Air Quality Community of Practice

Use of Transportation Control Measures and Reasonably Available Control Measures in Approved or Submitted State Implementation Plans

State-of-the-Practice

Requested by:

American Association of State Highway
and Transportation Officials (AASHTO)

Center for Environmental Excellence

Prepared by:

James M. Shrouds
AASHTO Consultant

April 2011

Acknowledgements

This State-of-the-Practice Report was requested by the Center for Environmental Excellence by the American Association of State Highway and Transportation Officials (AASHTO) as part of an Air Quality Community of Practice. The report was developed by James M. Shrouds who serves as a consultant to the AASHTO Center. The work was guided by the air quality community of practice members consisting of Mike Brady and Jim Elder from CALTRANS; Jill Schlaefer from CDOT; Phil Peevy from GADOT; Walt Zyznieuski from IDOT; Howard Simons and Gary Green from MDOT; Marilyn Jordahl-Larson from Mn/DOT; John Zamurs from NYSDOT; Terry Arellano, NCDOT; Mike Baker from PennDOT; Jackie Ploch from TxDOT; Christopher Voigt from VDOT; Tim Sexton from WSDOT; Patricia Trainer and Carolyn Amegashie from WISDOT; Cecilia Ho, Mark Glaze, Bob O'Loughlin, and Mike Roberts from FHWA; Andrea Martin from FTA; and Caroline Paulsen from AASHTO.

Disclaimer

This State-of-the-Practice Report summarizes the discussions of Air Quality Community of Practice members who spoke as individual members of the community and did not necessarily represent their agency's views or positions. In addition, the contents of the report do not necessarily represent the views or positions of AASHTO or the Center for Environmental Excellence.

Table of Contents

INTRODUCTION.....1

EPA REGULATIONS/GUIDANCE 3

FHWA/FTA REGULATIONS/GUIDANCE.....6

OVERVIEW OF THE STATE-OF-THE-PRACTICE ON THE USE OF TCMS AND RACMS IN APPROVED OR SUBMITTED SIPS. 7

California.....8
Colorado.....11
District of Columbia (D.C.)/Maryland/ Virginia 12
Georgia.....14
Maryland 16
Pennsylvania 17
Texas 18

RESEARCH & REPORTS 22

SUMMARY 24

REFERENCES……..…….26

INTRODUCTION

The Center for Environmental Excellence by AASHTO (Center) established an Air Quality Community of Practice (COP) in 2008. The purpose of the Air Quality COP is to assemble a group of State DOT practitioners to have a focused discussion on the state of the practice, emerging issues, and research data needs on particular issues, as well as on other air quality issues of interest. This effort has essentially two goals, the first of which is to extend the State DOT's networks and contacts, enabling them to share experiences and learn from each other. In this regard, this effort expands and supplements a November 2008 Air Quality Practitioner's Conference that was held in Albany, New York[1]. The second goal is to develop State-of-the-Practice Reports on selected focus areas. To date, the Air Quality COP effort has produced the following reports:

- State-of-the-Practice Report on *Mobile Source Air Toxics* in May 2009[2];
- State-of-the-Practice Report on *Short Term Impacts from Construction Equipment and Operations* in March 2010[3];
- State-of-the-Practice Report on *Air Quality Interagency Consultation* in June 2010[4]; and
- State-of-the-Practice Report on *Establishing Air Quality Background Concentration Levels for Projects* in December 2010[5].

The Air Quality COP consists of representatives from thirteen State DOTs, FHWA, FTA, and AASHTO. The Air Quality COP members considered a range of possible topic areas and agreed on the *Use of Transportation Control Measures (TCMS) and Reasonably Available Control Measures (RACMs) in Approved or Submitted State Implementation Plans (SIPs)* for the next report. While use of TCMs and RACMs in SIPs have been in use for decades, several recent changes have prompted interest among State DOTs to take a fresh look at some of the more recent measures being used. These changes include the promulgation of a new 1-hour nitrogen dioxide (NO_2) standard, a proposed tightening of the ozone standards, and proposed revisions to the monitoring requirements for carbon monoxide (CO). Another change was the issuance of the 2009 EPA TCM Substitution Policy which is intended to expedite and streamline the process for making TCM substitutions or adding new TCMs to an approved SIP.

TCMs are transportation strategies that reduce on-road emissions by reducing the number and/or length of vehicle trips and/or improve traffic flow. The U.S. Environmental Protection Agency's (EPA's) Transportation Conformity Regulations[6] define TCMs as "*any measure that is specifically identified and committed to in the applicable implementation plan, including a substitute or additional TCM that is incorporated into the applicable SIP through the process established in* [Clean Air Act] *CAA section 176(c)(8), that is either one of*

the types listed in CAA section 108, or any other measure for the purpose of reducing emissions or concentrations of air pollutants from transportation sources by reducing vehicle use or changing traffic flow or congestion conditions." Section 108(f) of the CAA[7] lists 16 example TCMs such as programs for improved public transit, trip reduction ordinances, traffic flow improvement programs, high-occupancy vehicle lanes, shared-ride services, bicycle/pedestrian facilities, programs to control extended idling of vehicles, flexible work schedules, etc.

The EPA defines RACMs as any potential control measure that reduces emissions from point, area, on-road and non-road sources and: 1) is technologically and economically feasible; 2) does not cause substantial widespread and long-term adverse impacts; 3) is not absurd, unenforceable, or impracticable; and 4) can advance the attainment date for a nonattainment area.[8] Section 172(c)(1) of the CAA requires that all nonattainment areas "implement reasonably available control measures", or RACM, as expeditiously as possible. EPA's State Implementation Plans: General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990[9] contains a discussion of the relationship between the RACM requirement of section 172(c)(1) and the list of TCMs in section 108(f). Basically the preamble indicates that section 108(f) TCMs are not presumptively RACM, but these should be considered by States as potential air quality control options to determine if they should be applied as RACMs. EPA guidance indicates that any measure suggested during the public comment period, measures adopted in other nonattainment areas, and measures that EPA has identified should be closely reviewed by the planning agency to determine if they are in fact reasonably available for implementation in the area in light of local circumstances. Thus RACM requirements compel consideration and, where necessary, adoption of TCMs.

Although TCMs generally produce only modest emission reduction benefits compared to cleaner vehicles and cleaner fuels, their timely implementation is a prerequisite for completing transportation conformity determinations for transportation plans and transportation improvement programs (TIPs). Section 176(c)(2)(B) of the CAA indicates that transportation programs may not proceed until they provide for timely implementation of TCMs consistent with schedules included in the applicable implementation plan. Thus, failure to provide for timely implementation of TCMs in an approved SIP would jeopardize conformity determinations and delay needed transportation programs and projects. TCMs must also receive priority funding. In addition, Section 179 of the CAA provides for highway sanctions if, among other things, "any requirement in an approved plan (or approved part of a plan) is not being implemented". Therefore failure to implement TCMs and/or RACMs could result in highway sanctions being implemented. During highway sanctions only certain categories of transportation projects may proceed in the sanctioned area. For these reasons, it is important that TCMs and transportation related RACMs be jointly evaluated by transportation and air quality agencies through an integrated transportation and air planning process before they are included in a SIP.

This State-of-the-Practice Report discusses EPA programs and requirements that have a bearing on TCMs and transportation-related RACMs; applicable FHWA/FTA requirements and guidance; the current state-of-the-practice of selected States in this COP

for the analysis and use of TCMs and transportation-related RACMs; and a summary of selected research documents and reports. Web links to the documents mentioned in this report are included in the reference section of the report.

EPA REGULATIONS/GUIDANCE

EPA has established a number of regulatory and guidance documents that relate to TCMs and RACMs that can be found on their various websites. The following is a summary of several of these documents and websites.

Transportation Control Measures

Transportation Conformity Rule:[10] EPA's Transportation Conformity Regulations contain several sections that are applicable to TCMs. The most relevant sections for purposes of this report are:

> ***Section 93.103 Priority:*** This section requires FHWA and FTA to give priority to the implementation of those transportation measures contained in an applicable SIP, consistent with statutory requirements for allocation of funds among States or other jurisdictions.
>
> ***Section 93.105, Consultation:*** This section requires States to develop consultation procedures in the SIP whereby representatives of the Metropolitan Planning Organizations (MPOs), State and local air quality planning agencies, State and local transportation agencies, and other organizations with responsibilities for developing, submitting, or implementing provisions of a SIP must consult with each other and with local or regional offices of EPA, FHWA, and FTA on the development of the implementation plan, the transportation plan, the TIP, and associated conformity determinations. The interagency consultation procedures must include, among other things, a process for the development of a list of the TCMs which are in the applicable SIP. Such procedures must also include a process for making a determination whether past obstacles to implementation of TCMs which are behind the SIP schedule have been identified and are being overcome, and whether State and local agencies are providing priority to approval or funding for TCMs.
>
> ***Section 93.113, Criteria and procedures: Timely implementation of TCMs:*** This section requires the timely implementation of all TCMs consistent with schedules included in the applicable SIP which are eligible for funding under title 23 U.S.C. or the Federal Transit Laws. It also indicates that that nothing in the transportation plan or TIP may interfere with the implementation of any TCM in the applicable SIP.

Guidance for Implementing the Clean Air Act Section 176(c)(8) Transportation Control Measure Substitution and Addition Provision:[11] The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) added a provision to section 176(c) of the CAA to allow states to substitute or add TCMs into SIPs without going through the standard SIP revision process which could be very time consuming. The purpose of this document is to provide guidance on how to substitute or add TCMs into approved SIPs in order to expedite the process for making TCM substitutions. The guidance also provides a streamlined process for adding TCMs to an approved SIP.

Transportation-Related Documents Website:[12] This EPA website provides numerous guidance documents to help State and local officials estimate the emission and travel activity effects of TCMs. It also lists TCM approval criteria that needs to be met so that a TCM can be incorporated into a SIP; provides a listing of a broad range of studies that have been conducted to evaluate the effectiveness of TCMs; and describes variations in implementation, examples of actual usage, expected transportation and emission impacts, and other important considerations for the 16 broad categories of TCMs as described in the CAA.

On March 2011, two recent reports were added to this website. The first report entitled, *Transportation Control Measures: An Information Document for Developing and Implementing Emissions Reduction Programs* catalogues selected transportation control measures that have been implemented across the country. The report provides an overview of project benefits, policy mechanisms, investments, key stakeholders, and other implementation considerations. The second report entitled, *Potential Changes in Emissions Due to Improvements in Travel Efficiency*, establishes information on the effectiveness of TCMs for changing travel activity and for quantifying the potential national emissions reductions that could result from those changes using EPA's MOVES2010 emission model. While the report has a national focus, EPA indicates that the methodology, data and other information that was developed can help State and local areas evaluate the effectiveness of travel efficiency strategies for reducing emissions in urban areas of different sizes.

Policy Guidance Website:[13] This EPA website contains a section on "Quantifying Benefits of Control Measures in SIPs and Conformity" which provides State and local officials with guidance on how to credit commuter benefit programs, such as EPA's Best Workplaces for Commuters, in a SIP or transportation conformity determination. This website also provides guidance on quantifying and using emission reductions from highway and non-road diesel vehicles, engines, and equipment that have been retrofitted; on quantifying emission reductions from the use of cetane improvement additives in diesel fuel; and on quantifying emission reductions from the use of technologies which reduce long duration truck idling emissions. It should be noted that while this site provides useful information on quantifying these various programs and technologies for purposes of SIP and conformity emissions reduction benefits, not all of these measures would qualify as TCMs. The transportation conformity regulation states that "vehicle technology-based,

fuel-based, and maintenance-based measures which control the emissions from vehicles under fixed traffic conditions are not TCMs" for conformity purposes.

Reasonably Available Control Measures

State Implementation Plans; General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990:[14] This General Preamble describes how EPA interprets various provisions of Title I, primarily those concerning SIP revisions required for nonattainment areas. Among other provisions, it includes a discussion on RACM requirements. The General Preamble indicates that EPA previously assumed that all TCMs listed in section 108(f) of the CAA were reasonably available and therefore areas that did not include such measures in their SIPs needed to justify why they were not reasonable. The preamble further states that based on experience with implementing TCMs over the years, EPA no longer considers it appropriate to presume all Section 108(f) TCMs are reasonable due to variations in local circumstances. It also indicates that States should consider groups of interacting TCM measures, rather than individual measures, on an area-specific basis. Where a section 108(f) measure is found to be reasonably available, however, section 172(c)(1) of the CAA requires its implementation.

Guidance on the Reasonably Available Control Measures (RACM) Requirement and Attainment Demonstration Submissions for Ozone Nonattainment Areas:[15] This document provides guidance on how EPA determines whether an Ozone attainment SIP provides for all RACM needed for attainment and whether implementation of those measures occurs as expeditiously as possible. The guidance indicates that States need to provide justification as to why potentially reasonable measures have not been adopted. This justification can be based on technological or economic grounds. The guidance also indicates that potentially reasonable measures include measures adopted in other nonattainment areas and measures that the EPA has identified in guidelines or other documents.

Additional Submission on RACM from States with Severe 1-hour Ozone Nonattainment Area SIPs:[16] On December 14, 2000, EPA put out additional guidance to ensure that current or revised SIP submissions for severe ozone nonattainment areas meet the CAA requirements to attain the national ambient air quality standards (NAAQS) as expeditiously as practicable, and give consideration to the availability of RACM that may advance the attainment date. The guidance tightens the definition of what constitutes a RACM by indicating that "measures could be justified as not meeting RACM if a measure (a) is not technologically or economically feasible, or (b) does not advance the attainment date for the area". It further indicates that TCMs in a TIP can be determined not to be RACM if they do not meet the RACM tests outlined in the guidance and the CAA.

Final Clean Air Fine Particle Implementation Rule For Implementation of 1997 $PM_{2.5}$ Standards:[17] This rule provides guidelines for making RACM determinations for each $PM_{2.5}$ nonattainment area. The guidance indicates that while States must conduct a thorough review of reasonably available measures they do not need to review every conceivable measure and that "reason" should drive the identification of the measures

analyzed. It further states that a State need only advance those reasonable measures that are technically and economically feasible and when considered collectively would advance the attainment date by one year or more. Thus the guidance more narrowly defines the criteria for determining which RACMs must be advanced in the SIP.

FHWA/FTA REGULATIONS/GUIDANCE

Statewide Transportation Planning; Metropolitan Transportation Planning:[18] The transportation planning regulations have a number of provisions that relate to the CAA, including TCMs and transportation conformity. With regard to TCMs, the regulations use the same definition for a TCM as contained in EPA's transportation conformity regulation. To better integrate the transportation and air quality planning processes the Statewide planning provisions (450.208(b)) require State air quality agencies to coordinate with the State DOTs when developing the transportation portion of the SIPs consistent with the requirements in the CAA. In ozone or CO nonattainment areas MPOs are required (450.322(d)) to coordinate the development of the metropolitan transportation plan with the process for developing TCMs in a SIP. The preamble to the regulation further encourages similar coordination in the development of the metropolitan transportation plan and SIP TCMs in ozone and CO maintenance areas, and in particulate matter (PM) and NO_2 nonattainment and maintenance areas.

The metropolitan planning provisions (450.322(10)(vi)) require the transportation plan to include a financial plan that demonstrates, among other things, that sufficient funds and strategies will be available to ensure the implementation of SIP TCMs. It also requires TIPs (450.324(e)(5)) in nonattainment and maintenance areas to identify those projects which are identified as TCMs in the applicable SIP, and to give such TCMs priority funding (450.324(i)) and provide for their timely implementation.

These provisions not only help integrate transportation and air quality planning but also help ensure that any TCMs that are included in a SIP have emerged from and met the requirements of the transportation planning process.

Transportation Control Measures Web Page:[19] FHWA has a webpage on TCMs that includes a list of Policy and Guidance documents related to TCMs and the transportation conformity process. This webpage also includes links to related information on TCM effectiveness and TCM methodologies and models that provide guidance on how to determine the emission reduction and cost benefits of certain TCMs and TCM type activities.

Congestion Mitigation and Air Quality Improvement (CMAQ) Program:[20] In 1991, Congress adopted the Intermodal Surface Transportation Efficiency Act (ISTEA) and authorized the CMAQ program to help fund transportation programs and projects that contribute to attainment of a NAAQS. The CMAQ program was reauthorized in 2005 under SAFETEA-LU. The final CMAQ Program Guidance composed under SAFETEA-LU was issued in October, 2008. The guidance indicates that most of the TCMs listed in

Section 108(f) of the CAA are eligible for CMAQ funding and that those listed in approved SIPs should receive priority funding. The one exception is for TCM programs that encourage removal of pre-1980 light-duty vehicles and light duty trucks which is specifically excluded from CMAQ eligibility by legislation.

Federal-Aid Highway Program Guidance on High Occupancy Vehicle (HOV) Lanes:[21] HOV lanes are one of the TCMs listed in section 108(f) of the CAA, and this guidance document provides useful information to States as they plan, design, operate, and manage HOV facilities. The guidance indicates that FHWA encourages the implementation of HOV and High Occupancy Toll **(**HOT) lanes as a part of an area-wide approach to help metropolitan areas address their requirements for improved mobility, safety, productivity, and environmental concerns.

OVERVIEW OF THE STATE-OF-THE-PRACTICE ON THE USE OF TCMS AND RACMS IN APPROVED OR SUBMITTED SIPS.

The transportation community first became involved with TCMs with the CAA amendments of 1970. This Act required States to submit SIPs to demonstrate how nonattainment areas would attain the NAAQS that were established to protect public health and welfare. TCMs were included in the Act because it was felt that emission controls on automobiles and stationary sources would not be sufficient to demonstrate attainment in all areas. Thus TCMs were intended to help reduce mobile source emissions through transportation efficiency measures and reductions in vehicle miles traveled (VMT). EPA indicates in its 1992 General Preamble that it put out guidance in 1979 that initially presumed that all of the section 108(f) TCMs were RACM and required areas to specifically justify why any such measure was not determined to be reasonable based on local circumstance. They reaffirmed this policy in 1981. As a result, in the 1970s there was a lot of pressure on States to included TCMs in SIPs. In some cases TCMs were included in Federal Implementation Plans promulgated by EPA

The 1990 CAA amendments continued to include TCMs as well as RACM measures**.** However, over the last 20 years, the use of TCMs in SIPs has diminished in many areas. This is due in part because: 1) EPA has over the years narrowed the criteria for determining which RACM strategies must be included in a SIP, and 2) because research has shown that TCMs and transportation-related RACMs only produce small emission reductions, especially on an area wide basis, as compared to those produced by technological advancements that produce cleaner vehicles and cleaner fuels.

During this study a number of States indicated that they do not include TCMs in their SIPs because they limit the flexibility for the areas to determine how they will attain and/or maintain the NAAQS. Other states report they are not in favor of including TCMs in SIPs unless they are absolutely needed, given the potential implications if they are not

implemented on schedule due to changing priorities, fiscal issues, or scheduling problems. It should be noted, however, that virtually all States implement TCM-type measures with their programs and projects such as HOV lanes, transit programs, carpool/vanpool programs, traffic flow improvements, bicycle/pedestrian programs, etc. These projects and programs are often funded with federal, state and local funds outside of the SIP process. While these measures help improve air quality they are not legally enforceable commitments since they are not identified as TCMs in the SIP.

This section contains an overview of selected State practices in the analysis and use of TCMs and RACMs. The section is not intended to be an all inclusive listing of practices in the selected states. Rather it gives a broad cross section and representative sampling of TCMs and RACMs that are being implemented or considered by the various States.

California

In 2004, Caltrans initiated a study to assess the TCM commitments contained in California SIPs. The study entitled, "*Transportation Control Measures (TCMs): Guidance for Conformity and State Implementation Plan Development*" [22] was competed by Douglas Eisinger and Dr. Deb Niemeier of U.C. Davis and represents a very comprehensive look at TCM and RACM policies, EPA's TCM substitution Policy, and compilation of SIP measures in California. Caltrans indicates that while this study and database is now several years old and represents a "snapshot" of the status of TCMs in 2004, it is indicative of the processes used to evaluate TCMs and of the types of TCMs that are included in the SIPs in California. Current TCMs vary, particularly in the South Coast air basin where there is not a fixed list in the SIP; in the South Coast area only, projects in the current TIP that meet certain criteria are considered TCMs unless formal action is taken by the MPO and interagency consultation to avoid that.

The study indicates that all of California's largest metropolitan areas include TCMs in their SIPs. The report also includes an area-by-area discussion of the 8 air basins that contain EPA approved SIP TCMs. The areas include the Great Basin Valleys which include the town of Mammoth Lakes; the North Central Coast which includes the Monterey Bay and Santa Cruz Areas; Sacramento Valley; San Diego; San Francisco Bay Area; San Joaquin Valley; South Central Coast, which includes Ventura and Santa Barbara counties; and the South Coast Air Basin. The report details the 100 California TCM SIP commitments in these areas, describes the implementation status of each TCM, and documents their assumed SIP emission reduction credits. The reader is encouraged to review this report for a comprehensive review of these TCMs and their status, as well as the nonattainment designations and SIP status for these areas. The following is a representative sampling and summary of some of the TCMs listed in the report that have been or are in the process of being implemented:

Mammoth Lakes Area:

- Vacuum street sweeping
- VMT restrictions to limit daily VMT to 106,600.

North Central Coast (Monterey Bay and Santa Cruz Areas):

- Short-range transit improvements
- Traffic flow improvements, signal optimization
- Improved bicycle facilities
- Area wide ridesharing and flextime promotion

Note: This area currently is not subject to conformity requirements.

Sacramento Valley:

- Education programs to encourage transit use and non-motorized transportation, and trip reduction
- Zoning changes to modify parking requirements and encourage transit use and non-motorized transportation
- Parking management ordinances to encourage bicycle use, transit, and ridesharing
- Concentrating urban expansion in areas served by transit
- Expansion of non-motorized travel options
- Park and ride incentives
- Light rail transit
- Bus traffic signal preemption along major bus corridors
- Employer trip reduction programs

San Diego:

- Ridesharing
- Transit
- Bicycle use
- Traffic flow improvements

San Francisco Bay Area: The U.C. Davis report indicates that as of 2004, 21 of the TCMs in the Bay Area were implemented, 1 TCM regarding a 15% increase in transit ridership was partially implemented, and the other 9 were underway; and that 24 of the 31 TCMs had SIP emission reduction credits associated with them. The TCMs included, among other things, performance measures for increasing transit ridership; pricing mechanism such as increasing bridge tolls and increasing the state gas tax; expanded transit facilities; support for HOV lane development; shared use park and ride lots; signal timing programs; freeway incident management, etc. The most recently added (2004 ozone attainment finding) SIP TCMs include[23]:

- Regional express bus program
- Bicycle/pedestrian program
- Transportation to support livable communities
- Additional freeway service patrol
- Transit access to airports

San Joaquin Valley:

- Traffic flow improvements
- Public transit
- Rideshare programs

- Bicycle programs
- Alternative fuels program

Note: San Joaquin Valley has a larger number than most areas of RACM measures that apply to transportation. Guidance for development of RACM, and their applicability in the conformity process, changed while the San Joaquin Valley SIP was being done and now usually results in fewer measures.

Ventura County:

- Ridesharing
- Non-motorized strategies
- Traffic flow management
- Land use
- Transit

Santa Barbara County:

- Trip reduction program
- Employer-based TDM program
- Work schedule changes
- Area wide ridesharing
- Public transportation
- Traffic flow improvements
- Parking management
- Park-and-ride fringe parking
- Bicycle-pedestrian facilities
- Accelerated retirement of vehicles
- Telecommunications
- Public education

Note: This area currently is not subject to conformity requirements.

South Coast Air Basin:

- HOV improvements
- Transit and transit system management
- Information service to educate the public and encourage alternative travel modes

Note: The South Coast basin has a unique system of determining what projects are TCMs within the general categories in the SIP, where projects that meet certain criteria in each TIP automatically become TCMs. This results in a very large list of TCM projects and can require TCM substitution for relatively minor project changes.

The U.C. Davis report also includes a table that includes broad TCM categories as well as examples of individual TCMs under each category that provides a useful starting point for areas seeking to identify candidate TCMs for RACM SIP analyses. These TCMs include the TCMs listed in Section 108(f) of the CAA, as well as several other documents.

Colorado

The Colorado Department of Public Health and Environment's Air Pollution Control Division, the Regional Air Quality Council, Colorado DOT, some state MPOs, and other air quality authorities collaborated to develop transportation control strategies to apply to early SIPs for CO, PM_{10} and the 1-hour ozone standard. The ad hoc effort utilized some early emissions strategies developed by other states as a starting point to define and develop several Colorado control strategy bundles used in the early SIPs. Examples of these strategies included: required commuter programs to encourage ride sharing for businesses with over 100 employees, bike lanes, HOV lanes, signalization, etc. Later as TCMs were further evaluated and EPA provided more specific TCM guidelines, some of these strategies were removed from the SIPs when they were determined to be unsustainable due to a variety of circumstances. Consequently, the allotted emissions reduction credits removed from the SIP had to be replaced, leading to substitution of equivalent reduction measures.

Colorado often attempts to incorporate reduction strategies as adjustments within the MPO air quality conformity modeling realm to account for emissions reduction that are determined as state only enforceable, voluntary, or do not meet the full TCM requirements. This use of modeling adjustments accounts directly for emissions reductions without being included in the SIP. These adjustments, by their nature, reflect available strategies and circumstances and are not permanent.

As a rule, Colorado focuses RACMs more on stationary source emissions rather than transportation related emissions. Colorado utilizes a controlled winter sanding/de-icing and sweeping program within affected PM_{10} plans across the state. This program involves dedicated sand sweeping after winter storms to collect excess roadside sand and letters of continued commitments from local agencies and city governments to implement consistent sweeping programs within the Denver metropolitan PM_{10} plan area.

Denver/North Front Range 8-hour Ozone Nonattainment Area

On November 20, 2007, EPA designated the Denver/North Front Range region as a marginal 8-hour ozone nonattainment area for the 1997 ozone standard. The area includes 7 full counties consisting of Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson and 2 partial counties consisting of Larimer and Weld. After extensive analysis, and stakeholder and public meetings, the Regional Air Quality Council proposed an Ozone Action Plan[24] to demonstrate attainment by 2010. The overall action plan included elements that would be included in the federally-enforceable SIP, elements that were included as state-only enforceable measures in state regulation, and elements that need further evaluation for a possible SIP amendment in the future.

The federally enforceable SIP measures included 3 stationary source measures. The state enforceable measures, which were not included in the SIP but were to be adopted and enforced exclusively under state authority, included the following mobile source measures:

- A motor vehicle I/M program for the North Front Range;
- More stringent cut points for the I/M program in the Denver metropolitan area;
- Continued implementation of the high-emitter pilot program in the Denver metropolitan area using remote sensing technology; and
- Tighter collector plate requirements in state law in order to close the emissions testing loophole for old, non collector vehicles.

The elements that need further evaluation for a possible SIP amendment in the future, and which are included in the Ozone Action Plan for information only, included mostly stationary source controls. However, one item relates to evaluating ozone fuels strategies such as 7.0 RVP gasoline, reformulated gasoline, eliminating the 1-pound per square inch RVP waiver for ethanol blended fuels, and any new fuel strategies that EPA may introduce.

Denver/North Front Range area also has a number of voluntary measures to help reduce emissions. The mobile source measures listed in the Ozone Action Plan include:

- A summertime Ozone Alert Program;
- A "Let's Take Care of Our Summer Air" public awareness program;
- Efforts to repair or salvage high-emitting vehicles that are identified on the road by remote-sensing technology;
- Employer-based travel reduction programs;
- Efforts to reduce emissions from diesel vehicles through education and application of emission control and anti-idling equipment;
- Car Care Fairs where area motorists can have their cars and trucks evaluated to improve vehicle performance and increase gas mileage;
- Implementation of land use and design policies to encourage sustainable development practices and mixed-use, transit-oriented development; and
- An Air Quality Programmatic Agreement to identify and commit to a number of proactive measures that will reduce mobile source air toxics and greenhouse gas emissions throughout Colorado, in addition to criteria air pollutants.

District of Columbia (D.C.)/Maryland/ Virginia

Washington D.C. Metropolitan 8-Hour Ozone Nonattainment Area:

The DC-MD-VA area is designated as a moderate 8-hour ozone nonattainment area. It includes the District of Columbia, Arlington, Fairfax, Loudoun, and Prince William counties, and the cities of Alexandria, Falls Church, Fairfax, Manassas, and Manassas Park in Virginia; as well as Calvert, Charles, Frederick, Montgomery, and Prince George's counties and the Cities of Bowie, College Park, Gaithersburg, Greenbelt, Frederick, Rockville, and Takoma Park in Maryland**.** The SIP for this area, dated May 23, 2007, was

developed by the Metropolitan Washington Air Quality Committee in cooperation with Maryland, Virginia, and DC.[25]

Chapter 4 of the SIP includes a description of the control measures that were implemented. On-road measures implemented by 2002 included:

- High-Tech vehicle I&M program;
- Reformulated Gasoline (on-road);
- Federal "Tier I" Vehicle Standards and New Car Evaporative Standards; and
- National Low Emission Vehicle Program.

Chapter 4 of the SIP also lists measures for which implementation was phased-in between 2002 and 2009. The on-road measures listed included:

- Heavy-Duty Diesel Engine Rule (2004);
- Heavy-Duty Diesel Engine Rule (2007);
- Tier 2 Motor Vehicle Emission Standards;
- I&M Program with Final Cutpoints;
- TCMs; and
- Vehicle Technology, Maintenance, or Fuel-Based Measures

Regarding the most current TCMs, the SIP indicates that these measures included the purchase of alternative-fueled vehicles, improvements to bicycle and pedestrian facilities, and improvements to transit services and access to transit facilities. The SIP also includes an estimate of the projected VOC and NO_x emissions reductions associated with these TCMs. A full list of TCMs and related measures implemented in the DC-MD-VA area can be found in Appendix F of the SIP.[26] The Appendix indicates the different measures that were implemented in each of DC, Maryland, and Virginia.

In addition the SIP includes the following voluntarily mobile source measures which local governments and state agencies committed to:

- Remote Sensing Program;
- Diesel Retrofit Program; and
- Alternative Fuel Vehicle/Low-emission Vehicle Purchase Program.

The Executive Summary for the SIP addressed RACM as follows:

> *"An extensive list of potential control measures was analyzed and evaluated against criteria used for potential RACM measures. Individual measures must meet the following criteria: 1) Will reduce emissions by the beginning of the Washington region's 2008 ozone season (May 1, 2008); 2) Enforceable; 3) Technically feasible; 4) Economically feasible (proposed as a cost of $3,500-$5,000 per ton or less); 5) Would not create substantial or widespread adverse impacts within the region; and 6) Emissions from the source being controlled exceed a de minimis threshold, proposed as 0.1 tons per day.*

> *If implemented collectively, any group of potential RACM measures would need to provide reductions of 20-40 tons per day of NOx and/or VOC by the 2008 ozone season. The region has reviewed all of the potential control measures to determine if collectively they could meet these criteria. Several mandatory programs are available that can provide moderate levels of emission reductions, however, none of these measures can provide benefits by the 2008 ozone season, and the total overall reduction that could be provided by these measures is below 20-40 tons per day. While there are potential voluntary measures that can be implemented before 2008, together these voluntary measures will not provide sufficient creditable emission reductions to advance the attainment date by one year. Therefore, there are no RACM appropriate for the Washington region's moderate area SIP."*

A full list of RACM measures that were considered for the region is provided in Appendix I of the SIP.[27]

Georgia

The Atlanta area was originally designated as a serious 1-hour ozone nonattainment area on November 6, 1991, but on June 14, 2005 EPA approved the state's request to be re-designated to attainment for the 1-hour ozone standard. The Atlanta area has a number of TCMs that were previously approved and implemented under the 1-hour ozone standard.[28] Examples of these TCMs include:

- HOV lanes on I–85 and I-75;
- Clean Fuel Vehicles Revolving Loan Program;
- Regional Commute Options Program and HOV Marketing Program;
- Two Park and Ride Lots;
- Metropolitan Atlanta Rapid Transit Authority (MARTA) Express Bus routes (15 buses);
- Signal preemption for several MARTA routes;
- Improve and expand service on MARTA's existing routes in southeast DeKalb County;
- Acquisition of clean fuel buses for MARTA and Cobb County Transit;
- Advanced Transportation Management Systems/Incident Management Program on several interstate route; and,
- Upgrading, coordination and computerizing intersections.

On April 30, 2004, Atlanta was designated as a marginal nonattainment area for the 1997 8-hour ozone standard, and that classification was reclassified on March 6, 2008 as a moderate nonattainment area. As a result of the most recent reclassification Georgia had to submit a SIP by December 2008 that would demonstrate attainment by June 15, 2010.[29] This submittal represents an attainment demonstration for the Atlanta metropolitan 8-hour ozone nonattainment area that consists of Barrow, Bartow, Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Henry, Newton, Paulding, Pickens, Rockdale, Spalding, and Walton counties.

The SIP indicates that significant reductions in VOC and NOx emission are being achieved through state and federal regulatory and voluntary control measures that were put in place for the 1-hour ozone standard. The current 8-hour ozone SIP revision relies on new federal and state control measures, while maintaining the 1-hour SIP requirements. Thus the existing requirements and voluntary efforts served as the basis for considering further control measures. The SIP indicates that since the Atlanta region is also designated nonattainment for PM $_{2.5}$, the SIP planning process involved integrating and harmonizing the control strategies for the $PM_{2.5}$ and the 8-hour ozone nonattainment areas to the extent possible. However, the ozone SIP does not address $PM_{2.5}$ control strategies as they are contained in a separate $PM_{2.5}$ SIP.

The ozone SIP includes an analysis of NOx and VOC emissions control measures for various emissions sources. These control measures include, among other things, federally mandated measures such as the vehicle inspection and maintenance (I/M) program, tighter tailpipe standards, etc.; a specific Georgia blended gasoline required by State law and allowed by a federal preemption waiver; and voluntary control measures.

The SIP indicates that the Georgia Environmental Protection Division (EPD) promotes emission reductions from voluntary programs. However, since these measures are not enforceable commitments, the EPD does not rely on any emission reductions from their implementation. The Georgia Department of Transportation (GDOT) has taken the lead role in developing and funding projects and programs that reduce emissions and improve Georgia's air quality. Examples of some of the voluntary programs include:

- The Clean Air Campaign
- Transportation Demand Management Strategies
- Pedestrian walkways and bikeways projects
- Traffic signal system retiming
- Idle reduction programs;
- Ridesharing;
- Teleworking;
- Transit use; and
- Vehicle replacement and retrofit measures.

The SIP indicates that all available RACM measures have been exhausted through nearly three decades of ozone nonattainment planning for Atlanta and have been included in previous SIPs. Therefore no new transportation related RACM measures were included in the most recent SIP.

On October 9, 2009, the Georgia Department of Natural Resources submitted a TCM substitution request to EPA to convert the I-85 HOV lanes, which has been a TCM in the SIP since 1990, to HOT lanes.[30] An analysis demonstrated that the new TCM would provide equivalent or greater NO_x and VOC emissions reductions for the ozone nonattainment area and equivalent or greater NO_x and $PM_{2.5}$ emissions reductions for the $PM_{2.5}$ nonattainment area. The process took over 8 months to develop a final document and submit it to EPA. EPA approved this substitution request on November 5, 2009.

Maryland

Baltimore 8-Hour Ozone Nonattainment Area:

The Baltimore region is designated a moderate 8-hour ozone nonattainment area. The region includes Baltimore City and the surrounding Counties of Baltimore, Carroll, Anne Arundel, Howard and Harford. On June 15, 2007, the Maryland Department of the Environment (MDE) submitted an Ozone SIP to demonstrate how they were going to attain the 8-hour ozone standard by June 15, 2010 in the Baltimore metropolitan area.[31] Among other things, the SIP includes a detailed analysis to ensure that the Baltimore nonattainment area is implementing all the RACM strategies necessary to demonstrate attainment with the 8-hour ozone standard on the earliest possible date.

The MDE first developed a master list of potential measures for a RACM analysis. This list incorporated the measures included in: 1) section 108(f) of the CAA; 2) the RACM analysis for the Washington D.C., Atlanta, and Houston regions; 3) 200 measures suggested as part of a series of regional calls, and 4) 24 additional measures that resulted from working with the Baltimore Metropolitan Council.

The MDE then conducted a RACM analysis consistent with EPA's guidance and a DC Circuit Court opinion (*Sierra Club v. EPA*, decided July 2, 2002) which upheld EPA's definition of RACM. The RACM analysis indicates individual measures had to meet the following criteria:

- Reduce emissions by the beginning of the 2008 ozone season (May 1, 2008)
- Enforceable
- Technically feasible
- Economically feasible (proposed as a cost of $3,500-$5,000 per ton or less)
- Would not create substantial or widespread adverse impacts within the region
- Emissions from the source being controlled exceed a *de minimis* threshold, proposed as 0.1 tons per day.

The RACM analysis includes an explanation of each of the criteria noted above. In addition, Appendix E-1[32] and E-2[33] of the SIP provides a detailed list of the potential measures that were evaluated against the RACM criteria. The SIP notes that each RACM criteria was reviewed for each individual measure identified on the lists. Among other categories, the RACM analyses evaluated 71 non-road sources and 167 mobile source measures.

The non-road strategies include measures such as:

- Developing alternative programs for state and local governments (public entities) to reduce on-road and off-road construction and maintenance related emissions;
- Awarding extra points to bidders using low emission industrial equipment;
- Developing a voluntary program encouraging retrofit of non-road diesel equipment in public and/or private fleets; and

- Developing a mandatory program requiring retrofit of non-road diesel equipment in public and/or private fleets.

Examples of mobile source measures that were analyzed include:

- Voluntary diesel retrofit programs for local, commercial, and State vehicles and school buses;
- Electric vehicle tax incentives;
- Idle reduction programs;
- Smart growth and infill development programs;
- Vanpool programs;
- Free parking for carpools and vanpools;
- Bicycle and pedestrian programs;
- Transit programs;
- Traffic signal optimization; and
- Pricing mechanisms.

For a full list of the measures that were analyzed, the reader is encouraged to review Appendix E-1 and E-2 at the websites included in the Reference section of this report.

As a result of a detailed analysis of these measures, MDE concluded that none of them met the RACM criteria. Consequently, no TCMs are included in the Baltimore 8-hour Ozone Nonattainment SIP.

Pennsylvania

Pennsylvania has 2 ozone nonattainment areas, 15 ozone maintenance areas, and 9 $PM_{2.5}$ nonattainment areas. This includes 37 ozone nonattainment and maintenance counties. Nineteen of these counties (full counties) and 5 partial counties are also nonattainment for $PM_{2.5}$. In 1994, the Pennsylvania State Department of Environmental Resources (DER) submitted two SIP revisions to EPA regarding the TCM SIP for the Philadelphia severe ozone nonattainment area.[34] The SIP revisions addressed: (1) the TCMs necessary to offset any increase in emissions that would result from growth in VMT or number of trips; and, (2) the TCMs necessary for meeting the 15 percent rate of progress plan requirements of section 182(b)(1) of the CAA amendments of 1990.

These SIP revisions were able to demonstrate that existing and new controls as required by the CAA amendments of 1990 were sufficient to hold vehicle emissions below 1990 levels despite rising VMT levels through the 2005 attainment year. The revisions also demonstrated that there would be no shortfall in the projected Rate-of-Progress Plan. As a result EPA determined that by implementing the CAA mandated control measures, no additional TCMs to reduce VMT were necessary in Philadelphia. The CAA mandated measures that were included consist of: 1) the federal motor vehicle control program; 2) an enhanced inspection and maintenance program; 3) reformulated gasoline; and 4) an employer trip reduction program.

PennDOT indicates that there have been no other formal SIP actions on TCMs since the 1994 SIP revisions because fuels and technology enhancements to mobile sources have more than offset the need for formal TCMs. However, a list of potential TCMs that could be used if the need arose was developed between PennDOT, DER, and the Delaware Valley Regional Planning Commission and submitted to EPA. This list contained many TCM-like projects, such as park-and-ride lots, rideshare programs, increased emphasis on transit and rail, etc., but the need never arose to use this list. As a result Pennsylvania does not have any formal TCMs in a SIP. However, PennDOT still focuses on TCM-type projects to maintain their air quality goals as they develop transportation plans and TIPs. Thus they are able to implements many TCM-type projects without going through formal SIP revisions. These TCM-type projects include:

- Support for public transit;
- Support for intercity rail;
- An ample park-and-ride lot program;
- Development of ridesharing and carpooling programs in urban areas;
- Support of Smart Transportation principles;
- Programs to educate employers and the public on transportation demand management strategies;
- Continued support for Pennsylvania's Transportation Management Associations (TMAs). There are 9 TMAs in Pennsylvania (6 in the Philadelphia area; 3 in Pittsburgh), whose main goal is to find ways to reduce congestion and improve air quality; and
- Many other congestion reduction and air quality improvement programs implemented as a part of the CMAQ program.

Pennsylvania has not included any transportation-related RACMs in SIPs since the CAA amendments of 1990 took effect. While they have included RACM analysis of TCMs in their SIPs, none of these measures were adopted.

Since Pennsylvania does not have any formal TCM SIPs, they have not used the EPA TCM Substitution Policy.

Texas

Houston-Galveston-Brazoria 8-Hour Ozone Nonattainment Area:

On March 10, 2010, the Texas Commission on Environmental Quality (TCEQ) adopted an Attainment Demonstration SIP Revision and a Reasonable Further Progress (RFP) SIP Revision for the Houston-Galveston-Brazoria (HGB) severe 8-hour ozone nonattainment area.[35] The HGB area includes 8-counties consisting of Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties. The TCEQ was required to submit a 1997 8-hour ozone SIP revision addressing the severe ozone nonattainment requirements of the CAA to EPA by April 15, 2010 which demonstrated attainment of the standard by no later than June 15, 2019.

The SIP revision includes a summary of existing measures that have been adopted in previous HGB SIP revisions to control ozone formation. The mobile source measures include a variety of measures to reduce VOC and NO_X emission from on-road and non-road sources through measures such as vehicle emission standards, reformulated gasoline, a vehicle I/M program, the Texas Low Emission Diesel program; TCMs, and Voluntary Mobile Emission Reduction Programs (VMEPs).

The SIP also contains an evaluation in Appendix F of potential new control strategies for the area.[36] This initial effort involved preparing and evaluating a master list of several hundred potential on-road mobile source measures and almost one hundred non-road measures. This initial master list included measures such as:

- Bicycle and pedestrian measures;
- Clean vehicle fleet programs;
- Additional freeway service patrols;
- Requiring through-traffic trucks to travel around rather than through nonattainment areas;
- Peak period truck bans on freeways and major arterials;
- Funding for school bus replacements; etc.

This master list was then narrowed down to those considered as VMEPs since they were of most interest to the Houston-Galveston Area Council (H-GAC) and its stakeholders; and that had emission reduction potential and could be implemented locally without requiring state regulations. This shortened list included 18 on-road and 11 non-road measures. The on-road voluntary measures that will aid in the improvement of the HGB region's air quality are included in Appendix H[37] of the SIP revision and include measures such as:

- Alternative commuting programs including bicycle and pedestrian measures, public transit improvements, compressed work weeks, internet ride matching services, vanpools, etc.;
- Regional traffic flow improvements which includes local signal improvements; and
- Vehicle retrofit and replacement programs including public and private sector clean fuel fleets, dedicated funding for school bus replacement, and electric vehicles and increased use of hybrid buses.

After further coordination by the H-GAC with the HGB area local governments and stakeholders, 6 projects were identified as TCMs that have been or will be implemented in the nonattainment area by the start of the 2018 ozone season. In addition, numerous voluntary measures were agreed upon with local governments. The TCMs are listed in Appendix G of the HGB SIP revision[38] and include measures such as:

- Pedestrian improvements;
- Pedestrian and transit improvements; and
- Bike lanes and bikeway networks.

The TCEQ also conducted a RACM analysis of potential control strategies for the HGB area. Each potential control measure identified through the control strategy development

process was evaluated to determine if the measure would meet the following RACM criteria:

- Is technologically feasible
- Is economically feasible
- Does not cause ‘‘substantial widespread and long-term adverse impacts’’
- Is not ‘‘absurd, unenforceable, or impracticable’’
- Can advance the attainment date by at least one year.

The SIP also indicates that if a control measure would not provide substantive and quantifiable benefit over the existing control measure they were not considered RACM because reasonable controls were already in place. Based on the RACM analysis, the TCEQ determined that none of the mobile source measures met the above RACM criteria.

The RFP SIP for the HGB ozone nonattainment area does not include any TCMs since they were not needed to meet the RFP requirements for the area.

Dallas-Fort Worth (DFW) 1997 8-Hour Ozone Nonattainment Area:

On May 23, 2007, the TCEQ adopted an Attainment Demonstration SIP Revision[39] and a RFP SIP Revision for the DFW ozone moderate nonattainment area which includes 9-counties consisting of Collin, Dallas, Denton, Ellis, Johnson, Kaufman, Parker, Rockwall, and Tarrant. The attainment SIP revision was required to demonstrate attainment of the 1997 8-hour ozone standard by the June 15, 2010, attainment deadline. A number of SIP revisions that dealt with issues such as contingency measures, reasonably available control technology, etc. were submitted subsequent to the May 23rd submission. On January 14, 2009, EPA published a final conditional approval of components of the attainment SIP and subsequent revisions. Among other things, the approval provided conditional approval of the RACM demonstration, and full approval of the local Voluntary Mobile Source Emission Reduction Plan (VMEP) and for the TCMs.

The attainment SIP revision includes additional commitments for TCMs, the VMEP, and contains a RACM analysis. To evaluate and quantify potential control measures the TCEQ contracted with the North Central Texas Council of Governments (NCTCOG). The NCTCOG sought public comment throughout the entire control strategy development process through a series of public meetings. As result, the NCTCOG has identified TCMs that have been or will be implemented in the nine-county nonattainment area. The SIP indicates that by the start of the 2009 ozone season, identified TCMs will reduce NO_X emissions in the DFW nonattainment area by 1.53 tons per day (tpd) and VOC emissions by 1.61 tpd. These TCMs include:

- Bicycle and pedestrian projects;
- Grade separation projects;
- HOV and managed lane projects;
- Intersection improvements;
- Park and ride facilities to promote carpooling and vanpooling;
- Rail transit projects; and

- Vanpool projects

Appendix F[40] of the attainment SIP lists TCMs that are not applicable for emission benefits under this SIP revision since they have exceed their project life or do not provide 2009 emission benefits under this SIP revision. In addition, the Appendix includes a list of implemented and completed projects that still have applicable emission benefits under this SIP revision.

The SIP notes that voluntary mobile source strategies that may achieve additional emissions reductions are being explored and that a number of such measures have already been implemented. The examples given include economic and market-based incentive programs, trip reduction programs, growth management strategies, ozone action programs, and targeted public outreach. The SIP indicates that NCTCOG has identified seven new or ongoing voluntary programs and will make a good faith effort to implement the projects and/or programs as part of this SIP. These programs include:

- Clean vehicle program;
- Employee trip reduction program;
- Locally enforced idling restrictions;
- Diesel freight idling restriction program;
- Smart Way Transport Demonstration Project;
- Public agency policy for construction equipment; and
- Aviation efficiencies.

More information on each of the voluntary commitments can be found in Appendix H[41] of the attainment SIP.

The SIP also includes an assortment of locally implemented strategies in the DFW area that could not be quantified, but were expected to be implemented by March 2009. These strategies include such measures as a light-emitting diode (LED) traffic signal replacement program, an air quality marketing and outreach program, a parking cash-out program, a truck lane restriction program, roadway peak period pricing, sustainable development program, etc. The SIP indicates that additional air quality benefits will be gained or existing programs enhanced from these measures.

With regard to RACM, the SIP indicates that the NCTCOG prepared a master list of emission control measures that contained 1,050 potential emission control strategies. This list included 176 strategies for area sources, 628 for on-road mobile sources, 86 for non-road mobile sources, and 106 for point sources. An additional 54 general policy and outreach measures were also included. This list was developed based on reviews of numerous control measure development studies conducted for the DFW area as well as for other ozone nonattainment areas in Texas and other states; and from input from affected stakeholders. Appendix L[42] of the SIP contains the master list of emission control strategies.

The master list was first evaluated against the EPA's criteria for SIP creditability which indicates that the measure must be permanent, surplus, quantifiable and enforceable.

Measures that did not meet these criteria were eliminated from further consideration. Measures that met these criteria then went through a qualitative ranking analysis to identify the most feasible and effective measures for further quantitative review. Those measures that received a high rank were then placed on a draft control measure short list where a quantitative evaluation of emissions benefits and costs was conducted so the measures could be ranked according to their cost/benefit ratio. The NCTCOG then analyzed and quantified 33 short list on-road mobile strategies. The measures that were adopted as part of the RACM analyses are noted in the TCM and voluntary measures discussions noted above.

The RFP SIP[43] indicates that the on-road mobile source controls used to demonstrate RFP include an annual vehicle I/M program with onboard diagnostics system checks on 1996 and newer model year cars and light trucks; a two-speed idle test for heavy duty gas vehicles; an Acceleration and Simulation 2-Mode test, which measures HC, CO and NOx emissions during a high load/low speed condition and a moderate load/moderate speed condition; an anti-tampering program; a gas cap pressure test; reformulated gasoline; the Federal Motor Vehicle Control Program (FMVCP); and the National Low Emission Vehicle (NLEV) program.

RESEARCH & REPORTS

The following is a summary of selected research documents and reports that are relevant to the analysis and use of TCMs and transportation-related RACMs in approved or submitted SIPs.

EPA – Transportation Control Measures Information Documents:[44] This document was prepared by EPA, in consultation with U.S. DOT, in response to section 108(f) of the CAA amendments of 1990. This document provides information on the "formulation and emissions reduction potential of transportation control measures related to criteria pollutants and their precursors". The report contains information documents on the 16 categories of TCMs listed in section 108(f), includes examples of the types of TCM measures that can be included in each of the categories; contains a discussion of implementation experience along with summaries of each of the TCMs; and defines technical considerations important to the development, analysis, and evaluation of TCMs.

EPA- Transportation and Air Quality Planning Guidelines:[45] This document was prepared by EPA, in consultation with U.S.DOT, in response to section 108(e) of the CAA amendments of 1990. This document is intended to "maintain a continuous transportation-air quality planning process" and to provide guidance on "the development and implementation of transportation and other measures necessary to demonstrate and maintain attainment of the national ambient air quality standards". The document contains guidelines and guidance to State and local agencies to assist them in their transportation planning efforts to reduce mobile source emissions.

EPA – TRAQ Technical Brief, Transportation Control Measures: Traffic Flow Improvements:[46] This technical document provides background information on traffic flow improvement projects; and a discussion of the costs and benefits, and implementation issues of such measures. It also includes a discussion of several comprehensive traffic flow improvement programs that have been implemented. This is one of a series of Technical Briefs. Others include such measures as Commuter Choice, Parking Pricing, Trip Reduction Ordinances, etc.

EPA – Benefits Estimates for Selected TCM Programs: [47] The document is intended to provide guidance to State and local officials on how to analyze and evaluate TCM programs that have been completed, are currently in progress, or are proposed for future implementation. The methodology includes an estimate of the effect of TCMs on both travel activity and emissions. The guidance also includes example applications to programs involving only one TCM as well as to packages of TCMs.

DOT/EPA – Clean Air Through Transportation: Challenges in Meeting National Air Quality Standards:[48] This was a joint report by U.S. DOT and EPA to Congress in response to Section 108(f)(3) of the CAA amendments of 1990. The purpose of the report was to address the challenges of improving air quality through transportation programs. Among other things, the report includes a discussion of TCMs and documents two major conclusions. First it indicates that "reducing vehicle emissions through TCMs is difficult" indicating that traditional TCMs will yield only a 1-2 percent reduction in mobile source emissions. Consequently the report indicates that State and local officials will need to look beyond TCMs in order to attain the ozone and CO standards. The second major conclusion is that "by themselves, capital-intensive [TCM] investments may not be the best way to address air quality concerns". This section includes a discussion of the emissions reduction potential of some capital intensive TCMs such as HOV lanes, and transit or intermodal facilities as compared to the emissions reduction potential of market based mechanisms such as smog fees, congestion pricing, gas taxes, and increased parking charges. The report indicates that in comparison, the capital-intensive TCMs are much less effective.

FHWA - A Sampling of Emissions Analysis Techniques for Transportation Control Measures:[49] This report describes modeling tools and other methods that can be used to assess the emissions benefits of transportation control measures and other projects in applying for CMAQ funds. The report is primarily intended for state or local air quality/transportation program analysts, but also others interested in estimating the emissions benefits of CMAQ projects. The report includes a brief overview of 19 methods for calculating benefits. These methods collectively address a wide range of potential CMAQ projects, including travel demand management, traffic flow improvements, and vehicle and fuel technology strategies.

FHWA - Multi-Pollutant Emissions Benefits of Transportation Strategies:[50] The purpose of this report is to help transportation practitioners consider appropriate transportation strategies for reducing transportation-related emissions of concern. The report provides a compendium of traditional and innovative transportation-related control

strategies. For each strategy, the document reports on the direction of emissions impacts that typically are expected for each of the pollutants. In addition, it includes calculations of emissions impacts for sample projects, and identifies EPA guidance documents that should be referenced and sample methodologies for calculating impacts.

TRB, Special Report 264, The Congestion Mitigation and Air Quality Improvement Program; Assessing 10 Years of Experience:[51] This study was completed in response to a legislative requirement for an evaluation of the effectiveness of the CMAQ program and the cost-effectiveness of the projects funded by the program. CMAQ funds are a primary source of funding for the TCMs contained in the 1990 CAA amendments, with the exception of removal of pre-1980 light-duty vehicles and light duty trucks. After completing their evaluation, the TRB committee concluded that, "when compared on the sole criterion of tons of emissions reduced per dollar spent, strategies aimed directly at emissions reductions such as emissions and fuel standards for new vehicles, well-structured inspection and maintenance programs, and vehicle scrappage programs are more cost-effective than the typical CMAQ TCMs, which tend to depend on changes in behavior". The committee did note that a few behaviorally based TCMs, such as pricing and regional ridesharing, compare favorably with vehicle- and fuel-based strategies.

NCHRP 25-25, Task 59 - Evaluate the Interactions between Transportation-Related Particulate Matter, Ozone, Air Toxics, Climate Change, and Other Air-Pollutant Control Strategies:[52] The objectives of this study "are to provide transportation officials with information on the effects of different transportation air quality control strategies on a full range of pollutants, and to identify methods for evaluating tradeoffs among different pollutants when selecting control strategies". The study assesses the effectiveness and cost-effectiveness of a variety of transportation emission control strategies at reducing emissions of various pollutants and identifies those strategies that may reduce some pollutants while increasing others. A total of 34 control strategies are reviewed in three categories consisting of transportation demand management, transportation systems management, and vehicle and fuel technology. The study also includes: 1) a review of different pollutant weighting systems used in evaluating projects across multiple pollutants; 2) a survey of how transportation and air quality agencies have evaluated cost-effectiveness and prioritized control strategies when considering multiple pollutants and tradeoffs among these pollutants; and 3) information gaps and research needs to assist agencies in selecting the most cost-effective control strategies when considering their potential impact on multiple pollutants.

SUMMARY

This State-of-the-Practice Report discusses EPA programs and requirements that have a bearing on TCMs and transportation-related RACMs; applicable FHWA/FTA requirements and guidance; the current state-of-the-practice of selected States in this COP for the analysis and use of TCMs and transportation-related RACMs; and a summary of selected research documents and reports.

While use of TCMs and RACMs in SIPs have been in use for decades, several recent changes have prompted interest among State DOTs to take a fresh look at some of the more recent measures being used. These changes include: 1) the promulgation of a new 1-hour nitrogen dioxide (NO_2) standard, 2) a proposed tightening of the ozone standards, 3) proposed revisions to the monitoring requirements for CO; and 4) the issuance of the 2009 EPA TCM Substitution Policy which is intended to expedite and streamline the process for making TCM substitutions or adding new TCMs to an approved SIP.

Section 108(f) of the CAA lists 16 example TCMs to help reduce on-road emissions by reducing the number and/or length of vehicle trips and/or improve traffic flow. In addition, Section 172(c)(1) of the CAA requires that all nonattainment areas "implement reasonably available control measures", or RACM, as expeditiously as possible. This RACM provision is the primary requirement compelling consideration and, where necessary, adoption of TCMs.

EPA guidance indicates that the TCMs listed in section 108(f) of the CAA are not presumptively RACM, but these measures and other measures should be considered by States as potential air quality control options to determine if they should be applied as RACMs. EPA guidance put out in the 1990s and early 2000s has helped to clarify the RACM criteria. Basically EPA defines RACMs as any potential control measure that reduces emissions from point, area, on-road and non-road sources and: 1) is technologically and economically feasible; 2) does not cause substantial widespread and long-term adverse impacts; 3) is not absurd, unenforceable, or impracticable; and 4) can advance the attainment date for a nonattainment area. Thus, State and local officials should pay close attention to the RACM criteria when developing their respective SIPs, and should determine which, if any, TCMs are RACM in their region.

While TCMs that meet the RACM criteria must be included in the SIP, most States have not had a problem eliminating these TCMs as RACM measures because TCMs individually or collectively do not substantially reduce overall on-road mobile source emissions. For this reason, most State and local officials can demonstrate that TCM measures will not advance the attainment date by one year, which is one of the key criteria for a RACM measure. As vehicles and fuels get cleaner and CO emissions continue to decline in the future, it will be even more difficult for TCMs to pass the RACM test. Nevertheless, a number of States continue to adopt TCMs and include them in their SIPs either as enforceable or voluntary measures, even when they fail the RACM test.

Transportation programs must provide for timely implementation of TCMs consistent with schedules included in the applicable implementation plan. Thus, failure to provide for timely implementation of TCMs in an approved SIP would jeopardize conformity determinations, could result in highway sanctions, and could delay needed transportation programs and projects. TCMs must also receive priority funding. For these reasons, it is important that TCMs and transportation related RACMs be jointly evaluated by transportation and air quality agencies through an integrated transportation and air planning process before they are included in a SIP as enforceable measures. This helps to

ensure that adequate funding and project sponsors are available to implement these measures in a timely manner.

A number of states indicate that they do not include TCMs in their SIPs because they limit the flexibility for the areas to determine how they will attain and/or maintain the NAAQS. Other states report they are not in favor of including TCMs in SIPs unless they are absolutely needed, given the potential implications if they are not implemented on schedule due to changing priorities, fiscal issues, or scheduling problems. To help address this issue, EPA put out guidance on TCM substitutions in response to SAFETEA-LU provisions. This guidance allows states to substitute or add TCMs into SIPs without going through the formal SIP revision process which could be very time consuming. This substitution policy has been used in States such as Georgia, Texas, and California. These States report the time needed to complete the new TCM substitution process ranges from 6-12 months depending on the complexity of the TCM. This is substantially shorter than going through the formal SIP revision process which can take several years to complete.

Virtually all States implement TCM-type measures which include programs and projects such as HOV lanes, transit programs, carpool/vanpool programs, traffic flow improvements, bicycle/pedestrian programs, etc. These projects and programs are often funded with federal, state and local funds outside of the SIP process. While these measures help improve air quality they are not legally enforceable commitments since they are not identified as TCMs in the SIP. Whether TCMs are included in a SIP or implemented as TCM-type projects outside of a SIP, State DOTs have taken a lead role in developing and funding programs and projects that reduce emissions and improve air quality in their respective States and nonattainment areas.

This report identifies a number of reports that State and local agencies can use to help evaluate the emissions reduction potential of various TCM measures. While no national database exists on the types and emission reduction potential of the TCMs currently included in SIPs, FHWA does collect national data on CMAQ funded projects on an annual basis.[53] These national reports include summaries of the types and costs of programs and projects that used CMAQ funds, and estimates of their respective emissions reductions.

REFERENCES

[1] AASHTO, *Air Quality Practitioner's Conference*, Albany, N.Y., November 17-20, 2008.

[2] AASHTO, State-of-The-Practice Report on *Mobile Source Air Toxics*, May 2009, available at http://environment.transportation.org/pdf/communities_of_practice/mobile_soruce_air_toxics_final_063009.pdf.

[3] AASHTO, State-of-the-Practice Report on *Short Term Impacts from Construction Equipment and Operations*, March 2010, available at http://environment.transportation.org/pdf/communities_of_practice/airqualconstr.pdf.

[4] AASHTO, State-of-the-Practice Report on *Air Quality Interagency Coordination*, June 2010, available at http://environment.transportation.org/pdf/communities_of_practice/aq%20interagency%20coordination%20report%206%2021%2010%20final.pdf

[5] AASHTO State-of-the-Practice Report on *Establishing Air Quality Background Concentration Levels for Projects*, December 2010, available at http://environment.transportation.org/pdf/communities_of_practice/aqcopbackconc12-17-10.pdf.

[6] EPA, *Transportation Conformity Regulations*, Section 93.101, dated March 2010, available at http://www.epa.gov/otaq/stateresources/transconf/regs/420b10006.pdf.

[7] Clean Air Act, *Air Quality Criteria and Control Techniques*, Section 108(f), dated February 24, 2004, available at http://epw.senate.gov/envlaws/cleanair.pdf.

[8] EPA, *RACM Fact Sheet*, dated May 29, 2001, available at http://www.fresnocog.org/files/Air%20Quality/RACM_BACM/Severe%201-Hour%20Ozone%20RACM/racm_fact_sheet2.pdf.

[9] EPA, *State Implementation Plans: General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990*, page 13560, dated April 16, 1992, available at http://www.fresnocog.org/files/Air%20Quality/RACM_BACM/Severe%201-Hour%20Ozone%20RACM/57fr_13560.pdf.

[10] EPA, *Transportation Conformity Regulations*, updated March 2010, available at http://www.epa.gov/otaq/stateresources/transconf/regs/420b10006.pdf

[11] EPA, *Guidance for Implementing the Clean Air Act Section 176(c)(8) Transportation Control Measure Substitution and Addition Provision*, dated January 2009, available at http://www.epa.gov/otaq/stateresources/transconf/policy/420b09002.pdf.

[12] EPA, *Transportation-Related Documents Website*, available at http://www.epa.gov/otaq/stateresources/policy/pag_transp.htm#tcm.

[13] EPA, *Policy Guidance Website*, available at http://www.epa.gov/otaq/stateresources/transconf/policy.htm.

[14] EPA, *State Implementation Plans; General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990*, dated April 16, 1992, available at http://www.fresnocog.org/files/Air%20Quality/RACM_BACM/Severe%201-Hour%20Ozone%20RACM/57fr_13560.pdf.

[15] EPA, *Guidance on the Reasonably Available Control Measures (RACM) Requirement and Attainment Demonstration Submissions for Ozone Nonattainment Areas*, dated November 30, 1999, available at http://www.epa.gov/ttncaaa1/t1/memoranda/revracm.pdf.

[16] EPA, *Additional Submission on RACM from States with Severe 1-hour Ozone Nonattainment Area SIPs*, dated December 14, 2000, available at http://www.epa.gov/ttn/caaa/t1/memoranda/121400_racmmemfin.pdf

[17] EPA, *Clean Air Fine Particle Implementation Rule f*or Implementation of 1997 $PM_{2.5}$ Standards, dated April 25, 2007, available at http://www.epa.gov/pmdesignations/1997standards/documents/Mar07/PM_rule_042507.pdf.

[18] FHWA/FTA, *Statewide Transportation Planning; Metropolitan Transportation Planning; Final Rule*, dated February 14, 2007, available at http://www.gpo.gov/fdsys/pkg/FR-2007-02-14/pdf/07-493.pdf.

[19] FHWA, *Transportation Control Measures Web Page*, available at http://www.fhwa.dot.gov/environment/air_quality/conformity/policy_and_guidance/tcm.cfm.

[20] FHWA, *Final Guidance on the Congestion Mitigation and Air Quality (CMAQ) Improvement Program under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users*, dated October 20, 2008, available at http://www.fhwa.dot.gov/environment/cmaq08gm.htm.

[21] FHWA, *Federal-Aid Highway Program Guidance on High Occupancy Vehicle (HOV) Lanes*, dated August 2008, available at http://www.ops.fhwa.dot.gov/freewaymgmt/hovguidance/index.htm.

[22] Eisinger, D.S. and Niemeier, D.A., U.C. Davis, *Transportation Control Measures (TCMs): Guidance for Conformity and State Implementation Plan Development*, dated August 18, 2004, available at http://aqp.engr.ucdavis.edu/Documents/TCM%20Conformity_SIP.pdf.

[23] For all TCMs in the San Francisco Bay Area see: http://www.mtc.ca.gov/funding/tip/Final_AQ_conformity_Analysis.pdf.

[24] Colorado Air Quality Control Commission, *Denver Metro Area & North Front Range: Ozone Action Plan Including Revisions to the State Implementation Plan*, dated December 12, 2008, available at http://www.cdphe.state.co.us/ap/ozone/RegDevelop/ozoneplan.pdf.

[25] Metropolitan Washington Council of Governments, *Plan to Improve Air Quality in the Washington, DC-MD-VA Region*, dated May 23, 2007, available at http://www.mwcog.org/uploads/pub-documents/9FhcXg20070525084306.pdf.

[26] Metropolitan Washington Council of Governments, *Plan to Improve Air Quality in the Washington, DC-MD-VA Region, Appendix F: Transportation Control Measures*, dated May 23, 2007, available at http://www.mwcog.org/environment/air/downloads/SIP_APP/App_F-_TCM_Documentation_5.23.07.pdf

[27] Metropolitan Washington Council of Governments, *Plan to Improve Air Quality in the Washington, DC-MD-VA Region, Appendix I: RACM Documentation*, dated March 15, 2007, available at http://www.mwcog.org/environment/air/downloads/SIP_APP/App_I_-_RACM_5.23.07.pdf.

[28] EPA, Federal Register, *Approval and Promulgation of Air Quality Implementation Plans: Georgia; 15 Percent Rate-of-Progress Plan and 9 Percent Rate-of-Progress Plan for the Atlanta Ozone Nonattainment Area*, dated December 29, 1999, available at http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=1999_register&docid=99-33527-filed.pdf.

[29] Georgia Department of Natural Resources, *Georgia's State Implementation Plan for the Atlanta 8-Hour Ozone Nonattainment Area*, dated September 8, 2009, available at http://www.georgiaair.org/airpermit/downloads/planningsupport/regdev/sips_and_revisions/atlanta_8hr_ozone/narrative.pdf.

[30] Georgia Department of Natural Resources, letter from Carol A. Couch, Director of Georgia Department of Natural Resources to A. Stanley Meiburg, Acting EPA Region IV Administrator, dated October 9, 2009. More information available upon request from GADOT by email to PPeevy@dot.ga.gov.

[31] Maryland Department of the Environment, *Baltimore Nonattainment Area 8-Hour Ozone State Implementation Plan and Base Year Inventory*, dated June 15, 2007, available at

http://www.mde.state.md.us/programs/Air/AirQualityPlanning/Documents/www.mde.state.md.us/assets/document/AirQuality/BALT_OZONE_SIP/BALT_OZONE_SIP.pdf.

[32] Maryland Department of the Environment, *Appendix E-1: List of Potential Control Measures for 8-Hour Ozone SIP*, dated June 15, 2007, available at *http://www.mde.state.md.us/programs/Air/AirQualityPlanning/Documents/www.mde.state.md.us/assets/document/AirQuality/BALT_OZONE_SIP/Appendix_E1.pdf*.

[33] Maryland Department of the Environment, *Appendix E-2: Baltimore Metropolitan Council Emission Reduction Measures List/ RACM Analysis*, dated June 15, 2007, available at http://www.mde.state.md.us/programs/Air/AirQualityPlanning/Documents/www.mde.state.md.us/assets/document/AirQuality/BALT_OZONE_SIP/Appendix_E2.pdf.

[34] EPA, Letter from Thomas J. Maslany, Director of EPA's Air, Radiation, and Toxics Division to James M. Salvaggio, Director of Pennsylvania's Bureau of Air Quality Control, dated June 29, 1994. More information available upon request from PennDOT by email to michaelba@state.pa.us**.**

[35] Texas Commission on Environmental Quality, *Houston-Galveston-Brazoria Attainment Demonstration and Reasonable Further Progress State Implementation Plan Revisions for the 1997 Eight-Hour Ozone Standard*, dated March 10, 2010, available at http://www.tceq.texas.gov/implementation/air/sip/HGB_eight_hour.html.

[36] Texas Commission on Environmental Quality, *Appendix F: Evaluation of Mobile Source Control Strategies for the Houston-Galveston-Brazoria State Implementation Plan*, dated May 11, 2009, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09017SIP_ado_Appendix_F.pdf.

[37] Texas Commission on Environmental Quality, *Appendix H*: *Voluntary Mobile Emission Reduction Programs for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard*, dated March 10, 2010, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09017SIP_ado_Appendix_H.pdf.

[38] Texas Commission on Environmental Quality, *Appendix G: Transportation Control Measures for the HGB Attainment Demonstration SIP Revision for the 1997 Eight-Hour Ozone Standard*, dated March 10, 2010, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/hgb/hgb_sip_2009/09017SIP_ado_Appendix_G.pdf.

[39] Texas Commission on Environmental Quality, *Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area Attainment Demonstration Texas*, dated May 23, 2007, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/dfw/dfw_ad_sip_2007/2006013SIPNR_ado_Intro_052407.pdf.

[40] Texas Commission on Environmental Quality, *Appendix F: Transportation Control Measures for The DFW Eight-Hour Ozone SIP*, dated May 23, 2010, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/dfw/dfw_ad_sip_2007/appendices/2006013SIPNR_App_F_COMPLETE_042707.pdf.

[41] Texas Commission on Environmental Quality, *Appendix H: NCTCOG Final Submittal of On-Road and Non-Road Mobile Emissions Benefit*, dated May 23, 2010, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/dfw/dfw_ad_sip_2007/appendices/2006013SIPNR_App_H_COMPLETE_052407.pdf.

[42] Texas Commission on Environmental Quality, *Appendix L: Emission Reduction Control Strategies, Environ Final Report* , dated August 29, 2009, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/dfw/dfw_ad_sip_2007/appendices/2006013SIPNR_App_L_Environ_Report_03.28.07.pdf.

[43] Texas Commission on Environmental Quality, *Dallas-Fort Worth Eight-Hour Ozone Nonattainment Area Reasonable Further Progress SIP*, dated May 23, 2007, available at http://www.tceq.state.tx.us/assets/public/implementation/air/sip/dfw/dfw_rfp_2007/DFW_RFP_SIP_CompleteDocument_woAppendices.pdf.

[44] EPA, *Transportation Control Measures Information Documents*, dated March 1992, available at http://www.epa.gov/oms/stateresources/policy/transp/tcms/summary.pdf.

[45] EPA, *Transportation and Air Quality Planning Guidelines*, dated July 1992. For more information contact the EPA library at library.rtp@epa.gov.

[46] EPA, *TRAQ Technical Brief, Transportation Control Measures: Traffic Flow Improvements*, dated September 1998, available at http://www.epa.gov/OMS/stateresources/rellinks/docs/S98012.pdf.

[47] EPA, *Benefits Estimates for Selected TCM Programs*, dated March 1999, available at http://www.epa.gov/otaq/stateresources/policy/420r98002.pdf.

[48] DOT/EPA, *Clean Air Through Transportation: Challenges in Meeting National Air Quality Standards*, dated August 1993. For more information contact FHWA at Cecilia.ho@dot.gov.

[49] FHWA - *A Sampling of Emissions Analysis Techniques for Transportation Control Measures*, dated November, 2000, available at http://www.fhwa.dot.gov/environment/air_quality/conformity/research/transportation_control_measures/emissions_analysis_techniques/index.cfm.

[50] FHWA - *Multi-Pollutant Emissions Benefits of Transportation Strategies*, dated November 2006, available at http://www.fhwa.dot.gov/environment/air_quality/conformity/research/mpe_benefits/.

[51] TRB, *Special Report 264, The Congestion Mitigation and Air Quality Improvement Program; Assessing 10 Years of Experience*, dated 2002, available at http://onlinepubs.trb.org/onlinepubs/sr/sr264.pdf.

[52] NCHRP 25-25, Task 59- *Evaluate the Interactions between Transportation-Related Particulate Matter, Ozone, Air Toxics, Climate Change, and Other Air-Pollutant Control Strategies*, dated July 19, 2010, available at http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(59)_FR.pdf.

[53] FHWA, *CMAQ Annual Reports*, available at http://www.fhwa.dot.gov/environment/air_quality/cmaq/populations/.