Air Works".

An early, unsuccessful SIP measure in the San Francisco Bay Area requiring a 15-percent increase in transit ridership was one factor that led to a more conservative approach regarding TCMs in the area. TCMs, like the other measures developed for local use in the Bay Area, are now submitted to CARB as a state-administered plan rather than being included as SIP measures, due largely to the difficulty of successfully enforcing these measures. Additional TCM "lessons learned" from the Bay Area's AQMD:

- Potential "heavy hitters" for emission reductions are land use and pricing mechanisms, but these are the most difficult to implement and even more difficult to mandate. The Bay Area's Air Quality Management District has learned that partnering with local governments on land use and development efforts is ultimately more effective than trying to direct that development via law-making. Land use measure emission reductions also require a long term to be realized.
- Pricing measures likewise have potential for reducing emissions, but getting public buy-in is difficult, particularly when gasoline prices are high. The Bay Area initially has focused on the High Occupancy Toll (HOT) lane network as a congestion pricing measure. Since drivers have the option of paying for the facility or using a free roadway, HOT lanes have been a less controversial way of achieving reductions through congestion pricing.

H-GAC in Texas has similarly learned to avoid certain categories of emission reduction rules that are likely to tie up a lot of time and money in court, opting for voluntary actions and public-private partnerships to achieve many of the vehicle/fleet and commuter-based emission reductions that would have been difficult to implement as mandatory programs.

The environmental speed limit reductions that were passed several years ago in Texas have produced emission reductions, but they were unpopular and difficult to enforce, The Texas state legislature has prohibited further speed limit reductions for this purpose, though the existing environmental speed limits in the NCTCOG and H-GAC regions are still in effect.

Incentive and Voluntary Programs

Monetary incentives can be a powerful tool to encourage both technological and behavioral emission reduction measures without the legal and political difficulties involved in implementing a legislative mandate. Programs that support alternate commute modes continue to gain participation in many urban areas as fuel prices and traffic congestion increase. Public outreach programs are credited as SIP measures in two of the regions surveyed, due to their roles in supporting other voluntary measures. Subsidized engine retrofits and vehicle replacements for high emitters belonging to lower income owners have also proven successful. Tables 15 through 17 list examples of incentive and voluntary programs used in SIPs.

Table 15. Fleet Vehicle/Off-Road Equipment Incentives and Support Programs

Measure	SIPs that Include the Measure
Texas Emission Reduction Program (TERP) funds for heavy-duty diesel replacement or retrofit • Emission Reduction Incentive Grants Program for mobile diesel sources • Rebate Grants Program for diesel off-road and non-road replacements and repowers • New Technology Research and Development Program helps to finance research, development, and commercialization of pollution-reducing technologies • Texas Clean School Bus Program provides grants for emissions-reducing technologies on school buses	Houston-Galveston Dallas-Fort Worth Beaumont-Port Arthur
Heavy-Duty Engine Emission Reduction Incentive Program • Funding for new purchases (differential cost), engine re-powers, retrofits	San Joaquin Valley, CA
SmartWay Transport Partnership • Voluntary partnership between EPA and freight industry that promotes strategies and technologies to improve fleet efficiencies and reduce emissions • Program provides information on small-business loans to help companies pay upfront costs for emissions reduction technologies	Dallas-Fort Worth Houston-Galveston
Blue Skyways Collaborative • Related to SmartWay; expands strategies and tech to other on-road and non-road sources	Houston-Galveston
Sacramento Emergency Clean Air and Transportation (SECAT) Program measures • New fleet vehicles • Fleet vehicle repowers and modernizations	Sacramento, CA
Carl Moyer and other grant programs (CARB) • Accelerated introduction of LEV, engine & fuel technologies • NOx reduction in heavy-duty vehicles • Light duty vehicle early retirement • Off-road engine repowers • After-treatment retrofits and early replacement for heavy-duty off-road equipment • Zero emission lawn and garden incentive (commercial)	South Coast, CA (2007 SIP) San Joaquin Valley, CA Sacramento, CA
Clean Vehicle Program/Texas Clean Fleet Program • Provides support for policies, practices, and technologies that help improve air quality through the use of clean fuel and clean technology	Dallas-Fort Worth Houston-Galveston
Incentives for auxiliary power units • Tour buses, commuter buses, trucks	Washington, D.C. (Gold Book**)
Proposed incentive program(s) similar to TERP, Carl Moyer programs	Washington, D.C. (Gold Book**)

** Measures in place, planned, or proposed; potential future SIP measures.

Table 16. Passenger Vehicle and Small Off-Road Equipment Incentives

Measure	SIPs that Include the Measure
AirCheck Texas Low Income Repair Retrofit and Accelerated Vehicle Retirement Program (LIRAP) • Provides funding to qualifying low-income households to repair or replace a high-emitting vehicle • More recent version, called "Drive a Clean Machine," increases the funding to repair or replace older vehicles	Dallas-Fort Worth Houston-Galveston
Vehicle high-emitter identification programs: pilot programs using remote sensing; owners of high emitters offered ability to repair or scrap vehicles. • Light-Duty Vehicle High-Emitter Identification Program: vehicles up to 8,500 lbs • Medium-Duty Vehicle High-Emitter Identification Program: vehicles 8,501 to 14,000 lbs	South Coast, CA (2007 SIP)
Expanded passenger vehicle retirement • Low-emission vehicle incentives • Vehicle buy-back program	San Francisco Bay Area *
REMOVE II Program – • Light and medium duty vehicle purchase incentives • Accelerated vehicle retirement • Alternate fuel vehicle mechanic training	San Joaquin Valley, CA
Expanded Exchange Program • Promoting accelerated turnover of small off-road engines (lawn mowers, leaf blowers, etc.) and recreational outboard engines	South Coast, CA (2007 SIP)
Zero emission lawn and garden incentive (residential)	Sacramento, CA
Electric lawnmower incentives	San Joaquin Valley, CA

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).

Table 17. Commuter and Outreach Programs.

Measure	SIPs that Include the Measure
Enhanced Employer Trip Reduction Program: voluntary program aimed at large employers and promoting rideshare, transit, other ways to reduce commute trips	Dallas-Fort Worth
Commute Solutions: ridematching, alternate commute information, transit information, telework information, and online "trip tracker" and commuting-cost calculators	Houston-Galveston
North Carolina employee trip reduction	Charlotte, North Carolina
Carpool and vanpool services and incentives, transit incentives	San Francisco Bay Area *
Regional Vanpool Program	Houston-Galveston
REMOVE II Program: • Bicycle infrastructure incentives • E-Mobility (telecommunications systems) • Public transportation and commuter vanpool subsidy	San Joaquin Valley, CA

Measure	SIPs that Include the Measure
Clean Air Teleworking Initiative • Pilot program, tracking system, and other activities to support teleworking among area employers and their employees on high-ozone days	Baltimore, Maryland
Spare the Air: district-wide ozone action day outreach & education program to encourage voluntary emission-reducing activities	San Joaquin Valley, Sacramento
Rideshare, transit, and traffic demand management marketing	South Coast, California (2007 SIP)
Public education/ intermittent control measures	San Francisco Bay Area *
Commuter Connections • Carpool/vanpool matching • Transit, HOV lane, bike to work information • Telework assistance • Employer assistance • MetroChek/Smart Benefits Program (employer-provided transit subsidies)	Washington, D.C. (Gold Book**)
Clean Air Partners Program • Clean air public outreach program for Maryland, Virginia, District of Columbia • Ozone Action Day (OAD) promotion of voluntary actions (carpooling, fueling after dark, trip reductions) • "Episodic measures" on OADs; voluntary suspension of emission producing activities (use of lawn equipment, painting, pesticide application, fleet vehicle refueling) by county and city governments in the region	Washington, D.C. (Gold Book**)
Safe Routes to School • Promotion of walking/biking to school	Washington, D.C. (Gold Book**)

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).
** Measures in place, planned, or proposed; potential future SIP measures.
[†]Contingency measure.

Implementation Experiences and Lessons Learned for Incentive and Voluntary Programs

Clean diesel standards was one of the more difficult measures to implement in North Carolina because of funding issues. The state environmental agency has focused on finding grant dollars to help with diesel retrofits in the more serious nonattainment areas. "Grants to Replace Aging Diesel Engines" (GRADE) is one example of this type of program. On the other hand, in Texas the legislature set up a fund using a portion of revenues from emission inspections; that fund helps to pay for retrofits and replacements for qualifying lower income owners.

The Washington, D.C. metropolitan area has found diesel retrofit programs relatively straightforward to implement when funding is available. So have the Dallas-Ft. Worth and Houston areas. Programs involving alternative fuels are more of a challenge to implement because of the need for new fueling infrastructure.

Incentive programs (for engine replacements and repowers, early retirement/fleet modernization, and similar projects) have been used in California as emission reduction strategies since the mid-1990s. Historically, incentive funding through the various programs is first-come, first-serve for projects that meet the cost-benefit requirements ($14,500/ton of emission reductions). The various air quality management districts (AQMDs) provide as many opportunities as possible; the SIP strategy is based on a menu of options that can be applied according to demand (within available funding). Funding for truck replacement has proven to be very effective; an earlier version of the program that replaced engines only didn't attract many applicants. Often, cost thresholds determine the type of incentive that will be effective. Re-powering can be more cost-effective than replacement for locomotives and for many types of construction and agricultural equipment; for a truck, replacing the vehicle is often more cost-effective.

Marketing is crucial; the success of an incentive or other voluntary program depends on getting the word out to as many people as possible. About 90 percent of incentive-program applications to the Sacramento Council of Governments (SACOG), for instance, are the result of "word of mouth" from previous awardees. SACOG also provides tools on its website to help applicants determine if they qualify for certain categories of incentive funding. It can take years for a public agency to build relationships with the private sector and the local community to accomplish these programs, but after an incentive program is established, it can really take off. SACOG now runs out of incentive money each year. Word of mouth also carries bad news fast; if there is a funding lapse in a given year, it can be hard to get people back on board when the funding returns.

Before voluntary programs can be included as part of a SIP, the infrastructure must be in place: funding, personnel, plans for program administration and evaluation. Once implemented, there is significant follow-up work by the administering agency to track participation levels and to ensure that participants are fulfilling commitments. In order to claim emissions reductions, the reductions from voluntary and incentive programs have to be quantifiable and enforceable. This means, for example, that applicants for vehicle or equipment subsidies have to estimate their future use of the new equipment (usually based on historic usage) to estimate the predicted emissions benefits. If an award recipient does not meet the expected vehicle/equipment usage, the local agency is supposed to try to reclaim the award amount. SACOG tries to balance the requirements of the funding program with their mission to provide a public service; if the discrepancy in usage levels is not due to fraud, they try to work out a compromise rather than demanding the money back.

Voluntary emission reduction programs, including vehicle replacement/retrofit and alternate commute programs, have been a great success in the Houston area. Participants in these programs commit to achieving a certain amount of emission reductions if feasible. In nearly all cases, participants have achieved their commitments or exceeded them. In one case, an attempted program (involving ferries) proved to be infeasible early in the implementation, and the money for the program was given back to H-GAC and used on other on-road voluntary projects.

Clean Vehicles and Commute Solutions are examples of public-private partnerships that have been very cost-effective and gotten much more cooperation from businesses and the general public than similar programs that H-GAC previously tried to implement as mandates.

Miscellaneous Measures

Table 18 lists SIP measures that did not fit into any of the categories already described. Mitigation fees on federally-owned or controlled planes, trains, and ships are a way to give CARB some degree of control over vehicles that are not under the state's jurisdiction. The indirect source rules in Sacramento's SIP are a sub-category of off-road control measures. "Backstop" measures support existing port emission reduction measures in the South Coast/Los Angeles region.

Table 18. Miscellaneous SIP Measures.

Measure	SIPs that Include the Measure
Mitigation fee for federal sources • Fee on planes, trains, and ships that are under federal jurisdiction to fund emission reduction projects	South Coast, California (2007 SIP)
Indirect source rules • Construction mitigation rule • Operational indirect source rule (applies to new land use development)	Sacramento, California (2008 draft SIP)
Backstop measures for indirect sources of emissions from ports and port-related facilities • Ensure adequacy of and effective implementation of port-related emission reduction measures	South Coast, California (2007 SIP)
TCM demonstration projects	San Francisco Bay Area *
Smart growth and transit oriented development	Washington, D.C. (Gold Book**)
Airport emission reductions • Improved ground equipment technology, alternative fuels, retrofits	Washington, D.C. (Gold Book**)

* Measures listed in San Francisco Bay Area Ozone Plan (not SIP).
** Measures in place, planned, or proposed; potential future SIP measures.

Findings and Conclusions

As shown in the preceding sections, there are a large number of emission reduction measures in use by the areas surveyed. A limited number of these provide the larger-scale reductions for their respective areas, generally those having to do with engine and/or fuel technology. The areas surveyed agreed that technology-driven measures, including voluntary measures such as early vehicle retirement, replacement, and retrofit, produce larger reductions than behavior-based measures such as commuter programs, simply because it is difficult to attract initial and continued participation in behavioral

programs. Technology-based measures coupled with inspection requirements and financial incentives or assistance yields the strongest results.

While the details of the selection procedure differ, the areas surveyed use similar criteria to select measures for implementation, with total emission reductions, cost-effectiveness, feasibility of implementation, and ease of implementation chief among them. The availability of funding is a limiting factor in implementing many emission reduction measures.

Increasing emphasis is being placed on older diesel engines, since they are now where the biggest reductions can be achieved. Incentives that encourage voluntary replacements and retrofits are more popular with the agencies surveyed than rules or disincentives, since the latter require more legislation and are more likely to be fought by stakeholders.