

**TRANSPORTATION CONTROL MEASURES (TCMS): FEDERAL REQUIREMENTS
AND SIP DEVELOPMENT CONSIDERATIONS**

UC Davis-Caltrans Air Quality Project
<http://AQP.engr.ucdavis.edu/>

Task Order No. 30

November 12, 2003

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Prepared for

Presentation at the Transportation Research Board
83rd Annual Meeting
Paper #04-2720
Session # 314
January 11-15, 2004
Washington, D.C.

and

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Prepared in response to

A Caltrans request to evaluate Transportation Control Measure policies regarding State Implementation Plan (SIP) substitutions and reasonably available control measures (RACM).

Transportation Control Measures (TCMs): Federal Requirements and SIP Development Considerations

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Paper #04-2720, for presentation at the Transportation Research Board's 83rd Annual Meeting, Session # 314, January 11-15, 2004, Washington, D.C.

ABSTRACT

U.S. transportation control measure (TCM) policies have evolved over the past several years, especially with respect to the identification of reasonably available control measures (RACM). In this paper, we use U.S. TCM experiences to examine transportation conformity in light of two important emerging policy issues: the identification of TCMs that are RACM and the substitution of TCMs in existing state implementation plans (SIPs). Building on recent U.S. Environmental Protection Agency (EPA) rulemaking actions, court decisions, research findings, and various state SIP adoption efforts, this study outlines the issues associated with building TCMs into SIPs while buffering against conformity difficulties. We also identify factors related to TCM substitution that take into consideration past EPA approval actions and recent considerations raised by public interest groups and planning agencies. The paper provides a process for identifying candidate TCMs for RACM analysis, explicit criteria for determining RACM TCMs, insights regarding TCMs that will be most effective in the future, and case study-derived recommendations on how to structure SIP TCM commitments.

INTRODUCTION

During the next decade, many urban areas are expected to update or prepare entirely new state implementation plans (SIPs) to meet national ambient air quality standards (NAAQS). The Clean Air Act Amendments (CAAA) of 1990 require implementation of all reasonably available control measures (RACM) in nonattainment areas for ozone (O₃), carbon monoxide (CO), and particulate matter less than 10 microns in diameter (PM₁₀). Transportation control measures (TCMs), if they meet RACM criteria, must be included in SIPs. The presence of TCMs in a SIP signals two important ramifications for the transportation planning community. First, SIP TCMs for which emission reduction credit is claimed have funding priority over other transportation improvement program (TIP) and regional transportation plan (RTP) projects (1). Second, transportation conformity regulations require documentation of successful TCM implementation as a prerequisite for TIP and RTP approval.

Despite their funding priority and importance in the conformity process, TCMs have generally been found to contribute only a small fraction of regional emission reductions relative to other on-road motor vehicle control programs such as new vehicle tailpipe emission standards, fuel reformulation, and motor vehicle inspection and maintenance (2, 3). Yet, even with relatively small emission reductions, many existing air quality management plans employ TCMs to provide the marginal reductions needed to meet national ambient air quality standards (NAAQS) and to pass transportation conformity emission budget tests.

Among all the SIP control measures, TCM commitments are unique. Unlike other SIP controls, the implementation progress of TCMs must be demonstrated a minimum of every two years, since conformity demands ongoing demonstrations of timely TCM implementation. If a SIP TCM is off-schedule or less effective than forecasted, problems must be corrected to avoid conformity failure. No other SIP control measure reviews occur on a basis as frequent or stringent as the conformity check against TCM implementation.

As agencies prepare SIPs, they must decide whether to adopt TCMs, and if TCMs are to be included in the SIPs, how to structure the SIP commitments. These decisions will have long-lasting ramifications for the communities involved. Including TCMs in SIPs can irrevocably link TCM implementation progress to future conformity determinations, govern the flow of federal transportation funds to the region, and prioritize how federal transportation dollars are spent. Regional air quality and transportation planning agencies need to understand the TCM requirements that govern the SIP development process, as well as what lessons to draw from past TCM analysis, SIP development, and conformity implementation experiences.

In this study, we extend previous research by identifying and analyzing federal TCM-related policies, court decisions, and various state SIP development actions, to examine transportation conformity in light of two important emerging policy issues: the identification of TCMs that are RACM and the substitution of TCMs in existing SIPs. Since the early 1990s, EPA's TCM RACM policies have been relatively flexible, granting states and regions broad discretion to determine RACM on an area-by-area basis and to construct SIPs with minimal TCM commitments. Legal challenges, however, are motivating consideration of more extensive TCM RACM SIP commitments. Thus, defining what constitutes RACM is an emerging significant issue. In addition, replacing SIP TCM commitments that become outdated over time is a major consideration of growing interest. Since any SIP TCM implementation failure can result in a conformity problem, transportation and air quality planners have long sought a mechanism that allows SIP TCMs to be updated without the need for time-consuming SIP amendments. This study clarifies federal TCM SIP mandates and provides a SIP-building roadmap that includes a TCM substitution mechanism.

STATUTORY REQUIREMENTS AND TCMS IN SIPS

There are several reasons why TCMs are often included in SIPs. The CAAA generally require states to implement all reasonably available measures so that attainment of air quality standards can be achieved as quickly as possible, considering, as described in section 172(a)(1)(A), both the "availability and feasibility" of necessary controls. The CAAA, 172(a)(2)(A), also state that areas must achieve the standards "as expeditiously as practicable". The first nonattainment area planning requirement identified in the CAAA, section 172(c)(1), is the provision for "...the implementation of all reasonably available control measures as expeditiously as practicable...." To the extent that TCMs are identified as RACM, which we discuss in a subsequent section, their implementation is required in all nonattainment areas.

In addition to the RACM requirements, the 1990 CAAA specify a graduated series of TCM requirements corresponding to the severity of an area's air pollution. The worse the air pollution problem, the more likely the statutory need for TCMs. The CAAA also includes section 108(f), an explicit listing of 16 separate TCMs for consideration. Prior to passage of the 1990 CAAA, the U.S. Environmental Protection Agency (EPA) interpreted earlier versions of CAAA section 108(f) to include TCMs that were RACM for all U.S. metropolitan regions (4). Areas that prepared SIPs prior to passage of the 1990 CAAA were required by EPA to adopt the 108(f) measures or justify why the measures were excluded from the SIP. In Monterey, Sacramento, and San Francisco, California, for example, TCMs were included in O₃ SIPs submitted to EPA in 1982 under the Clean Air Act Amendments of 1977. Despite these requirements, however, the evolution of SIP policies and recent court decisions, as described in the sections that follow, make clear that the RACM provisions are the key determinant of whether TCMs must be included in SIPs.

TCM SIP policies, as clarified by the courts, have evolved over the past decade from broad, flexible requirements to narrowly defined mandates. Here, we provide a synopsis of the key policy changes that have occurred. In its 1992 General Preamble (Preamble) explaining CAAA implementation policies, EPA altered its earlier TCM policy that presumed the 108(f) measures were RACM for all areas. The 1992 Preamble stated it was "inappropriate" to presume that section 108(f) measures were RACM and acknowledged that area-to-area conditions varied enough to allow each area to identify RACM TCMs. In addition, the 1992 guidance stated it would be appropriate for areas to commit to packages of TCMs, rather than individual measures (4). EPA said the 108(f) list was not exhaustive, but indicative of the measures to be considered. The Preamble created a broadly defined mandate. Consistent with this broad approach, EPA SIP approvals during the mid-1990s, for example EPA's September 1996 approval of the Sacramento O₃ SIP, established minimal documentation requirements for TCM analysis and adoption.

In support of O₃ SIP rulemakings, EPA issued guidance in late 1999 that clarified and narrowed the agency's interpretation of the RACM requirement (5). EPA announced that states needed to document why

potentially reasonable measures had not been included in the SIP; exclusion of measures could be based on technical or economic considerations.

In December 2000, EPA provided additional RACM guidance to EPA Regions covering 10 serious and severe 1-hr O₃ nonattainment areas. EPA issued the guidance in response to public comments criticizing SIPs for failing to include all RACM, including TCMs (6). The December 2000 guidance further narrowed the definition of RACM by defining when candidate TCMs failed the RACM test. First, a measure was not RACM if it did not advance the attainment date for the area. Or, second, a measure was not RACM if it was either technologically or economically infeasible. The policy stated that even if measures were included in a TIP, they may not be RACM if they do not meet the CAAA's or EPA's RACM tests (7).

Advancing Attainment

Given EPA's current, more narrowly defined criteria for determining RACM, a logical question is, "what does it mean to advance the attainment date?" The base criterion is, in effect, whether a measure or group of measures will help an area achieve attainment one year earlier than in the absence of the measure(s). However, EPA has been reluctant to provide a written policy establishing one year as an absolute definition, in part to give states flexibility to apply the "advance the attainment date" concept in a manner that makes sense for individual regions (unpublished data, Beth Lowe, Metropolitan Washington Council of Governments, June 2003). Recent SIP development experiences in Washington, D.C., and Phoenix, Arizona, and a RACM analysis performed by EPA illustrate how different regions and EPA itself have interpreted whether TCMs meet the advancing-attainment requirement.

Washington, D.C. Draft Ozone SIP (June 2003)

The Metropolitan Washington Council of Governments (MWCOG) released a draft O₃ SIP revision in June 2003. To prepare the revised SIP, MWCOG completed a three-step process to identify whether TCMs met the advancing-attainment RACM test (8). First MWCOG determined, in consultation with EPA, that since O₃ attainment is measured for an entire O₃ season, advancing-attainment would mean achieving attainment one O₃ season (i.e., one year) earlier than expected. Washington D.C. agencies worked with legal staff from EPA regional and headquarters offices to construct an EPA-approvable interpretation of advancing-attainment (unpublished data, Beth Lowe, Metropolitan Washington Council of Governments, June 2003). Second, using air quality modeling, they estimated that 1 ppb of O₃ reduction was needed to advance attainment one year, and that either 8.8 tpd of NO_x reduction, or 34.0 tpd of VOC reduction, would reduce O₃ 1 ppb. Finally, MWCOG estimated emission reductions from candidate measures to decide whether they would advance attainment. MWCOG estimated that TCMs would produce 0.3 tpd of VOC and 0.7 tpd of NO_x reductions; therefore, the TCM measures were not considered RACM.

Phoenix Area PM₁₀ Plan (Approved by EPA January 2002)

The Maricopa Association of Governments (MAG) prepared a PM₁₀ SIP in 1999 (9), which EPA approved January 2002 (10). In its proposed SIP-approval, EPA described a two-step process to identify whether implementation of California diesel fuel (CARB diesel) in the Phoenix area would meet the advancing-attainment RACM test (11). First EPA found, based on information provided by MAG, that a minimum 4 tpd of PM reduction was necessary to advance attainment by one year. EPA then noted that CARB diesel would generate a total PM reduction of 0.8 tpd in 2006 and would, therefore, not advance attainment by one year.

EPA RACM Analysis (October 2000)

In October 2000 EPA published an analysis of RACM TCMs in support of several O₃ SIP rulemakings (12). The October 2000 RACM analysis is noteworthy because it is the only recent example of an EPA-conducted TCM RACM analysis, and also because two recent lawsuits (13,14) (see "Related Recent Litigation" below) challenged EPA's interpretation of the RACM requirement.

In 1999, EPA proposed various approval actions for O₃ attainment demonstrations covering 10 metropolitan areas in the eastern United States (15). The proposed approvals did not remark on the suitability of the RACM analyses performed by the 10 areas, and environmental organizations subsequently commented on the proposed actions, stating that a RACM analysis should have been performed (16). EPA was under significant time pressure to approve O₃ plans in 4 of the 10 areas: Greater Connecticut, Western Massachusetts (Springfield), Metropolitan Washington (D.C., Maryland, Virginia), and Atlanta, Georgia (17). In response to the adverse public

comments, EPA took the unusual step of completing, on its own, a RACM analysis on behalf of the four serious O₃ non-attainment areas.

EPA evaluated seven TCM categories and concluded the measures did not qualify as RACM because EPA believed they would either require “an intensive and costly effort” or would not advance attainment. EPA estimated that TCMs would achieve between 2.03 and 11.38 tpd of VOC and between 3.56 and 17.07 tpd of NO_x emission reductions. EPA stated these reductions were “far less” than what was needed to demonstrate attainment and would, therefore, not advance the attainment date. As further clarification, EPA stated it did not believe the measures were RACM because their small emission reductions were not sufficient to allow any of the four areas to achieve the NAAQS “in advance of full implementation of all other required measures” (12).

Technical and Economic Feasibility

The second key RACM test is whether measures are technically and economically feasible. Recent research and motor vehicle emission trends help establish feasibility parameters. Regarding cost-effectiveness, research by TRB (2), and Arizona and California agency actions, have defined the RACM economic feasibility test. TCMs that achieve pollution reductions at or below \$10,000 to \$20,000 per ton of pollution reduced (year 2000 dollars) are generally considered cost-effective. Regarding technical feasibility, as the vehicle fleet becomes cleaner, TCMs are expected to become less cost-effective (2). In the future, TCMs that target gross-polluting vehicles, and TCMs that focus on reducing vehicle *starts* (as opposed to vehicle miles traveled [VMT]), may have the greatest opportunity to reduce emissions. Thus, areas might place greater emphasis on TCMs that reduce trips over TCMs that simply reduce VMT.

Related Recent Litigation

Two recent Circuit Court decisions have upheld EPA’s criteria for what constitutes RACM: measures need to *both* advance the attainment date and be technically and economically feasible. The courts have also sent a strong signal that RACM assessments need to comprehensively identify candidate measures and adequately evaluate each measure to ascertain whether it meets the feasibility and advance-attainment tests.

In the first court decision, the Sierra Club sued EPA, challenging the agency’s January 2001 final rule approving the Washington, D.C. area O₃ attainment SIP, extension of the O₃ attainment deadline, and EPA’s TCM RACM analysis for the Washington, D.C. area. On July 2, 2002, the U.S. Court of Appeals upheld EPA’s criteria for determining whether TCMs were RACM, stating that EPA’s construction of the term “RACM” was reasonable and deferring to EPA’s interpretation of RACM as requiring both an advancement of the attainment date and implementation efforts that were neither “intensive nor costly” (13). However, the court determined that EPA had not adequately completed its RACM analysis. The court noted that during the SIP approval process, EPA identified several measures such as retrofitting diesel trucks and buses and controlling ground support equipment at airports that, when taken together, might provide significant emission reductions. The court found that EPA had not analyzed these measures during its RACM evaluation and thus failed to complete an adequate evaluation of candidate measures (13). In other words, EPA’s RACM criteria, i.e., advancing the attainment date and being technologically and economically feasible, were sound, but a RACM evaluation required a more thorough review of candidate measures.

In the second case, similar to the Washington, D.C. lawsuit, the Sierra Club and other plaintiffs sued EPA for approving the Beaumont-Port Arthur, Texas area O₃ SIP and attainment deadline extension. In its complaint, Sierra Club *et al.* challenged EPA’s finding that unless TCMs advanced the attainment date, they were not RACM. The U.S. Court of Appeals, Fifth Circuit, ruled on the lawsuit December 11, 2002 (14), upholding EPA’s approach to identify RACM measures.

The court agreed with EPA that measures are not required (i.e., are not RACM) if they do not assist in attaining the NAAQS as expeditiously as practicable (14). In addition, the Court found that EPA need not require an analysis of all TCMs listed in CAAA section 108(f). The Fifth Circuit ruled it was not possible to evaluate “all available measures and consider the effects of such measures in every possible combination” (14). Further, the court acknowledged and approved the analytical approach taken by EPA in preparing a TCM RACM analysis for the Greater Connecticut, Western Massachusetts, Washington, D.C., and Atlanta areas: “...EPA did conclude that it would be reasonable to use a midpoint level of program effectiveness to analyze potential reductions from TCMs, a level that would be economically feasible and provide effective implementation...we affirm the portion of the

EPA's final action that treats as potential RACMs only those measures that would advance the attainment date and considers implementation costs when rejecting certain control measures" (14).

The Beaumont-Port Arthur case is notable for another reason. In addition to upholding EPA's criteria for determining which TCMs were RACM, the court emphasized that EPA had two duties to adequately evaluate candidate measures: to examine the relevant data necessary to properly evaluate candidate measures; and to explain why it rejected candidate measures, and in particular, why rejected measures, either individually or in combination, did not advance an area's attainment date. Thus, the Beaumont-Port Arthur case upheld EPA's criteria for identifying RACM measures, but also cautioned that EPA, and by extension states, needed to conduct a comprehensive RACM evaluation and explain the evaluation results.

TCM SUBSTITUTION

With the inclusion of TCMs in SIPs, over time, SIP assumptions regarding anticipated control measure benefits can become outdated for a variety of reasons. Individual SIP controls may prove more or less difficult to implement than originally anticipated, new controls may be identified, or improved data become available regarding emissions, travel activity, and the contribution of mobile sources to air pollution. In contrast to the requirements for periodic TIP and RTP updates, there is no corollary requirement for periodic SIP revisions.

Once a TCM is included in a SIP, it is generally difficult to remove the measure, particularly if the measure can be interpreted as "reasonably available" or is otherwise contributing to "expeditious" attainment of the NAAQS. In what has proven to be a difficult challenge for some areas, all SIP TCMs, regardless of when they were first included in the SIP, are covered by the 1990 CAAA transportation conformity requirements and must be implemented as planned to facilitate TIP and RTP approvals.

Perhaps one of the more striking examples of an outdated TCM involves the San Francisco Bay Area's 1982 O₃ SIP commitment to implement TCM-2, a 15% increase in transit ridership. Although the original SIP commitment required a 15% increase in 1982-83 transit ridership levels by 1987, as of Fall 2003 Bay Area officials had not yet demonstrated complete implementation of TCM-2. Failure to implement TCM-2 has resulted in litigation and delayed conformity determinations. As stated by the courts in response to TCM-2 litigation, "Now that the target [15% transit ridership] increase has been set, Defendants' only alternative, besides compliance, is to petition the EPA for removal of TCM 2 from the SIP..."(18).

Given inevitable changes in travel activity, emissions, and control measure effectiveness over time, transportation and air quality planners have sought a mechanism that allows SIP TCMs to be updated without time-consuming SIP amendments. In some regions, TCM "substitution" policies have been created that allow individual SIP TCMs to be replaced (substituted) through a process separate from the SIP amendment process; these approaches usually involve using the existing conformity consultation process.

As of Fall 2003, there was no established national policy to accommodate TCM substitutions, although EPA intends to release TCM substitution guidance in 2003 (unpublished data, Rudolph Kapichak, EPA Office of Transportation and Air Quality, September 2003). However, EPA has indicated support for TCM substitutions in the transportation conformity regulations, "...EPA remains committed to issuing guidance on how areas can substitute TCMs in previously approved SIPs without additional EPA approvals" (19). EPA also stated in the conformity rule that development of a TCM substitution mechanism is possible under existing SIP policies. In the absence of a national TCM substitution policy, EPA has, on a case-by-case basis, evaluated substitution policies. As of Fall 2003, EPA had approved TCM substitution mechanisms in Massachusetts, Oregon, New Mexico, and Texas. The Massachusetts example represents the earliest approval and, as such, lacks the details of subsequent substitution processes approved in Oregon, New Mexico, and Texas. In addition to these formal TCM substitution provisions, EPA also approved SIP provisions in the Los Angeles area that, in effect, allow project-level TCM substitutions.

Portland, Oregon

One of the earliest examples of an EPA-approved TCM substitution policy involves Portland, Oregon. The 1996 O₃ maintenance SIP included five TCMs: land use measures, an employer commute-options program, a voluntary parking management program to complement the employer-based program, increased transit service, and bicycle and pedestrian facilities (20). The SIP also allowed for the substitution of TCMs, in whole or in part, as long as replacement TCMs provided emission reductions equivalent to the original measures (20). EPA approved the region's O₃ SIP revision, including the TCM substitution provisions, in 1997 (21). Oregon's SIP substitution

requirements have served as the template for substitution provisions later approved by EPA for both New Mexico and Texas; the provisions are summarized in Table 1. The TCM substitution policy has not been used since its creation (unpublished data, Marianne Fitzgerald, Oregon Department of Environmental Quality, May 2003).

Albuquerque, New Mexico

The Albuquerque, New Mexico, area has a TCM substitution policy as part of its conformity SIP. The conformity SIP was adopted in 1998 and approved by EPA in 1999 (22). The New Mexico substitution process parallels the process approved by EPA for Oregon. Although the Albuquerque region has an approved TCM substitution policy, the existing SIP does not include TCMs (unpublished data, Dan Warren, Albuquerque/Bernalillo County Air Quality Control Board, May 2003).

Texas

Various Texas nonattainment areas include TCMs in existing SIPs. For example, the Houston/Galveston O₃ nonattainment area included eight TCMs in its December 2000 SIP revision (23): a computerized traffic management system, an arterial traffic management system, bicycle and pedestrian projects, intersection improvements, a transitway project, park-and-ride lots, port projects to reduce truck traffic and improve traffic flow, and light-rail service to the Houston Astrodome.

In May 2000, Texas submitted a statewide TCM SIP to EPA that included substitution provisions virtually identical to those for Portland. Members of the public commented in mid-2001 on EPA's proposed approval of the Texas policy. Concerns ranged from ensuring adequate EPA participation in the substitution process, to enabling proper enforcement of substitute TCMs, to mitigating environmental justice impacts. EPA addressed these comments in its December 5, 2002 SIP approval (24). Table 2 summarizes the public comments and EPA responses.

South Coast Air Basin (Greater Los Angeles area) in Southern California

The 1997 air quality management plan (AQMP) for the South Coast Air Basin (SoCAB) includes a commitment to implement three categories of TCMs: HOV lanes, transit and transit system management improvements, and information services to educate the public and promote alternative travel modes (25). The implementation commitment is limited, however, only to those TCM measures included during the first two years of the TIP applicable as of November 1996. Following those two years, and through 2010, the AQMP provides a commitment for continued equivalent emission reductions from TCMs, although the AQMP states the "specific mix of projects...may ultimately change"(25). EPA approved the 1997 SoCAB AQMP (including 1999 SIP amendments unrelated to TCMs), in 2000 (26). Although the SoCAB SIP does not include a formal TCM substitution policy as described in the Oregon, New Mexico, and Texas SIPs, the SoCAB SIP includes flexibility to modify over time which projects are considered to be TCMs.

As of Fall 2003, transportation and air quality agencies in the SoCAB had drafted a SIP revision which included a more formal TCM substitution policy. The SoCAB draft SIP included two TCM substitution elements: a general rollover policy and a substitution policy for individual projects. The substitution policy for individual projects was patterned after the Oregon, New Mexico, and Texas examples. The general rollover policy acknowledged that every two years, as the regional TIP is updated, older TIP projects will be replaced with newer TIP projects; thus, the specific projects associated with SIP TCMs will vary over time. As part of the formal interagency consultation process under the transportation conformity regulations, the agencies participating in interagency consultation shall "assess the suitability and appropriateness" of new TCM projects (27).

In 2003, the Federal Highway Administration (FHWA) raised concerns about the mechanics of TCM substitution as part of its review of the Southern California Association of Governments' (SCAG) draft SIP language for TCM substitution. FHWA was concerned about its ability to properly identify individual transportation projects that qualify as TCMs. The identification of individual TCM projects is important, since TCMs in an approved SIP are allowed to move forward during a conformity lapse. FHWA cautioned that substitution mechanisms would be best constructed if they facilitated identification of projects that qualify as either the original SIP TCMs or the substituted measures.

POLICY AND PLANNING IMPLICATIONS, OR, “BUILDING A TCM SIP”

TCMs, RACMs, and SIPs

The CAAA provide a graduated array of control requirements, with increasingly stringent obligations for more polluted regions. However, experience indicates that, independent of the specific TCM provisions included in the CAAA, the RACM requirement, which applies to all nonattainment areas, is the primary motivating force compelling TCM adoption. Based on EPA guidance and recent court decisions, it is incumbent upon areas to formulate a list of candidate TCMs in order to evaluate which measures are RACM. EPA, in various guidance documents, and more recently TRB (2) have identified an array of candidate measures. The measures listed in Table 3 are a useful starting point for areas seeking to identify candidate TCMs for RACM SIP analyses.

The requirement to implement TCMs that qualify as being reasonably available is fundamentally a process requirement to adequately identify and evaluate candidate measures for individual regions. Several insights are available, however, to help regions work through the RACM evaluation process. First, the broad flexibility offered by EPA in the early 1990s, essentially allowing regions to forego documentation of RACM analyses for TCMs, is no longer directly applicable. Although EPA policy remains somewhat vague concerning RACM, the agency acknowledged in late 1999 that the RACM requirement would be more clearly defined following judicial review (5).

Second, recent court decisions have upheld EPA criteria for determining which measures are reasonably available. There are two tests, both of which must be satisfied: first, a measure must advance an area's attainment date by at least one year; second, the measure must be technically and economically feasible. RACM analyses must adequately document that all appropriate measures are considered and must document why measures are rejected.

Once RACM TCMs are identified, careful attention should be paid to the structure of the SIP commitment. SIP commitments to specific operational objectives are absolute and have been upheld by the courts. The most notable example is the San Francisco Bay Area's 1982 TCM-2 commitment to increased transit ridership. In contrast to operational commitments, EPA has provided states with some flexibility concerning emission reduction commitments attached to TCMs. Failure to achieve emissions goals for individual measures or entire TCM packages is not necessarily a significant problem either for attainment or conformity, depending upon the success of other controls. EPA and others have recognized that emissions analyses are difficult for individual TCMs, that synergistic effects can occur among a package of measures, and that TCM emissions modeling involves large uncertainties (3). The 1992 Preamble allows and encourages areas to consider TCM packages, rather than individual measures (4). San Francisco, for example, adopted in 2001 a package of five individual SIP TCMs but estimated emission reduction benefits from the package, rather than from individual measures (28).

In summary, regions should complete three analysis steps to conduct a RACM evaluation. First, identify candidate TCMs. Second, evaluate whether measures (individually or as a group) will advance attainment by at least one year. Third (assuming some measure[s] pass the advance-attainment test), identify whether measure(s) are technically and economically feasible. Once a set of measures has been determined to be RACM, careful attention must then be paid to the structure of the SIP commitment.

The SIP Structure: TCMs and Substitution

In three separate notice-and-comment public rulemakings (Oregon-New Mexico-Texas), EPA approved TCM substitution policies based on the processes and criteria described in Table 1. In one of these approvals (Texas), EPA responded to public comments and defended the overall TCM substitution concept and the specific steps established by Oregon-New Mexico-Texas. Despite the lack of a national TCM substitution policy, there is a *de facto* EPA-approved TCM substitution framework. As of Fall 2003, these same procedures are also under consideration in the Los Angeles area.

Recent comments raised by members of the public and FHWA suggest the *de facto* Oregon-New Mexico-Texas TCM substitution framework lacks the specificity needed to help agencies and the public ascertain at all times not only which TCMs are in the SIP, but also which specific projects qualify as SIP TCMs. There is an important distinction between a TCM in a SIP and an individual TIP transportation project identified as a TCM. As an illustration, the SoCAB SIP included the TCM, “HOV Improvements,” while the SCAG 2001 TIP included numerous “HOV Improvement” projects, an example of which is an expansion of the Agoura Hills park-and-ride lot from 93 to 193 spaces (25, 29).

One approach to augment the Oregon-New Mexico-Texas substitution framework would be to specify that each TIP clearly identify projects that qualify as SIP TCMs. The identification of TIP TCM projects will facilitate implementation tracking and allow for ready identification of projects eligible to proceed in the event of a conformity lapse. An additional approach might be to have a TCM substitution trigger a required TIP amendment within a reasonable time period (one year for example); the TIP amendment would be the documentation vehicle to revise the list of TIP projects associated with SIP TCMs, and to illustrate that the substituted TCMs yield emission reductions equivalent to or greater than the original SIP measures. A third option would be to require that once a SIP TCM substitution occurred, all subsequent TIPs include an appendix with a copy of the SIP TCM substitution documentation submitted to EPA (see Table 1). The identification in the TIP of (a) the most current list of SIP TCMs and (b) the specific TIP projects that qualify as TCMs, would together ensure that agencies and the public could check implementation status.

Environmental justice concerns have also been raised concerning the implementation and substitution of TCMs (see Table 2). One approach to address these concerns is to incorporate in the substitution policy a statement that encourages, where feasible, implementation of substitute TCMs in the same geographic area and serving the same demographic subpopulation as affected by the SIP TCM being replaced. The TCM substitution policy included in the draft SoCAB SIP incorporates such a statement (27).

In summary, a TCM substitution framework comprises several potential elements:

1. The substitution of procedural steps and specific measure criteria outlined in Table 1.
2. A requirement that each TIP identify the specific projects which qualify as SIP TCMs.
3. A requirement that TCM substitution trigger a TIP amendment to
 - a. document the SIP TCM substitutions that occurred,
 - b. update the TIP list of specific projects that qualify as SIP TCMs,
 - c. document the emission reduction equivalency of the substitute TCMs, and
 - d. insure that interested agencies and members of the public had a resource to identify TCMs for enforcement and conformity purposes.
4. A requirement that once a TCM substitution occurs, all subsequent TIPs include a copy of the substitution documentation as an appendix.
5. A statement that encourages, where feasible, implementation of substitute TCMs in the same geographic area and serving the same demographic subpopulation as affected by the SIP TCM being replaced.

CONCLUSIONS

Based on EPA actions, court decisions, recent research findings, and various state SIP adoption efforts, an evolution in national TCM policy has occurred over the past several years. Nonattainment areas embarking on SIP update or development efforts now have the opportunity to identify and evaluate candidate TCMs and to prepare a flexible SIP commitment to appropriate measures. Nonattainment areas reluctant to adopt SIP TCMs due to concerns that implementation problems will lead to conformity failure should understand that several approaches are now available to create SIP commitments that avoid conformity problems. Those charged with developing SIPs should plan to complete a comprehensive RACM analysis; this paper describes the criteria to use when completing such an analysis, and illustrates how several areas and EPA have determined which TCMs constitute RACM. Finally, areas have the opportunity to create a process to replace outdated SIP TCMs without amending the SIP. This paper identifies the key elements of a TCM substitution process that takes into consideration past EPA approval actions and recent considerations raised by public interest groups and planning agencies. Taken together, the findings presented here offer agencies guidance on how to appropriately build TCMs into SIPs while buffering against conformity difficulties.

ACKNOWLEDGMENTS

Support for this research was partially provided by the California Department of Transportation, under the direction of Michael J. Brady. The authors appreciate assistance provided by support staff at Sonoma Technology, Inc., where Douglas Eisinger is Senior Manager, Transportation Policy and Planning. The authors also appreciate the assistance of the Albuquerque/Bernalillo County Air Quality Control Board (Albuquerque); the Federal Highway Administration (Washington, D.C. and San Francisco); the Metropolitan Transportation Commission (San Francisco); the Metropolitan Washington Council of Governments (Washington, D.C.); the Oregon Department of Environmental Quality (Portland), the South Coast Air Quality Management District and the Southern California

Association of Governments (Los Angeles); and the U.S. Environmental Protection Agency Office of Transportation and Air Quality (Ann Arbor), Region 6 (Dallas), and Region 9 (San Francisco). The views are those of the authors alone.

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TABLE 1 Portland, Oregon, TCM Substitution Process, Approved by EPA in 1997 (20, 21)

Step / Criteria	Responsible Parties
Process to Complete a TCM Substitution	
1. A determination must be made that an existing TCM in the SIP is no longer appropriate.	Regional and state agency staff.
2. The Metropolitan Planning Organization (MPO) will convene a working group to identify and evaluate substitute measures, and shall consult with EPA by sending copies of all draft and final documents, agendas and reports to EPA's regional office.	The working group shall include members from all affected jurisdictions, state and/or local air quality agencies and local transportation agencies.
3. Interagency consultation must result in concurrence of the appropriateness and emission reduction equivalency of the substitute TCM.	The MPO, state agency, and EPA regional office.
4. The substitute TCM must have been subject to at least one public hearing and a public comment process.	State agency.
5. The state shall submit to the EPA regional office a summary of comments received, along with the state's responses.	State agency.
6. EPA shall notify the state within 14 days if EPA's concurrence with the substitution has changed as a result of the public comments.	EPA.
7. The measure to be replaced shall stay in effect until the substitute measure has been adopted and the old measure rescinded.	State agency.
8. The analysis of substitute measures must be consistent with the methodology used for evaluating measures in the SIP, or shall use the latest modeling techniques to demonstrate equivalent or greater emissions reductions.	State or local agency.
9. Documentation of approved TCM substitutions must be maintained, and must provide a description of the substitute and replaced TCMs, including requirements and schedules. The documentation will also provide a description of the substitution process including the working group members, the public hearing and comment process, EPA's concurrence, and state adoption. The documentation will be submitted to EPA following adoption, and made available to the public as an attachment to the SIP.	State agency.

TABLE 1 Portland, Oregon, TCM Substitution Process, Approved by EPA in 1997 (20, 21)

Step / Criteria	Responsible Parties
Criteria Concerning the Replacement Measure(s)	
1. There must be evidence of adequate personnel, funding and authority under State or local law to implement, monitor, and enforce replacement measures.	Commitments to implement the substitute TCMs must be made by the agency with legal authority for implementation.
2. The replacement measure must provide equivalent or greater emissions reductions than the measure contained in the maintenance plan.	Federal, state, and local agencies must concur.
3. Replacement measure must be implemented in the time frame established for the original measure contained in the SIP, or, if the deadlines have passed, funding for the replacement measure must be included in the first year of the next TIP and long range plan adopted by the MPO.	MPO.
4. The substitute measures must be fully implemented within two years after the implementation date of the original measure. <i>[see note at end of table]</i>	MPO.

Note: EPA has approved substitution provisions for New Mexico and Texas that are virtually identical to those established in Portland, Oregon; one exception is that New Mexico allows only a one year extension of the original SIP implementation deadlines, rather than the two years allowed in Oregon.

TABLE 2 Public Comments and EPA Responses, Texas TCM Substitution Program (24)

TCM Substitution Comment	EPA Responses
1. Need greater specificity about when substitution is appropriate.	Substitute TCMs must achieve equal or greater emission reductions; in addition, various requirements mandate active TCM monitoring and enforcement.
2. Public should be represented during interagency work group deliberations over TCM substitution.	The public hearing and comment processes provide adequate public input opportunities.
3. EPA concurrence period of 14 days is too short and should be at least 60 days. EPA should make an independent finding and publish it in the Federal Register.	EPA must be consulted throughout the substitution process and must concur on the suitability of substitute measures, prior to the public comment period. The need for a federal register publication would impede the goal of allowing for flexible and timely substitutions. By definition, by concurring with the substituted measures, EPA has found them to be equivalent (or better) than the existing SIP.
4. Substitute equivalency should be determined in units of emission reductions, VMT reductions, and trip start reductions.	The substitute must produce equivalent emissions reductions. In addition, the substitute analysis methodology must be consistent with the analysis methodology used for existing TCMs, including using the latest emissions modeling techniques.
5. The analysis of substitution candidates should include comparative environmental and social justice impacts; an environmental justice representative should be part of the analysis work group.	EPA encourages the MPO to include representatives on the TCM substitution work from the communities affected by the TCM substitution, and those concerned about environmental justice. In addition, the public comment and hearing processes provide adequate opportunity for public input.
6. The implementation deadline for the substitute measure should be the same as for the original TCM, or as expeditiously as practicable. Any temporal loss in emission reduction benefits should be backfilled through emission reduction credit (ERC) purchases from an ERC bank, or through other offsetting emission reductions.	EPA believes substitutes will be implemented as expeditiously as practicable, given the requirements to implement the measure on the original SIP schedule, or no later than two years after the original SIP schedule. In addition, measures that require funding must be included in the first year of the next TIP and RTP adopted by the MPO. Participation in obtaining ERC-banked credits is unnecessary.
7. The enforceability of the substituted, and the substituting, TCMs is not apparent. States cannot unilaterally change the SIP.	The SIP revision to substitute a TCM must include evidence documenting adequate personnel, funding, and authority, to implement, monitor, and enforce the measures. Also, EPA can order proper SIP implementation, and EPA and citizens can bring suit to enforce SIP provisions. States are not unilaterally changing the SIP, since the substitution process requires interagency concurrence.
8. EPA has not sufficiently analyzed the enforceability of TCMs under a substitution framework.	EPA believes that a replicable procedure for enforceable TCM substitution is consistent with SIP policy.

TABLE 3 Candidate TCMs for RACM SIP Analyses^a

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TCMs: Broad Category Example individual measures	Source Identifying Measure Category				
	CMAQ Program Evaluation ^b	EPA RACM Analysis for Four East- Coast Areas ^c	EPA-Identified Potential Controls for Serious and Severe Ozone Areas ^d	Clean Air Act Section 108(f) ^e	TCMs: SIP Guidance ^f
Traffic Flow Improvements	•		•	•	•
Traffic Signalization	•		•		•
Freeway/incident management	•	•			•
HOV facilities	•			•	•
Traveler information	•				
Turn lanes and other intersection improvements	•				•
Bus traffic signal preemption					•
Other traffic flow improvements (e.g., road widening, turning restrictions, new traffic lanes)	•				•
Traffic condition/ announcement signs					•
One-way streets					•
Ramp metering					•
Motorist aid services					•
Ridesharing	•	•			•
Regional rideshares	•	•	•	•	•
Vanpool programs	•	•	•	•	•
Park-and-ride lots	•	•		•	•
Ride matching		•		•	•
Transportation management associations		•			•
School car pools			•		
Public information					•

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Travel Demand Management	•				
Regional TDM	•				
Employer trip reduction programs	•	•	•	•	•
Guaranteed ride home		•			
Improved airport access			•		
Ozone action day programs			•		
Proximate commute programs to encourage more efficient employment patterns			•		
Flex time			•	•	•
Compressed work week					•
Trip reduction ordinances				•	•
Vehicle use restrictions by geographic area or peak use periods (including area licensing, residential traffic controls)				•	•
No-drive days					•
In-house transportation coordinator					•
Tele-work (Telecommute)	•	•	•		•
Satellite work centers					

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Bicycle/Pedestrian Oriented Programs	•	•	•	•	•
Designated lanes/routes		•		•	•
Safety enhancements		•			
Transit support facilities		•			
Secure bicycle storage				•	•
Education programs					•
Shower/locker facilities					•
Widening sidewalks					•
Pedestrian grade separation					•
Pedestrian control barriers					•
Pedestrian malls					•
Transit Improvements	•	•		•	•
Shuttles, feeders, paratransit, multi- modal transfer centers	•	•			•
New capital systems/vehicles	•				
Conventional service upgrades	•				
Park-and-ride lots	•	•			
Station and bus stop improvements (including security)	•				•
Transit service expansions	•		•		
Express bus		•			•
Shuttle circulators		•			
Coordinated fare		•			
Station cars			•		
Fare reductions			•		•

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Transit Improvements (Continued)					
Guided busways			•		
Heavy transit rail			•		
Light rail transit			•		
On-site transit pass sales					•
Exclusive bus and HOV lanes/streets/freeway bypasses					•
Contra-flow bus and HOV lanes					•
Marketing					•
Operations monitoring and improvements					•
Transfer improvements					•
Elderly and youth fares					•
Commuter discounts					•
Simplified fare collection					•
Pricing	•				
Subsidies and discounts	•	•			•
Charges and fees	•		•		
Parking cash-out		•	•		
Transit checks			•		
Congestion pricing			•		
HOV toll reductions			•		
Tax incentives for transit					•
Peak hour tolls					•
Low-occupancy vehicle tolls					•

TABLE 3 Candidate TCMs for RACM SIP Analyses^a

TCMs: Broad Category Example individual measures	Source Identifying Measure Category				
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Pricing (Continued)					
Gasoline tax					•
Peak/off-peak transit fares					•
Elderly and handicapped fares					•
Reduced transit fares					•
Employer-subsidized pooling programs					•
Parking rate changes/taxes					•
Vehicle taxes					•
Parking Management		•			•
Preferential parking for HOV		•			•
Parking pricing		•			•
Zoning requirements		•			•
Commercial vehicle management		•			•
On-street parking restrictions					•
Residential parking control					•
Off-street parking restrictions					•
Parking rate changes					•
Bus stop relocations					•
Loading zone restrictions					•
Sidewalk widening (safety buffer)					•
Parking duration restrictions					•
Improved enforcement efforts					•
Elimination of parking subsidies					•

TABLE 3 Candidate TCMs for RACM SIP Analyses^a

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Smart Growth		•	•		
Infill development		•			
Transit oriented development		•			
Mixed-use development		•			
Location efficient mortgages to encourage development near transit			•		
Programs to facilitate non-automotive travel to new shopping centers, special events, and other activity centers				•	
Extended Idling Controls				•	
Reduce truck idling			•		
Voluntary Removal of pre-1980 Light Duty Vehicles and Trucks from Fleet				•	
Commercial Vehicle Control					•
On-street loading zone restrictions					•
Off-street loading areas					•
Peak hour on-street loading prohibition					•
Truck route system					•
Peak-hour truck restrictions					•

TABLE 3 Candidate TCMs for RACM SIP Analyses^a

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Improved Paratransit					•
Taxi/group riding programs					•
Dial-a-ride					•
Jitney service					•
Taxi deregulation					•
Marketing					•

^aTable 3 is organized primarily by the TCM categories presented in Transportation Research Board (TRB) (2); TCMs identified from other sources are added if they are not in the TRB list; sources are presented in chronological order of publication. Other than TRB (2), sources referenced are EPA TCM guidance documents or publications referenced in EPA TCM guidance. Other TCM literature is readily accessible via EPA (http://www.epa.gov/otaq/transp/publicat/pub_tcms.htm) and FHWA (<http://www.fhwa.dot.gov/environment/tcm.htm>) web sites. Note that EPA has emphasized evaluating groups of interacting measures, rather than individual measures, when assessing which TCMs are RACM (4).

^bSource: TRB, Table 4-2 (2). Fuel and technology measures identified by TRB are not included here, since they do not meet the definition of a TCM for conformity purposes (2).

^cSource: U.S. Environmental Protection Agency (12).

^dSource: U.S. Environmental Protection Agency, Table 11 (30).

^eTailpipe emission standards to reduce extreme cold starts is not listed here, but is included in section 108(f); it is not a TCM for conformity purposes.

^fSource: Eisinger *et al.*, Table 2-2 (31).