CONGESTION MITIGATION AND AIR QUALITY PROGRAM (CMAQ)

Call for Projects
Application Packet

Grant Application Deadline: December 17, 2015
Lifeline Application Deadline: February 18, 2016

Madera County Transportation Commission
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www.maderactc.org
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I. INTRODUCTION

The purpose of the Congestion Mitigation and Air Quality Improvement (CMAQ) Program is to fund transportation projects or programs that will contribute to attainment of maintenance of national ambient air quality standards (NAAQS). Funding can be expended on projects to reduce ozone precursor emissions, (including nitrogen oxides (NOx) and volatile organic compounds (VOC)), carbon monoxide (CO), and particulate matter (PM) emissions or PM precursor emissions from transportation. This program will also assist in meeting the intent of SB 375, also known as the Sustainable Communities Protection Act of 2008.

The Madera County Transportation Commission, acting in its role as a Metropolitan Planning Organization (MPO), is in the process of programming the future federal transportation revenues that will come to the Madera Region. CMAQ funds are reimbursable federal aid funds, subject to the requirements of Title 23, United States Code. Eligible costs for funds include preliminary engineering, right-of-way acquisition, capital costs, and construction costs associated with an eligible activity. Approximately $5,699,048 in CMAQ funding is available for the October 2015 Call for Projects ($4,629,792 Grant, and $1,069,256 Lifeline).

A. Schedule

The tentative schedule for the MCTC CMAQ Call for Projects and related Federal Transportation Improvement Programming (FTIP) and Air Quality Conformity process are as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>October 16, 2015</td>
<td>Release of CMAQ Call for Projects</td>
</tr>
<tr>
<td>December 17, 2015</td>
<td>CMAQ Grant Project Submittals Due</td>
</tr>
<tr>
<td>February 18, 2016</td>
<td>CMAQ Lifeline Project Submittals Due</td>
</tr>
<tr>
<td>June 22, 2016</td>
<td>Anticipated Adoption of FTIP and Conformity Analysis</td>
</tr>
<tr>
<td>December 2016</td>
<td>Anticipated FHWA Approval of FTIP and Conformity Analysis</td>
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II. CMAQ PROGRAM FUNDING AVAILABILITY

The MCTC CMAQ Program allows for 70% of the total apportionment to be available to local government agencies/districts/jurisdictions and public/private partnerships in the Madera County Region through a competitive grant program. Completed applications for eligible projects under the CMAQ Grant Program as outlined in this Application Packet must be received by MCTC no later than 3:00 p.m., Thursday, December 17, 2015. Grant applications must include emission reduction calculations.

The following table indicates the funding levels available under the CMAQ Program. A maximum of $600,000 may be awarded for an individual project and a maximum of $2,300,000 may be awarded to an individual agency. The aforementioned maximum amounts may be raised for projects that are below the $30 per pound cost effectiveness threshold and meet PM2.5 target reductions.

The MCTC CMAQ Program allows 30% of the total Madera County apportionment to be set aside as a Lifeline amount. Each MCTC member agency is provided with a guaranteed level of CMAQ funding that can be used for any eligible CMAQ project. Each agency is required to submit a formal application for their Lifeline projects to the MCTC Office by no later than 3:00 p.m., Thursday, February 18, 2016. Lifeline applications must include emission reduction calculations. Additionally, “Lifeline” funds may not be applied to an existing project if the funding increases the cost-effectiveness to over $30 per pound.

Approximately $5,699,048 in CMAQ funding is available for the October 2015 Call for Projects ($4,629,792 Grant, and $1,069,256 Lifeline).

<table>
<thead>
<tr>
<th></th>
<th>FY 16/17</th>
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<th>FY 18/19</th>
<th>FY 19/20</th>
<th>Total</th>
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<tr>
<td>MCTC 100%</td>
<td>$1,067,432</td>
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<td>$1,782,092</td>
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<tr>
<td>City of Chowchilla</td>
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<tr>
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<tr>
<td>GRANT 70%</td>
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<td>$1,247,464</td>
<td>$1,247,464</td>
<td>$4,629,792</td>
</tr>
</tbody>
</table>

*Lifeline funding was awarded during prior CMAQ Cycle.
III. ELIGIBLE PROJECTS

The guidance for project eligibility is based on FHWA's Congestion Mitigation and Air Quality (CMAQ) Improvement Program Guidance. A copy of the guidance document is available in Appendix A. Additional and updated information may be found on FHWA's website: http://www.fhwa.dot.gov/environment/air_quality/cmaq/policy_and_guidance/.

All projects and programs eligible for CMAQ funds must come from a conforming Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP), and be consistent with the Transportation Conformity Rule. Projects need to be included in the TIPs or statewide transportation improvement projects developed by MPOs or States respectively, under the metropolitan or State planning regulations. Projects also need to complete the National Environmental Policy Act (NEPA) requirements and meet basic eligibility requirements for funding under titles 23 and 49 of the United States Code. Projects must comply with the Americans with Disabilities Act (ADA) requirement, and provisions of Buy America.

Project applicant is either a public agency, i.e., city, county, special district, Caltrans, transit operator, transit authority, or a non-profit agency with the sponsorship of a public agency. Successful applicants, or their sponsors, must have executed a master agreement with Caltrans or be a Federal Transit Administration (FTA) eligible grant applicant, or have an agreement with such an eligible agency to sponsor the project.

Capital Investment

CMAQ funds may be used to establish new or expanded transportation projects or programs that reduce emissions, including capital investments in transportation infrastructure, congestion relief efforts, diesel engine retrofits (not repowers), or other capital projects.

Operating Assistance

MAP-21 made an important change to the program in recognizing the importance of flexibility in the timing of financial assistance, the three years of operating assistance allowable under the CMAQ Program may now be spread over a longer period, for a total of up to five sequential years of support. At the end of the five year period, operating costs would have to be maintained with non-CMAQ funding.

There are several general conditions that must be met for operating assistance to be eligible under the CMAQ Program:

- Operating assistance is limited to new transit, commuter and intercity passenger rail services, intermodal facilities, travel demand management strategies, including traffic operation centers, inspection and maintenance programs, and the incremental cost of expanding these services.
• In using CMAQ funds for operating assistance, the intent is to help start up viable new transportation services that can demonstrate air quality benefits and eventually cover costs as much as possible. Other funding sources should supplement and ultimately replace CMAQ funds for operating assistance, as these projects no longer represent additional, net air quality benefits but have become part of the baseline transportation network. The provisions in 23 U.S.C. 116 place responsibilities for maintenance of transportation facilities on the States. Since facility maintenance is similar to operations, a time-limited period of CMAQ assistance provides adequate incentive and flexibility while not creating a pattern of excessive or even perpetual support.

• Operating assistance includes all costs of providing new transportation services, including, but not limited to, labor, fuel, administrative costs, and maintenance.

• When CMAQ funds are used for operating assistance, non-Federal share requirements still apply.

• With the focus on start-up, and recognizing the importance of flexibility in the timing of financial assistance, the 3 years of operating assistance allowable under the CMAQ Program may now be spread over a longer period, for a total of up to 5 sequential years of support. Grantees who propose to use CMAQ funding for operating support may spread the third year amount (an amount not to exceed the greater of year 1 or 2) across an additional two years (i.e., years 4 and 5). This will provide an incremental, taper-down approach, while other funding is used for a higher proportion of the operating costs as needed. At the conclusion of the 5-year period, operating costs would have to be maintained with non-CMAQ funding. It is anticipated that this may apply to years 1 and/or 2 and are established at the discretion of the State or local sponsor.

Except as noted in this paragraph, activities that already have received 3 years of operating support under prior reauthorizations of the CMAQ Program are not considered to be in a start-up phase and are not eligible for the expanded assistance period.

• Elements of operating assistance prohibited by statute or regulation are not eligible for CMAQ participation, regardless of their emissions or congestion reduction potential.

Emission Reductions Required

Air quality improvements is defined by several distinct terms in 23 U.S.C. §149. These terms include contribution to attainment, reduction in pollution, air quality benefits, and others. For purposes of this guidance, the FHWA uses emission reduction to represent this group of terms. CMAQ-invested projects or programs must reduce CO, ozone precursor, PM or PM precursor emissions from transportation. These reductions must contribute to the area’s overall clean air
strategy and can be demonstrated by the assessment that is required under this guidance. States and MPOs also may consider the ancillary benefits of eligible projects, including greenhouse gas reductions, congestion relief, safety, or other elements, when programming CMAQ funds, though such benefits do not alone establish eligibility.

Planning and Project Development

Activities in support of eligible projects also may be appropriate for CMAQ investments. Studies that are part of the project development pipeline (e.g., preliminary engineering) under the National Environmental Policy Act (NEPA) are eligible for CMAQ support, as are FTA’s Alternative Analyses. General studies that fall outside specific project development do not qualify for CMAQ funding. Examples of such efforts include major investment studies, commuter preference studies, modal market polls or surveys, transit master plans, and others. These activities are eligible for Federal planning funds, not CMAQ funds.

Projects Not Eligible for CMAQ Funding

- Vehicle projects other than transit vehicles or PM certified street sweepers.
- Light-duty vehicle scrappage programs.
- Projects that add new capacity for single occupancy vehicles (SOVs) are ineligible for CMAQ funding unless construction is limited to high-occupancy vehicle (HOV) lanes.
- Routine maintenance and rehabilitation projects (e.g., replacement-in-kind of track or other equipment, reconstruction of bridges, stations, and other facilities, and repaving or repairing roads) are ineligible for CMAQ funding as they only maintain existing levels of highway and transit service, and therefore do not reduce emissions. Other funding sources such as STP and FTA’s Section 5307 program are available for such activities.
- Administrative costs of the CMAQ Program may not be defrayed with program funds, (e.g., support for State’s “CMAQ Project Management Office”) is not eligible.
- Projects that do not meet the specific eligibility requirements of titles 23 and 49 U.S.C. are ineligible for CMAQ funds.
- Stand-alone projects to purchase fuel.
A. Example Project Types

1. Transit Improvements

- New transit facilities, if they are associated with new or enhanced transit service.
- Acquisition of new transit vehicles (transit bus, school bus, rail) to expand the fleet.
- Replacement or retrofit (not repower) of existing transit vehicles.
- Operating assistance to support new transit services (maximum of 5 years).
- Subsidies for regular transit fares, but only if the reduced or free fare is part of an overall program for preventing exceedances of an air quality standard during periods of high pollutant levels.

2. Cleaner Fuel Technologies

- Purchase of alternative fuel vehicles for transportation related purposes, but only the differential cost between a new conventional fuel vehicle and a new alternative fuel vehicle is eligible. “Clean” Diesel is not considered an alternative fuel.
- Establishment of on-site fueling facilities and other infrastructure needed to fuel alternative-fuel vehicles.
- Purchase and installation of diesel retrofits (non-transit). Engine replacements are considered repowers, not retrofits, therefore are not eligible.
- CMAQ funding for vehicles that serve general government operations (e.g. police and firefighting) is limited to the incremental cost difference between standard and alternative fuel vehicles. For public fleet alternative fuel vehicles that provide a dominant transportation function, the full vehicle is eligible for participation. Please check FHWA’s website for the latest updated information.

3. Traffic Flow Improvements

- Projects to develop, establish, and implement the congestion management system for both highway and transit facilities.
- Traffic signal and/or intersection modernization, coordination or synchronization projects designed to improve traffic flow within a corridor or throughout an area.
• Operating expenses that can be shown to: (1) have air quality benefits, (2) result from new or additional services, and (3) not displace previous funding mechanisms, such as fares or fees for services (maximum 5 years).

4. Traffic Signal Projects

• Traffic signal projects designed to improve traffic flow at congested 4-way stop sign intersections within a corridor or throughout an area.

5. Pedestrian/Bicycle Projects

• Construction of bicycle and pedestrian facilities.

• Non-construction projects related to safe bicycle use.

• Establishment and funding of State bicycle pedestrian coordinator positions, including public education, promotional, and safety programs.

6. PM-10 Reduction

• Purchase of PM-10 efficient street sweepers, paving unpaved roads, paving/stabilizing shoulders, and other particulate matter reduction projects. For your reference, a list of PM Certified Street Sweepers maintained by the South Coast Air Quality Management District may be found at: http://www.aqmd.gov/docs/default-source/rule-book/support-documents/rule-1186/certified-street-sweepers-equipment-list.pdf?sfvrsn=2

7. Miscellaneous

• Travel demand management, including activities ranging from carpool and vanpool programs to parking management and road pricing measures.

• Outreach activities such as public education on transportation and air quality, advertising of transportation alternatives to SOV travel, and technical assistance to employers or other outreach activities relating to promoting non-SOV travel.

• Marketing programs to increase use of transportation alternatives to SOV travel and public education campaigns involving linkage between transportation and air quality.

• Carpool and vanpool programs include computer matching of individuals seeking to carpool and employer outreach to establish rideshare programs and meet Clean Air Act requirements.
• New or expanded rideshare programs, such as new locations for matching services, upgrades for computer matching software, etc.

• Purchasing or leasing vehicles for new vanpool activities (5-year maximum for operating costs).

• Planning and technical and feasibility studies, training, coordination, marketing and promotion of telecommuting.

• Intermodal freight facilities.

• Project development activities that lead to construction of facilities or new services and programs with air quality benefits, such as preliminary engineering or project planning studies.

• Advanced truck stop electrification and idle reduction technology projects.

Please see Appendix A for descriptions of eligible projects and visit FHWA’s website for additional and updated information: http://www.fhwa.dot.gov/environment/air_quality/cmaq/policy_and_guidance/.

Cost-Effectiveness

Cost-effective projects are those projects that meet the $30 per pound ($60,000 per ton) cost-effectiveness threshold. Project cost-effectiveness is determined by the California Air Resources Board’s (ARB) Air Quality Cost-Effectiveness Calculations Methodology: http://www.arb.ca.gov/planning/tsaq/eval/eval.htm.

Additional information is available in Section IV.

Buy America

Buy America provisions ensure that transportation infrastructure projects are built with American-made products. That means that Department of Transportation investments are able to support an entire supply chain of American companies and their employees. **If your project is selected, you must work directly with Caltrans Local Assistance to ensure that all provisions of Buy America are met.**
IV. CMAQ SCORING CRITERIA

A. Cost-Effectiveness Policy

All eight of the San Joaquin Valley Metropolitan Planning Organizations (MPOs) adopted policies for distributing at least 20% of the CMAQ funds to projects that meet a cost-effectiveness threshold for emission reductions.

The policies indicate that prior allocation of CMAQ funds with RTP/FTIP updates to the SJV MPOs in consultation with the interagency consultation (IAC) partners will develop the cost-effectiveness threshold. The threshold is $30 per pound ($60,000 per ton).

MAP-21 requires PM2.5 nonattainment or maintenance areas must use at least 25% of CMAQ funds for projects that have PM2.5 emission reductions. During the scoring committee process, projects identified as cost-effective are scored and selected first. Those selected projects will be further identified as PM2.5 projects or not. Those projects will be tallied to see if the 25% PM2.5 commitment has been met. If more projects are needed to fulfill the PM2.5 commitment, they will be prioritized until the full commitment is met.

Methodology

The methodology used for calculating cost-effectiveness is the 2005 ARB “Methods to Find Cost-effectiveness of Funding Air Quality Projects” (Attachment F). Cost-effectiveness for CMAQ projects should be expressed as dollars spent per pound of pollutant reduced (VOC + NOx + PM). CO emissions are not included in the formula. CO is several orders of magnitude larger than ozone precursors and overwhelms cost-effectiveness ratios unless CO emission reductions are scaled back significantly, typically by a factor of seven.

As with the Carl Moyer Heavy-Duty Vehicle Program, diesel particulate matter can be given an additional weighting factor of 20, since exhaust PM10 has also been identified as a toxic air contaminant. As indicated in the policy, cost-effectiveness is based on CMAQ dollars only (vs. total project costs which include capital investments and operating costs).

The funding dollars are amortized over the expected project life using a discount rate. The amortization formula yields a capital recovery factor, which, when multiplied by the funding, gives the annual funding for the project over its expected lifetime. Cost-effectiveness is determined by dividing annualized funds by annual emission reductions (VOC + NOx + PM).

Example Formula

Cost-Effectiveness = (Capital Recovery Factor * CMAQ funding) / (VOC + NOx + PM) dollars/pound

Project cost-effectiveness is determined by the California Air Resources Board’s (ARB) Air Quality Cost-Effectiveness Calculations Methodology:
B. CMAQ Scoring Criteria Description

General Intent: The CMAQ Program provides funding for transportation projects or programs that will reduce transportation-related emissions. The MCTC CMAQ Program is aimed toward providing transportation projects that will improve our air quality. Major emphasis is placed upon projects that support alternative modes of transportation, provide congestion relief measures, provide low-polluting transit vehicles and equipment, and provide new technologies/improvements geared toward providing a more efficient and safer transportation system. In choosing to fund CMAQ projects, MCTC can improve air quality and make progress toward achieving attainment status and ensuring compliance with the transportation conformity provisions of the Clean Air Act. Additionally, the reduction of greenhouse gas emissions is a priority.

<table>
<thead>
<tr>
<th>Maximum 20 Points</th>
<th>Trip Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project reduces vehicle trips and/or vehicle miles traveled.</td>
</tr>
<tr>
<td>Maximum 20 Points</td>
<td>Congestion Relief</td>
</tr>
<tr>
<td></td>
<td>Has impact on congestion and increases service capacity and/or reliability.</td>
</tr>
<tr>
<td>Maximum 20 Points</td>
<td>Air Quality Emission Reduction</td>
</tr>
<tr>
<td></td>
<td>Incorporates transportation control measure and/or reduces air pollution emissions of organic compounds, oxides of nitrogen and/or particulate matter.</td>
</tr>
<tr>
<td>Maximum 35 Points</td>
<td>Cost Benefit Ratio</td>
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<tr>
<td></td>
<td>Quantified annual air emissions reduction (pounds per year) divided by annualized project cost.</td>
</tr>
<tr>
<td>Maximum 5 Points</td>
<td>PM2.5 Reduction</td>
</tr>
<tr>
<td></td>
<td>Achieves a quantifiable PM2.5 reduction.</td>
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100 TOTAL POINTS AVAILABLE

Note: Each category cannot exceed amount assigned.

The nature of this program and associated scoring criteria is consistent with the intent of SB 375, also known as the Sustainable Communities Protection Act of 2008.
TRIP REDUCTION

20-point range

TRANSIT - ROADS - BICYCLE/PEDESTRIAN:

Highest reduction in VMT/emission reductions will rank highest and receive more points.

Significantly reduces vehicle trips and VMT.

Reduces vehicle trips and VMT somewhat.

Does not reduce vehicle trips or VMT.

Increases vehicle trips and VMT. [Project is not eligible for funding].

CONGESTION RELIEF

20-point range

TRANSIT

High impact. Significantly reduces transit vehicle crowding, increases service capacity significantly, Transportation Control Measure, increases service reliability significantly. Interconnect or fare coordination project, bus turnouts at major intersections, intermodal facility accommodating major transfers. Reduces travel time.

Medium impact. Increases service reliability in a minor capacity, interconnect or fare coordination project, general bus turnouts, intermodal facility accommodating major transfers.

Low impact. Increases passenger comfort or convenience, bike racks.

ROADS

High impact. Transportation Control Measure, signal coordination of multiple (>3) signals, gap closure projects, Traffic Operations System, left turn pockets, other intersection improvements, and traffic flow improvements.

Medium impact. HOV lanes, auxiliary lanes, signal coordination, park and ride lots.

Low impact. New signals where none currently exists and is warranted by volume or delay, ramp metering with HOV bypasses (when shown not to adversely affect surface streets).
BICYCLE/PEDESTRIAN

**High impact.** Transportation Control Measure, facility that will primarily serve commuters and/or school sites, sidewalks where none exist.

**Medium impact.** Public educational, promotional, and safety programs that promote and facilitate increased use of non-motorized modes of transportation.

**Low impact.** Mixed use bicycle/pedestrian facility (recreation & commuter), usable sidewalk segments including upgrades and new installations and signage.

### AIR POLLUTANT EMISSIONS REDUCTION 20-point range

Projects will be evaluated on a relative basis; (i.e. how they compare to each other) based on the submitted air pollutant reductions and cost effectiveness analysis.

Reduces emissions of volatile organic compounds, oxides of nitrogen, and/or particulate matter. Greenhouse gas emissions are a priority.

Projects will be evaluated on a relative basis, i.e. how they compare to each other. Highest emission reductions will rank highest and receive more points.

Increases air pollution emissions. [Project is not eligible for funding]

### COST-EFFECTIVENESS 35-point range

Project cost-effectiveness is determined by the California Air Resources Board (ARB) Air Quality Cost-Effectiveness Calculations Methodology: [http://www.arb.ca.gov/planning/tsaq/eval/eval.htm](http://www.arb.ca.gov/planning/tsaq/eval/eval.htm).

Projects that achieve emission reductions of $30 per pound or lower will receive 35 points. Projects will be evaluated on a relative basis, i.e. how they compare to each other. Highest emission reductions will rank highest and receive more points.

### PM2.5 REDUCTION 5-point range

Projects must achieve a quantifiable PM2.5 emission reduction.

Projects will be evaluated on a relative basis, i.e. how they compare to each other. Highest emission reductions will rank highest and receive more points.
V. APPLICATION SUBMITTAL

A. CMAQ Project Submittal Instructions

1. **Agency**
   Indicate the name of your Jurisdiction or Agency.

2. **Lifeline/Grant**
   Indicate whether the project is a “Lifeline” or “Grant” project by checking the appropriate box.

3. **Priority #**
   The bidder should rank the projects that are submitted in accordance with their own priorities.

4. **Project Description**
   Indicate the type of project that you propose with sufficient detail so that the Scoring Committee can understand the purpose and extent of your project. It may be expansion of transit services to reduce air emissions (i.e. purchase clean air particulate trap buses), conversion of an abandoned right-of-way (i.e. rail line to a bicycle path) etc. You should refer to the “Eligible Projects” Section for proper description.

5. **Warrant Study**
   If project is a traffic signal project, include “Warrant Study” to include level of service and traffic volumes (on each leg).

6. **Route # or Name**
   List the name of the road or highway if applicable.

7. **Project Location/Length**
   Indicate the length of the facility (road, highway, bikeway, etc.) measured in miles including tenths of a mile. If postmiles are available, indicate postmile limits if applicable. Indicate the nearest cross-street at each end of the travelway. (Example: Road 26 between Avenue 7 and Avenue 9).

8. **Air Pollution Reduction**
   Utilizing the ARB “Emission Reduction Methodology Cost-Effectiveness Guidelines”, you must calculate the amount of pounds per day of VOC, PM10, and NOX pollutants that will be eliminated if the project is implemented. Using this guide, you will also determine the cost effectiveness of the project measured in total $ cost per pound of pollutants reduced. If you have any questions concerning this requirement or need assistance, please call Jeff Findley or Sandy Ebersole at 675-0721.

9. **ADT**
   Average Daily Traffic Volume on a road facility or equivalent volume levels for transit/bicycle/pedestrian facilities if applicable.
### 10. Accident Rate
Accidents divided by millions of vehicle miles. For traffic signal or bridge, use accidents divided by millions of vehicles. Would need number of accidents, over past three years.

### 11. Photo of Facility/Project:
Although photos are optional, they are highly recommended.

### 12. Air Quality Screening
Please select the applicable “air quality screening” code from the attached list.

### 13. Construction Award/Vehicle Purchase Date
Please identify the anticipated Construction Award or purchase date.

### 14. ROW Acquisition Date
Please identify the anticipated right-of-way acquisition date if applicable.

### 15. Project Delivery
Please program the specific work phase and dollar amount into the appropriate Fiscal Year. **Use a 3.5% per annum escalation rate.** (Example: If 2016/17 estimate = $1,000, 2017/18 cost = $1035.00 and 2018/19 cost = $1071.00)

### CODES

*Use the codes as shown below for Fund Type and Work Phase:*

#### FUND TYPE:
- **CMAQ**: Congestion Mitigation & Air Quality
- **Local**: Local Agency Funds

#### WORK PHASE:
- **PE**: Preliminary Engineering/Development
- **ROW**: Right-of-Way Acquisition
- **CON**: Construction
B. CMAQ Project Submittal Form

CMAQ PROJECT SUBMITTAL FORM

______________________________________________________________
Agency

Lifeline Project: ☐  Grant Project: ☐

Priority #: ____ of ____

Project Description (Purpose of Project)/Scope of Work:

Warrant Study (Submit calculations as attachment):

Route # or Name:

Postmile/Project Limits/Length:

Air Pollution Reduction/Cost-Effectiveness (Submit calculations as attachment):

Average Daily Traffic Volume (ADT):

Accident Rate:

Photo of Facility/Project (Optional-Please Attach):

Air Quality Screening Criteria Code:

Construction (Vehicle Purchase) Award Date:

ROW Acquisition Date:

PROJECT DELIVERY SCHEDULE

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<th>Work Phase</th>
<th>Fund Type</th>
<th>FY 16/17</th>
<th>FY 17/18</th>
<th>FY 18/19</th>
<th>FY 19/20</th>
<th>Fund Total</th>
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<td>PE</td>
<td>CMAQ Share – 88.53%</td>
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<td>PE</td>
<td>Local Match – 11.47%</td>
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<td>ROW</td>
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<tr>
<td>CON</td>
<td>CMAQ Share – 88.53%</td>
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<td>TOTALS</td>
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</tbody>
</table>
Proposed Source of Local Match Funding

Place an “X” in the box signifying where local matching funds for this project will be coming from and specify dollar amount.

<table>
<thead>
<tr>
<th>LOCAL</th>
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<tbody>
<tr>
<td><strong>Sales Tax</strong></td>
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<td>-- City</td>
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<td>-- Other (Transportation Development Act, Measure T)</td>
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<tr>
<td><strong>Gas Tax</strong></td>
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<tr>
<th>REGIONAL</th>
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<tr>
<td><strong>Tolls</strong></td>
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<td>-- Bridge</td>
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<td>-- Corridor</td>
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<tr>
<td>Regional Gas Tax</td>
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<tr>
<td>Vehicle Registration Fees (CARB Fees, SAFE)</td>
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<tr>
<td><strong>Other</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Toll Credits</strong></td>
<td></td>
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</tbody>
</table>

| TOTAL |               |
C. Sample Forms

SAMPLE TRANSIT PROJECT SUBMITTAL FORM
City of Madera
Agency

Lifeline Project: ☐      Grant Project:  X

Priority #:   1 of 8

Project Description/ Transit Van Purchase
Scope of Work:  Purchase of 10 Compressed Natural Gas Modified Vans. To expand existing MAX Transit System in order to provide greater levels of service and meet the present and future transportation needs of the City. Major air quality benefits include reduction of ozone, carbon monoxide, and particulate by using "clean air vans."

Warrant Study:  NA

Route # or Name:  NA (MAX Sub-Systems)

Postmile Limits/Length:  NA

Air Pollution Reduction:    
& Cost Effectiveness:  Pounds Per Day Reduced:  Project Cost-Effectiveness:  
                      ROG = 0.37  $325.00/lb. reduced
                      NOX = 0.50
(See attached calculations)

Average Daily Traffic Volume (ADT):  NA

Accident Rate:  Accident rates should decrease as a result of a decrease in miles traveled.

Photo Of Facility/Project (Optional-Please Attach):  Information regarding the proposed buses is attached.

Air Quality Screening Criteria Code:  2.10

Proposed Purchase Award Date:  June 2017

ROW Acquisition Date:  NA

PROPOSED PROJECT DELIVERY SCHEDULE

<table>
<thead>
<tr>
<th>Work Phase</th>
<th>Fund Type</th>
<th>FY 16/17</th>
<th>FY 17/18</th>
<th>FY 18/19</th>
<th>FY 19/20</th>
<th>Fund Total</th>
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<tbody>
<tr>
<td>Capital Purchase</td>
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<td>$531,180</td>
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<td>Capital Purchase</td>
<td>Local Match – 11.47%</td>
<td></td>
<td></td>
<td>$68,820</td>
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<td>$68,820</td>
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<tr>
<td>TOTALS</td>
<td></td>
<td></td>
<td></td>
<td>$600,000</td>
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<td>$600,000</td>
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</table>
### Proposed Source of Local Match Funding

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<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
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<tbody>
<tr>
<td><strong>Sales Tax</strong></td>
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<td>-- City</td>
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<td>-- County</td>
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<tr>
<td>-- Other (Transportation Development Act, Measure T)</td>
<td>X - $68,820</td>
</tr>
<tr>
<td><strong>Gas Tax</strong></td>
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<tr>
<td>Toll Credits</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>$68,820</td>
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</table>
SAMPLE SIGNAL PROJECT SUBMITTAL FORM

County of Madera
Agency

<table>
<thead>
<tr>
<th>Lifeline Project:</th>
<th>Grant Project:</th>
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<tbody>
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<td>X</td>
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**Priority #:** _6_ of _8_  
NA - Lifeline Project

**Project Description:** 
Replace existing four-way stop control at the intersection of Avenue 12 and Road 26 with a traffic signal. To reduce delay, congestion, and air pollution.

**Scope of Work:** 
Avenue 12 and Road 26 with a traffic signal.

**Warrant Study:** 
See attached Study

**Route # or Name:** 
Intersection of Avenue 12 and Road 26

**Postmile Limits/Length:** 
NA

**Air Pollution Reduction:** 
Pounds Per Day Reduced: ROG = 0.37  
Project Cost Effectiveness: $150.00 per pound reduced

& Cost Effectiveness: NOX = 0.50  
$100.00 per pound reduced

(Attach Calculation Methodology to Application Submittal)

**Average Daily Traffic Volume (ADT):** 
Avenue 12 ADT is 18,688 (1999) and Road 26 ADT is 2,510 (1999)

**Accident Rate:** 
There have been 23 accidents over the last five years at this intersection for an accident rate of 0.85 accidents per million vehicle miles.

**Photo of Facility/Project (Optional-Please Attach):** 
Photographs of the intersection are attached.

**Air Quality Screening Criteria Code:** 
5.02

**Construction Award Date:** 
June 2017

**ROW Acquisition Date:** 
N/A

**PROPOSED PROJECT DELIVERY SCHEDULE**

<table>
<thead>
<tr>
<th>Work Phase</th>
<th>Fund Type</th>
<th>FY 16/17</th>
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<th>Fund Total</th>
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<td>PE</td>
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<td><strong>TOTALS</strong></td>
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<td><strong>$180,000</strong></td>
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MADERA CTC  
Marketable Clean Transportation Credits  
Page 19
### Proposed Source of Local Match Funding

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| REGIONAL                   |                     |                     |                     |
| **Tolls**                  |                     |                     |                     |
| -- Bridge                  |                     |                     |                     |
| -- Corridor                |                     |                     |                     |
| **Regional Transit Fares/Measures Regional Sales** |                     |                     |                     |
| Tax "Measure T" Regional Bond Revenue |                     |                     |                     |
| **Regional Gas Tax**       |                     |                     |                     |
| **Vehicle Registration Fees (CARB Fees, SAFE)** |                     |                     |                     |
| **Other**                  |                     |                     |                     |
| **Toll Credits**           |                     |                     |                     |

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<tr>
<th>TOTAL</th>
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<td><strong>TOTAL</strong></td>
<td>$20,646</td>
<td>$20,646</td>
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</tbody>
</table>
Air Quality Screening Criteria

1.00 SAFETY PROGRAMS

1.01 Railroad/Highway Crossing
1.02 Hazard Elimination Program
1.03 Safer non Federal-aid system roads
1.04 Shoulder improvements
1.05 Increasing sight distance
1.06 Safety Improvement Program
1.07 Traffic control devices and operating assistance other than signalization projects
1.08 Railroad/highway crossing warning devices
1.09 Guardrail, median barriers, crash cushions
1.10 Pavement resurfacing and/or rehabilitation
1.11 Pavement marking demonstration
1.12 Emergency Relief (23 U.S.C. 125)
1.13 Fencing
1.14 Skid treatments
1.15 Safety roadside rest areas
1.16 Adding medians
1.17 Truck climbing lanes outside the urbanized area
1.18 Lighting improvements
1.19 Widening narrow pavements or reconstructing bridges (no additional travel lanes)
1.20 Emergency truck pullovers

2.00 MASS TRANSIT

2.01 Operating assistance to transit agencies
2.02 Purchase of support vehicles
2.03 Rehabilitation of transit vehicles
2.04 Purchase of office, shop and operating equipment for existing facilities
2.05 Purchase of operating equipment for vehicles (e.g. radios, fareboxes, lifts, etc.)
2.06 Construction or renovation of power, signal, and communications systems
2.07 Construction of small passenger shelters and information kiosks
2.08 Reconstruction or renovation of transit buildings and structures
2.09 Rehabilitation or reconstruction of track structures, track, and trackbed in existing right-of-way
2.10 Purchase of new buses and rail cars to replace existing vehicles or for minor expansions of fleet
2.11 Construction of new bus, rail storage/maintenance facilities categorically excluded (23 CFR 771)

3.00 AIR QUALITY
3.01 Continuation of ride-sharing and van-pooling promotion activities at current levels
3.02 Bicycle and pedestrian facilities

4.00 LANDSCAPING/SIGNS
4.01 Specific activities which do not involve or lead directly to construction
4.05 Engineering to assess social, economic, and environmental effects of the proposed action or alternatives to that action
4.06 Noise attenuation
4.07 Emergency or hardship advance land acquisitions [23 CFR 712.204(d)].
4.08 Acquisition of scenic easements
4.09 Plantings, landscape, etc.
4.10 Sign removal
4.11 Directional and informational signs
4.12 Transportation enhancement activities (excepting rehabilitation and operation of historic buildings, structures, or facilities).
4.13 Repair of damage caused by natural disasters, civil unrest, or terrorist acts, except projects involving substantial functional, locational or capacity increase

5.00 OTHER
5.01 Intersection channelization projects
5.02 Intersection signalization projects at individual intersections
5.03 Changes in vertical and horizontal alignment
5.04 Interchange reconfiguration projects
5.05 Truck size and weight inspection stations
5.06 Bus terminals and transfer points
5.07 Traffic signal synchronization
D. Sample Council/Board Resolution Supporting Delivery Schedule

Approval of AB 1012 requires that both State and Federal funds be used in a “timely” manner. In order to avoid losing any Federal or State funds to our Region, the “use it or lose it” requirements of AB 1012 place local governmental agencies in a position that they must be able to deliver their projects on time. That is, they must be able to meet their project delivery schedules as proposed and as programmed within the Federal Transportation Improvement Program (FTIP).

If an agency does not meet the project delivery deadlines, the MCTC Board may terminate the agency’s project and reprogram the CMAQ funds as deemed necessary.

Amendments to CMAQ projects that propose a delay in project delivery will not be considered. A one time, one year extension of the project may be granted under extraordinary circumstances at the discretion of the MCTC Executive Director.

Given AB 1012 requirements, MCTC believes that each agency must be able to assure that their project(s) can be delivered timely. Therefore, each application must be accompanied by a formal Council/Board/District Resolution stating that each project will meet project delivery schedules and that staff be directed to ensure that projects are delivered timely. (The Resolution must be prepared and received by MCTC prior to the submittal deadline of December 17, 2015). The attached “Sample” Resolution has been prepared as a guide for helping prepare the required resolution(s).

Please note: Each Council/Board/District Resolution needs to contain a list of the projects being submitted for potential CMAQ funding.
E. Sample Resolution

BEFORE THE

(NAME OF CITY/COUNTY/DISTRICT COUNCIL/BOARD)

RESOLUTION NO. 2015-___

In the Matter of:

Project Delivery Schedules
CMAQ PROGRAM
RESOLUTION SUPPORTING
AND IMPLEMENTING AB 1012
“TIMELY USE OF FUNDING”

WHEREAS, AB 1012 has been enacted into State Law in part to provide for the “timely use” of State and Federal funding; and

WHEREAS, the (City/County/District) is able to apply for and receive Federal and State funding under the Moving Ahead for Progress in the 21st Century (MAP-21) federal transportation act; and

WHEREAS, the (City/County/District) desires to ensure that its projects are delivered in a timely manner to preclude the Madera Region from losing those funds for non-delivery; and

WHEREAS, it is understood by the (City/County/District) that failure for not meeting project delivery dates for any phase of a project may jeopardize federal or state funding to the Region, and

NOW THEREFORE BE IT RESOLVED, that the (Council/Board) hereby agrees to ensure that all project delivery deadlines for all project phases will be met or exceeded.

BE IT FURTHER RESOLVED, that failure to meet project delivery deadlines may be deemed as sufficient cause for the Madera County Transportation Commission Policy Board to terminate an agency’s project and reprogram Federal/State funds as deemed necessary.

BE IT FURTHER RESOLVED, that the (City/County/District) (Council/Board) does direct its management and engineering staffs to ensure all CMAQ projects are carried out in a timely manner as per the requirements of AB 1012 and the directive of the (City/County/District) (Council/Board).

THE FOREGOING RESOLUTION was passed and adopted by the (Council/Board) on December ____, 2015.

AYES: Signed: __________________________

NOES: Mayor, City of (------)

ABSTAIN: Chair, Board of (------)

ABSENT Chair, (----) Board

ATTEST:

I hereby certify that the foregoing is a true copy of a resolution of the (Council/Board) duly adopted at a regular meeting thereof held on the _____ day of December 2015.

Signed: __________________________

(-------------------, City/County Clerk)
F. Emission Reductions and Cost-Effectiveness Methodologies

The California Air Resources Board (ARB) publication Methods to Find the Cost-Effectiveness of Funding Air Quality Projects, 2005 (Attachment F) and the associated cost-effectiveness calculation worksheets can be obtained by downloading the files from the ARB’s website at: http://www.arb.ca.gov/planning/tsaq/eval/eval.htm.

G. CMAQ Program Scoring Committee Representatives

- Air Pollution Control District
- Madera County Transportation Commission (2)
- Caltrans
- City of Madera
- City of Chowchilla
- County of Madera

H. Contact Information:

Jeff Findley or Sandy Ebersole  
Madera County Transportation Commission  
2001 Howard Road, Suite 201  
Madera, CA 93637  
(559) 675-0721  
jeff@maderactc.org or sandy@maderactc.org
Appendix A – FHWA CMAQ Program Guidance, 2008
The guidance contained in this document is intended to be nonbinding, except insofar as it references existing statutory requirements. In this guidance document, the use of mandatory language such as “shall,” “must,” “required,” or “requirement” is only used to reflect statutory or regulatory mandates and does not create new requirements. This guidance does not create or confer any rights for or on any person and should not be construed as rules of general applicability and legal effect.
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   C. Transferability of CMAQ Funds
   D. CMAQ and Innovative Finance

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V. Annual Apportionments of CMAQ Funds to States
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   B. Area Designations: Attainment vs. Nonattainment
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X. Appendix 1: 23 U.S.C §149

XI. Appendix 2: 23 U.S.C. §104(b)(2) Apportionment

XII. Appendix 3: Considerations for Diesel Retrofit Projects
I. INTRODUCTION

The CMAQ program was created under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, continued under the Transportation Equity Act for the 21st Century (TEA-21), and reauthorized by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU).¹ Over $8.6 billion is authorized over the five-year program (2005-2009), with annual authorization amounts increasing each year during this period. Through 2005, the program has supported nearly 16,000 transportation projects across the country.

This guidance replaces the April 1999 version and provides information on the CMAQ program, including:

- Authorization levels and apportionment factors specific to the SAFETEA-LU
- Flexibility and transferability provisions available to States
- Geographic area eligibility for CMAQ funds
- Project eligibility information
- Project selection processes
- Program administration

Appendices 1-3 provide updated statutory language relating to the CMAQ program. Appendix 4 provides supplemental information on diesel retrofit projects. [NOTE: Appendices 1 and 2 provide updated statutory language. Appendix 3 provides information on diesel retrofits, while original Appendix 4 on cost-effectiveness has been dropped in deference to EPA’s referenced research on this subject].

Information on the current annual apportionment to each State and an electronic version of this guidance are available at http://www.fhwa.dot.gov/environment/cmaqpgs/index.htm.

This guidance document has been prepared by the Air Quality Team in FHWA’s Office of Environment and Planning.

II. PROGRAM PURPOSE

The purpose of the CMAQ program is to fund transportation projects or programs that will contribute to attainment or maintenance of the national ambient air quality standards (NAAQS) for ozone, carbon monoxide (CO), and particulate matter (PM).

The CMAQ program supports two important goals of the Department of Transportation: improving air quality and relieving congestion. While these goals are not new elements of the program, they are strengthened in a new provision added to the CMAQ statute by SAFETEA-LU, establishing priority consideration for cost-effective emission reduction and congestion mitigation activities when using CMAQ funding.²

Reducing pollution and other adverse environmental effects of transportation projects and transportation system inefficiency have been long-standing objectives of the Department of

² 23 U.S.C. §149(f)(3) (SAFETEA-LU §1808(d))
Reducing congestion is also a key objective of the Department of Transportation, and one that has gained increasing attention in the past several years. The cost of congestion, which negatively affects the U.S. economy, quality of life, and air quality, has risen dramatically in the last 25 years despite record levels of transportation investment. Some economists estimate that the overall cost of congestion to the U.S. economy approaches $200 billion a year. As a result, in May 2006, the Department of Transportation announced its National Strategy to Reduce Congestion on America’s Transportation Network (the Congestion Initiative) that aims to meaningfully reduce the economic and social costs of congestion on our nation’s highways and in other transportation facilities. This strategy can be found at: http://isddc.dot.gov/OLPFiles/OST/012988.pdf.

Since congestion relief projects also reduce idling, the negative emissions impacts of “stop and go” driving, and the number of vehicles on the road, they have a corollary benefit of improving air quality. Based on their emissions reductions, these types of projects, including investments in improved system pricing and operations, are eligible for CMAQ funding. The Department believes State and local governments can simultaneously reduce the costly impacts of congestion while also improving air quality.

III. AUTHORIZATION LEVELS UNDER THE SAFETEA-LU

A. Authorization Levels

Table 1 shows the SAFETEA-LU CMAQ authorization levels by fiscal year. The CMAQ funds will be apportioned to States each year based upon the apportionment factors discussed in Section V.

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Amount Authorized</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 2005</td>
<td>$1,667,255,304</td>
</tr>
<tr>
<td>FY 2006</td>
<td>$1,694,101,866</td>
</tr>
<tr>
<td>FY 2007</td>
<td>$1,721,380,718</td>
</tr>
<tr>
<td>FY 2008</td>
<td>$1,749,098,821</td>
</tr>
</tbody>
</table>

3 42 U.S.C. §7506 Section 176(c)
4 Speaking before the National Retail Federation’s annual conference on May 16, 2006, in Washington, D.C., former U.S. Transportation Secretary Norman Mineta unveiled a new plan to reduce congestion plaguing America’s roads, rails, and airports. The National Strategy to Reduce Congestion on America’s Transportation Network includes a number of initiatives designed to reduce transportation congestion. The transcript of these remarks is available at the following URL: http://www.dot.gov/affairs/minetasp051606.htm
5 23 U.S.C. §149(b)(5)
| FY 2009 | $1,777,263,247 |
B. Equity Bonus

Similar to the minimum guarantee under the TEA-21, the Equity Bonus in SAFETEA-LU provides additional funding beyond the authorized levels so that each State receives a minimum percentage of its gas tax receipts back in the form of Federal-aid funds.\(^6\)

C. Transferability of CMAQ Funds

Since transportation and environmental program priorities fluctuate, States may choose to transfer a limited portion of their CMAQ apportionment to the following Federal-aid highway programs: Surface Transportation Program (STP), National Highway System (NHS), Highway Bridge Program (HBP), Interstate Maintenance (IM), Recreational Trails Program (RTP), and the Highway Safety Improvement Program (HSIP).

States may transfer CMAQ funds according to the following provision: An amount not to exceed 50 percent of the quantity of the State's annual apportionment less the amount the State would have received if the CMAQ program had been authorized at $1,350,000,000.\(^7\) For example, if the annual national apportionment is $1.75 billion and a State receives $10 million more than it would have received if the national apportionment had been $1.35 billion, the State can transfer up to $5 million to other programs. Any transfer of such funds must still be obligated in nonattainment and maintenance areas.\(^8\) The amount of transferable funds will differ each year and by State, depending on overall authorization levels. Each year, the FHWA will inform States how much, if any, CMAQ funding is transferable and will track this movement of CMAQ funds. States also may transfer CMAQ funds to other Federal agencies. The SAFETEA-LU provides additional flexibility to complete such transfers when the receiving Federal agency has entered into an agreement with the State to undertake an eligible Federal-aid project.\(^9\) These opportunities apply to projects that have met all CMAQ eligibility requirements prior to the transfer.

D. CMAQ and Innovative Finance: State Infrastructure Bank (SIB) and Section 129 Loans

Projects with dedicated repayment streams, i.e., a consistent source of revenue, may be financed with loans through DOT’s innovative finance program as an alternative or supplement to CMAQ funding.

State Infrastructure Banks are State-directed programs that allow Federal-aid funds to be lent to sponsors of eligible Federal-aid projects (any project under Title 23 or capital projects, as defined by 49 U.S.C. §5302, are eligible). SIBs may be capitalized with several Federal-aid highway apportionments including the National Highway System Program, the Surface Transportation Program, the Highway Bridge Program, the Interstate Maintenance Program, and the Equity Bonus program. (Note: CMAQ may not be used to capitalize a SIB, but SIB funds may be used to finance CMAQ projects). State funds also may be used to capitalize the SIB. The State then receives repayments over time that can be directed toward other transportation

\(^6\) 23 U.S.C. §105 (SAFETEA-LU §1104)
\(^7\) 23 U.S.C. §126(c)
\(^8\) 23 U.S.C. §149(b)
\(^9\) 23 U.S.C. §132(a) (SAFETEA-LU §1119)
projects. For example, New York State was successful in utilizing its SIB to implement two truck stop electrification projects along the New York State Thruway.

Section 129 loans (23 U.S.C.129(a)(7)) allow states to use Federal-aid highway apportionments to make loans for projects with dedicated revenue streams (this is only applicable to highway, bridge, tunnel, ferry boat, and ferry terminal projects). A Section 129 loan may be used to construct a truck stop electrification facility if the facility is located on the Interstate right-of-way.\footnote{23 U.S.C. §111(d) (SAFETEA-LU §1412)} [NOTE: The provision for construction in the Interstate ROW has since been removed via Public Law No. 110-244, 122 Stat. 1572 the SAFETEA-LU Technical Corrections Bill]

The SAFETEA-LU establishes a new SIB program under which all States are authorized to enter into cooperative agreements with the U.S. DOT to establish infrastructure revolving-funds eligible to be capitalized with Federal transportation funds.\footnote{23 U.S.C. §190 (SAFETEA-LU §1602)} The key difference between a Section 129 loan and a SIB is that a Section 129 loan usually provides financing to an individual project and funding a SIB capitalizes a financial entity that can assist multiple projects. The two loan programs have similar maximum allowable terms established by Federal law:

- Both public and private entities are eligible to be project sponsors
- Repayments begin within 5 years of project completion
- Maximum loan term is 30 years after project authorization (Section 129) or 30 years after first repayment (SIB)
- Interest rate may be set by State, at or below market rates
- Loans can only be made up to 80 percent of eligible project costs (Section 129). For SIBs, loans can be made up to 80 percent of eligible project costs (although the non-Federal share can be reduced under 23 U.S.C. §120(b) if the sliding scale rate is used).

These innovative loan programs can increase the efficiency of States’ transportation investments and significantly leverage Federal resources by attracting non-Federal public and private investment, and provide greater flexibility to the States by allowing other types of project assistance in addition to grant assistance. This type of financing is important for new technologies or start-up businesses that may have difficulty finding financing in the private capital markets. In addition to SIBs and section 129 loans, the FHWA also administers the Transportation Infrastructure Finance and Innovation Act (TIFIA) program, which provides Federal credit assistance to large-scale projects greater than $50 million.

The following example illustrates how a Section 129 loan could work to construct an idle-reduction facility on an Interstate right-of-way. A private party intends to build a stationary idle-reduction facility, and seeks grant funding for it from the State DOT. The idle reduction facility will eventually earn a profit by charging user fees, but since the capital costs are high, the private party needs assistance with financing the initial construction. Instead of providing an outright grant, the State could offer a loan of Federal-aid funds with flexible repayment terms. If the facility required $1 million for initial construction, the State could make a loan at five percent over fifteen years. The State could accelerate the payments if the facility were more successful than expected, and delay repayment if the facility failed to meet revenue targets. The State could also build in credits for additional emissions reductions, providing incentives for additional loans.
IV. PRIORITY FOR USE OF CMAQ FUNDS

The SAFETEA-LU directs States and MPOs to give priority to two categories of funding. First, priority is for diesel retrofits, particularly where necessary to facilitate contract compliance, and other cost-effective emission reduction activities, taking into consideration air quality and health effects. Second, priority is to be given to cost-effective congestion mitigation activities that provide air quality benefits. Other projects also may be cost-effective. The priority provisions in the statute apply to the portion of CMAQ funds derived from the application of sections 104(b)(2)(B) and 104(b)(2)(C) of SAFETEA-LU, i.e., the CMAQ apportionment formula. They do not apply to areas where CMAQ funding has been derived from the minimum apportionment provisions.

In accordance with the SAFETEA-LU, the EPA has released a guidance document, *The Cost Effectiveness of Heavy-Duty Diesel Retrofits and Other Mobile Source Emission Reduction Projects and Programs*, which provides cost-effectiveness data on diesel engine retrofit technologies and other CMAQ-eligible activities. It is available online at: [http://www.epa.gov/cleandiesel/publications.htm](http://www.epa.gov/cleandiesel/publications.htm)

In addition, the Transportation Research Board published *The Congestion Mitigation and Air Quality Improvement Program: Assessing 10 Years of Experience* in 2002, providing a number of effectiveness measures for both emissions and travel activity.

Though SAFETEA-LU establishes these CMAQ investment priorities, it also retains State and local agencies’ authority in project selection. The law maintains the existing roles and authorities of public agencies, and substantial shifts in local procedures are not required by the SAFETEA-LU. However, project selection should reflect the positive cost-effectiveness relationships highlighted in the EPA guidance. State and local transportation programs that implement a broad array of these cost-effective measures may record a more rapid rate of progress toward their clean air goals, since many of these endeavors generate immediate benefits. Local procedures that elevate the importance of these efforts in project selection—and rate them accordingly—may accelerate the drive to air quality attainment.

In addition to the SAFETEA-LU priority on cost-effectiveness, Section 176(c) of the Clean Air Act requires that the FHWA and FTA ensure timely implementation of transportation control measures (TCMs) in applicable State Implementation Plans (SIPs). These and other CMAQ-eligible projects identified in approved SIPs should receive funding priority.

The FHWA recommends that States and MPOs develop their transportation/air quality programs using complementary measures that provide alternatives to single-occupant vehicle (SOV) travel

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12 23 U.S.C. §149(f)(3) (SAFETEA-LU §1808(d))
13 23 U.S.C. §149(f)(2)(c) (SAFETEA-LU §1808(d))
16 42 U.S.C. §7506 Section 176(c)(2)(B)
while improving traffic flow through operational strategies and balancing supply and demand through pricing, parking management, regulatory, or other means.

V. ANNUAL APPORTIONMENTS OF CMAQ FUNDS TO STATES

A. CMAQ Apportionments

Federal CMAQ funds are apportioned annually to each State according to the severity of its ozone and CO problem (see Appendix 2). The population of each county (based upon Census Bureau data) that is in a nonattainment or maintenance area for ozone and/or CO is weighted by multiplying by the appropriate factor listed in Table 2. PM nonattainment and maintenance areas and former 1-hour areas, except those few 1-hour maintenance areas participating in Early Action Compacts, are not included in the apportionments.

Note: CMAQ apportionments and CMAQ eligibility are two different things. Some areas in which CMAQ funds may be spent are not included in the apportionments (see Section VI.).

CMAQ apportionments are calculated based on the nonattainment and maintenance areas that exist at the time of apportionment. Generally, apportionments are calculated prior to the beginning of each fiscal year.

B. Area Designations: Attainment vs. Nonattainment

Each State is guaranteed a minimum apportionment of one-half percent of the year's total program funding, regardless of whether the State has any nonattainment or maintenance areas.

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17 23 U.S.C. §104(b)(2) (SAFETEA-LU §1103(d))
These flexible funds or minimum apportionment funds can be used anywhere in the State for projects eligible for either CMAQ or the STP.\textsuperscript{18}

The FHWA Budget Division identifies annual apportionments of CMAQ funds as either mandatory or flexible. All funding is considered mandatory for States with weighted populations yielding one-half percent or more of the authorized funds (based on the table above). Annual CMAQ funding apportioned through the application of sections 104(b)(2)(B) and 104(b)(2)(C) must be used for projects in nonattainment/maintenance areas.\textsuperscript{19}

States with weighted populations yielding at least some apportioned value but less than one-half percent of the authorized funds receive both mandatory and flexible funds to reach the minimum apportionment. For example, if a State's weighted population yields two tenths of one percent of the authorized funds, it would receive two tenths of one percent of the national funds as mandatory funds, and three tenths of one percent as flexible funds. Thus, 40 percent of the State's funds would be mandatory and 60 percent would be flexible.

For States with no areas applicable to the apportionment table, their minimum apportionment, one-half percent, is all flexible funding. The FHWA reports the breakdown of mandatory and flexible funds by State in its fiscal year apportionment tables.

\section*{C. Apportionments and State Allocation}

Notwithstanding the statutory formula for determining the apportionment amount, the State may use its CMAQ funds in any ozone, CO, or PM nonattainment or maintenance area. A State is under no statutory obligation to allocate CMAQ funds in the same way they are apportioned. States are encouraged to consult affected MPOs to determine regional and local CMAQ priorities and work with them to allocate funds accordingly.

\section*{D. Federal Share and State/Local Match Requirements}

The Federal share for most CMAQ projects, generally, has been 80 percent. However, under the Energy Independence and Security Act of 2007,\textsuperscript{20} the Federal share for eligible CMAQ projects carried out with funds obligated in fiscal year 2008 or 2009, or both, may be, at the discretion of the State, up to 100 percent of the cost of the project or program.

\section*{VI. GEOGRAPHIC AREAS THAT ARE ELIGIBLE TO USE CMAQ FUNDS}

\section*{A. Eligible Areas}

CMAQ funds may be invested in all ozone, CO, and PM nonattainment and maintenance areas. Funds also may be spent in the few remaining 1-hour ozone maintenance areas (these counties also have Early Action Compacts in place), since the 1-hour standard remains in effect for these areas.

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{18} 23 U.S.C. §149(c) (SAFETEA-LU §1808(c))
\item \textsuperscript{19} 23 U.S.C. §149(b)
\item \textsuperscript{20} Pub. L. 110-140, Sect. 1131 (December 20, 2007).
\end{itemize}
\end{footnotesize}
Funds also may be used for projects in proximity to nonattainment and maintenance areas if the benefits will be realized primarily within the nonattainment or maintenance area. The delineation of an area considered “in proximity” should be discussed with the FHWA and FTA field offices and elevated to headquarters if necessary.

B. Maintenance Areas

CMAQ funds may be invested in maintenance areas that have approved maintenance plans under CAA section 175A. In States with ozone or CO maintenance areas but no nonattainment areas, mandatory CMAQ funds must be used in the maintenance areas.21

C. Maintenance Plan Requirement, SAFETEA-LU

CMAQ funds may be invested in former 1-hour ozone areas that were not designated under the 8-hour standard but where the 1-hour standard has been revoked. Since these areas are required to file maintenance plans, they are considered eligible for CMAQ funding under provisions of SAFETEA-LU.22

D. Flexible Funds in PM Areas

While States may use flexible CMAQ funding anywhere and for any CMAQ- or STP-eligible project (see V.B. on minimum apportionment), the FHWA encourages States and MPOs to evaluate the cost-effectiveness and benefits to public health of targeting flexible CMAQ funding to projects that reduce PM. Examples of such projects include implementing a diesel retrofit or idle reduction program, constructing freight/intermodal transfer facilities, traffic signalization, or ITS projects that reduce congestion; paving dirt roads, and purchasing street sweeping equipment.

VII. PROJECT ELIGIBILITY PROVISIONS

A. Project Eligibility: General Conditions

To be eligible for CMAQ funds, a project must be included in the MPO’s current transportation plan and TIP (or the current STIP in areas without an MPO). In nonattainment and maintenance areas, the project also must meet the conformity provisions contained in section 176(c) of the Clean Air Act and the transportation conformity regulations.23 In addition, all CMAQ-funded projects need to complete National Environmental Policy Act (NEPA) requirements and meet basic eligibility requirements for funding under titles 23 and 49 of the United States Code.

The following should guide CMAQ eligibility decisions:

1. Capital Investment

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21 23 U.S.C. §149(b)
22 23 U.S.C. §149(b) (SAFETEA-LU §1808(a))
23 40 CFR Parts 51 and 93
CMAQ funds may be used to establish new or expanded transportation projects or programs that reduce emissions, including capital investments in transportation infrastructure, congestion relief efforts, diesel engine retrofits, or other capital projects.
2. Operating Assistance

There are several general conditions that must be met for operating assistance to be eligible under the CMAQ program:

a. Operating assistance is limited to new transit services, intermodal facilities, and travel demand management strategies (including traffic operation centers); and the incremental cost of expanding existing transit services.

b. In using CMAQ funds for operating assistance, the intent is to help start up viable new transportation services that can demonstrate air quality benefits and eventually cover their costs as much as possible. Other funding sources should supplement and ultimately replace CMAQ funds for operating assistance, as these projects no longer represent additional, net air quality benefits but have become part of the baseline transportation network.

c. Operating assistance includes all costs of providing new transportation services, including, but not limited to, labor, fuel, administrative costs, and maintenance.

d. When CMAQ funds are used for operating assistance, non-Federal share requirements still apply.

e. With the focus on start-up costs only, operating assistance under the CMAQ program is limited to three years. The provisions in 23 U.S.C. §116 place responsibilities for maintenance on States. Since facility maintenance is akin to operations, three years of CMAQ assistance provides adequate incentive and flexibility while not creating a pattern of excessive or even perpetual support. Exceptions are listed below under VII.D.7 Travel Demand Management, VII.D.8 Public Education, and VII.D.10 Carpooling and Vanpooling.

3. Emission Reduction

Air quality improvement is defined by several distinct terms in 23 U.S.C. §149. These terms include contribution to attainment, reduction in pollution, air quality benefits, and others. For purposes of this guidance, the FHWA uses emission reduction to represent this group of terms. CMAQ-invested projects or programs must reduce CO, ozone precursor (NOx and VOCs), PM, or PM precursor (e.g., NOx) emissions from transportation; these reductions must contribute to the area’s overall clean air strategy and can be demonstrated by the assessment that is required under this guidance. States and MPOs also may consider the ancillary benefits of eligible projects, including greenhouse gas reductions, congestion relief, safety, or other elements, when programming CMAQ funds, though such benefits do not alone establish eligibility.

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25 23 U.S.C. §149(b)
4. Planning and Project Development

Activities in support of eligible projects also may be appropriate for CMAQ investments. Studies that are part of the project development pipeline (e.g., preliminary engineering) under NEPA are eligible for CMAQ support, as are FTA’s Alternatives Analyses. General studies that fall outside specific project development do not qualify for CMAQ funding. Examples of such efforts include major investment studies, commuter preference studies, modal market polls or surveys, transit master plans, and others. These activities are eligible for Federal planning funds.

B. Projects Ineligible for CMAQ Funding

The following projects are ineligible for CMAQ funding:

1. Light-duty vehicle scrappage programs.26
2. Projects that add new capacity for SOVs are ineligible for CMAQ funding unless construction is limited to high-occupancy vehicle (HOV) lanes.27 This HOV lane eligibility includes the full range of HOV facility uses authorized under 23 U.S.C §166, such as high-occupancy toll (HOT) and low-emission vehicles.
3. Routine maintenance and rehabilitation projects (e.g., replacement-in-kind of track or other equipment, reconstruction of bridges, stations, and other facilities, and repaving or repairing roads) are ineligible for CMAQ funding as they only maintain existing levels of highway and transit service, and therefore do not reduce emissions.28 Other funding sources, such as STP and FTA’s Section 5307 program, are available for such activities.
4. Administrative costs of the CMAQ program may not be defrayed with program funds, e.g., support for a State’s “CMAQ Project Management Office” is not eligible.
5. Projects that do not meet the specific eligibility requirements of titles 23 and 49 U.S.C. are ineligible for CMAQ funds.
6. Stand-alone projects to purchase fuel. One exception is listed below in Section VII.D.3.29

C. Public-Private Partnerships (PPPs)

In a PPP, a private or non-profit entity’s resources replace or supplement State or local funds and possibly a portion of the Federal-aid in a selected project. The PPP elements of the program have been refined over the last two transportation reauthorizations, and these partnerships have become a critical part of CMAQ.30

Partnerships should have a legally-binding written agreement in place between the public agency and the private or non-profit entity before a CMAQ-funded project may be implemented. These agreements should be developed under relevant Federal and State law and should specify the intended use for CMAQ funding; the roles and responsibilities of the participating entities; and how the disposition of land, facilities, and equipment

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26 23 U.S.C. §149(b)
27 23 U.S.C. §149(b)
28 23 U.S.C. §116
29 23 U.S.C. §149(k)
30 23 U.S.C. §149(e)
Public funds should not be invested where a strong public benefit cannot be demonstrated. Consequently, CMAQ funds should be devoted to PPPs that benefit the general public by clearly reducing emissions, not for financing marginal projects. Consistent with the planning and project selection provisions of the Federal-aid highway program, the FHWA considers it essential that all interested parties have full, open, and timely access to the project selection process.

There are several other statutory restrictions and special provisions on the use of CMAQ funds in PPPs. Eligible costs under this section should not include costs to fund an obligation imposed on private sector or non-profit entities under the CAA or any other Federal law. However, if the private or non-profit entity is clearly exceeding its obligations under Federal law, CMAQ funds may be used for that incremental portion of the project.

Eligible non-monetary activities that satisfy the non-Federal match requirements under the partnership provisions include the following:

- Ownership or operation of land, facilities, or other physical assets
- Construction or project management
- Other forms of participation approved by the U.S. DOT

Sharing of total project costs, both capital and operating, is a critical element of a successful public-private venture, particularly if the private entity is expected to realize profits as part of the joint venture. State and local officials are urged to consider a full range of cost-sharing options when developing a PPP, including a larger State/local match. For detailed information on cost principles beyond the scope of this guidance, please consult OMB Circular A-87, which focuses on determining allowable costs for State, local, and tribal governments; and 49 CFR Part 18, which provides direction on administering Federal grants to State and local governments.

D. Eligible Projects and Programs

Eligibility information is provided below. Not all possible requests for CMAQ funding are covered—this section provides examples of activities eligible for CMAQ funds.

1. Transportation Control Measures (TCMs)

Most of the TCMs included in Section 108 of the CAA, listed below, are eligible for CMAQ funding. One CAA TCM, programs to encourage removal of pre-1980 light-duty vehicles, is specifically excluded from CMAQ eligibility. Programs for improved public transit;

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31 23 U.S.C. § 149(e)(5)
ii. restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or HOV;

iii. employer-based transportation management plans, including incentives;

iv. trip-reduction ordinances;

v. traffic flow improvement programs that reduce emissions;

vi. fringe and transportation corridor parking facilities serving multiple-occupancy vehicle programs or transit service;

vii. programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration particularly during periods of peak use;

viii. programs for the provision of all forms of high-occupancy, shared-ride services;

ix. programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;

x. programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;

xi. programs to control extended idling of vehicles;

xii. reducing emissions from extreme cold-start conditions;

xiii. employer-sponsored programs to permit flexible work schedules;

xiv. programs and ordinances to facilitate non-automobile travel, provision and utilization of mass transit, and to generally reduce the need for SOV travel, as part of transportation planning and development efforts of a locality, including programs and ordinances applicable to new shopping centers, special events, and other centers of vehicle activity; and

xv. programs for new construction and major reconstructions of paths, tracks, or areas solely for the use by pedestrian or other non-motorized means of transportation when economically feasible and in the public interest.

2. Extreme Low-Temperature Cold Start Programs

Projects intended to reduce emissions from extreme cold-start conditions are eligible for CMAQ funding. Such projects include retrofitting vehicles and fleets with water and oil heaters and installing electrical outlets and equipment in publicly-owned garages or fleet storage facilities (See Section VII.C. for a possible expansion to privately-owned equipment and facilities).

3. Alternative Fuels and Vehicles

Fuel

With the exception of Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, and Ohio, fuel costs are not an eligible expense as a stand-alone project.33 Only these seven States may use CMAQ funds to purchase the alternative fuels defined in section 301 of the 1992 Energy Policy Act (natural gas, ethanol, etc.) or biodiesel, assuming such projects meet other applicable eligibility requirements noted in Section VII.B. above.

33 SAFETEA-LU, §1808(k)
Establishing publicly-owned fueling facilities and other infrastructure needed to fuel alternative-fuel vehicles is an eligible expense, unless privately-owned fueling stations are in place and reasonably accessible. Additionally, CMAQ funds may support converting a private fueling facility to support alternative fuels through a public-private partnership agreement (See Section VII.C.).

Non-transit Vehicles

CMAQ funds may be used to purchase publicly-owned alternative fuel vehicles, including passenger vehicles, refuse trucks, street cleaners, and others. Costs associated with converting fleets to run on alternative fuels are also eligible. When private vehicles are purchased, only the cost difference between the alternative fuel vehicles and comparable conventional fuel vehicles is eligible. Such vehicles should be fueled by one of the alternative fuels identified in section 301 of the 1992 Energy Policy Act or biodiesel. Eligible projects also include alternatives to diesel engines and vehicles.

Hybrid Vehicles

Although not defined by the Energy Policy Act of 1992 as alternative fuel vehicles, certain hybrid vehicles that have lower emissions rates than their non-hybrid counterparts may be eligible for CMAQ investment. Hybrid passenger vehicles must meet EPA’s low emissions and energy efficiency requirements for certification under the HOV exception provisions of the SAFETEA-LU to be eligible for CMAQ funding.34 [NOTE: The final rule is in the last stages of review, although no date set for publication in the Federal Register, as of November 14, 2008].

Projects involving heavier vehicles, including refuse haulers and delivery trucks, also may be appropriate for program support. Eligibility should be based on a comparison of the emissions projections of these larger candidate vehicles and other comparable models.

4. Congestion Reduction & Traffic Flow Improvements

Traffic flow improvements may include the following:

a. Traditional Improvements

Traditional traffic flow improvements, such as the construction of roundabouts, HOV lanes, left-turn or other managed lanes, are eligible for CMAQ funding provided they demonstrate net emissions benefits.

b. Intelligent Transportation Systems

Intelligent Transportation Systems (ITS) projects, such as traffic signal synchronization projects, traffic management projects, and traveler information

34 23 U.S.C. §166(e) (SAFETEA-LU §1121(a)). The required rulemaking developed by EPA has been published in the Federal Register at 72 FR 29102, http://www.epa.gov/fedregstr/EPA-AIR/2007/May/Day-24/a9821.htm
systems, can be effective in relieving traffic congestion, enhancing transit bus performance, and improving air quality. The following have the greatest potential for improving air quality:

- Regional multi-modal traveler information systems
- Traffic signal control systems
- Freeway management systems
- Electronic toll-collection systems
- Transit management systems
- Incident management programs

A lengthier discussion of the benefits associated with various operational improvements can be found at: http://ops.fhwa.dot.gov/program_areas/programareas.htm

c. Value/Congestion Pricing

As part of its Congestion Initiative referenced above, the Department broadly promotes highway congestion pricing and is also seeking an area-wide demonstration of the effectiveness of congestion pricing (along with other elements). Congestion pricing is a market-based mechanism that allows tolls to rise and fall depending on available capacity and demand. It has gained increasing attention and popularity in recent years following several highly successful facility demonstrations in the U.S. and several network wide demonstrations abroad. Tolls can be charged electronically, thereby eliminating the need for tollbooths. In addition to the benefits associated with reducing congestion, revenue is generated that can be used to pay for a wide range of transportation improvements, including Title 23-eligible transit services in the newly tolled corridor.

Parking pricing can include time-of-day parking charges that reflect congested conditions. These strategies should be designed to influence trip-making behavior and may include charges for using a parking facility at peak periods, or a range of employer-based parking cash-out policies that provide financial incentives to avoid parking or driving alone. Parking pricing integrated with other pricing strategies is encouraged.

Pricing encompasses a variety of market-based approaches such as:

- **HOT lanes**, or High Occupancy Toll lanes, on which variable tolls are charged to drivers of low-occupancy vehicles using HOV lanes, such as the “FasTrak” Lanes on I-15 in San Diego and the recently converted I-394 in Minneapolis in which prices vary dynamically every two minutes based on traffic conditions
- **New variably tolled express lanes** on existing toll-free facilities, such as the “91 Express Lanes” on State Route 91 in Orange County, CA
- **Variable tolls on existing or new toll roads**, such as on the bridges and tunnels operated by the Port Authority of New York and New Jersey
• **Network-wide or cordon pricing**, such as implemented in Stockholm, London and Singapore
• **Usage-based vehicle pricing**, such as mileage-based vehicle taxation being explored by the State of Oregon, or pay-per-mile car insurance

As with any eligible CMAQ project, value pricing should generate an emissions reduction. Marketing and outreach efforts to expand and encourage the use of eligible pricing measures may be funded indefinitely. Eligible expenses for reimbursement include, but are not limited to: tolling infrastructure, such as transponders and other electronic toll or fare payment systems; small roadway modifications to enable tolling, marketing, public outreach, and support services, such as transit in a newly tolled corridor. Innovative pricing approaches yet to be deployed in the U.S. also may be supported through the *Value Pricing Pilot Program*. A more complete discussion of projects currently underway in the U.S. can be found at: [http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/index.htm](http://ops.fhwa.dot.gov/tolling_pricing/value_pricing/index.htm).

Operating expenses for traffic flow improvements are eligible for CMAQ funding for three years if they can be shown to produce air quality benefits, if the expenses are incurred from new or additional services, and if previous funding mechanisms, such as fares or fees for services, are not displaced.

Projects or programs that involve the purchase of integrated, interoperable emergency communications equipment are eligible for CMAQ funding.35

5. Transit Improvements

Many transit projects are eligible for CMAQ funds. The general guideline for determining eligibility is whether the project increases capacity and would likely result in an increase in transit ridership and a potential reduction in congestion. As with other types of CMAQ projects, there should be a quantified estimate of the project’s emissions benefits accompanying the proposal.

The FTA administers most transit projects. Once the FTA determines a project eligible, CMAQ funds will be transferred from the FHWA to the FTA, and the project will be administered according to the requirements of the FTA’s Urbanized Area Formula Grant Program.36 Certain types of transit projects for which the FTA lacks statutory authority, such as diesel retrofit equipment for public school bus fleets, are administered by the FHWA.

a. Facilities

New transit facilities (e.g., lines, stations, terminals, transfer facilities) are eligible if they are associated with new or enhanced mass transit service. Routine maintenance or rehabilitation of existing facilities is not eligible, as it does not reduce emissions. However, rehabilitation of a facility may be eligible if the vast

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35 23 U.S.C. §149(b)(6) (SAFETEA-LU §1808(b)(4))
36 49 U.S.C. §5307
majority of the project involves physical improvements that will increase capacity. In such cases there should be supporting documentation showing an increase in transit ridership that is more than minimal. If the vast majority of the project involves capacity enhancements, other elements involving refurbishment and replacement-in-kind also are eligible.

b. Vehicles and Equipment

New transit vehicles (bus, rail, or van) to expand the fleet or replace existing vehicles are eligible. Transit agencies are encouraged to purchase vehicles that are most cost-effective in reducing emissions. Diesel engine retrofits, such as replacement engines and exhaust after-treatment devices, are eligible if certified or verified by the EPA or California Air Resources Board (CARB). Routine preventive maintenance for vehicles is not eligible as it only returns the vehicles to baseline conditions. Besides diesel engine retrofits, other transit equipment may be eligible if it represents a major system-wide upgrade that will significantly improve speed or reliability of transit service, such as advanced signal and communications systems.

c. Fuel

Fuel, whether conventional or alternative fuel, is an eligible expense only as part of a project providing operating assistance for new or expanded transit service under the CMAQ program. This includes fuels and fuel additives considered diesel retrofit technologies by the EPA or CARB. See Section VII.D.3 for statutory exceptions for certain states regarding the purchase of alternative fuel with CMAQ funds.

d. Operating Assistance

Operating assistance to introduce new transit service or expand existing service is eligible. It may be a new type of service, service to a new geographic area, or an expansion of existing service providing additional hours of service or reduced headways. For a service expansion, only the operating costs of the new increment of service are eligible. Eligible operating costs include labor, fuel, maintenance, and related expenses. Operating assistance may be CMAQ-funded for a maximum of three years. The intent is to support the demonstration of new services that may prove successful enough to sustain with other funding sources, and to free up CMAQ funds to generate new air quality benefits.

e. Transit Fare Subsidies

CMAQ funds may be used to subsidize regular transit fares in an effort to prevent the NAAQS from being exceeded, but only under the following conditions: The reduced or free fare should be part of a comprehensive area-wide program to prevent the NAAQS from being exceeded. “Ozone Action” programs vary in scope around the country, but they generally include actions that individuals and employers can take and they are aimed at all major sources of air pollution, not
just transportation. The subsidized fare should be available to the general public and may not be limited to specific groups. It may only be offered during periods of elevated pollution when the threat of exceeding the NAAQS is greatest; it is not intended for the entire high-ozone season. Finally, the fare subsidy proposal should demonstrate that the responsible local agencies will combine the reduced or free fare with a robust marketing program to inform SOV drivers of other transportation options. Because the fare subsidy is not strictly a form of operating assistance, it would not be subject to the three-year limit.

6. Bicycle and Pedestrian Facilities and Programs

Bicycle and pedestrian facilities and programs are included as a TCM in section 108(f)(1)(A) of the CAA. The following are eligible projects:

- Constructing bicycle and pedestrian facilities (paths, bike racks, support facilities, etc.) that are not exclusively recreational and reduce vehicle trips
- Non-construction outreach related to safe bicycle use
- Establishing and funding State bicycle/pedestrian coordinator positions for promoting and facilitating nonmotorized transportation modes through public education, safety programs, etc. (Limited to one full-time position per State)³⁷

7. Travel Demand Management

Travel demand management (TDM) encompasses a diverse set of activities that focus on physical assets and services that provide real-time information on network performance and support better decision-making for travelers choosing modes, times, routes, and locations. Such projects can help ease congestion and reduce SOV use—contributing to mobility, while enhancing air quality and saving energy resources. Similar to ITS and Value Pricing, today’s TDM programs seek to optimize the performance of local and regional transportation networks. The following activities are eligible if they are explicitly aimed at reducing SOV travel and associated emissions:

- Fringe parking
- Traveler information services
- Shuttle services
- Guaranteed ride home programs
- Market research and planning in support of TDM implementation
- Carpools, vanpools (see item 10 below)
- Traffic calming measures
- Parking pricing
- Variable road pricing
- Telecommuting
- Employer-based commuter choice programs

CMAQ funds may support capital expenses and up to three years of operating assistance to administer and manage new or expanded TDM programs.

³⁷ 23 U.S.C. §217(d)
Marketing and outreach efforts to expand use of TDM measures may be funded indefinitely, but only if they are broken out as distinct line items (See Section VII.D.8. below).

Eligible telecommuting activities include planning, preparing technical and feasibility studies, and training. Construction of telecommuting centers and computer and office equipment purchases should not be supported with CMAQ funds.

8. Public Education and Outreach Activities

The goal of CMAQ-funded public education and outreach activities is to educate the public, community leaders, and potential project sponsors about connections among trip making and transportation mode choices, traffic congestion, and air quality. Public education and outreach can help communities reduce emissions and congestion by inducing drivers to change their transportation choices. More important, an informed public is likely to support larger regional measures necessary to reduce congestion and meet CAA requirements.

A wide range of public education and outreach activities is eligible for CMAQ funding, including activities that promote new or existing transportation services, developing messages and advertising materials (including market research, focus groups, and creative), placing messages and materials, evaluating message and material dissemination and public awareness, technical assistance, programs that promote the Tax Code provision related to commute benefits,\(^\text{38}\) transit “store” operations, and any other activities that help forward less-polluting transportation options.

Using CMAQ funds, communities have disseminated many transportation and air quality public education messages, including maintain your vehicle; curb SOV travel by trip chaining, telecommuting and using alternate modes; fuel properly; observe speed limits; don’t idle your vehicle for long durations; eliminate “jack-rabbit” starts and stops, and others.

The *It All Adds Up to Cleaner Air* public education messages and materials (regarding vehicle maintenance, proper fueling, trip chaining, and alternate modes) have been successful in raising awareness, garnering funds and in-kind support, and building coalitions of diverse groups across the country. These commercial-quality materials, which were developed in response to requests by State and local transportation and air agencies, are free and communities are encouraged to use and build on them. More information is available at [http://www.italladdsup.gov/](http://www.italladdsup.gov/).

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\(^{38}\) Section 132(f) of the Internal Revenue Code allows employers to pay their employees, as of November 5, 2007, up to $115 per month for transit and vanpool expenses and up to $215 per month for qualified parking. 26 U.S.C. §132(f). Each of these benefits is subject to annual increases based on changes to the Consumer Price Index. 26 U.S.C. §1(f)(3). Alternately, employers may allow employees to use their pre-tax income to purchase these commuter benefits. Employers may also provide a combination of these employer-paid and employee paid tax-free benefits. For more information, please visit [http://www.commuterchoice.com/](http://www.commuterchoice.com/).
Long-term public education and outreach can be effective in raising awareness that can lead to changes in travel behavior and ongoing emissions reductions; therefore, these activities may be funded indefinitely.

9. Transportation Management Associations

Transportation Management Associations (TMAs) are groups of citizens, firms, or employers that organize to address the transportation issues in their immediate locale by promoting rideshare programs, transit, shuttles, or other measures. TMAs can play a useful role in brokering transportation services to private employers.

CMAQ funds may be used to establish TMAs provided that they reduce emissions. Eligible expenses include TMA start-up costs and up to three years of operating assistance. Eligibility of specific TMA activities is addressed throughout this guidance.

10. Carpooling and Vanpooling

Eligible activities can be divided into two types of costs: *marketing* (which applies to both carpools and vanpools) and *vehicle* (which applies to vanpools only).

a. Carpool/vanpool marketing covers existing, expanded, and new activities designed to increase the use of carpools and vanpools, and includes purchase and use of computerized matching software and outreach to employers. Guaranteed ride home programs are also considered marketing tools. Marketing costs may be funded indefinitely.

b. Vanpool vehicle capital costs include purchasing or leasing vans for use in vanpools. Eligible operating costs, limited to three years, include empty-seat subsidies, maintenance, insurance, administration, and other related expenses.

CMAQ funds should not be used to buy or lease vans that would directly compete with or impede private sector initiatives. States and MPOs should consult with the private sector prior to using CMAQ funds to purchase vans, and if private firms have definite plans to provide adequate vanpool service, CMAQ funds should not be used to supplant that service.

Carpooling and vanpooling activities may be funded with up to 100% federal funding, with certain limitations.\(^{39}\)

11. Freight/Intermodal

Projects and programs targeting freight capital costs—rolling stock or ground infrastructure—are eligible provided that air quality benefits can be demonstrated.\(^{40}\) Freight projects that reduce emissions fall generally into two categories: primary efforts that target emissions directly or secondary projects that reduce net emissions.

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\(^{39}\) 23 U.S.C. §120(c)

\(^{40}\) 23 U.S.C. §149(b)(3)
Successful primary projects could include new diesel engine technology or retrofits of vehicles or engines. Eligibility is not confined to highway projects, but also applies to nonroad mobile freight projects, such as rail.\textsuperscript{41} See Section VII.D.12. below on diesel retrofit technology—examples of primary freight projects—and for information on EPA’s guidance and model rule for emissions reduction credit in the SIP and conformity processes.

Secondary projects reduce emissions through shifts in or additions to infrastructure. Support for an intermodal container transfer facility may be eligible if the project demonstrates reduced diesel engine emissions when balancing the drop in truck VMT against the increase in locomotive or other non-highway activity. Intermodal facilities, such as inland transshipment ports or near/on-dock rail, may generate substantial emissions reductions through the decrease in miles traveled for pre-1986 heavy-duty diesel trucks. This secondary, indirect effect on truck traffic and the ensuing drop in diesel emissions help demonstrate eligibility.

The transportation function of these freight/intermodal projects should be emphasized. Marginal projects that support freight operations in a very tangential manner are not eligible for CMAQ funding. Warehouse handling equipment, for example, is not an eligible investment of program funds. However, equipment that provides a transportation function or directly supports this function is eligible, such as railyard switch locomotives or shunters.

12. Diesel Engine Retrofits & Other Advanced Truck Technologies

The SAFETEA-LU places a new emphasis on diesel engine retrofits and the various types of projects that fall under this broad category.\textsuperscript{42} These efforts are defined as vehicle replacement, repowering (replacing an engine with a cleaner diesel engine, alternative fuels, etc.), rebuilding an engine, or other technologies determined by the EPA as appropriate for reducing emissions from diesel engines.\textsuperscript{43} This latter point, highlighting developing technologies, establishes a degree of flexibility and a need for periodic adjustment in the definition by the EPA. The legislation defines retrofit projects as applicable to both on-road motor vehicles and nonroad construction equipment; the latter must be used in Title 23 projects based in nonattainment or maintenance areas for either PM or ozone.\textsuperscript{44}

There are a number of project types in the diesel retrofit area for which CMAQ funds are eligible. Assuming all other CMAQ criteria are met, eligible projects include diesel engine replacement; full engine rebuilding and reconditioning; and purchase and installation of after-treatment hardware, including particulate matter traps and oxidation catalysts, and other technologies; and support for heavy-duty vehicle retirement programs. Project agreements involving replacements of either engine or full vehicle

\textsuperscript{41} 23 U.S.C. §149(b)(3)
\textsuperscript{42} 23 U.S.C. §149(f)(3) (SAFETEA-LU §1808(d))
\textsuperscript{43} 23 U.S.C. §149(f)(2) (SAFETEA-LU §1808(d))
\textsuperscript{44} 23 U.S.C. §149(b)(7) (SAFETEA-LU §1808(b)
should include a provision for disposal of the engine block and a process to verify the retirement of this equipment.\footnote{45}

CMAQ funds may be used to purchase and install emission control equipment on school buses. (Such projects, generally, should be administered by FHWA; see VII.D.5, Transit Improvements, above.) In addition, although CMAQ funds should not be used for the initial purchase of airport parking lot shuttles, funds may be used for purchase and installation of after treatment hardware or repowering (with a hybrid drive train, for example).

Refueling is not eligible as a stand-alone project, but is eligible if it is required to support the installation of emissions control equipment, repowering, rebuilding, or other retrofits of non-road engines.\footnote{46} For example, ultra-low sulfur diesel (ULSD) may be purchased as part of a project to install diesel particulate filters on nonroad construction equipment because these devices need ULSD to function properly. Costs associated with ULSD are eligible for CMAQ funding only until the standards are effective and the fuel becomes commonly available through the regional supply and logistics chain, effectively rendering ULSD the only remaining diesel fuel distributed. Eligible costs are limited to the difference between standard nonroad diesel fuel and ULSD.

In addition to equipment and technology, outreach activities that provide information exchange and technical assistance to diesel owners and operators on retrofit options are eligible investments. These projects could include the actual education and outreach program, construction or acquisition of appropriate buildings, and other efforts to promote the use of retrofit technologies. Please see Appendix 4 for more detail on diesel retrofits and the various strategies available in this developing air quality field.

The FHWA acknowledges that diesel retrofit projects may include nonroad mobile source endeavors, which traditionally have been outside the Federal-aid process. However, the SAFETEA-LU clarifies CMAQ eligibility for nonroad diesel retrofit projects.\footnote{47} Areas that fund these projects are not required to take credit for the projects in the transportation conformity process. For areas that want to take credit, the EPA developed guidance for estimating diesel retrofit emission reductions and for applying the credit in the SIP and transportation conformity processes. The guidance can be found at \url{http://www.epa.gov/otaq/stateresources/transconf/policy.htm#retrofit}.

In addition to retrofit projects, upgrading long-haul heavy-duty diesel trucks with advanced technologies, such as idle reduction devices, cab and trailer aerodynamic fixtures, and single-wide or other efficient tires, has been demonstrated by the EPA’s \textit{Smart Way Transport Partnership Program} to reduce NOx emissions and save fuel. These strategies also are eligible for CMAQ support. Such projects funded directly by CMAQ that involve the private sector should be part of a Public-Private Partnership, as discussed in Section VII.C.

\footnote{45}Reimbursement of costs for full-vehicle replacement may be limited to those elements that lead to emission reductions.\footnote{46} 23 U.S.C. §149(f) (SAFETEA-LU §1808(d))\footnote{47} 23 U.S.C. §149(b)(7) (SAFETEA-LU §1808(b))
13. Idle Reduction

Idle reduction projects that reduce emissions and are located within, or in proximity to and primarily benefiting, a nonattainment or maintenance area are eligible for CMAQ investment (The geographic requirement mainly applies to off-board projects, i.e. truck stop electrification (TSE) efforts). However, if CMAQ funding is used for an on-board project (i.e. auxiliary power units, direct fired heaters, etc.) the vehicle—usually a heavy-duty truck—should travel within, or in proximity to and primarily benefiting, a nonattainment or maintenance area.

There have been several instances where operating assistance funds have been requested for TSE services. CMAQ funding to date for TSE projects has been limited to capital costs (i.e. deployment of TSE infrastructure). Operating assistance for TSE projects should not be funded under the CMAQ program because TSE projects generate their own revenue stream and therefore should be able to cover all operating expenses from the accumulated revenue. See Section III.D for information on innovative financing opportunities available for these efforts.

The SAFETEA-LU also permits electrification or other idling reduction facilities and equipment to be constructed or located on rights-of-way of the Interstate system.48 Prior to the enactment of the SAFETEA-LU, this activity was prohibited. [NOTE: As mentioned earlier, the SAFETEA-LU Technical Corrections Bill removed the provision for facility construction in the Interstate ROW].

The EPA issued guidance in January 2004 on methods for calculating emissions reduction credits in SIPs and in the transportation conformity process for long-haul truck idle reduction projects. The guidance can be found at www.epa.gov/smartway/idlingimpacts.htm.

14. Training

The SAFETEA-LU provides that States and MPOs may use Federal-aid funds to support training and educational development for the transportation workforce.49 The FHWA encourages State and local officials to weigh the air quality benefits of such training against other cost-effective strategies detailed elsewhere in this guidance before using CMAQ funds for this purpose. Training funded with CMAQ dollars should be directly related to implementing air quality improvements and be approved in advance by the FHWA Division office.

15. Inspection/Maintenance (I/M) Programs

Funds under the CMAQ program may be used to establish either publicly or privately owned I/M facilities. Eligible activities include construction of facilities, purchase of equipment, I/M program development, and one-time start-up activities, such as updating quality assurance software or developing a mechanic training curriculum. The I/M

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48 23 U.S.C. §111(d) (SAFETEA-LU §1412)
49 23 U.S.C. §504(e) (SAFETEA-LU §5204(e))
program must constitute new or additional efforts, \(^{50}\) existing funding (including inspection fees) should not be displaced, and operating expenses are eligible for three years.

*Privately Owned I/M Facilities*

In States that rely on privately owned I/M facilities, State or local I/M program-related administrative costs may be funded under the CMAQ program as in States that use public I/M facilities. However, CMAQ support to establish I/M facilities at privately owned stations, such as service stations that own the equipment and conduct emission test-and-repair services, requires a public-private partnership (See Section VII.C.).

The establishment of "portable" I/M programs, including remote sensing, is also eligible under the CMAQ program, provided that they are public services, reduce emissions, and do not conflict with statutory I/M requirements or EPA regulations.

16. Experimental Pilot Projects

State and local organizations have experimented with various types of transportation services to better meet the travel needs of their constituents. These "experimental" projects may show promise in reducing emissions, but do not yet have supporting data. The FHWA has supported and funded some of these projects as demonstrations to determine their benefits and costs. These experimental pilots are not intended to bypass the definition of basic project eligibility but seek to better define the projects’ future role in strategies to reduce emissions.

For a project or program to qualify as an experimental pilot, it should be defined as a transportation project and be expected to reduce emissions by decreasing vehicle miles traveled (VMT), fuel consumption, congestion, or by other factors. The FHWA encourages States and MPOs to creatively address their air quality problems and to experiment with new services, innovative financing arrangements, public-private partnerships, and complementary approaches that use transportation strategies to reach clean air goals. The CMAQ program may be used to support a well-conceived project even if the proposal may not fully meet the eligibility criteria of this guidance.

Given the untried nature of these pilot projects, before-and-after studies should be completed to determine actual project impacts on air quality as measured by net emissions reduced. These assessments should document the project’s immediate impacts in addition to long-term benefits. A schedule for completing the study should be a part of the project agreement. Completed studies should be submitted to the FHWA Division office within three years of implementation of the project or one year after the project’s completion, whichever is sooner.

**VIII. PROJECT SELECTION PROCESS-GENERAL CONDITIONS**

\(^{50}\) 23 U.S.C. §149(b)
Proposals for CMAQ funding should include a precise description of the project, providing information on its size, scope, location, and timetable. Also, an assessment of the project’s expected emission reduction benefits should be completed prior to project selection to better inform the selection of CMAQ projects (See Below).

A. Air Quality Analysis

1. Quantitative Analyses

Quantified emissions benefits (i.e., emissions reductions) and disbenefits (i.e., emissions increases) should be included in all project proposals, except where it is not possible to quantify emissions benefits (see Qualitative Assessment, below). Benefits and disbenefits should be included for all pollutants for which the area is in nonattainment or maintenance status and should include appropriate precursor emissions. Benefits should be listed in a consistent fashion (i.e., kg/day) across projects to allow accurate comparison during the project selection process. Net benefits from all emissions sources involved should be included in the analysis. For example, in analyzing a commuter rail project, net benefits would include emissions reductions from the auto trips avoided, and emissions increases tied to locomotive operation.

State and local transportation and air quality agencies conduct CMAQ-project air quality analyses with different approaches, analytical capabilities, and technical expertise. The SAFETEA-LU encourages State DOTs and MPOs to consult with State and local air quality agencies about the estimated emission reductions from CMAQ proposals. However, while no single method is specified, every effort must be taken to ensure that determinations of air quality benefits are credible and based on a reproducible and logical analytical procedure.

2. Qualitative Assessment

Although quantitative analysis of air quality impacts is expected for almost all project types, an exception will be made when it is not possible to accurately quantify emissions benefits. In these cases, qualitative assessments based on reasoned and logical determinations that the projects or programs will decrease emissions and contribute to attainment or maintenance of a NAAQS are acceptable.

Public education, marketing, and other outreach efforts, which can include advertising alternatives to SOV travel, employer outreach, and public education campaigns, may fall into this category. The primary benefit of these activities is enhanced communication and outreach that is expected to influence travel behavior, and thus air quality.

3. Analyzing Groups of Projects

In some situations, it may be more appropriate to examine the impacts of comprehensive strategies to improve air quality by grouping projects. For example, transit improvements

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51 23 U.S.C. §149(e) (SAFETEA-LU §1808(e))
52 23 U.S.C. §149(b)(1); (SAFETEA-LU §1808(b))
coupled with demand management to reduce SOV use in a corridor might best be analyzed together. Other examples include linked signalization projects, transit improvements, marketing and outreach programs, and ridesharing programs that affect an entire region or corridor.

4. Tradeoffs

As noted above, emissions benefits should be calculated for all pollutants for which an area is in nonattainment or maintenance status. Some potential projects may lead to benefits for one pollutant and increased emissions for another, especially when the balance involves precursors such as NOx and VOC. States and MPOs should consult with relevant air agencies to weigh the net benefits of the project.

IX. PROGRAM ADMINISTRATION

A. Project Selection—MPO and State Responsibilities

CMAQ projects are selected by the State or the MPO. MPOs, State DOTs, and transit agencies should develop CMAQ project selection processes in accordance with the metropolitan and/or statewide planning process. The selection process should involve State and/or local transportation and air quality agencies. This selection process provides an opportunity for States and/or local agencies to present a case for the selection of eligible projects that will best use CMAQ funding to meet the requirements and advance the goals of the Clean Air Act.

The CMAQ project selection process should be transparent, in writing, and publicly available. The process should identify the agencies involved in rating proposed projects, clarify how projects are rated, and name the committee or group responsible for making the final recommendation to the MPO board or other approving body. The selection process should also clearly identify the basis for rating projects, including emissions benefits, cost effectiveness, and any other ancillary selection factors such as congestion relief, greenhouse gas reductions, safety, system preservation, access to opportunity, sustainable development and freight, reduced SOV reliance, multi-modal benefits, and others. At a minimum, projects should be identified by year and proposed funding source.

Close coordination is encouraged between the State and MPO to ensure that CMAQ funds are used appropriately and to maximize their effectiveness in meeting the CAA requirements. While the program of projects is being developed, the State or MPO should consult with FHWA and FTA to resolve any questions about eligibility. This will ensure that the projects programmed for CMAQ funding in the TIP are all eligible.

States and MPOs should fulfill this responsibility so that nonattainment and maintenance areas are able to make good-faith efforts to attain and maintain the NAAQS by the prescribed deadlines. State DOTs and MPOs should consult with State and local air quality agencies to develop an appropriate project list of CMAQ programming priorities that will have the greatest impact on air quality. In developing this list, MPOs and States should evaluate the cost-effectiveness of the projects and give priority consideration to those that will create the greatest emissions reductions for the least cost. The SAFETEA-LU calls out diesel retrofits as one type of cost-effective project to which priority consideration shall be given. The EPA has conducted
a study of the cost-effectiveness of diesel retrofits in reducing PM, NOx, and VOC emissions. In addition, the National Academy of Science’s Transportation Research Board has evaluated the cost-effectiveness of other CMAQ eligible projects, with a focus on NOx and HC reductions. This study can be found at http://www.fhwa.dot.gov/environment/cmaqpgs/index.htm. Information on the cost-effectiveness of CMAQ-eligible projects can be used as a guidepost in evaluating the different types of projects under consideration by an MPO or State. However, cost-effectiveness ultimately will depend on local conditions and project specific factors that affect emission reductions and costs.

B. Federal Agency Responsibilities and Coordination

1. Eligibility Determinations

The FTA determines the eligibility of transit projects, and the FHWA determines the eligibility of all other projects. The FHWA, FTA, and EPA field offices should establish and maintain a consultation and coordination process to review CMAQ funding proposals as needed. While the eligibility determination is not made jointly, every effort should be made to satisfy the concerns raised by the agencies’ field offices. The FHWA or FTA field offices may request additional information from the State or MPO to help determine eligibility. The consultation process should provide for timely review and handling of CMAQ funding proposals. The FHWA and FTA headquarters offices are available to consult with their field offices on eligibility determinations.

2. Program Administration

The FHWA Division offices and the FTA Regional offices are responsible for administering the CMAQ program. In general, the FHWA transfers funds to the FTA to administer CMAQ-funded transit projects. In cases where the FTA lacks statutory authority (e.g., school bus fleets), the FHWA will administer the transit project. For projects that involve transit and non-transit elements, such as park-and-ride lots and intermodal passenger projects, the administering agency is decided on a case-by-case basis. All other projects are administered by the FHWA.

3. Tracking Mandatory/Flexible Funds

The FHWA Division office is responsible for tracking obligation of mandatory and flexible CMAQ funds in appropriate areas (See Section V.B.).

C. Annual Reports

States should prepare annual reports detailing how CMAQ funds have been invested. CMAQ reporting is not only useful for the FHWA, the FTA, and the general public, but maintenance of a cumulative database of all CMAQ projects is required by SAFETEA-LU. In addition, the annual reports will be key in developing the CMAQ Evaluation and Assessment, a major research effort designed to gauge the impact of the program, and also required by the statute.54

54 23 U.S.C. §149(h) (SAFETEA-LU §1808(f))
CMAQ annual reports should be submitted through the web-based CMAQ Tracking System. More information on the CMAQ system is available at: [http://www.fhwa.dot.gov/environment/cmaqpgs/usersguidemail.htm](http://www.fhwa.dot.gov/environment/cmaqpgs/usersguidemail.htm).

The FHWA Division offices, State DOTs, and MPOs should develop a process for entering and approving the data in a timely manner. This report should be approved by the FHWA Division office by the first day of March following the end of the previous Federal fiscal year (September 30) and cover all CMAQ obligations for that fiscal year. Thus, State DOTs and MPOs should report the data early enough that the Division office has time to review and comment on the report. The report as entered into the CMAQ Tracking System should include:

1. A list of projects funded under CMAQ, in seven main project categories:
   - **Transit**: facilities, vehicles, and equipment, operating assistance for new transit service, etc. Include all transit projects whether administered by the FTA or the FHWA
   - **Shared Ride**: vanpool and carpool programs and parking for shared-ride services
   - **Traffic Flow Improvements**: traffic management and control services, signalization projects, ITS projects, intersection improvements, and construction or dedication of HOV lanes
   - **Demand Management**: trip reduction programs, transportation management plans, flexible work schedule programs, vehicle restriction programs
   - **Pedestrian/Bicycle**: bikeways, storage facilities, promotional activities
   - **I/M and other TCMs**: projects not covered by the above categories
   - **STP/CMAQ**: projects funded with flexible funds

   For reporting purposes, obligations for all CMAQ-eligible phases (beginning with the NEPA process) should be reported for the project they support.

2. The amount of CMAQ funds obligated or deobligated for each project during the Federal fiscal year. Enter deobligations as a negative number. (Do not include Advance Construct funds, as these are not obligations of federal CMAQ funds. Such projects should be reported later when converted to CMAQ funds.)

3. Emissions benefits (and disbenefits) for each project developed from project-level analyses. Report projected emissions benefits expected to occur in the first year that a project is fully operational, in kilograms reduced per day. Benefits should be reported the first time a project is entered into the system, and only then to avoid double counting of benefits. (Because funds may be obligated for a project over several years, an individual CMAQ project may show up in reports for multiple years.) Additionally, address all pollutants for which the area is in nonattainment or maintenance status. Do not enter emissions benefits for deobligations or projects funded with flexible funds (STP/CMAQ).

4. Public-private partnerships and experimental pilot projects should be identified in the system. Transmit electronic versions of completed before-and-after studies for experimental pilot projects to the Division offices (See Section VII.D.16., Experimental Pilot Projects).
5. Other required information: MPO, nonattainment/maintenance area, project description.

6. Optional information: TIP, State and/or FMIS project numbers—highly recommended. Other optional information includes: greenhouse gas emission reductions, cost effectiveness, safety, congestion relief, and other ancillary benefits.
§ 149. Congestion mitigation and air quality improvement program
(a) Establishment.— The Secretary shall establish and implement a congestion mitigation and air quality improvement program in accordance with this section.
(b) Eligible Projects.— Except as provided in subsection (c), a State may obligate funds apportioned to it under section 104 (b)(2) for the congestion mitigation and air quality improvement program only for a transportation project or program if the project or program is for an area in the State that is or was designated as a nonattainment area for ozone, carbon monoxide, or particulate matter under section 107(d) of the Clean Air Act (42 U.S.C. 7407(d)) and classified pursuant to section 181(a), 186(a), 188(a), or 188(b) of the Clean Air Act (42 U.S.C. 7511(a), 7512(a), 7513(a), or 7513(b)) or is or was designated as a nonattainment area under such section 107(d) after December 31, 1997, or is required to prepare, and file with the Administrator of the Environmental Protection Agency, maintenance plans under the Clean Air Act (42 U.S.C. 7401 et seq.) and—
(1)(A)(i) if the Secretary, after consultation with the Administrator determines, on the basis of information published by the Environmental Protection Agency pursuant to section 108(f)(1)(A) of the Clean Air Act (other than clause (xvi)) that the project or program is likely to contribute to—
(I) the attainment of a national ambient air quality standard; or
(II) the maintenance of a national ambient air quality standard in a maintenance area; and
(ii) a high level of effectiveness in reducing air pollution, in cases of projects or programs where sufficient information is available in the database established pursuant to subsection (h) to determine the relative effectiveness of such projects or programs; or,
(B) in any case in which such information is not available, if the Secretary, after such consultation, determines that the project or program is part of a program, method, or strategy described in such section 108(f)(1)(A);
(2) if the project or program is included in a State implementation plan that has been approved pursuant to the Clean Air Act and the project will have air quality benefits;
(3) the Secretary, after consultation with the Administrator of the Environmental Protection Agency, determines that the project or program is likely to contribute to the attainment of a national ambient air quality standard, whether through reductions in vehicle miles traveled, fuel consumption, or through other factors;
(4) to establish or operate a traffic monitoring, management, and control facility or program if the Secretary, after consultation with the Administrator of the Environmental Protection Agency, determines that the facility or program, including advanced truck stop electrification systems, is likely to contribute to the attainment of a national ambient air quality standard; (removed “or”)
(5) if the program or project improves traffic flow, including projects to improve signalization, construct high occupancy vehicle lanes, improve intersections, improve transportation systems management and operations that mitigate congestion and improve air quality, and implement intelligent transportation system strategies and such other projects that are eligible for assistance under this section on the day before the date of enactment of this paragraph;
(6) if the project or program involves the purchase of integrated, interoperable emergency communications equipment; or
(7) if the project or program is for—
(A) the purchase of diesel retrofits that are—
   (i) for motor vehicles (as defined in section 216 of the Clean Air Act (42 U.S.C. 7550));
   or
   (ii) published in the list under subsection (f)(2) for non-road vehicles and non-road engines (as defined in section 216 of the Clean Air Act (42 U.S.C. 7550)) that are used in construction projects that are—
      (I) located in nonattainment or maintenance areas for ozone, PM_{10}, or PM_{2.5} (as defined under the Clean Air Act (42 U.S.C. 7401 et seq.)); and
      (II) funded, in whole or in part, under this title; or
   (B) the conduct of outreach activities that are designed to provide information and technical assistance to the owners and operators of diesel equipment and vehicles regarding the purchase and installation of diesel retrofits.

No funds may be provided under this section for a project which will result in the construction of new capacity available to single occupant vehicles unless the project consists of a high occupancy vehicle facility available to single occupant vehicles only at other than peak travel times. In areas of a State which are nonattainment for ozone or carbon monoxide, or both, and for PM–10 resulting from transportation activities, the State may obligate such funds for any project or program under paragraph (1) or (2) without regard to any limitation of the Department of Transportation relating to the type of ambient air quality standard such project or program addresses.

(c) States Receiving Minimum Apportionment.—
(1) States without a nonattainment area.— If a State does not have, and never has had, a nonattainment area designated under the Clean Air Act (42 U.S.C. 7401 et seq.), the State may use funds apportioned to the State under section 104 (b)(2) for any project in the State that—
   (A) would otherwise be eligible under this section as if the project were carried out in a nonattainment or maintenance area; or
   (B) is eligible under the surface transportation program under section 133.

(2) States with a nonattainment area.— If a State has a nonattainment area or maintenance area and receives funds under section 104 (b)(2)(D) above the amount of funds that the State would have received based on its nonattainment and maintenance area population under subparagraphs (B) and (C) of section 104 (b)(2), the State may use that portion of the funds not based on its nonattainment and maintenance area population under subparagraphs (B) and (C) of section 104 (b)(2) for any project in the State that—
   (A) would otherwise be eligible under this section as if the project were carried out in a nonattainment or maintenance area; or
   (B) is eligible under the surface transportation program under section 133.

(d) Applicability of Planning Requirements.— Programming and expenditure of funds for projects under this section shall be consistent with the requirements of sections 134 and 135 of this title.

(e) Partnerships With Nongovernmental Entities.—
(1) In general.— Notwithstanding any other provision of this title and in accordance with this subsection, a metropolitan planning organization, State transportation department, or other project sponsor may enter into an agreement with any public, private, or nonprofit entity to cooperatively implement any project carried out under this section.
   (2) Forms of participation by entities.— Participation by an entity under paragraph (1) may consist of—
(A) ownership or operation of any land, facility, vehicle, or other physical asset
associated with the project;
(B) cost sharing of any project expense;
(C) carrying out of administration, construction management, project management,
project operation, or any other management or operational duty associated with the project; and
(D) any other form of participation approved by the Secretary.

(3) Allocation to entities.— A State may allocate funds apportioned under section 104
(b)(2) to an entity described in paragraph (1).

(4) Alternative fuel projects.— In the case of a project that will provide for the use of
alternative fuels by privately owned vehicles or vehicle fleets, activities eligible for funding
under this subsection—

(A) may include the costs of vehicle refueling infrastructure, including infrastructure that
would support the development, production, and use of emerging technologies that reduce
emissions of air pollutants from motor vehicles, and other capital investments associated with the
project;
(B) shall include only the incremental cost of an alternative fueled vehicle, as compared
to a conventionally fueled vehicle, that would otherwise be borne by a private party; and
(C) shall apply other governmental financial purchase contributions in the calculation of
net incremental cost.

(5) Prohibition on federal participation with respect to required activities.— A Federal
participation payment under this subsection may not be made to an entity to fund an obligation
imposed under the Clean Air Act (42 U.S.C. 7401 et seq.) or any other Federal law.

(f) Cost-Effective Emission Reduction Guidance.—

(1) Definitions.—In this subsection, the following definitions apply:

(A) Administrator.—The term `Administrator' means the Administrator of the
Environmental Protection Agency.

(B) Diesel retrofit.—The term `diesel retrofit' means a replacement, repowering,
rebuilding, after treatment, or other technology, as determined by the Administrator.

(2) Emission reduction guidance.—The Administrator, in consultation with the
Secretary, shall publish a list of diesel retrofit technologies and supporting technical information
for—

(A) diesel emission reduction technologies certified or verified by the Administrator, the
California Air Resources Board, or any other entity recognized by the Administrator for the
same purpose;
(B) diesel emission reduction technologies identified by the Administrator as having an
application and approvable test plan for verification by the Administrator or the California Air
Resources Board that is submitted not later than 18 months of the date of enactment of this
subsection;
(C) available information regarding the emission reduction effectiveness and cost
effectiveness of technologies identified in this paragraph, taking into consideration air quality
and health effects.

(3) Priority.—

(A) In general.—States and metropolitan planning organizations shall give priority in
distributing funds received for congestion mitigation and air quality projects and programs from
apportionments derived from application of sections 104(b)(2)(B) and 104(b)(2)(C) to—

(i) diesel retrofits, particularly where necessary to facilitate contract compliance, and
other cost-effective emission reduction activities, taking into consideration air quality and health
effects; and
(ii) cost-effective congestion mitigation activities that provide air quality benefits.

(B) Savings.—This paragraph is not intended to disturb the existing authorities and roles of governmental agencies in making final project selections.

(4) No effect on authority or restrictions.—Nothing in this subsection modifies or otherwise affects any authority or restriction established under the Clean Air Act (42 U.S.C. 7401 et seq.) or any other law (other than provisions of this title relating to congestion mitigation and air quality).

(g) Interagency Consultation.—The Secretary shall encourage States and metropolitan planning organizations to consult with State and local air quality agencies in nonattainment and maintenance areas on the estimated emission reductions from proposed congestion mitigation and air quality improvement programs and projects.

(h) Evaluation and Assessment of Projects.—

(1) In general.—The Secretary, in consultation with the Administrator of the Environmental Protection Agency, shall evaluate and assess a representative sample of projects funded under the congestion mitigation and air quality program to—

(A) determine the direct and indirect impact of the projects on air quality and congestion levels; and

(B) ensure the effective implementation of the program.

(2) Database.—Using appropriate assessments of projects funded under the congestion mitigation and air quality program and results from other research, the Secretary shall maintain and disseminate a cumulative database describing the impacts of the projects.

(3) Consideration.—The Secretary, in consultation with the Administrator, shall consider the recommendations and findings of the report submitted to Congress under section 1110(e) of the Transportation Equity Act for the 21st Century (112 Stat. 144), including recommendations and findings that would improve the operation and evaluation of the congestion mitigation and air quality improvement program.
SAFETEA-LU Section 1808: Additional Provisions

The following provisions were included in the SAFETEA-LU Section 1808. These provisions do not amend 23 U.S.C. and therefore sunset when the SAFETEA-LU expires. To avoid confusion, they are presented here separate from the rest of the statutory text.

(g) Flexibility in the State of Montana.—The State of Montana may use funds apportioned under section 104(b)(2) of title 23, United States Code, for the operation of public transit activities that serve a nonattainment or maintenance area.

(h) Availability of Funds for State of Michigan.—The State of Michigan may use funds apportioned under section 104(b)(2) of such title for the operation and maintenance of intelligent transportation system strategies that serve a nonattainment or maintenance area.

(i) Availability of Funds for the State of Maine.—The State of Maine may use funds apportioned under section 104(b)(2) of such title to support, through September 30, 2009, the operation of passenger rail service between Boston, Massachusetts, and Portland, Maine.

(j) Availability of Funds for Oregon.—The State of Oregon may use funds apportioned on or before September 30, 2009, under section 104(b)(2) of such title to support the operation of additional passenger rail service between Eugene and Portland.

(k) Availability of Funds for Certain Other States.—The States of Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, and Ohio may use funds apportioned under section 104(b)(2) of such title to purchase alternative fuel (as defined in section 301 of the Energy Policy Act of 1992 (42 U.S.C. 13211)) or biodiesel.
APPENDIX 2: 23 U.S.C. §104(b)(2) APPORTIONMENT

(2) Congestion mitigation and air quality improvement program.—
   (A) In general.—For the congestion mitigation and air quality improvement program, in the ratio that—
      (i) the total of all weighted nonattainment and maintenance area populations in each State; bears to
      (ii) the total of all weighted nonattainment and maintenance area populations in all States.
   (B) Calculation of weighted nonattainment and maintenance area population.—Subject to subparagraph (C), for the purpose of subparagraph (A), the weighted nonattainment and maintenance area population shall be calculated by multiplying the population of each area in a State that was a nonattainment area or maintenance area as described in section 149(b) for ozone or carbon monoxide by a factor of—
      (i) 1.0 if, at the time of apportionment, the area is a maintenance area;
      (ii) 1.0 if, at the time of the apportionment, the area is classified as a marginal ozone nonattainment area under subpart 2 of part D of title I of the Clean Air Act (42 U.S.C. 7511 et seq.);
      (iii) 1.1 if, at the time of the apportionment, the area is classified as a moderate ozone nonattainment area under such subpart;
      (iv) 1.2 if, at the time of the apportionment, the area is classified as a serious ozone nonattainment area under such subpart;
      (v) 1.3 if, at the time of the apportionment, the area is classified as a severe ozone nonattainment area under such subpart;
      (vi) 1.4 if, at the time of the apportionment, the area is classified as an extreme ozone nonattainment area under such subpart;
      (vii) 1.0 if, at the time of the apportionment, the area is not a nonattainment or maintenance area as described in section 149(b) for ozone, but is classified under subpart 3 of part D of title I of such Act (42 U.S.C. 7512 et seq.) as a nonattainment area described in section 149(b) for carbon monoxide; or
      (viii) 1.0 if, at the time of apportionment, an area is designated as nonattainment for ozone under subpart 1 of part D of title I of such Act (42 U.S.C. 7512 et seq.).
   (C) Additional Adjustment for Carbon Monoxide Areas.—If, in addition to being designated as a nonattainment or maintenance area for ozone as described in section 149(b), any county within the area was also classified under subpart 3 of part D of title I of the Clean Air Act (42 U.S.C. 7512 et seq.) as a nonattainment or maintenance area described in section 149(b) for carbon monoxide, the weighted nonattainment or maintenance area population of the county, as determined under clauses (i) through (vii) or clause (viii) of subparagraph (B), shall be further multiplied by a factor of 1.2.
   (D) Minimum apportionment.—Notwithstanding any other provision of this paragraph, each State shall receive a minimum of 1/2 of 1 percent of the funds apportioned under this paragraph.
   (E) Determinations of population.—In determining population figures for the purposes of this paragraph, the Secretary shall use the latest available annual estimates prepared by the Secretary of Commerce.
APPENDIX 3: CONSIDERATIONS FOR DIESEL RETROFIT PROJECTS

The term diesel retrofit includes any technology or system that achieves emission reductions beyond that required by the EPA regulations at the time of engine certification. Assuming all other criteria are met, eligible diesel retrofit projects include the replacement of high-emitting vehicles/equipment with cleaner vehicles/equipment (including hybrid or alternative fuel models), repowering or engine replacement, rebuilding the engine to a cleaner standard, the purchase and installation of advanced emissions control technologies (such as particulate matter traps or oxidation catalysts) or the use of a cleaner fuel to support eligible nonroad devices. The legislation defines retrofit projects as applicable to both on-road motor vehicles and nonroad construction equipment. Retrofit strategies include:

Emissions Control Technologies
The EPA and the California Air Resources Board (CARB) have retrofit technology verification programs that evaluate the performance of advanced emissions control technologies and engine rebuild kits. CMAQ-funded diesel retrofit projects must use retrofit technologies that are verified under the EPA’s Voluntary Diesel Retrofit Program or CARB. A list of EPA-verified technologies is available at [http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm](http://www.epa.gov/otaq/retrofit/retroverifiedlist.htm). CARB’s verification program can be found at [http://www.arb.ca.gov/diesel/verdev/home/home.htm](http://www.arb.ca.gov/diesel/verdev/home/home.htm). In addition, for more detailed information on the cost-effectiveness of various diesel retrofit technologies, the EPA’s study, "The Cost-Effectiveness of Heavy-Duty Diesel Retrofits and Other Mobile Source Emission Reduction Projects and Programs" can be found at: [http://www.epa.gov/cleandiesel/publications.htm](http://www.epa.gov/cleandiesel/publications.htm)

Refueling
Refueling is eligible when combined with an overall diesel retrofit project for which the cleaner fuel is required. For example, ultra-low sulfur diesel (ULSD) may be purchased as part of a project to install diesel particulate filters on highway construction equipment only because these devices require ULSD to function properly.

Fuel-related technologies identified in EPA’s list of retrofit strategies are eligible only until standards for such clean fuel are effective. For example, ULSD is eligible for CMAQ only until the standard is effective. For on-road use, ULSD is mandated for use in October 2006. According to EPA’s regulatory development calendar, low sulfur diesel (500 ppm of sulfur) will be required for nonroad use in 2007, while ULSD (15 ppm of sulfur) will be required for nonroad use in 2010.

Vehicle/Equipment Replacement Projects
Replacement projects occur when older vehicles/equipment are replaced with cleaner vehicles/equipment before they would have been removed through normal fleet turnover or attrition. The vehicle or equipment being replaced should be scrapped or the engine remanufactured to a cleaner standard. For areas that want to take credit in the SIP and transportation conformity processes for these projects, see the EPA's retrofit guidance at: [http://www.epa.gov/otaq/stateresources/transconf/policy.htm#retrofit](http://www.epa.gov/otaq/stateresources/transconf/policy.htm#retrofit).

55 23 U.S.C. §149(b)(7) (SAFETEA-LU §1808(b))
Generally, the replacement vehicle or equipment would perform the same function as the vehicle or equipment that is being replaced (e.g., an excavator used to dig pipelines or utility trenches would be replaced by an excavator that continues these duties).

In addition, the vehicle or equipment being replaced would be in good working order and able to perform the duties of the new vehicle or equipment. Removing vehicles that no longer function or are at the end of their useful life will not lead to an emissions reduction.

Repower or Engine Replacement Projects
Engine replacement projects involve the replacement of an older, higher emitting engine with a newer, cleaner engine. Engine replacements can also be combined with emission control technologies. The engines being replaced should be scrapped or remanufactured to a cleaner standard. As noted above, for areas that want to take credit in the SIP and transportation conformity processes for these projects, see EPA's retrofit guidance at: http://www.epa.gov/otaq/stateresources/transconf/policy.htm#retrofit.

New engines also must be EPA-certified. For a complete list of all EPA certified large highway and nonroad engines, please consult the list at http://www.epa.gov/otaq/certdata.htm.

For more information on diesel retrofits, please see the EPA’s National Clean Diesel Campaign website at http://www.epa.gov/cleandiesel/.

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56 23 U.S.C. §149(b)(7) (SAFETEA-LU §1808(b))
The purpose of this message is to clarify an issue that Congressional Staffs raised related to the application of Federal, government-wide cost principles and the obligation and expenditure of Congestion Mitigation and Air Quality Improvement (CMAQ) funds for alternative fuel vehicles (AFVs). The applicable principles (2 CFR 225) require that costs be equitably allocated to benefiting cost objectives. The question at hand relates to eligibility for police cruisers designed and powered for flexible fuel. It is important that we are consistent in our interpretation on this issue.

Title 23 funds cannot be used to fund general government operations, including the acquisition of vehicles that perform such general functions, e.g. police and firefighting. Cost allocation is required between the environmental elements in which we can participate and costs of state and local governments that are not eligible for FAHP funding. In the matter first brought to our attention, the project sponsor was proposing to use full Federal share for CMAQ costs, as provided by the Energy Independence and Security Act of 2007, to purchase police cruisers designed and powered for flexible fuel use. While FHWA supports the use of alternative fuels and vehicles, we can only participate in the pro-rata share that benefits air quality. See 2 CFR 225 App. B. Selected Item of Cost, 19a(5), relating to General Government Expenses. Police and fire equipment are called out as explicit examples in this provision.

To accommodate States and other sponsors intending to avail themselves of CMAQ funds for alternative fuel efforts consistent with the Federal cost principles, FHWA may participate in the eligible portion of such vehicle purchases, limited to the marginal emissions-reducing elements of the project, e.g. the incremental cost difference between standard and AFV, the expected emissions reduction projected form AFV use, or other methodology for allocating costs to CMAQ eligible portions of the purchase. Staff is available to assist project sponsors in developing an appropriate level of eligible cost share that can be tied to an air quality benefit, and thus, allocated to the CMAQ award.

For public fleet AFVs that provide a dominant transportation function, the full vehicle is eligible for participation. These types include transit buses, paratransit, freeway courtesy vans/tow trucks, incident management patrol vehicles, and others. While these types of acquisitions could be eligible for full participation, the 100 percent CMAQ cost sharing under the Energy Act is optional at the discretion of the State DOT.

Should your State DOT or other local project sponsor develop a cost sharing approach, we are available for review and discussion. Please consult with Michael Koontz, CMAQ program manager on my staff, or David Bruce in the Office of the Chief Financial Officer. Mr. Koontz can be reached via email at michael.koontz@dot.gov or phone at (202) 366-2076 and Mr. Bruce at david.bruce@dot.gov or (802) 828-4567.
The guidance contained in this document is intended to be nonbinding, except insofar as it references existing statutory requirements. In this guidance document, the use of mandatory language such as “shall,” “must,” “required,” or “requirement” is only used to reflect statutory or regulatory mandates and does not create new requirements. This guidance does not create or confer any rights for or on any person and should not be construed as rules of general applicability and legal effect.
I. INTRODUCTION

The Congestion Mitigation and Air Quality Improvement Program (CMAQ) was created under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 19911, and reauthorized under the Transportation Equity Act for the 21st Century (TEA-21)2, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)3, and, most recently, the Moving Ahead for Progress in the 21st Century Act (MAP-21).4 Through Fiscal Year (FY) 2012, the CMAQ program has supported nearly 28,000 transportation projects across the country, accounting for nearly $30 billion in transportation investments since its inception in 1992.

This guidance replaces the October 2008 edition and provides information on the CMAQ program, including:

- Authorization levels and apportionment changes specific to the MAP-21
- Flexibility and transferability provisions available to States
- Geographic area eligibility for CMAQ funds
- Project eligibility information
- Project selection processes
- Program administration
- Annual reporting
- Performance management

The guidance has been prepared by the Air Quality and Transportation Conformity Team in Federal Highway Administration’s (FHWA) Office of Natural Environment, in cooperation with the Federal Transit Administration’s (FTA) Office of Planning and Environment.

II. PROGRAM PURPOSE

The purpose of the CMAQ program is to fund transportation projects or programs that will contribute to attainment or maintenance of the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide (CO), and particulate matter (both PM$_{10}$ and PM$_{2.5}$).5

The CMAQ program supports two important goals of the U.S. Department of Transportation (Department): improving air quality and relieving congestion. While these goals are not new elements of the program, they were strengthened in the SAFETEA-LU and further bolstered in provisions added to the MAP-21.

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1 Sec. 1008, Pub. L. 102-240 (December 18, 1991).
2 Sec. 1110, Pub. L. 105-178 (June 9, 1998).
3 Sec. 1808, Pub. L. 109-59 (August 10, 2005).
4 Sec. 1113, Pub. L. 112-141, (July 6, 2012).
5 PM$_{10}$ refers to particulate matter 10 microns or less in diameter; PM$_{2.5}$ refers to 2.5 microns or less.
Reducing pollution and other adverse environmental effects of transportation projects and transportation system inefficiency have been long-standing objectives of the Department. The strategic plans for the Department and for the FHWA both include initiatives specifically focused on reducing air pollution from transportation sources. The CMAQ program provides funding for a broad array of tools to accomplish these goals. By choosing to fund or sponsor a CMAQ project, a State or local government, transit agency, or other eligible project sponsor can improve air quality and make progress toward achieving attainment status and ensuring compliance with the transportation conformity provisions of the Clean Air Act (CAA).  

Growing highway congestion continues to rise at a faster rate than transportation investments. Reducing congestion is a key objective of the Department, and one that has gathered increasing importance in the past several years. The costs of congestion can be an obstacle to economic activity. In addition, congestion can hamper quality of life through diminished air quality, lost personal time, and other negative factors.

Since some congestion relief projects also reduce idling, the negative emissions impacts of “stop and go” driving, and the number of vehicles on the road, they have a corollary benefit of improving air quality. Based on their emissions reductions, these types of projects are eligible for CMAQ funding. The Department believes State and local governments can simultaneously reduce the costly impacts of congestion while also improving air quality.

III. AUTHORIZATION LEVELS UNDER THE MAP-21

A. Authorization Levels

The MAP-21 covers FY 2013 and FY 2014. Total apportioned Federal-aid highway program authorization is $37.40 billion for FY 2013 and just under $37.8 billion for FY 2014. Table 1 shows the MAP-21 CMAQ levels by fiscal year. The CMAQ funds will be apportioned to States each year based upon a modified process established in the legislation and codified at 23 U.S.C. 104 (See Section V discussion of Apportionment).

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6 42 U.S.C. 7506 (Section 176(c) of the CAA). The CAA (42 U.S.C. 7401–7671q) consists of Pub. L. 84-159, 69 Stat. 322 (July 14, 1955); and subsequent amendments.

7 Sec. 1101, Pub. L. 112-141 (July 6, 2012). Section 149(m) of title 23, United States Code, states that “[a] State may obligate funds apportioned under section 104(b)(2) [of Title 23] . . . .” FHWA has interpreted the reference to section 104(b)(2), which is the Surface Transportation Program, as a drafting error. Under prior law, section 104(b)(2) was the funding authorization for the CMAQ program, and MAP-21 placed CMAQ funding in section 104(b)(4). The FHWA intends to apply section 149(m) as though the reference read “funds apportioned under section 104(b)(4) . . . .”
### TABLE 1

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Amount</th>
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<tr>
<td>FY 2013</td>
<td>$2.20 Billion (actual)</td>
</tr>
<tr>
<td>FY 2014</td>
<td>$2.23 Billion (estimated)</td>
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</tbody>
</table>

**B. Transferability of CMAQ Funds**

Since transportation and environmental program priorities fluctuate, States have been able to transfer a limited amount of their CMAQ apportionment. The MAP-21 changed the transfer provisions for CMAQ considerably, as the legislation amended 23 U.S.C. 126, *Uniform transferability of Federal-aid highway funds.*\(^8\) Prior to MAP-21, State transfer of CMAQ funds to other elements of the Federal-aid highway program was subject to a specific statutory process that served to limit such annual transfer flexibility to approximately 20 percent of a State’s overall CMAQ funds (the percentage varied somewhat by State). Through MAP-21, the unique transfer process required for CMAQ has been removed, and the standard provisions of 23 U.S.C. 126 now apply, i.e. subject to certain adjustments, up to 50 percent of apportioned program funds can be transferred each year from program funds eligible for transfer. For CMAQ, the apportioned funds eligible for transfer will not include the statutory PM\(_{2.5}\) priority set-aside, which is discussed later in the guidance (Section V.C.). This interpretation gives meaning to both the statutory transfer language in Section 126 and to the PM\(_{2.5}\) priority established by Congress in 23 U.S.C. 149(k). This safeguarding of PM\(_{2.5}\) set-aside funds from transfer does not affect the ability of a State to transfer up to 50 percent of its CMAQ funds to another apportioned program.

The FHWA’s Chief Financial Officer will issue a detailed memorandum covering these and other transfer provisions encompassing the full Federal-aid highway program, including guidance on program-specific transfer requirements, limitations, process and logistics, and other factors associated with Federal-aid transfer.

### IV. COST-EFFECTIVENESS AND PRIORITY USE OF CMAQ FUNDS

The SAFETEA-LU directed States and Metropolitan Planning Organizations (MPOs) to give priority to cost-effective projects, including diesel retrofits and congestion-mitigation efforts that also produced an air quality benefit. The MAP-21 continues and expands the focus on efficiency and cost-effective project selection.\(^9\) The new legislation also calls for the Department, in consultation with the Environmental Protection Agency (EPA), to develop a series of graphs or tables that illustrate the cost-effectiveness of a cross section of

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\(^8\) 23 U.S.C. 126(a), as amended by Sec. 1509, Pub. L. 112-141 (July 6, 2012).

\(^9\) 23 U.S.C. 149(g), as amended by Sec. 1113(b)(5), Pub. L. 112-141 (July 6, 2012).
eligible project types. These tables are intended to inform States, MPOs, and other project sponsors on the air quality benefits derived from a variety of project types compared to the investment required. The tables are intended to be a resource for State and local planners as they consider CMAQ investments and the emissions reduction needs in the areas covering their programs.

A number of other resources are available to assist with development of the cost-effectiveness tables. In 2009, the FHWA published *SAFETEA-LU 1808: CMAQ Evaluation and Assessment*, a two-phase progress report on the program that was required by Section 1808 of the legislation. The EPA released a guidance document, *The Cost Effectiveness of Heavy-Duty Diesel Retrofits and Other Mobile Source Emission Reduction Projects and Programs*, which provides cost-effectiveness data on diesel engine retrofit technologies and other CMAQ-eligible activities. In addition, the Transportation Research Board published *The Congestion Mitigation and Air Quality Improvement Program: Assessing 10 Years of Experience* in 2002, providing estimates of costs, changes in vehicle miles travelled (VMT), emission reductions, and other benefits. Private industry provides a variety of other cost-effectiveness studies and graphics that focuses on specific service sectors, such as heavy-duty diesel equipment, alternative fuels, and others.

While no single cost-effectiveness document or table is required to establish State or local programs, project selection should reflect the positive cost-effectiveness relationships highlighted in these guidance documents. State and local transportation programs that implement a broad array of these cost-effective measures may record a more rapid rate of progress toward their clean air goals, since many of these endeavors generate immediate benefits. Local procedures that elevate the importance of these efforts in project selection—and rate them accordingly—may accelerate the drive to air quality attainment. Based on MAP-21, States and other sponsors are expected to record cost-effectiveness analyses in their CMAQ annual reports to the extent they have been providing such information.

In addition to the MAP-21 priority on cost-effectiveness, Section 176(c) of the CAA requires that the FHWA and FTA ensure timely implementation of transportation control measures (TCMs) in applicable State Implementation Plans (SIPs). These and other CMAQ-eligible projects identified in approved SIPs should receive funding priority.

The FHWA recommends that States and MPOs develop their transportation/air quality programs using complementary measures that provide alternatives to single-occupant vehicle (SOV) travel while improving traffic flow through operational strategies and balancing supply and demand through pricing, parking management, regulatory, or other

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14 23 U.S.C. 149(i)(1)(A), as amended by Sec. 1113(b)(6)).
15 42 U.S.C. 7506(c)(2)(B) (Section 176 of the CAA).
V. ANNUAL APPORTIONMENT PROCESS FOR CMAQ FUNDS

A. State Federal-aid Apportionment

The MAP-21 establishes that for the apportioned Federal-aid highway program, the combined total for each State in FY 2013 shall equal the combined total apportioned for that State for FY 2012. In FY 2014, a similar process will be followed with the exception that no State shall receive less than 95 percent of the estimated tax payments in that State that were provided to the Highway Trust Fund.\textsuperscript{16}

B. CMAQ Apportionment

Under ISTEA, TEA-21, and SAFETEA-LU, funding apportionments for each State were calculated based on a formula for weighted populations in ozone and CO nonattainment and maintenance areas. Unlike previous legislation, MAP-21 does not contain a specific statutory distribution formula for CMAQ apportionment. Under 23 U.S.C. 104(b)(4), as amended by Section 1105 of MAP-21, CMAQ apportionments are determined using a ratio of the State’s FY 2009 CMAQ funding relative to the State’s total apportioned Federal-aid for that year. The resulting ratio applies to both FY 2013 and FY 2014 CMAQ apportionments. The FY 2009 apportionment was calculated with the statutory formula from SAFETEA-LU. Therefore, the weighting factors from SAFETEA-LU, shown in Table 2, have been carried forward through MAP-21’s use of the 2009 apportionments to set the FY 2013 and 2014 apportionments. The CMAQ apportionment for FY 2013 is $2.20 billion; for FY 2014, apportionment is estimated at $2.23 billion.\textsuperscript{17}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{POLLUTANT} & \textbf{CLASSIFICATION AT THE TIME OF ANNUAL APPORTIONMENT} & \textbf{WEIGHTING FACTOR} \\
\hline
Ozone (O\textsubscript{3}) or (CO) & Maintenance (these areas had to be previously eligible as nonattainment areas - See Section VI.) & 1.0 \\
\hline
Ozone & Subpart 1 ("Basic")\textsuperscript{18} & 1.0 \\
\hline
Ozone & Marginal & 1.0 \\
\hline
Ozone & Moderate & 1.1 \\
\hline
\end{tabular}
\caption{SAFETEA-LU CMAQ APPORTIONMENT FACTORS}
\end{table}

\textsuperscript{16} 23 U.S.C. 104(c), as amended by Sec. 1105(a), Pub. L. 112-141 (July 6, 2012).
\textsuperscript{17} 23 U.S.C. 104(b)(4), as amended by Sec. 1105(a), Pub. L. 112-141 (July 6, 2012).
\textsuperscript{18} Subpart 1 classification carried under SAFETEA-LU since removed by EPA rulemaking, see 77 FR 28424 (May 14, 2012), available at \url{http://www.gpo.gov/fdsys/pkg/FR-2012-05-14/pdf/2012-11232.pdf#page=2}. 
November 12, 2013

<table>
<thead>
<tr>
<th>Pollutant</th>
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</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Ozone</td>
<td>Severe</td>
<td>1.3</td>
</tr>
<tr>
<td>Ozone</td>
<td>Extreme</td>
<td>1.4</td>
</tr>
<tr>
<td>CO</td>
<td>Nonattainment</td>
<td>1.0</td>
</tr>
<tr>
<td>Ozone and CO</td>
<td>Ozone nonattainment or maintenance and CO nonattainment or maintenance</td>
<td>1.2 x O₃ factor</td>
</tr>
<tr>
<td>All States – minimum apportionment</td>
<td>1/2 of 1 percent total annual apportionment of CMAQ funds</td>
<td>N/A</td>
</tr>
</tbody>
</table>

C. Priority Set-aside for PM₂.₅ Areas

Any State that has a PM₂.₅ nonattainment or maintenance area—including those with approved SIPs that identify on-road mobile sources as insignificant for regional transportation conformity—is required under MAP-21 to invest a portion of its CMAQ funding in projects that reduce PM₂.₅ directly or its precursors.¹⁹ More specifically, an amount equal to 25 percent of the funds attributable to PM₂.₅ nonattainment in each of the affected States must be used for projects targeting PM₂.₅ reductions in those nonattainment and maintenance areas.²⁰ In addition, the legislation highlights diesel retrofits as a primary example of such related projects. Since MAP-21 removed the CMAQ apportionment formula that was in prior legislation—the primary means of establishing the weighted population that would be used in part to calculate the 25 percent—the FHWA is proposing a weighting factor for PM₂.₅ through a rulemaking and public comment process. If this process leads to a final rule, FHWA plans on using the PM₂.₅ weighting factor developed during that rulemaking for set-aside determinations made after the effective date of the final rule.

The pollutant weightings in Table 2 reflect the last statutory apportionment factors, i.e. the SAFETEA-LU formula. Please see the following section on State Flexibility and minimum apportionment considerations for further discussion.

D. State Flexibility: Mandatory—Flexible CMAQ Funding

Prior to MAP-21, each State was guaranteed a minimum of one-half percent of the year's total CMAQ program funding, regardless of whether the State had any nonattainment or maintenance areas. The minimum apportionment provision of SAFETEA-LU and past transportation authorizations has been eliminated under MAP-21, and replaced with a section on State Flexibility.²¹ However, MAP-21’s use of FY 2009 apportionments as the basis for FY 2013 and FY 2014 apportionments results in each State still receiving a minimum amount of funding. For both FY 2013 and 2014, States that received the

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¹⁹ 23 U.S.C. 149(k), as amended by Sec. 1113(b)(6), Pub. L. 112-141 (July 6, 2012).
²⁰ 23 U.S.C. 149(k), as amended by Sec. 1113(b)(6), Pub. L. 112-141 (July 6, 2012).
minimum apportionment in FY 2009 under Section 104(b)(2)(d) as in effect on the day before enactment of MAP-21 and have designated nonattainment or maintenance areas for ozone or CO, will be able to use a portion of their CMAQ funding for any project eligible under either the CMAQ program or under the Surface Transportation Program (STP) at 23 U.S.C. 133. The flexible portion is determined by multiplying the ratio described in 23 U.S.C. 149(d)(2)(B) by the CMAQ amount apportioned to the State under 23 U.S.C. 104(b)(4) after deduction of the PM$_{2.5}$ set-aside. The flexible portion is determined by multiplying the ratio described in 23 U.S.C. 149(d)(2)(B) by the CMAQ amount apportioned to the State under 23 U.S.C. 104(b)(4) after deduction of the PM$_{2.5}$ set-aside. This ratio is, essentially, the amount of FY 2009 CMAQ funding each State was permitted to spend on projects eligible under the STP bears to the total amount of CMAQ funding apportioned for that State under 23 U.S.C. 104(b)(2) as in effect on September 30, 2012. States that have no ozone or CO nonattainment or maintenance areas will be able to use all their CMAQ funds for either CMAQ- or STP-eligible projects.

Under past authorizations, the FHWA Office of Planning, Environment, and Realty and the Budget Division have identified annual apportionments of CMAQ funds as either mandatory or flexible. All funding was considered mandatory for States with weighted populations yielding one-half percent or more of the authorized funds (based on the table above). Prior to MAP-21 enactment, annual CMAQ funding apportioned through the application of 23 U.S.C. 104(b)(2)(B) and 104(b)(2)(C) had to be used for projects in nonattainment/maintenance areas. States with weighted populations yielding at least some apportioned value but less than one-half percent of the authorized funds received both mandatory and flexible funds to reach the minimum apportionment. For example, if a State's weighted population yielded two-tenths of 1 percent of the total authorized funds, it would receive two-tenths of 1 percent of the national funds as mandatory funds, and three-tenths of 1 percent as flexible funds. Thus, in this example, 40 percent of the State's funds would be mandatory and 60 percent would be flexible.

For States with no areas applicable to the apportionment table, their one-half percent is all flexible funding. These flexible funds can be used anywhere in the State for projects eligible for either CMAQ or the STP. The FHWA reports the breakdown of mandatory and flexible funds by State in its fiscal year apportionment documentation, i.e. the supplemental tables.

As noted earlier, the specific CMAQ statutory apportionment formula in SAFETEA-LU was not carried forward under MAP-21. While State apportionments have been set using the 2009 levels as a base, the fine PM portion and the State flexibility considerations must be addressed through an assessment of all relevant criteria pollutants in each State. However, with the exception of the PM$_{2.5}$ values, these weights will be used to address the State Flexibility covering former minimum apportionment areas, since 23 U.S.C. 149(d)(3), as amended by MAP-21, requires the FHWA to factor in any changes in nonattainment and maintenance area designation. Consequently, the FY 2009 weighted nonattainment and maintenance area populations have been or will continue to be updated.
to reflect changes in these designations for FY 2013 and FY 2014; the 2009 factors have been used because MAP-21 uses this fiscal year as the basis for the calculation. Unlike past apportionments, however, the update of the FY 2009 basis for the purposes of State Flexibility in minimum apportionment will not include revised population—only the changes in nonattainment and maintenance designations for the pollutants that applied in 2009.

E. Apportionments and State Allocation

With the exception of the PM$_{2.5}$ priority set-aside, the State may use its CMAQ funds in any ozone, CO, or PM nonattainment or maintenance area. Except for the PM$_{2.5}$ set-aside, a State is under no statutory obligation to allocate CMAQ funds in the same way they have been apportioned at the Federal level—either directly prior to MAP-21, or by reference via the 2009 apportionments under MAP-21. State departments of transportation (State DOT) are encouraged to consult affected MPOs and air quality agencies to determine regional and local CMAQ priorities and work with them to allocate funds accordingly.

F. Federal Share and State/Local Match Requirements

The Federal share for most CMAQ projects, generally, has been 80 percent. An exception to the Federal share requirement was provided via the Energy Independence and Security Act of 2007. This legislation amended 23 U.S.C. 120, Federal share payable, to provide temporary flexibility for States to use a 100 percent Federal share on all CMAQ projects. This flexibility was carried forward with each of the SAFETEA-LU extensions, but was not continued under the MAP-21. Consequently, as of October 1, 2012, Federal share requirements for CMAQ revert to the standard provisions of 23 U.S.C. 120. It should be noted that States are able to program a full, 100 percent Federal share for a select few project types listed under 23 U.S.C. 120(c). This section sets a priority for safety projects, although there are a number listed that also provide the potential for emissions reduction, including roundabouts, carpool/vanpool projects, traffic signalization, and others.$^{26}$

The FHWA publishes a detailed manual, outlining the options and requirements for cost sharing, accounting structure and allowable costs as a matching share, and a host of other factors surrounding the financial elements of project implementation. Additional guidance on matching requirements for Federal Highway Administration (FHWA) funded grants and subgrants can be found in Non-Federal Matching Requirements.$^{27}$

VI. GEOGRAPHIC AREAS THAT ARE ELIGIBLE TO USE CMAQ FUNDS

A. Eligible Areas

$^{26}$ 23 U.S.C. 120(c)(1).
$^{27}$ See http://www.fhwa.dot.gov/legsregs/directives/policy/memonfmr20091229.htm
The CMAQ funds may be invested in all ozone, CO, and PM nonattainment and maintenance areas, including former areas where the NAAQS has been revoked. Funds also may be used for projects in proximity to nonattainment and maintenance areas if the benefits will be realized primarily within the nonattainment or maintenance area. The delineation of an area considered “in proximity” should be discussed with the FHWA and FTA field offices and elevated to headquarters if necessary. The FHWA issued a Federal Register notice\(^\text{28}\) discussing this policy in 2002.

### B. Maintenance Areas

The CMAQ funds may be invested in maintenance areas that have approved maintenance plans under CAA section 175A (42 U.S.C. 7505a) and 23 U.S.C. 149(b)). In States with ozone or CO maintenance areas but no nonattainment areas, mandatory CMAQ funds must be used in the maintenance areas.

### C. Flexible Funds in PM Areas

While States may use flexible CMAQ funding anywhere and for any CMAQ- or STP-eligible project, the FHWA encourages States and MPOs to evaluate the cost-effectiveness and benefits to public health of targeting flexible CMAQ funding to projects that reduce PM. Examples of such projects include implementing a diesel retrofit or idle reduction program, constructing freight/intermodal transfer facilities, traffic signalization, Intelligent Transportation Systems (ITS) projects that reduce congestion, treating dirt or gravel roads, and purchasing street sweeping equipment.

VII. PROJECT ELIGIBILITY PROVISIONS

A. Project Eligibility: General Conditions

Each CMAQ project must meet three basic criteria: it must be a transportation project, it must generate an emissions reduction, and it must be located in or benefit a nonattainment or maintenance area. In addition, all Federal–aid projects—CMAQ is no exception—must be included in the MPO’s current transportation plan and Transportation Improvement Program (TIP) (or the current Statewide Transportation Improvement Program (STIP) in areas without an MPO). In nonattainment and maintenance areas, the project also must meet the conformity provisions contained in section 176(c) of the CAA and the transportation conformity regulations. Lastly, all CMAQ-funded projects need to complete National Environmental Policy Act (NEPA) requirements and satisfy the basic eligibility requirements under titles 23 and 49 of the United States Code.

The following should guide CMAQ eligibility decisions:

1. Capital Investment

The CMAQ funds may be used to establish new or expanded transportation projects or programs that reduce emissions, including capital investments in transportation infrastructure, congestion relief efforts, vehicle acquisitions, diesel engine retrofits, or other capital projects.

2. Operating Assistance

There are several general conditions for operating assistance eligibility under the CMAQ program:

a. Operating assistance is limited to new transit, commuter and intercity passenger rail services, intermodal facilities, travel demand management strategies, including traffic operation centers, inspection and maintenance programs, and the incremental cost of expanding these services.

b. In using CMAQ funds for operating assistance, the intent is to help start up viable new transportation services that can demonstrate air quality benefits and eventually cover costs as much as possible. Other funding sources should supplement and ultimately replace CMAQ funds for operating assistance, as these projects no longer represent additional, net air quality benefits but have become part of the baseline transportation network. The provisions in 23 U.S.C. 116 place

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29 See discussion of the term “emissions reduction” in Section VII(A)(3).
30 23 U.S.C. 149(b).
32 40 CFR Part 93, Subpart B.
responsibilities for maintenance of transportation facilities on the States. Since facility maintenance is akin to operations, a time-limited period of CMAQ assistance provides adequate incentive and flexibility while not creating a pattern of excessive or even perpetual support.

c. Operating assistance includes all costs of providing new transportation services, including, but not limited to, labor, fuel, administrative costs, and maintenance.

d. When CMAQ funds are used for operating assistance, non-Federal share requirements still apply.

e. With the focus on start-up, and recognizing the importance of flexibility in the timing of financial assistance, the 3 years of operating assistance allowable under the CMAQ program may now be spread over a longer period, for a total of up to 5 sequential years of support. Grantees who propose to use CMAQ funding for operating support may spread the third year amount (an amount not to exceed the greater of year 1 or year 2) across an additional 2 years (i.e. years 4 and 5). This will provide an incremental, taper-down approach, while other funding is used for a higher proportion of the operating costs as needed. See Table 3 for examples of possible funding allocations. At the conclusion of the 5-year period, operating costs would have to be maintained with non-CMAQ funding. It is anticipated that this may enable a transition to more independent system operation. The amounts, which apply to years 1 and/or 2, are established at the discretion of the State or local sponsor.

<table>
<thead>
<tr>
<th>Example</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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<td>$200</td>
<td>$50</td>
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</tr>
<tr>
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<td>100</td>
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<td>200</td>
<td>100</td>
<td>100</td>
<td>900</td>
</tr>
</tbody>
</table>

Eligible activities that used CMAQ funds for operating support in FY 2012, as described in the 2008 CMAQ Program Guidance, and that had not received operating assistance for three fiscal years as of September 30, 2012, may continue to receive operating assistance under MAP-21, transitioning into the 5-year schedule described above. The number of prior years of operating assistance will determine which year of the 5-year cycle applies in FY 2013.

Except as noted in this paragraph, activities that already have received 3 years of operating support under prior authorizations of the CMAQ program are not considered to be in a start-up phase and are not eligible for the expanded assistance period. Those transportation uses expressly eligible for CMAQ funding under SAFETEA-LU sections 1808(g)-(k) and certain provisions in appropriations acts are eligible for CMAQ dollars for an additional 5 years.
consistent with this Section. The maximum allowable assistance level and the 5-year time period described above will apply.

f. Elements of operating assistance prohibited by statute or regulation are not eligible for CMAQ participation, regardless of their emissions or congestion reduction potential.

3. Emission Reduction

Air quality improvement is defined by several distinct terms in 23 U.S.C. 149. These terms include contribution to attainment, reduction in pollution, air quality benefits, and others. For purposes of this guidance, emission reduction represents this group of terms. CMAQ-funded projects or programs must reduce CO, ozone precursors (NOx and VOCs), PM2.5, PM10, or PM precursor (e.g., NOx) emissions from transportation; these reductions must contribute to the area’s overall clean air strategy and can be demonstrated by the emissions reduction analysis that is required under this guidance.33 States and MPOs also may consider the ancillary benefits of eligible projects, including greenhouse gas reductions, congestion relief, mobility, safety, or other elements, when programming CMAQ funds, though such benefits do not alone establish eligibility.

4. Planning and Project Development

Activities in support of other Title 23-eligible projects also may be appropriate for CMAQ investments. All phases of eligible projects—not only construction—are eligible for CMAQ funding. For example, studies that are part of the project development pipeline (e.g., preliminary engineering) under NEPA are eligible for CMAQ support. General studies that fall outside specific project development do not qualify for CMAQ funding. Examples of such ineligible efforts include major investment studies, commuter preference studies, modal market polls or surveys, transit master plans, and others. These activities are eligible for Federal planning funds.

B. Projects Ineligible for CMAQ Funding

The following projects are ineligible for CMAQ funding:

1. Light-duty vehicle scrappage programs.
2. Projects that add new capacity for SOVs are ineligible for CMAQ funding unless construction is limited to high-occupancy vehicle (HOV) lanes.34 This HOV lane eligibility includes the full range of HOV facility uses authorized under 23 U.S.C 166, such as high-occupancy toll (HOT) and low-emission vehicles.
3. Routine maintenance and rehabilitation projects (e.g., replacement-in-kind of track or

33 See 23 U.S.C. 149(b).
other equipment, reconstruction of bridges, stations, and other facilities, and repaving or repairing roads) are ineligible for CMAQ funding as they only maintain existing levels of highway and transit service, and therefore do not reduce emissions.\(^{35}\) (See previous section covering eligibility for operational support.) Other funding sources, such as STP and FTA’s Urbanized Area Formula Program (49 U.S.C. 5307), are available for such activities.

4. Administrative costs of the CMAQ program may not be defrayed with program funds, e.g., support for a State’s “CMAQ Project Management Office” is not eligible.

5. Projects that do not meet the specific eligibility requirements of Titles 23 and 49, United States Code, are ineligible for CMAQ funds.

6. Stand-alone projects to purchase fuel.

7. Models and Monitors—Acquisition, operation, or development of models or monitoring networks are not eligible for CMAQ funds. As modeling or monitoring emissions, traffic operations, travel demand or other related variables do not directly lead to an emissions reduction, these activities or acquisitions are not eligible. Such efforts may be appropriate for Federal planning funds.

8. Litigation costs surrounding CMAQ or other Federal-aid projects.

C. Public-Private Partnerships (PPPs)

In a PPP, a private or non-profit entity’s resources replace or supplement State or local funds and possibly a portion of the Federal-aid in a selected project.\(^{36}\) The PPP component of CMAQ has evolved into a critical element of the program, as private sector involvement in such activities as freight and diesel retrofits has grown considerably.

Partnerships should have a legally binding, written agreement in place between the public agency and the private or non-profit entity before a CMAQ-funded project may be implemented. These agreements should be developed under relevant Federal and State law and should specify the intended use for CMAQ funding; the roles and responsibilities of the participating entities; and how the disposition of land, facilities, and equipment will be carried out should the original terms of the agreement be altered (e.g., due to insolvency, change in ownership, or other changes in the structure of the PPP).

Public funds should not be invested where a strong public benefit cannot be demonstrated. Consequently, CMAQ funds should be devoted to PPPs that benefit the general public by clearly reducing emissions, not for financing marginal projects. Consistent with the planning and project selection provisions of the Federal-aid highway program, the FHWA considers it essential that all interested parties have full, open, and timely access to the project selection process.

There are several other statutory restrictions and special provisions on the use of CMAQ funds in PPPs.\(^{37}\) Eligible costs under this section should not include costs to fund an

\(^{35}\) 23 U.S.C. 166.

\(^{36}\) 23 U.S.C. 149(f), as amended by Sec. 1113(b), Pub. L. 112-141 (July 6, 2012).

obligation imposed on private sector or non-profit entities under the CAA or any other Federal law. However, if the private or non-profit entity clearly is exceeding its obligations under Federal law, CMAQ funds may be used for that incremental portion of the project.

Eligible non-monetary activities that satisfy the non-Federal match requirements under the partnership provisions include the following:

• Ownership or operation of land, facilities, or other physical assets
• Construction or project management
• Other forms of participation approved by the Department.

Sharing of total project costs, both capital and operating, is a critical element of a successful public-private venture, particularly if the private entity is expected to realize profits as part of the joint venture. State and local officials are urged to consider a full range of cost-sharing options when developing a PPP, including a larger State/local match.

D. Costs and other Regulatory Requirements

The CMAQ projects must comply with other applicable Federal requirements, including those affecting determinations of eligible project costs. All Federal projects must conform to the appropriate cost principles for Federal-aid. Most CMAQ projects are subject to 2 CFR Part 225—also known as OMB Circular A-87—the cost principles for State, local, and Indian tribal governments. These principles focus on determining the allowable costs for the subject government entities and also provide a discussion of the relationship between appropriate costs and the purpose of the program.

Sponsors also should be familiar with the general cost and accounting components of 49 CFR Part 18, which provides direction on administering Federal grants to State and local governments.

E. Programmatic Eligibility

The MAP-21 provides flexibility for States and MPOs to conduct a technical assessment of the program of CMAQ projects under review that fulfills the requirement for an emissions reduction demonstration. This technical assessment is fully optional and can include the full program as listed in the TIP or a subset of that full program. The technical methods are at the discretion of the MPO but can include modeling or other contemporary tools generally found acceptable by professionals in the field. If the assessment is successful in demonstrating an emissions reduction, no further analysis will need to be provided by the MPO for those projects included, and these efforts can proceed to CMAQ obligation. However, emissions reductions also should be demonstrated for CMAQ projects not

F. Eligible Projects and Programs

Eligibility information is provided below. Not all possible requests for CMAQ funding are covered—this section provides examples of general project types that may be eligible for CMAQ funds.

1. Diesel Engine Retrofits & Other Advanced Truck Technologies

The MAP-21 continues the emphasis SAFETEA-LU placed on diesel engine retrofits and the various types of projects that fall under this broad category. These efforts are defined as vehicle replacement, repowering (replacing an engine with a cleaner diesel engine, alternative fuels, etc.), rebuilding an engine, or other technologies determined by the EPA as appropriate for reducing emissions from diesel engines. This latter point, highlighting developing technologies, establishes a degree of flexibility and a need for periodic adjustment in the definition by the EPA. The legislation defines retrofit projects as applicable to both on-road motor vehicles and non-road construction equipment; the latter must be used in Title 23 projects based in nonattainment or maintenance areas for either PM or ozone.

The MAP-21 expands the prior focus created by the SAFETEA-LU. Specifically for PM areas, diesel retrofits are called out as eligible projects in the Priority Consideration section. Similarly, such efforts are again highlighted in the discussion of the PM priority set-aside, and emphasized again in the closely related section on construction vehicles and equipment.

More than 13 million diesel engines make up the legacy fleet operating in the U.S. The vast majority of these power on-road heavy-duty and medium-duty trucks, locomotives, and off-road construction equipment—all of which may be eligible for CMAQ funding.

There are a number of specific project types in the diesel retrofit area for which CMAQ funds are eligible. Assuming all other CMAQ criteria are met, eligible projects could include diesel engine or full vehicle replacement; full engine rebuilding and reconditioning; and purchase and installation of after-treatment hardware, including particulate matter traps and oxidation catalysts, and other technologies; and support for heavy-duty vehicle retirement programs. Project agreements involving replacements for either engines or full vehicles should include a provision for disposal or destruction of the engine block, verification that the engine is no longer contributing emissions in the nonattainment or non-attainment areas.  

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40 23 U.S.C. 149(b)(8).  
41 Id.  
43 23 U.S.C. 149(k), as amended by Sec. 1113(b)(6), Pub. L. 112-141 (July 6, 2012).
maintenance area, or for other processes at the State’s discretion that track the retirement of the vehicle or engine in accordance with the State’s or sub-grantee’s program. The MAP-21 provided one change to the approach in establishing eligibility for emissions control equipment. After-treatment and other on-board control devices are restricted to those EPA or the California Air Resources Board (CARB) verified and/or technologies as defined in section 791 of the Energy Policy Act of 2005 (42 U.S.C. 16131).

A strong component of the SAFETEA-LU focus on diesel retrofits, construction vehicles and equipment also are eligible under MAP-21. Eligible acquisitions or retrofits would be for those capital items used for highway construction projects in PM2.5 nonattainment or maintenance areas. Equipment or vehicles used predominantly in a maintenance role would not qualify. These would include loaders or backhoes in yard or depot work, tractors assigned to mowing or other median maintenance, impactors or rollers involved in routine work, such as pothole repair, and others.

The CMAQ funds may be used to purchase and install emission control equipment on school buses. (Such projects, generally, should be administered by FHWA; see Transit Improvements, below). In addition, although CMAQ funds should not be used for the initial purchase of conventionally fueled airport parking lot shuttles, funds may be used for purchase and installation of after treatment hardware or repowering (with a hybrid drive train, for example).

Refueling is not eligible as a stand-alone project, but is eligible if it is required to support the installation of emissions control equipment, repowering, rebuilding, or other retrofits of non-road engines.

In addition to equipment and technology, outreach activities that provide information exchange and technical assistance to diesel owners and operators on retrofit options are eligible investments. These projects could include the actual education and outreach program, construction or acquisition of appropriate classroom buildings, and other efforts to promote the use of retrofit technologies.

Non-road mobile source projects also are eligible for CMAQ funding. Most notably, a considerable amount of CMAQ support has been directed to locomotive retrofit and the acquisition of clean locomotives, such as railyard switchers and shunters that fit the generator-set criterion (See Freight and Intermodal, Section VII. F. 4). The FHWA acknowledges that diesel retrofit projects may include non-road mobile source endeavors, which traditionally have been outside the Federal-aid process. However, the MAP-21 clarifies CMAQ eligibility for non-road diesel retrofit projects. Areas that fund these projects are not required to take credit for the projects in the transportation conformity process. For areas that want to take credit,

Note that if a replacement project does not require the permanent destruction of the replaced vehicle or engine, it is not eligible to receive emission reduction credit in a SIP or conformity determination in accordance with EPA policy and guidance (http://www.epa.gov/otaq/stateresources/transconf/policy.htm#retrofit).

the EPA developed guidance for estimating diesel retrofit emission reductions and for applying the credit in the SIP and transportation conformity processes.

Transportation projects that are part of an effort associated with EPA’s Diesel Emissions Reduction Act (DERA) also may be eligible. Federal field offices, State DOTs, and other local sponsors should consult with the nearest EPA Regional Office on projects that feature DERA elements or mutual funding with CMAQ.

In addition to retrofit projects, upgrading long-haul heavy-duty diesel trucks with EPA and/or CARB verified advanced technologies, such as idle reduction devices, cab and trailer aerodynamic fixtures, and single-wide or other efficient tires, has been demonstrated by the EPA’s Smart Way Transport Partnership Program to reduce NOx emissions and save fuel. These strategies also are eligible for CMAQ support. Such projects funded directly by CMAQ that involve the private sector should be part of a PPP, as discussed in Section VII.C.

Many diesel retrofit projects involve private sector participation. Although standard match rates established in 23 U.S.C. 120 apply to these efforts, States and local governments are encouraged to seek a higher non-Federal match from those participants that ultimately will own the equipment. An even 50-50 split share between the Federal CMAQ and all other sources has been a frequent compromise for many past projects in this arena.

2. Idle Reduction

Idle reduction projects that reduce emissions and are located within, or in proximity to and primarily benefiting, a nonattainment or maintenance area are eligible for CMAQ investment. (The geographic requirement mainly applies to off-board projects, i.e., truck stop electrification (TSE) efforts.) However, if CMAQ funding is used for an on-board project (i.e. auxiliary power units, direct fired heaters, etc.) the vehicle—usually a heavy-duty truck—should travel within, or in proximity to and primarily benefiting, a nonattainment or maintenance area. Idle reduction devices are verified by the EPA.

There have been several instances where operating assistance funds have been requested for TSE services. The CMAQ funding for TSE projects has been limited to capital costs (i.e. deployment of TSE infrastructure). Operating assistance for TSE projects should not be funded under the CMAQ program since TSE projects generate their own revenue stream and therefore should be able to cover all operating expenses from the accumulated revenue.

Commercial idle reduction facilities cannot be located within rest areas of the Interstate right-of-way (ROW).47 The SAFETEA-LU initially provided for these facilities in the ROW. However, this provision was removed with the SAFETEA-LU Technical

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46 See http://www.epa.gov/otaq/stateresources/transconf/policy.htm#retrofit.
Corrections Bill that followed.

3. Congestion Reduction & Traffic Flow Improvements

Traffic flow improvements may include the following:

a. Traditional Improvements

Traditional traffic flow improvements, such as the construction of roundabouts, HOV lanes, left-turn or other managed lanes, are eligible for CMAQ funding provided they demonstrate net emissions benefits through congestion relief.

b. Intelligent Transportation Systems

ITS projects, such as traffic signal synchronization projects, traffic management projects, and traveler information systems, can be effective in relieving traffic congestion, enhancing transit bus performance, and improving air quality. The following have the greatest potential for improving air quality:

- Regional multimodal traveler information systems
- Traffic signal control systems
- Freeway management systems
- Electronic toll-collection systems
- Transit management systems
- Incident management programs.

The FHWA has provided a lengthier discussion of the benefits associated with various operational improvements.

c. Value/Congestion Pricing

Congestion pricing is a market-based mechanism that allows tolls to rise and fall depending on available capacity and demand. Tolls can be charged electronically, thereby eliminating the need for full stops at tollbooths. In addition to the benefits associated with reducing congestion, revenue is generated that can be used to pay for a wide range of transportation improvements, including Title 23-eligible transit services in the newly tolled corridor.

Parking pricing can include time-of-day parking charges that reflect congested conditions. These strategies should be designed to influence trip-making behavior and may include charges for using a parking facility at peak periods, or a range of employer-based parking cash-out policies that provide financial incentives to avoid parking or driving alone. Parking pricing integrated with other pricing strategies is

encouraged.

Pricing encompasses a variety of market-based approaches such as:

- **HOT lanes**, or High Occupancy Toll lanes, on which variable tolls are charged to drivers of low-occupancy vehicles using HOV lanes, such as the “FasTrak” Lanes on I-15 in San Diego and the recently converted I-394 in Minneapolis in which prices vary dynamically every 2 minutes based on traffic conditions.

- **New variably tolled express lanes** on existing toll-free facilities, such as the “91 Express Lanes” on State Route 91 in Orange County, CA.

- **Variable tolls on existing or new toll roads**, such as on the bridges and tunnels operated by the Port Authority of New York and New Jersey.

- **Network-wide or cordon pricing**, such as implemented in Stockholm, London, and Singapore.

- **Usage-based vehicle pricing**, such as mileage-based vehicle taxation being explored by the State of Oregon, or pay-per-mile car insurance.

As with any eligible CMAQ project, value pricing should generate an emissions reduction. Marketing and outreach efforts to expand and encourage the use of eligible pricing measures may be funded indefinitely. Eligible expenses for reimbursement include, but are not limited to: tolling infrastructure, such as transponders and other electronic toll or fare payment systems; small roadway modifications to enable tolling, marketing, public outreach, and support services, such as transit in a newly tolled corridor. Innovative pricing approaches yet to be deployed in the U.S. also may be supported through the** Value Pricing Pilot Program.**

Operating expenses for traffic operating centers (TOCs) are eligible for CMAQ funding if they can be shown to produce air quality benefits, and if the expenses are incurred from new or additional capacity. The operating assistance parameters discussed in Section VII.A.2 apply.

Projects or programs that involve the purchase of integrated, interoperable emergency communications equipment are eligible for CMAQ funding.

### 4. Freight/Intermodal

Projects and programs targeting freight capital costs—rolling stock or ground infrastructure—are eligible provided that air quality benefits can be demonstrated. Freight projects that reduce emissions fall generally into two categories: primary efforts that target emissions directly or secondary projects that reduce net emissions.

Successful primary projects could include new diesel engine technology or retrofits of

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vehicles or engines. See discussion in Section VII.F.1. Eligibility under CMAQ is not confined to highway projects, but also applies to nonroad mobile freight projects such as rail.

Secondary projects reduce emissions through modifications or additions to infrastructure and the ensuing modal shift. Support for an intermodal container transfer facility may be eligible if the project demonstrates reduced diesel engine emissions when balancing the drop in truck VMT against the increase in locomotive or other non-highway activity. Intermodal facilities, such as inland transshipment ports or near/on-dock rail, may generate substantial emissions reductions through the decrease in miles traveled for older, higher-polluting heavy-duty diesel trucks. This secondary, indirect effect on truck traffic and the ensuing drop in diesel emissions help demonstrate eligibility.

The transportation function of these freight/intermodal projects should be emphasized. Marginal projects that support freight operations in a very tangential manner are not eligible for CMAQ funding. Warehouse handling equipment, for example, is not an eligible investment of program funds. Warehouses, themselves, or other similar structures, such as transit sheds, bulk silos or other permanent, non-mobile facilities that function more as storage resources are not eligible. However, equipment that provides a transportation function or directly supports this function is eligible, such as railyard switch locomotives or shunters that fall into the generator-set or other clean engine category. Similarly, large-scale container gantry cranes, or other heavy-duty container handling equipment that is a clear link in the intermodal process can be eligible as well. Also, on the ground operations side of aviation, the purchase or retrofit of airport handling equipment can be eligible, including baggage handlers, aircraft tow motors, and other equipment that plays a role in this intermodal link.

5. Transportation Control Measures (TCM)

Most of the TCMs included in Section 108 of the CAA, listed below, are eligible for CMAQ funding. We would note that one particular CAA TCM, created to encourage removal of pre-1980 light-duty vehicles, is specifically excluded from CMAQ eligibility.\footnote{23 U.S.C. 149(b)(1)(A)(i)}

i. Programs for improved public transit;
ii. Restriction of certain roads or lanes to, or construction of such roads or lanes for use by, passenger buses or HOV;
iii. Employer-based transportation management plans, including incentives;
iv. Trip-reduction ordinances;
v. Traffic flow improvement programs that reduce emissions;
vi. Fringe and transportation corridor parking facilities serving multiple-occupancy vehicle programs or transit service;

\footnote{23 U.S.C. 149(b)(1)(A)(i)}
vii. Programs to limit or restrict vehicle use in downtown areas or other areas of emission concentration particularly during periods of peak use;
viii. Programs for the provision of all forms of high-occupancy, shared-ride services;
ix. Programs to limit portions of road surfaces or certain sections of the metropolitan area to the use of non-motorized vehicles or pedestrian use, both as to time and place;
x. Programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists, in both public and private areas;
xii. Programs to control extended idling of vehicles;
xiii. Programs to control extended idling of vehicles;
xiv. Programs to control extended idling of vehicles;
xv. Programs to control extended idling of vehicles;
xvi. Programs to control extended idling of vehicles;
xvii. Programs to control extended idling of vehicles;
xviii. Programs to control extended idling of vehicles;
xix. Programs to control extended idling of vehicles;
xx. Programs to control extended idling of vehicles;

6. Transit Improvements

Many transit projects are eligible for CMAQ funds. The general guideline for determining eligibility is whether the project increases transit capacity and would likely result in an increase in transit ridership and a potential reduction in congestion. As with other types of CMAQ projects, there should be a quantified estimate of the project’s emissions benefits accompanying the proposal.

The FTA administers most transit projects. For such projects, after the FTA determines a project eligible, CMAQ funds will be transferred, or “flexed,” from the FHWA to the FTA, and the project will be administered according to the appropriate FTA program requirements. Certain types of eligible transit projects for which FTA lacks statutory authority, such as diesel retrofit equipment for public school bus fleets, may be the responsibility of the State or other eligible project sponsor and are administered by FHWA.

a. Facilities

New transit facilities (e.g., lines, stations, terminals, transfer facilities) are eligible if they are associated with new or enhanced public transit, passenger rail, or other similar services. Routine maintenance or rehabilitation of existing facilities is not eligible, as it does not reduce emissions. However, rehabilitation of a facility may be eligible if the vast majority of the project involves physical improvements that will increase transit service capacity. In such cases there should be supporting
documentation showing an expected increase in transit ridership that is more than minimal. If the vast majority of the project involves capacity enhancements, other elements involving refurbishment and replacement-in-kind also are eligible.

b. Vehicles and Equipment

New transit vehicles (bus, rail, or van) to expand the fleet or replace existing vehicles are eligible. Transit agencies are encouraged to purchase vehicles that are most cost-effective in reducing emissions. Diesel engine retrofits, such as replacement engines and exhaust after-treatment devices, are eligible if certified or verified by the EPA or California Air Resources Board (CARB). See discussion in Section VII.F.1. Routine preventive maintenance for vehicles is not eligible as it only returns the vehicles to baseline conditions. Other than diesel engine retrofits, other transit equipment may be eligible if it represents a major systemwide upgrade that will significantly improve speed or reliability of transit service, such as advanced signal and communications systems.

c. Fuel

Fuel, whether conventional or alternative fuel, is an eligible expense only as part of a project providing operating assistance for new or expanded transit service under the CMAQ program. This includes fuels and fuel additives considered diesel retrofit technologies by the EPA or CARB. Purchase of alternative fuels is authorized in some States based on the continuation of a series of exemptions for uses expressly eligible for CMAQ funding under SAFETEA-LU section 1808(k) and certain provisions in subsequent appropriations acts. The maximum allowable assistance level and time limitation described in Section VII.A.2 will apply.

d. Operating Assistance

Operating assistance to introduce new transit service or expand existing transit service is eligible. The eligibility applies regardless of the size of the urbanized area (UZA) or whether a particular grantee is or was previously authorized to use funding under Chapter 53 of Title 49 U.S.C. for operating assistance. For a detailed discussion of operating assistance eligibility, including the changes brought about by MAP-21, please see Section VII.A.2 above.

e. Transit Fare Subsidies

The CMAQ funds may be used to subsidize regular transit fares in an effort to prevent the NAAQS from being exceeded, but only under the following conditions: The reduced or free fare should be part of a comprehensive areawide program to prevent such an anticipated exceedance. For example, “Ozone Action” programs vary in scope around the country, but they generally include actions that individuals and employers can take, and they are aimed at all major sources of air pollution, not just transportation. The subsidized fare should be available to the general public and may
not be limited to specific groups. It may only be offered during periods of elevated pollution when the threat of exceeding the NAAQS is greatest; e.g., it is not intended for the entire high-ozone season. The fare subsidy proposal should demonstrate that the responsible local agencies will combine the reduced or free fare with a robust marketing program to inform SOV drivers of other transportation options. Because the fare subsidy is not strictly a form of operating assistance, it would not be subject to the 5-year limit.

7. Bicycle and Pedestrian Facilities and Programs

Bicycle and pedestrian facilities and programs are included as a TCM in section 108(f)(1)(A) of the CAA (42 U.S.C. 7408(f)(1)(A)). The following are eligible projects:

- Constructing bicycle and pedestrian facilities (paths, bike racks, support facilities, etc.) that are not exclusively recreational and reduce vehicle trips.
- Non-construction outreach related to safe bicycle use.
- Establishing and funding State bicycle/pedestrian coordinator positions for promoting and facilitating nonmotorized transportation modes through public education, safety programs, etc. (Limited to one full-time position per State).

Bicycle and pedestrian programs that are not supported under 23 CFR Part 652, Pedestrian and Bicycle Accommodations and Projects, also are not eligible for CMAQ funding. For example, under 23 CFR 652.9(b)(3), a non-construction bicycle project does not include salaries for administration, maintenance costs, and other items akin to operational support under 23 CFR 652.9(b)(3), and, therefore, these are not allowable CMAQ costs.

Additional activities related to bicycle and pedestrian programs can be supported by other elements of the Federal-aid highway program. These efforts are described at the FHWA’s Bicycle and Pedestrian Programs Web site.  

8. Travel Demand Management

Travel demand management (TDM) encompasses a diverse set of activities that focus on physical assets and services that provide real-time information on network performance and support better decisionmaking for travelers choosing modes, times, routes, and locations. Such projects can help ease congestion and reduce SOV use—contributing to mobility, while enhancing air quality and saving energy resources. Similar to ITS and Value Pricing, today’s TDM programs seek to optimize the performance of local and regional transportation networks. The following activities are eligible if they are explicitly aimed at reducing SOV travel and associated emissions:

- Fringe parking
- Traveler information services

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51 See http://www.fhwa.dot.gov/environment/bicycle_pedestrian/
- Shuttle services
- Guaranteed ride home programs
- Carpools, vanpools
- Traffic calming measures
- Parking pricing
- Variable road pricing
- Telecommuting/Teleworking
- Employer-based commuter choice programs.

The CMAQ funds may support capital expenses and, as discussed in Section VII.A.2, up to 5 years of operating assistance to administer and manage new or expanded TDM programs. Marketing and outreach efforts to expand use of TDM measures may be funded indefinitely, but only if they are broken out as distinct line items.

Eligible telecommuting activities include planning, preparing technical and feasibility studies, and training. Construction of telecommuting centers and computer and office equipment purchases should not be supported with CMAQ funds.

9. Public Education and Outreach Activities

The goal of CMAQ-funded public education and outreach activities is to educate the public, community leaders, and potential project sponsors about connections among trip making and transportation mode choices, traffic congestion, and air quality. Public education and outreach can help communities reduce emissions and congestion by inducing drivers to change their transportation choices. More important, an informed public is likely to support larger regional measures necessary to reduce congestion and meet CAA requirements.

A wide range of public education and outreach activities is eligible for CMAQ funding, including activities that promote new or existing transportation services, developing messages and advertising materials (including market research, focus groups, and creative), placing messages and materials, evaluating message and material dissemination and public awareness, technical assistance, programs that promote the Tax Code provision related to commute benefits, transit “store” operations, and any other activities that help forward less-polluting transportation options.

Using CMAQ funds, communities have disseminated many transportation and air quality public education messages, including maintain your vehicle; curb SOV travel by trip chaining, telecommute and use alternate modes; fuel properly; observe speed limits; don’t idle your vehicle for long durations; eliminate “jack-rabbit” starts and stops; and others.

Long-term public education and outreach can be effective in raising awareness that can lead to changes in travel behavior and ongoing emissions reductions; therefore, these activities may be funded indefinitely.
10. Transportation Management Associations

Transportation Management Associations (TMAs) are groups of citizens, firms, or employers that organize to address the transportation issues in their immediate locale by promoting rideshare programs, transit, shuttles, or other measures. The TMAs can play a useful role in brokering transportation services to private employers.

Subject to applicable cost principles under 2 CFR Part 225, CMAQ funds may be used to establish TMAs provided that they reduce emissions. Eligible expenses include TMA start-up costs and up to 5 years of operating assistance as discussed in Section VII.A.2. Eligibility of specific TMA activities is addressed throughout this guidance.

11. Carpooling and Vanpooling

Eligible activities can be divided into two types of costs: marketing (which applies to both carpools and vanpools) and vehicle (which applies to vanpools only).

a. Carpool/vanpool marketing covers existing, expanded, and new activities designed to increase the use of carpools and vanpools, and includes purchase and use of computerized matching software and outreach to employers. Guaranteed ride home programs are also considered marketing tools. Marketing costs may be funded indefinitely.

b. Vanpool vehicle capital costs include purchasing or leasing vans for use in vanpools. Eligible operating costs, limited to 5 years as set forth in Section VII.A.2, empty-seat subsidies, maintenance, insurance, administration, and other related expenses. Prorated cost sharing plans that establish grant proportions for undefined shares of capital and operating costs need to be broken down to the specific components or line items that establish the capital-operating shares.

The CMAQ funds should not be used to buy or lease vans that would directly compete with or impede private sector initiatives. States and MPOs should consult with the private sector prior to using CMAQ funds to purchase vans, and if private firms have definite plans to provide adequate vanpool service, CMAQ funds should not be used to supplant that service.

In accordance with 23 U.S.C. 120(c)(1), carpooling and vanpooling activities may be supported with up to 100 percent Federal funding, under certain limitations.

12. Carsharing

The MAP-21 specifically highlights carsharing projects in the amended section
on traffic demand.\textsuperscript{52} These efforts involve the pooling of efficient, low-emission vehicles, provided to travelers who have occasional need for a vehicle but not the constant, daily necessity that demands ownership. As with any CMAQ project, sponsors need to demonstrate an emissions reduction from the carsharing program. If a programwide emissions reduction cannot be demonstrated, CMAQ funding may be available to support vehicle costs under Alternative Fuels and Vehicles eligibility, discussed in Section VII.F.17.

\textbf{13. Extreme Low-Temperature Cold Start Programs}

Projects intended to reduce emissions from extreme cold-start conditions are eligible for CMAQ funding. Such projects include retrofitting vehicles and fleets with water and oil heaters and installing electrical outlets and equipment in publicly owned garages or fleet storage facilities.

\textbf{14. Training}

States and MPOs may use Federal-aid funds to support training and educational development for the transportation workforce. Such activities are subject to applicable cost principles in 2 CFR Part 225. The FHWA encourages State and local officials to weigh the air quality benefits of such training against other cost-effective strategies detailed elsewhere in this guidance before using CMAQ funds for this purpose. Training funded with CMAQ dollars should be directly related to implementing air quality improvements and be approved in advance by the FHWA Division office.

\textbf{15. Inspection/Maintenance (I&M) Programs}

Funds under the CMAQ program may be used to establish either publicly or privately owned I&M facilities. Eligible activities include construction of facilities, purchase of equipment, I&M program development, and one-time start-up activities, such as updating quality assurance software or developing a mechanic training curriculum. The I&M program must constitute new or additional efforts, existing funding (including inspection fees) should not be displaced, and operating expenses are eligible for 5 years as discussed in Section VII.A.2.

States or other sponsors planning new or expanded I&M programs that incorporate other elements of a State’s vehicle administrative function, e.g. registration, safety inspection, titling, etc., must remove these line items from the CMAQ project. These tasks are not linked to the CMAQ purpose and are, therefore, not allowable costs.

\textit{Privately Owned I&M Facilities}

\textsuperscript{52} 23 U.S.C. 149(b)(7), as amended by Sec. 1113(b)(7), Pub. L. 112-141 (July 6, 2012).
In States that rely on privately owned I&M facilities, State or local I&M program-related administrative costs may be funded under the CMAQ program as in States that use public I&M facilities. However, CMAQ support to establish I&M facilities at privately owned stations, such as service stations that own the equipment and conduct emission test-and-repair services, requires a PPP.

The establishment of "portable" I&M programs, including remote sensing, is also eligible under the CMAQ program, provided that they are public services, reduce emissions, and do not conflict with statutory I&M requirements or EPA regulations.

16. Innovative Projects

State and local organizations have worked with various types of transportation services to better meet the travel needs of their constituents. These innovative projects also may show promise in reducing emissions, but do not yet have supporting data. The FHWA has supported and funded some of these projects as demonstrations to determine their benefits and costs. Such innovative strategies are not intended to bypass the definition of basic project eligibility, but seek to better define the projects’ future role in strategies to reduce emissions.

For a project or program to qualify as an innovative project, it should be defined as a transportation project and be expected to reduce emissions by decreasing VMT, fuel consumption, congestion, or by other factors. The FHWA encourages States and MPOs to creatively address their air quality problems and to consider new services, innovative financing arrangements, PPPs, and complementary approaches that use transportation strategies to reach clean air goals.

Given the untried nature of these innovative projects, before-and-after studies should be completed to determine actual project impacts on air quality as measured by net emissions reduced. These assessments should document the project’s immediate impacts in addition to long-term benefits. A schedule for completing the study should be a part of the project agreement. Completed studies should be submitted to the FHWA Division office within 3 years of implementation of the project or 1 year after the project’s completion, whichever is sooner.

17. Alternative Fuels and Vehicles

The FHWA issued a memorandum in April 2011, covering the relationship between the required emissions reduction benefits of alternative fuel vehicles and the associated cost principles at 2 CFR Part 225. 53 Essentially, this guidance illustrates the cost-benefit relationship between different vehicle types and functions and the air quality benefit provided as a cost basis under the CMAQ program. The memorandum, outlining the requirements in 23 U.S.C. 149, supports eligibility only for the incremental cost, limited to the marginal emissions-reducing elements of the alternative fuel vehicles that are acquired.

53 Memorandum is at the following link:
through PPPs or that are purchased by public sponsors.

Program funds may be used to support projects involving the alternative or renewable fuels defined in the Energy Policy Act of 1992\textsuperscript{54} or the Energy Independence and Security Act of 2007.\textsuperscript{55} All standard eligibility criteria apply. Aside from fuel acquisitions that are part of a transit operating support effort, stand-alone purchase of any fuel—alternative or otherwise—is not an eligible CMAQ cost. However, the few exceptions provided by Section 1808(k) of SAFETEA-LU continue under MAP-21, subject to the limitation on operating assistance as described in Section VII.A.2.

Generally, CMAQ support for alternative fuel vehicle projects can be broken into the following areas:

\textit{Infrastructure}

Except as noted below, establishing publicly owned fueling facilities and other infrastructure needed to fuel alternative-fuel vehicles is an eligible expense, unless privately-owned fueling stations are in place and reasonably accessible. Fueling facilities can dispense one or more of the alternative fuels identified in section 301 of the 1992 Energy Policy Act or biodiesel, or provide recharging for electric vehicles. Additionally, CMAQ funds may support converting a private fueling facility to support alternative fuels through a public-private partnership agreement. In accordance with 23 U.S.C. 149(c)(2), and 23 U.S.C. 111, regarding the prohibition of commercial activities in the Interstate ROW, CMAQ-funds may be used to establish or support refueling facilities within the Interstate ROW, providing these services are offered at no charge.

\textit{Non-transit Vehicles}

The CMAQ funds may be used to purchase publicly-owned alternative fuel vehicles, including passenger vehicles, service trucks, street cleaners, and others. However, only publicly owned vehicles providing a dominant transportation function can be fully funded, such as paratransit vans, incident management support vehicles, refuse haulers, and others. Costs associated with converting fleets to run on alternative fuels are also eligible. When non-transit vehicles are purchased through PPPs, only the cost difference between the alternative fuel vehicles and comparable conventional fuel vehicles is eligible. Such vehicles should be fueled by one of the alternative fuels identified in section 301 of the 1992 Energy Policy Act or biodiesel.

Eligible projects also include alternatives to diesel engines and vehicles. Alternative fuel vehicle projects that are implemented as diesel retrofits and involve the replacement of an operable engine—not standard fleet turnover—would be eligible for full Federal


participation, i.e. an 80 percent Federal share of the full vehicle cost.

*Hybrid Vehicles*

Although not defined by the Energy Policy Act of 1992 as alternative fuel vehicles, certain hybrid vehicles that have lower emissions rates than their non-hybrid counterparts may be eligible for CMAQ investment. Hybrid vehicle models that are in part the focus of State legislation addressing HOV exemptions for alternative fuel and low emissions vehicles are considered eligible for CMAQ support.\(^5\) Other hybrid vehicles will be assessed on a case specific basis, as there is no specific EPA regulation available to rate the lower emissions and energy efficiency advantages of the models involved.

Projects involving heavier vehicles, including refuse haulers and delivery trucks, also may be appropriate for program support. Eligibility should be based on a comparison of the emissions projections of these larger candidate vehicles and other comparable models.

**VIII. PROJECT SELECTION PROCESS-GENERAL CONDITIONS**

Proposals for CMAQ funding should include a precise description of the project, providing information on its size, scope, location, and timetable. Also, an assessment of the project’s expected emission reduction benefits should be completed prior to project selection to better inform the selection of CMAQ projects (See below).

**A. Air Quality Analysis**

1. **Quantitative Analyses**

Quantified emissions benefits (i.e., emissions reductions) and disbenefits (i.e., emissions increases) should be included in all project proposals, except where it is not possible to quantify emissions benefits (see Qualitative Assessment, Section VII(A)(2) below). Benefits and disbenefits should be included for all pollutants for which the area is in nonattainment or maintenance status and should include appropriate precursor emissions. Benefits should be listed in a consistent fashion (i.e., kg/day) across projects to allow accurate comparison during the project selection process. Net benefits from all emissions sources involved should be included in the analysis. For example, in analyzing a commuter rail project, net benefits would include emissions reductions from the auto trips avoided, and emissions increases tied to locomotive operation.

State and local transportation and air quality agencies conduct CMAQ-project air quality analyses with different approaches, analytical capabilities, and technical expertise. Section 149(h) of title 23, United States Code, encourages State DOTs and MPOs to consult with State and local air quality agencies in nonattainment and maintenance areas.

about the estimated emission reductions from CMAQ proposals. However, while no single method is specified, every effort should be taken to ensure that determinations of air quality benefits are credible and based on a reproducible and logical analytical procedure.

2. Qualitative Assessment

Although quantitative analysis of air quality impacts is expected for almost all project types, an exception will be made when it is not possible to accurately quantify emissions benefits. In these cases, qualitative assessments based on reasoned and logical determinations that the projects or programs will decrease emissions and contribute to attainment or maintenance of a NAAQS are acceptable.

Public education, marketing, and other outreach efforts, which can include advertising alternatives to SOV travel, employer outreach, and public education campaigns, may fall into this category. The primary benefit of these activities is enhanced communication and outreach that is expected to influence travel behavior and thus air quality.

3. Analyzing Groups of Projects

In some situations, it may be more appropriate to examine the impacts of comprehensive strategies to improve air quality by grouping projects. For example, transit improvements coupled with demand management to reduce SOV use in a corridor might best be analyzed together. Other examples include linked signalization projects, transit improvements, marketing and outreach programs, and ridesharing programs that affect an entire region or corridor.

4. Tradeoffs

As noted above, emissions benefits should be calculated for all pollutants for which an area is in nonattainment or maintenance status. Some potential projects may lead to benefits for one pollutant and increased emissions for another, especially when the balance involves precursors such as NO\textsubscript{x} and VOC. States and MPOs should consult with relevant air agencies to weigh the net benefits of the project.

IX. PROGRAM ADMINISTRATION

A. Project Selection—MPO and State Responsibilities

Title 23, United States Code, protects State sovereignty in implementing the Federal-aid highway program.\textsuperscript{57} In addition, 23 U.S.C. 145 emphasizes that Title 23 provides for a federally assisted State program. Consequently, all projects in the Federal-aid highway program, including those supported with CMAQ funds, are selected by the State or the State

\textsuperscript{57} 23 U.S.C. 145.
in conjunction with the MPO.

To ensure that projects deemed most effective in reducing motor vehicle emissions and congestion are programmed for early implementation in the TIP, MPOs, State DOTs, and transit agencies should develop CMAQ project selection processes in accordance with the metropolitan and/or statewide planning process under 23 U.S.C. 134 and 135. The selection process should involve State and/or local transportation and air quality agencies. This selection process provides an opportunity for States and/or local agencies to present a case for the selection of eligible projects that will best use CMAQ funding to meet the requirements and advance the goals of the Clean Air Act.

The CMAQ project selection process should be transparent, in writing, and publicly available. The process should identify the agencies involved in rating proposed projects, clarify how projects are rated, and name the committee or group responsible for making the final recommendation to the MPO board or other approving body. The selection process should also clearly identify the basis for rating projects, including emissions benefits, cost-effectiveness, and any other ancillary selection factors such as congestion relief, greenhouse gas reductions, safety, system preservation, access to opportunity, sustainable development and freight, reduced SOV reliance, multimodal benefits, and others. At a minimum, projects should be identified by year and proposed funding source.

Close coordination is encouraged between the State and MPO to ensure that CMAQ funds are used appropriately and to maximize their effectiveness in meeting the CAA requirements. While the program of projects is being developed, the State or MPO should consult with FHWA and FTA to resolve any questions about eligibility. This will ensure that the projects programmed for CMAQ funding in the TIP are all eligible.

States and MPOs should fulfill this responsibility so that nonattainment and maintenance areas are able to make good-faith efforts to attain and maintain the NAAQS by the prescribed deadlines. State DOTs and MPOs should consult with State and local air quality agencies to develop an appropriate project list of CMAQ programming priorities that will have the greatest impact on air quality. In developing this list, MPOs and States should evaluate the cost-effectiveness of the projects and give priority consideration to those that will create the greatest emissions reductions for the least cost, especially in those areas designated nonattainment or maintenance for PM$_{2.5}$.

The MAP-21 calls out diesel retrofits as one type of cost-effective project to which priority consideration shall be given. The EPA has conducted a study of the cost-effectiveness of diesel retrofits in reducing PM, NO$_x$, and VOC emissions. In addition, the National Academy of Science’s Transportation Research Board has evaluated the cost-effectiveness of other CMAQ eligible projects, with a focus on NO$_x$ and HC reductions. The CMAQ Program: Assessing Ten Years of Experience was completed in response to prior Federal transportation legislation.

Information on the cost-effectiveness of CMAQ-eligible projects can be used as a guidepost.

in evaluating the different types of projects under consideration by an MPO or State. However, cost-effectiveness ultimately will depend on local conditions and project specific factors that affect emission reductions and costs. As noted earlier in this guidance, the FHWA and FTA, in consultation with EPA, are developing cost-effectiveness tables and other graphic representations of these relationships to aid States and other project sponsors in selecting the most efficient mix of CMAQ projects.

B. Federal Agency Responsibilities and Coordination

1. Eligibility Determinations

The FTA determines the eligibility of transit projects, and the FHWA determines the eligibility of all other projects. The FHWA, FTA, and EPA field offices should establish and maintain a consultation and coordination process to review CMAQ funding proposals. While the eligibility determination is not made jointly, every effort should be made to satisfy the concerns raised by the agencies’ field offices. The FHWA or FTA field offices may request additional information from the State or MPO to help determine eligibility. The consultation process should provide for timely review and handling of CMAQ funding proposals. The FHWA and FTA headquarters offices are available to consult with their field offices on eligibility determinations.

2. Program Administration

The FHWA Division offices and the FTA Regional offices are responsible for administering the CMAQ program. In general, the FHWA transfers funds to FTA to administer CMAQ-funded transit projects. In cases where the FTA lacks statutory authority (e.g., school bus fleets), the FHWA will administer the transit project. For projects that involve transit and non-transit elements, such as park-and-ride lots and intermodal passenger projects, the administering agency is decided on a case-by-case basis. All other projects are administered by the FHWA.

3. Tracking Mandatory/Flexible and PM2.5 Set-aside Funds

The FHWA’s Chief Financial Officer has established accounting codes in the Fiscal Management Information System (FMIS) to track State investments of CMAQ funds in the mandatory and flexible spending areas, and the set-aside spending for the MAP-21 PM2.5 priority. States and other sponsors are encouraged to accurately reflect these CMAQ obligations as they record project data in the FMIS or provide information that ultimately populates the system.

C. Annual Reports

States should prepare annual reports detailing how CMAQ funds have been invested. The CMAQ reporting is not only useful for the FHWA, the FTA, and the general public, but the development and maintenance of a cumulative database of all CMAQ projects by the Secretary is
required by MAP-21. In addition, more recent annual reports will be key in supporting case studies for the CMAQ Outcomes Study, a major research effort designed to gauge the impact of the program, and also required by the statute. The CMAQ annual reports should be submitted through the Web-based CMAQ Tracking System.

The FHWA Division offices, State DOTs, and MPOs should develop a process for entering and approving the data in a timely manner. This report should be approved by the FHWA Division office by the first day of March following the end of the previous Federal fiscal year (September 30) and cover all CMAQ obligations for that fiscal year. Thus, State DOTs and MPOs should report the data early enough that the Division office has time to review and comment on the report. The report as entered into the CMAQ Tracking System should include:

1. A list of projects funded under CMAQ, in seven main project categories:
   - **Transit:** facilities, vehicles, equipment, and related activities, operating assistance for new transit service, etc. Include all transit projects whether administered by the FTA or the FHWA.
   - **Shared Ride:** vanpool and carpool programs and parking for shared-ride services.
   - **Traffic Flow Improvements:** traffic management and control services, signalization projects, ITS projects, intersection improvements, and construction or dedication of HOV lanes.
   - **Demand Management:** trip reduction programs, transportation management plans, flexible work schedule programs, vehicle restriction programs.
   - **Pedestrian/Bicycle:** bikeways, storage facilities, promotional activities.
   - **I/M and other TCMs:** projects not covered by the above categories.
   - **STP/CMAQ:** projects funded with the flexible funds provided in those States receiving the minimum apportionment.

For reporting purposes, obligations for all CMAQ-eligible phases (beginning with the NEPA process) should be reported for the project they support.

2. The amount of CMAQ funds obligated or deobligated for each project during the Federal fiscal year. Enter deobligations as a negative number. (Do not include Advance Construction funds, as these are not obligations of Federal CMAQ funds. Such projects should be reported later when converted to CMAQ funds.)

3. A quantitative analysis. Given the emphasis MAP-21 places on cost-effectiveness and performance measurement, quantitative assessment should be provided whenever possible. In addition, to the extent this information has been provided historically, a cost-effectiveness assessment for each reported project should be projected as well. Emissions benefits (and disbenefits) should be developed for each project from project-level analyses. Emissions estimates may be derived from EPA’s MOVES model, CARB’s EMFAC model, and AP-42, among others. Report

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60Sec. 1113(c), Pub. L. 112-141 (July 6, 2012).
projected emissions benefits expected to occur in the first year that a project is fully operational, in kilograms reduced per day. Benefits should be reported the first time a project is entered into the system, and only then to avoid double counting of benefits. (Because funds may be obligated for a project over several years, an individual CMAQ project may show up in reports for multiple years.) Additionally, all pollutants for which the area is in nonattainment or maintenance status, regardless of which pollutant contributed to the area’s weighted population for apportionment, should be addressed. Emissions benefits for deobligations or projects funded with flexible funds (STP/CMAQ) should not be entered.

4. Public-private partnerships and experimental pilot projects should be identified in the system. Transmit electronic versions of completed before-and-after studies for experimental pilot projects to the Division offices.

5. Other requested information: MPO, nonattainment/maintenance area, project description.

6. Optional information: TIP, State and/or FMIS project numbers—highly recommended. Other optional information includes: greenhouse gas emission reductions, cost-effectiveness, safety, congestion relief, and other ancillary benefits.

D. Performance Plan

The MAP-21 established a requirement in 23 U.S.C. 149(l) for a CMAQ performance plan covering MPOs that serve a TMA\(^{62}\) of one million or more population and that represent a nonattainment or maintenance area. In addition, performance measures and target setting for emissions and traffic congestion reduction for the CMAQ program will be established through a rulemaking process. The CMAQ performance plan will be completed and updated biennially and will include:

1. Baseline levels for traffic congestion and on-road mobile source emissions for which the area is in nonattainment or maintenance;

2. A progress report on achievements in reaching performance targets described in 23 U.S.C. 150(d);

3. A description of the projects identified for CMAQ funding and a projection of how these projects will contribute to achieving the emission and traffic congestion reduction targets developed pursuant to 23 U.S.C. 150(d);\(^{63}\)

4. A separate report assessing the progress of the projects under the previous

\(^{62}\) 23 U.S.C. 134(k).

plan in achieving the air quality and congestion targets of the previous plan.⁶⁴

The biennial performance plan will be submitted with the CMAQ annual report for that year. Reports will be turned in to the FHWA Division Office through the State DOT. Further guidance on FHWA’s approach to performance management will be provided as the rulemaking process covering changes under MAP-21 continues.

Appendix D – FHWA CMAQ Program Revised Interim Guidance for Operating Assistance, 2014
Section 125 of the Consolidated Appropriations Act, 2014 (Public Law 113-76) (2014 Appropriations Act), modified 23 U.S.C. 149(m) to eliminate any time limitation on the use of CMAQ funds for operating assistance for certain activities. This Revised Interim Guidance updates and supersedes Interim Guidance on CMAQ Operating Assistance issued in June 2013.

There are several general conditions for operating assistance eligibility under the CMAQ program (see the November 2013 CMAQ Program Interim Guidance for a complete discussion on CMAQ project eligibility requirements):

a. Operating assistance is limited to start up operating costs for new transportation services or the incremental costs of expanding such services, including transit, commuter and intercity passenger rail services, intermodal facilities, and travel demand management strategies, including traffic operation centers.

b. In using CMAQ funds for operating assistance, the intent is to help start up viable new transportation services that can demonstrate air quality benefits and eventually cover costs as much as possible. Other funding sources should supplement and ultimately replace CMAQ funds for operating assistance, as these projects no longer represent additional, net air quality benefits but have become part of the baseline transportation network. The provisions in 23 U.S.C. 116 place responsibilities for maintenance of transportation facilities on the States. Since facility maintenance is akin to operations, a time-limited period of CMAQ assistance provides adequate incentive and flexibility while not creating a pattern of excessive or even perpetual support.

c. Operating assistance includes all costs of providing new transportation services, including, but not limited to, labor, fuel, administrative costs, and maintenance.

d. When CMAQ funds are used for operating assistance, non-Federal share requirements still apply.

e. With the focus on start-up, and recognizing the importance of flexibility in the timing of financial assistance, the 3 years of operating assistance allowable under the CMAQ program may now be spread over a longer period, for a total of up to 5 sequential years of support. Grantees who propose to use CMAQ funding for operating support may spread the third year amount (an amount not to exceed the greater of year 1 or 2) across an additional 2 years (i.e. years 4 and 5). This approach will provide an incremental, taper-down approach, while other funding is used for a higher proportion of the operating costs as needed. See Table 3 for examples of possible funding allocations. At the conclusion of the 5-year period, operating costs would have to be maintained with non-CMAQ funding. It is anticipated that this approach may enable a transition to more independent system operation. The amounts which apply to years 1 and/or 2 are established at the discretion of the State or local sponsor.

**Table 3 - Example Allocations of CMAQ Funds for Operating Assistance**

<table>
<thead>
<tr>
<th>Example</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$300</td>
<td>$300</td>
<td>$200</td>
<td>$50</td>
<td>$50</td>
<td>$900</td>
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<tr>
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<td>300</td>
<td>100</td>
<td>100</td>
<td>100</td>
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</tr>
<tr>
<td>C</td>
<td>100</td>
<td>400</td>
<td>200</td>
<td>100</td>
<td>100</td>
<td>900</td>
</tr>
</tbody>
</table>

Except as noted in paragraph (f) below, activities that already have received 3 years of...
operating assistance under prior authorizations of the CMAQ program are not considered to be in a start-up phase and are not eligible for new CMAQ operating assistance or the expanded assistance period.

f. Section 125 of the 2014 Appropriations Act included changes to the Operating Assistance Section of the CMAQ program (23 USC 149(m)). The changes added new language that specifically prohibits the imposition of a time limitation for operating assistance eligibility on a system "for which CMAQ funding was made available, obligated or expended in fiscal year 2012." The phrase "made available" applies to projects designated for CMAQ operating assistance in statute, or to any commitment by the party that by law selects projects for operating assistance funding so long as it occurred during FY2012. There must be official documentation demonstrating that there was a specific commitment in FY 2012 to provide CMAQ funding for operating assistance for a particular project or service. Such official documentation could include a TIP or STIP, or other State or MPO official records. The specific project or service for which the CMAQ funds are being sought for operating assistance without a time limitation must be clearly identified in this documentation. Transportation services expressly eligible for CMAQ funding under SAFETEA-LU sections 1808(g)-(k) and certain provisions in previous appropriations acts are eligible to use CMAQ funds for operating assistance without time limitations. Consistent with Section IX of the CMAQ Program Interim Guidance, States retain the discretion to decide whether or not to fund the operating assistance.

g. Elements of operating assistance prohibited by statute or regulation are not eligible for CMAQ participation, regardless of their emissions or congestion reduction potential.
Diesel Retrofits: Quantifying and Using Their Emission Benefits in SIPs and Conformity

Guidance for State and Local Air and Transportation Agencies
Diesel Retrofits: Quantifying and Using Their Emission Benefits in SIPs and Conformity

Guidance for State and Local Air and Transportation Agencies

Transportation and Climate Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
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APPENDIX C:

MODEL RULE FOR TRADING EMISSION REDUCTIONS FROM NONROAD RETROFIT PROJECTS FOR TRANSPORTATION CONFORMITY
SECTION 1: INTRODUCTION

1.1 What is the purpose of this guidance?

Technology is available to reduce diesel vehicle and engine emissions in a cost-effective way. The ability to use diesel emission reductions for state implementation plan (SIP) and conformity purposes gives states and localities additional incentive to implement diesel retrofit projects. Diesel retrofit technologies reduce pollution from the existing diesel engine fleet by up to 90% for particulate matter (PM), up to 75% for nitrogen oxides (NOx), and up to 90% for volatile organic compounds (VOCs). Many diesel retrofit projects are being successfully implemented around the country. Clean diesel projects already initiated are expected to result in approximately 20,000 tons of particulate matter reduced over the life of the projects, with estimated public health benefits of about $5 billion.

The purpose of this document is to provide guidance on quantifying and using emission reductions from on-road and nonroad diesel vehicles, engines, and equipment that have been retrofitted with emission reduction technology. This guidance document describes how to quantify and use reductions of NOx, VOCs, PM$_{2.5}$, PM$_{10}$, and carbon monoxide (CO) in ozone, PM$_{2.5}$, PM$_{10}$, nitrogen dioxide (NO$_2$), and CO nonattainment and maintenance areas. You can use the emission reductions resulting from implementing a retrofit project in a SIP to help achieve reasonable further progress (RFP), attainment of the national ambient air quality standard (NAAQS or “standard”), or maintenance of the NAAQS; and in transportation conformity and general conformity determinations. This guidance document is updated to reflect the new quantification procedures to use EPA’s latest on-road emissions model, the MOtor Vehicle Emissions Simulator (MOVES) model.\footnote{1} For nonroad emissions, the nonroad portion of the National MOBILE Inventory Model (NMIM) is the preferred way to estimate benefits of retrofit programs. State and local agencies developing SIPs and conformity analyses for California should consult with EPA Region 9 for information on the current version of EMFAC approved for use in California and for information on how to quantify emission reductions from retrofit projects.

Retrofit projects provide a unique and cost-effective opportunity for state and local governments to reduce pollution from on-road and nonroad diesel vehicle and equipment fleets, and as a result, could assist areas in attaining the NAAQS. The current transportation law, Moving Ahead for Progress in the 21st Century (MAP-21), continues to provide federal funding for on-road retrofits under the Congestion Mitigation and Air Quality Improvement Program (CMAQ), and funding for diesel retrofit projects.\footnote{2} MAP-21 recognizes the importance of diesel retrofit projects and other mobile source emission reduction strategies and directs states and metropolitan planning organizations (MPOs) to give priority for use of CMAQ funds for projects that reduce fine particulate matter emissions, including diesel retrofits in PM$_{2.5}$ nonattainment and maintenance areas. The law also notes that states and MPOs continue to have final CMAQ project selection authority.

\footnote{1} The previous version of this document, EPA420-B-06-005, was released in June 2006. Today’s version supersedes the previous document.
\footnote{2} 23 U.S.C 149(b)(8)
This guidance also fulfills the directive from the Energy Policy Act of 2005\(^3\) that requires EPA to provide SIP guidance for retrofit projects under the diesel emission reduction provision (also known as “DERA”) and takes the additional step of providing guidance for crediting retrofits in conformity determinations. In addition to assisting MPOs and states in evaluating diesel retrofits for CMAQ project selection, we anticipate that this guidance will also be useful for implementing the DERA program. DERA authorizes federal funds for retrofit projects that reduce diesel emissions from existing engines.

This guidance is focused on quantifying emission reductions from diesel retrofits for SIP and conformity purposes and therefore has an intended audience of air quality and transportation planners. Other audiences can use this guidance for quantifying emissions reductions for non-SIP or conformity purposes by reading Section 1 for background and referring to Section 2 of the guidance for quantifying emission reductions. This guidance document is written for current and future NAAQS as well as current and future versions of MOVES. EPA will re-evaluate the applicability of this guidance as needed.

1.2 How can emission reductions from retrofit projects be used to meet SIP and conformity needs?

This guidance is intended to facilitate the development of retrofit projects as a cost-effective way to achieve needed emission reductions while ensuring that these projects meet SIP and conformity requirements. This document describes several different options for the use of emission reductions from retrofit projects to meet both near term and longer term SIP and conformity needs.

State and local air and transportation agencies should work together to determine how reductions from diesel retrofits should be used given local air quality needs. The interagency consultation process can also be used to identify retrofit projects to implement for future SIP or conformity needs. If those reductions are used in the near term for conformity, then state and local agencies should work together to determine what additional retrofit projects could be implemented to meet any additional air quality needs.

Under any of the options highlighted below, it is in the best interests of state and local agencies to act as quickly as possible to get retrofit projects in place. Retrofit projects will provide their greatest benefits in the near term, while significant numbers of vehicles, engines, and equipment built before EPA’s 2007/2010 on-road and 2008 nonroad standards remain in the fleet.

1.2.1 On-road and nonroad retrofit projects in SIPs

One option is to use retrofit reductions to help demonstrate RFP, attainment, or maintenance

\(^3\) See Energy Policy Act of 2005, Title VII, Subtitle G (sections 791 to 797) at http://www.epa.gov/oust/fedlaws/epact_05.htm
in upcoming SIP submissions. On-road and nonroad retrofit projects are subject to the same SIP requirements as any other control measures. This guidance document provides the necessary information to include retrofit projects in a SIP, including a calculation method that ensures that emission reductions calculated for the retrofit project are consistent with the rest of the SIP. State and local agencies can include these retrofit projects in the SIPs being developed to meet the applicable NAAQS, but they will want to consider implementing them as soon as possible to ensure the maximum available reductions from the retrofit projects. General SIP requirements for retrofit projects are described in Section 3 of this document.

1.2.2 On-road retrofit projects in transportation conformity

Alternatively, state and local agencies could also use on-road retrofit projects to meet transportation conformity requirements now or in the future with little additional effort beyond what is required to properly implement the project and quantify the emission reductions. These reductions could be incorporated into a transportation conformity determination without making any change in the SIP. Section 4.3 of this document explains this process.

1.2.3 Nonroad retrofit projects in transportation conformity

This document also provides guidance on options for using reductions from nonroad retrofit projects in regional emissions analyses for transportation conformity determinations (see Section 4). These options require a SIP revision before they can be implemented. One option, adding a safety margin to the SIP, could be implemented in the context of the process of developing a new SIP to meet an applicable NAAQS. SIP safety margins have been implemented and used to meet transportation conformity requirements many times in the past. We have provided detailed information on how this option works in Section 4 and Appendix A.

Another option for using the nonroad retrofit reductions in transportation conformity determinations is to include a trading mechanism in the SIP. This can be done as a SIP prior to the completion of an RFP or attainment SIP. We have provided detailed information on how to implement a trading mechanism as a SIP in Section 4 and Appendix B. To help reduce the time needed to develop, submit and approve a trading mechanism SIP, we have provided a model trading rule in Appendix C. States that adopt this rule without significant revisions could expect an expedited approval by EPA.

EPA also notes that reductions from retrofits can be applied as mitigation measures in quantitative PM$_{2.5}$ or PM$_{10}$ hot-spot analyses for project level conformity determinations. The methodology in Section 2 of this guidance can be used for such analyses. For further background on PM hot-spot analyses, see EPA’s Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM$_{2.5}$ and PM$_{10}$ Nonattainment and Maintenance Areas at [www.epa.gov/otaq/stateresources/transconf/projectlevel-hotspot.htm#pm-hotspot](http://www.epa.gov/otaq/stateresources/transconf/projectlevel-hotspot.htm#pm-hotspot)
1.2.4 Retrofit projects in general conformity

Finally, this guidance also provides information on the use of retrofit reductions to meet general conformity requirements (see Section 5). The use of nonroad retrofit reductions in general conformity does not require a SIP revision.

1.3 What vehicles, engines, and equipment does this guidance address?

This guidance focuses on emission reductions from heavy-duty on-road and nonroad diesel vehicles, engines, and equipment, and fuels. This guidance excludes locomotive and marine applications because they are not currently contained in NMIM. New emission standards, enacted in 2001, affected all on-road heavy-duty highway vehicles and engines, starting in 2007 model year, with an additional set of NOx requirements beginning in 2010. Tighter emission standards (Nonroad Tier 4) were phased in for 2008 and future model year nonroad engines. Ultra-low sulfur diesel fuel (15 ppm sulfur content) was required for on-road use beginning in October 2006. For nonroad vehicles, engines, and equipment, low sulfur diesel fuel (500 ppm sulfur content) was required beginning in 2007, with ultra-low sulfur diesel fuel required beginning in 2010. In general, this guidance applies to the retrofit of vehicles, engines, and equipment manufactured before those standards took effect and that will not have to comply with EPA’s 2007/2010 on-road and 2008 nonroad regulations. This guidance document can be used, however, for emission reductions from retrofits of post-2007/2010 and post-2008 vehicles, engines, and equipment if such activities meet the definition of “retrofit” discussed below.

1.4 What is a retrofit project?

For the purpose of this guidance only, a “retrofit project” is defined broadly to include any technology, device, fuel, or system that when applied to an existing diesel engine achieves emission reductions beyond that currently required by EPA regulations at the time of its certification. Therefore, for those existing vehicles, engines, or equipment that will not have to comply with EPA’s 2007/2010 heavy-duty on-road and 2008 nonroad standards, any additional emission reduction beyond the current regulation of these vehicle, engine, or equipment emission levels is considered a retrofit project. These technologies may include, but are not limited to, the following:

- EPA “verified” emission control technologies (for example, oxidation catalysts and PM filters and upgrade kits)

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4 On-road sources include vehicles used on roads for transportation of passengers and freight. These sources are also sometimes referred to as highway sources. Nonroad sources include vehicles, engines, and equipment used for construction, agriculture, nonroad transportation, recreation, and many other purposes. These sources are also sometimes referred to as off-road sources. Within these broad categories, on-road and nonroad sources are further distinguished by size, weight, use, and/or horsepower.

5 For a complete list of all EPA verified technologies, consult the list at the following web site: [http://www.epa.gov/cleandiesel/verification/verif-list.htm](http://www.epa.gov/cleandiesel/verification/verif-list.htm). Any diesel fuel and/or diesel fuel additive included on
California’s Air Resources Board (CARB) “verified” emission control technologies (see paragraph below)

EPA certified engines⁶ as engine replacements (see Section 1.5)

Technologies that have not been verified by EPA or CARB and operational strategies are beyond the scope of this guidance document.

In 2004, EPA signed a Memorandum of Agreement (MOA)⁷ with CARB to coordinate the verification of diesel retrofit technologies. This MOA commits the agencies to establish reciprocity in verification of hardware or device-based retrofits, and further establishes our joint commitment to cooperate on the evaluation of retrofit technologies. This agreement commits EPA and CARB to accept each other’s verification of the amount of PM and NOx reduced by a particular retrofit technology. Currently, EPA accepts CARB verified technologies, and CARB accepts EPA verified technologies. Additionally, as retrofit manufacturers initiate and conduct in-use testing, both agencies agreed to coordinate this testing so data generated may satisfy the requirements of both agencies. This MOA is intended to expedite the verification and introduction into the market of innovative emission reduction technologies. Additionally, this MOA reduces the effort needed for retrofit technology manufacturers to complete verification.

The verification of diesel technologies is specific to particular types of vehicles, engines, or equipment as defined in the “applicability” section of the EPA and CARB verified technology lists. Verified retrofit technologies can be applied only to the vehicles, engines, or equipment specified in those lists. For example, a technology that has been verified for on-road vehicles will not necessarily be suitable for nonroad vehicles, engines, or equipment unless it is also been verified for such use.

1.5 What are the requirements for using vehicle, engine, or equipment replacements in SIPs and conformity?

In addition to the EPA and CARB verified retrofit technologies, this guidance also applies to the use of EPA certified engines as engine replacements,⁸ or the early replacement of older vehicles or equipment (e.g., bulldozers) with cleaner vehicles or equipment. Emission reductions that result from vehicle, engine, or equipment replacements that would have occurred through normal attrition

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⁶ For a complete list of all EPA certified large on-road and nonroad engines, consult the list at the following web site: [www.epa.gov/otaq/certdata.htm](http://www.epa.gov/otaq/certdata.htm).
⁷ The MOA is at the following web site: [http://www.epa.gov/cleandiesel/documents/epa-arb_moa.pdf](http://www.epa.gov/cleandiesel/documents/epa-arb_moa.pdf). The CARB verified technology list can be found here: [http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm](http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm).
⁸ Engine replacement is sometimes referred to as an engine “repower;” EPA uses only the term “replacement” in this guidance.
are considered to be the result of normal fleet turnover and are not addressed by this guidance. The effects of fleet turnover are already included in the MOVES and NMIM/NONROAD models. Furthermore, the purchase of new vehicles or equipment to expand a fleet is not covered by the guidance. To be considered a replacement, the purchase of new vehicles, engines, and equipment would need to be accompanied by the scrappage of old vehicles, engines, and equipment and occur before normal attrition.

To be able to use emission reductions from any replacements in a SIP or in a conformity determination, the following statements would apply:

- The vehicle, engine, or equipment being replaced would be scrapped (permanently disabled or destroyed), or the replaced engine would be returned to the original engine manufacturer for remanufacturing to a cleaner standard.

- The replacement vehicle, engine, or equipment would perform the same function as the vehicle, engine, or equipment that is being replaced (e.g., an excavator used to dig pipelines would be replaced by an excavator that continues to dig pipelines).

- The replacement vehicle, engine, or equipment would be of the same type and similar gross vehicle weight rating or horsepower as the vehicle, engine, or equipment being replaced (e.g., a 300 horsepower bulldozer is replaced by a bulldozer of similar horsepower).

In addition, when emission reductions are calculated for replacements, note that:

- The emission reductions are available only for the remaining useful life of the vehicle, engine, or equipment being replaced (e.g., if the vehicle being replaced had a remaining useful life of 5 years, the additional emission reductions from the new vehicle are available for SIP or conformity purposes under this guidance only for 5 years).

- The emission reductions are available only for activity (e.g., travel or hours of use) of the vehicle, engine, or equipment being replaced within the nonattainment or maintenance area. Thus, if you replace an older, less used vehicle or piece of equipment with a piece of new equipment, it is likely that the new equipment would be used more than the item it replaces. However, emission reductions from the new equipment would need to be calculated based on the activity level of the old equipment.

### 1.6 How does this guidance relate to the Voluntary Mobile Source Emission Reduction Program SIP guidance?

In October 1997, EPA issued its “Guidance on Incorporating Voluntary Mobile Source Emission Reduction Programs in State Implementation Plans (SIPs)” (the VMEP guidance). EPA notes that the VMEP guidance is related to SIP measures, rather than transportation or general conformity determinations.
The purpose of the 1997 VMEP guidance is to support innovative methods in achieving emission reductions for SIPs. The VMEP guidance applies to SIP emission reduction measures that rely on voluntary actions of individuals and other parties.

Many state or federally-funded retrofit projects may not be subject to the VMEP guidance if they have well-defined requirements to ensure the full implementation of a SIP program. For example, retrofit projects would not be subject to the VMEP guidance if a state or local regulation or ordinance that required retrofit projects was included in the SIP. Another example of a project that would not be subject to the VMEP guidance would be a state program that is described in the SIP that requires state transportation construction contracts to be implemented with retrofitted construction equipment. Please consult your EPA Region early in the development of a retrofit project to determine the appropriate use of the VMEP guidance. Retrofit projects that are pre-empted under applicable provisions of Clean Air Act section 209, as discussed in Section 1.7, may not be included in the SIP.

Under the VMEP guidance, the amount of emission reductions allowed for voluntary mobile measures in a SIP is presumed to be no greater than three percent of the total projected future year emission reductions required to attain the applicable air quality standards. EPA acknowledges that it may be possible to demonstrate that voluntary measures may achieve credible reductions higher than the three percent cap. In that case, EPA will re-evaluate that cap on a case-by-case basis and allow the cap to be exceeded if the cap hinders the implementation of effective voluntary control measures, subject to notice and comment during SIP approval. Today’s guidance relies on EPA’s 1997 VMEP guidance for voluntary retrofit projects. Interested parties should refer to that guidance at the time a specific retrofit project is under development.

1.7 Can a state require retrofits of on-road and nonroad vehicles, engines, or equipment?

The answer to this question depends on the circumstances for an individual state. Clean Air Act section 209 sets forth certain restrictions on the abilities of states and localities to adopt and implement emission standards for certain on-road and nonroad vehicles, engines, and equipment. The effect of Clean Air Act section 209 on a particular state’s retrofit requirements can vary depending on the specific provisions of those retrofit requirements. State and local agencies should check with EPA before promulgating any state or local regulations or programs mandating retrofit projects for SIP or conformity purposes. See Section 1.9 of this guidance for EPA contact information.

measures for conformity determinations must meet the relevant criteria in the transportation and general conformity regulations.
### 1.8 Does this guidance create any new requirements?

This guidance does not create any new requirements, but explains to state and local air agencies, transportation agencies, MPOs, and the general public how the air quality benefits of commuter programs could be included in a SIP or in a transportation conformity determination. The Clean Air Act (CAA) and implementing regulations contain legally binding requirements. SIP requirements can be found in Clean Air Act sections 110(a)(2) and 172(c). Transportation and general conformity requirements can be found in Clean Air Act section 176(c) and applicable regulations (40 CFR Parts 51 and 93). This guidance document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it does not impose binding, enforceable requirements on any party, and may not be applicable in all situations. EPA and State decision makers retain the discretion to adopt approaches for approval of SIP measures that differ from this guidance where appropriate and consistent with applicable law and regulations. Any final decisions by EPA regarding a particular SIP measure will only be made based on the statute and regulations in the context of EPA notice and comment rulemaking on a submitted SIP revision. This guidance may be revised periodically without public notice.

### 1.9 Who should I contact for additional information?

If this guidance document does not answer a specific question, please contact the appropriate EPA regional office with responsibility for air quality planning and/or conformity in the area where the retrofit project is located. A contact list of EPA Regions is available at the following web address: [www.epa.gov/epahome/locate2.htm](http://www.epa.gov/epahome/locate2.htm). In addition, contact information for EPA regional transportation conformity staff can be found at the following website: [www.epa.gov/otaq/stateresources/transconf/contacts.htm](http://www.epa.gov/otaq/stateresources/transconf/contacts.htm).

For general questions regarding retrofit projects or the application of verified retrofit technologies for the existing fleet of on-road and nonroad vehicles, engines, and equipment, please contact EPA’s National Clean Diesel Campaign at [cleandiesel@epa.gov](mailto:cleandiesel@epa.gov).

For technical questions regarding the use of MOVES or NMIM/NONROAD for calculating emission reductions from retrofit projects, please contact EPA’s Office of Transportation and Air Quality at [mobile@epa.gov](mailto:mobile@epa.gov).

For general questions concerning the use of emission reductions from retrofit projects in SIPs or in transportation conformity, please contact Astrid Larsen of EPA’s Office of Transportation and Air Quality at (734) 214-4812, [larsen.astrid@epa.gov](mailto:larsen.astrid@epa.gov) or Gary Dolce also at EPA’s Office of Transportation and Air Quality at (734) 214-4414, [dolce.gary@epa.gov](mailto:dolce.gary@epa.gov).

For general questions concerning the use of emission reductions from retrofit projects in general conformity, please contact Tom Coda of EPA’s Office of Air Quality Planning and Standards at (919) 541-3037, [coda.tom@epa.gov](mailto:coda.tom@epa.gov).
SECTION 2: QUANTIFYING RETROFIT EMISSION REDUCTIONS

2.1 How do you quantify emission reductions from retrofit projects?

To estimate emission reductions from retrofit projects for SIPs and for conformity analyses in states other than California, EPA recommends the use of the following models:

- The MQtor Vehicle Emissions Simulator (MOVES) for on-road vehicles\(^\text{10}\) and
- The National Mobile Inventory Model (NMIM) containing NONROAD2008 for nonroad sources contained in the model.\(^\text{11}\)

The most recent approved versions of these models should be used. Users should check EPA’s MOVES and NMIM websites for the most current approved version of these models (MOVES2010b and NMIM2008 as of the release date of this guidance document). EPA intends to integrate nonroad capabilities into a future version of MOVES.

EPA is not providing a methodology at this time for the quantification of emission reductions from retrofit projects in California. State and local agencies developing SIPs and conformity analyses for California should consult with EPA Region 9 for information on the current version of EMFAC approved for use in California and for information on how to quantify emission reductions from retrofit projects.

2.2 What are MOVES and NMIM and why should they be used to quantify emission reductions from retrofits?

MOVES is EPA’s latest motor vehicle emissions model for state and local agencies to estimate volatile organic compounds (VOCs), nitrogen oxides (NOx), particulate matter (PM), carbon monoxide (CO), and other precursors from cars, trucks, buses, and motorcycles for SIP purposes and conformity determinations outside of California. MOVES is available at [http://www.epa.gov/otaq/models/moves/index.htm](http://www.epa.gov/otaq/models/moves/index.htm). MOVES replaced MOBILE6.2, EPA’s previous emissions model. MOVES is required for SIPs begun after December 2009 and regional transportation conformity analyses begun after March 2, 2013. See EPA’s “Policy Guidance on the

\(^{10}\) This guidance is applicable to current and future versions of the MOVES model, unless EPA notes otherwise when approving the model for conformity purposes. Modelers should follow the “Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a, and 2010b,” EPA-420-B-12-028 (April 2012); available online at [www.epa.gov/otaq/models/moves/index.htm#sip](http://www.epa.gov/otaq/models/moves/index.htm#sip). The MOVES model, user guide, and supporting documentation are available online at [www.epa.gov/otaq/models/moves/index.htm](http://www.epa.gov/otaq/models/moves/index.htm).

\(^{11}\) NMIM2008 and supporting documentation are available online at [www.epa.gov/otaq/nmim.htm](http://www.epa.gov/otaq/nmim.htm). NONROAD2008 could also be used, but EPA does not recommend this because NONROAD2008 does not include the fleet specific capabilities included in NMIM. NONROAD2008 also may not work with newer 64-bit operating systems.

\(^{12}\) Note that this guidance refers to “MOVES” generally rather than a particular MOVES version because EPA will release updated versions of MOVES in the future.
Use of MOVES2010 and Subsequent Minor Revisions for State Implementation Plan Development, Transportation Conformity, and Other Purposes” (available at www.epa.gov/otaq/models/moves/documents/420b12010.pdf) for more details. MOVES includes features that are specifically intended for modeling retrofit programs which are described in detail in Sections 2.5 and 2.6 below.

NMIM is a graphical user interface (GUI) that contains the NONROAD2008 and (the now no longer used) MOBILE6.2 models and a database of county-level input information, called the National County Database (NCD). NMIM was created to simplify the process of developing county-by-county emissions inventories for multi-county areas, states, or the entire nation. MOVES has replaced NMIM for on-road emissions estimation and, as a result, the use of on-road emissions estimates from NMIM is not currently acceptable for any regulatory purpose. However, the portion of NMIM that contains NONROAD2008 is the best option for modeling retrofit, rebuild, and replacement programs that affect nonroad equipment. The use of NMIM to model retrofit programs for nonroad equipment is described in detail in Sections 2.7 and 2.8 below. NMIM is available at www.epa.gov/otaq/nmim.htm.

MOVES and NMIM incorporate EPA’s latest emissions data for on-road and nonroad sources respectively, as well as the capabilities to apply retrofit benefits to emission factors or inventories that are generated by MOVES and NONROAD under local conditions. The emissions of retrofit highway and nonroad vehicles, engines, and equipment are subject to the same external factors as are the emissions for all other vehicles, engines, and equipment. These external factors include environmental factors (e.g., temperature, humidity), fleet characteristics (e.g., age distribution of fleet, distribution of VMT by vehicle class, number and types of nonroad engines or equipment), activity measures (e.g., speed distributions, distribution of VMT by roadway type, distribution of hours of operation for nonroad equipment), and fuel characteristics (e.g., sulfur content, Reid vapor pressure (RVP)). The majority of impacts of these external factors on the emissions of vehicles, engines, and equipment meeting past, current, and future emission standards are incorporated in EPA’s MOVES and NONROAD emissions models which are used to develop emissions inventories for SIPS and for regional transportation conformity analyses. Using MOVES and NMIM to generate retrofit emission reductions ensures that those reductions are based on the same conditions used to generate the rest of the inventory used in the SIP or conformity analysis.

2.3 How should the data included in MOVES and NMIM be used when quantifying emission reductions from retrofits?

As with any model, the quality of the inputs in MOVES and NMIM affects the quality of the model results. As required by Clean Air Act Section 172(c)(3) and EPA’s regulations at 40 CFR 51.112(a), States must use the latest planning assumptions available at the time the SIP is developed, including, but not limited to VMT, speeds, fleet mix and SIP control measures.

MOVES includes a national default database of fleet and activity information that is applied at the county level. However, in most cases, local data should be used instead of default fleet and activity data. Detailed guidance on the development of MOVES inputs for SIP and conformity
analyses is included in “Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a, and 2010b” (hereafter referred to as the MOVES Technical Guidance) available on the MOVES web page at http://www.epa.gov/otaq/models/moves/index.htm#sip. All inputs used in estimating retrofit benefits for SIP or conformity purposes should be consistent with the MOVES Technical Guidance. This retrofit guidance document addresses the specific inputs needed for on-road retrofit programs which are not covered in the MOVES Technical Guidance.

As stated above, NMIM should be used only for modeling retrofit, rebuild, and replacement programs that affect nonroad equipment. NMIM includes a database of county-level nonroad information called the National County Database (NCD). States have provided some local information for the National County Database (NCD) as part of the National Emissions Inventory (NEI) development process. However, given the NEI cycle, this may not be the most recent or best available information at the time a state initiates modeling. For SIPS and regional conformity analyses, state and local agencies should review the information in the NCD to evaluate whether it includes the latest and best information currently available. Where more current or better information is available, the database must be modified to incorporate it to meet regulatory requirements for the use of latest planning assumptions in SIPS and conformity determinations. The interagency consultation process should be used to evaluate what changes are needed in the NMIM database for the area.

2.4 Can you use MOVES or NMIM to estimate emission reductions from retrofit projects for uses other than SIPS or conformity determinations?

Yes. MOVES could be used to evaluate on-road retrofit projects and NMIM could be used to evaluate nonroad retrofit projects for other purposes, such as the development of proposals for retrofit projects. For these purposes, MOVES and NMIM users could rely more on default data in MOVES and NMIM or other more simplified methods for using MOVES and NMIM than would otherwise be necessary for SIP or conformity purposes. These simplified methods may result in emission reduction estimates that are not completely consistent with emission reductions calculated for SIP or conformity purposes using more rigorous methods. Consultation between organizations developing project proposals and state and local air quality and transportation agencies about appropriate methods and interpretation of results is important to ensure that retrofit projects are properly evaluated.

2.5 How do you use MOVES2010b to quantify emission reductions from retrofit projects?

Retrofit projects are modeled using the On-Road Retrofit option in the Control Strategies panel to create an on-road retrofit input file in MOVES. The details of how to do this in MOVES2010b are described in Section 2.2.9 and Appendix D of the MOVES2010b User Guide.

13 EPA encourages states to separately submit updates to the NCD so that the most accurate database is available for both national and local inventory development.
EPA has supplied a Retrofit Converter tool for simplifying the creation of an on-road retrofit input file, which is available at www.epa.gov/otaq/models/moves/tools.htm under the heading “Retrofit Converter”. The Retrofit Converter allows the user to describe the retrofit project in terms of the verified technology and vehicles to which it applies (type, number, model year), and creates the appropriate input file for MOVES. The tool automatically accounts for chained pollutants (i.e., emissions for pollutants that are dependent in MOVES on the emissions of another pollutant), creates input lines for each pollutant process, and uses the appropriate abbreviated name, among other things. For SIP and conformity purposes, the Retrofit Converter tool should be used in a manner consistent with the guidance in this document and the MOVES Technical Guidance. The instructions that come with the tool do not provide all of the detail included in this guidance and are not a substitute for it. The Retrofit Converter does have some limitations which are described in Sections 2.5.2 and 2.5.7. Users of the Retrofit Converter should always check the output of the converter to make sure it is consistent with the rest of this guidance.

The MOVES retrofit input file describes the details of the retrofit project. This includes inputs that specify the pollutants and pollutant processes affected by the retrofit project, the fuel types affected, the vehicle types affected, the calendar years during which the retrofits occur, the model years of the vehicles that will be retrofitted, the percentage of the fleet VMT accounted for by retrofit vehicles per year, and the percentage effectiveness of the retrofit technology applied to the vehicles. Details on the use of these inputs are described in the Appendix D of the MOVES User Guide. Specific guidance on these inputs, where applicable, is given below.

2.5.1 Pollutant

EPA and CARB have verified emission reductions from retrofit technologies only for NOx, VOC, CO, PM_{10}, and PM_{2.5} emissions. Therefore, when estimating emission reductions from retrofit projects for a SIP or conformity purposes, only these pollutants and any pollutants that are needed by MOVES to calculate emissions of these pollutants should be selected (see Section 2.2.7.2 of the MOVES User Guide for a list of base and dependent pollutants or use the Retrofit Converter tool to automatically include any other pollutants are needed to calculate the emission of the pollutant you are estimating). As discussed in Section 2.5.7 below, a retrofit evaluation for SIP or conformity purposes should include all pollutants for which the project area is nonattainment or maintenance, including any that increase as a result of the retrofit technology.

2.5.2 Pollutant Process

The retrofit parameter file will include a separate line for each pollutant process affected by the retrofit technology. All retrofit parameter files must include start and running exhaust processes
for each pollutant for which you are estimating reductions. Some retrofit technologies may also reduce crankcase running and crankcase start emissions and will include lines for each of these processes. There are no reductions associated with the extended idle process for retrofit technologies included in the EPA and CARB verified technology lists. The Retrofit Converter tool automatically creates the inputs for start and running exhaust processes, but not for crankcase start and running exhaust processes, which must be entered separately. Section 2.5.7 of this document provides additional guidance on selecting pollutant process inputs for technologies that reduce crankcase emissions.

2.5.3 Fuel Type and Source Type

As discussed in Section 1.3, this guidance document addresses on-road retrofit projects only for heavy-duty diesel vehicles. The retrofit input in MOVES allows you to enter the full range of on-road source types (vehicle types) and fuel types, but only inputs for heavy-duty diesel vehicles should be used for retrofit emission reductions in SIPs or conformity determinations. The Retrofit Converter will convert fuel and source type names to the appropriate abbreviated names.

2.5.4 Initial Calendar Year and Final Calendar Year of Retrofit Implementation

The Initial Calendar Year and the Final Calendar Year of Retrofit Implementation should be equal to the calendar year you are modeling. For example, if the calendar year of your analysis is 2012, the initial and final years of implementation should also be 2012. Using other years may cause an incorrect result.

2.5.5 Initial Model and Final Model Year Retrofitted

This input allows you to define the vehicle model years covered by the retrofit project. Note that the Retrofit Converter only has a single input line labeled “Vehicle Model Year”. For projects that cover multiple model years, simply create a new line in the converter for each year. Using this approach will ensure that differences in fractions of the fleet retrofit by model year are accounted for in the retrofit calculation.

2.5.6 Fraction of Fleet Retrofit

This input represents the fraction of activity (VMT for running emissions and vehicle population for start emissions) associated with retrofitted vehicles for a particular model year and source type. This number can be a value from 0.00 through 1.00. For example, if retrofitted 2010 model year school buses account for 40% of all 2010 model year school bus VMT in the calendar year of analysis, you would enter 0.40 for the fraction of the school bus fleet retrofitted for the 2010 model year.
2.5.7 Effectiveness of the Retrofit

This input is used to describe the effectiveness of the particular vehicle, engine, or equipment technologies being used in the retrofit project. As mentioned in Section 1.4, EPA has verified the emission reductions for certain retrofit technologies. A list of these EPA-verified retrofit technologies, the vehicle types and model years they apply to, and the emission reductions associated with them can be found at [http://www.epa.gov/cleandiesel/verification/verif-list.htm](http://www.epa.gov/cleandiesel/verification/verif-list.htm). Retrofit technologies that have been verified by the California Air Resources Board (CARB) can be found at: [http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm](http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm). You should use retrofit reductions from these verified retrofit technology lists as inputs for MOVES. These reductions are entered in MOVES as a fraction less than or equal to 1.00 (e.g., a 50% reduction is entered as 0.50). The same value should be added for both running and start emissions processes.

Retrofit technologies that include closed crankcase systems will require some adjustments to the values included given in the verified technology list to account for the way MOVES separates crankcase start and running emissions as separate processes from tailpipe start and running emissions. For closed crankcase technologies, add additional lines to the input file for crankcase start emissions and crankcase running emissions with an effectiveness fraction of 1.00 (i.e., 100% reduction in crankcase emissions) for PM emissions (do not add lines for crankcase emissions for any other pollutants). In addition, the values for tailpipe start and running emissions benefits for PM should be adjusted downward by 5%. For example, if the retrofit technology includes a closed crankcase system and the verified technology list gives a PM reduction of 30%, you should have four lines in the input file for PM:

1. Crankcase start with an effectiveness value of 1.00
2. Crankcase running with an effectiveness value of 1.00
3. Start exhaust with an effectiveness value of 0.25
4. Running exhaust with an effectiveness value of 0.25

The Retrofit Converter includes information from EPA’s verified technology list in Column J of the User Input tab under the heading “Default Removal Efficiency” based on the technology selected in Column A, “Verified Technology.” However, this information may change and the Converter may not be up-to-date. You should always look up the benefit in the verified technology list and enter that number in Column C, “User Specified Removal Efficiency.” If you are relying on a technology from CARB’s verified technology list, you will have to look up those reductions on the CARB website and enter them in Column C.

Note that the Converter only enters lines for the start exhaust and running exhaust processes. You will have to manually enter lines for PM for crankcase start and running emissions for technologies that include closed crankcase systems. The Retrofit Converter also does not automatically adjust the start and running exhaust emissions downward as described above. The user specified removal efficiency will have to be adjusted to reflect the decreased benefits for start and running exhaust.

Note that the emission reductions for each verified technology in the EPA and CARB verified technology lists are specific to certain categories of vehicles or engines and to certain model years. The emission reductions in those lists should be applied only to the categories of vehicle or
engines and model years for which they have been specifically verified. Also note that the Retrofit Converter does not check that the vehicle types and model years given in the verified technology list for a particular retrofit technology are consistent with the vehicle types and model years entered by the user in the Converter. It is your responsibility to check and edit the input file created by the Retrofit Converter as needed to ensure it is consistent with the information in the verified technology list and this guidance.

Some verified retrofit technologies may result in emission reductions for one pollutant and emissions increases for another. Any analysis of retrofit projects for SIPs or conformity purposes should include all pollutants for which the project area is nonattainment or maintenance that are affected by the retrofit project, including any that increase as a result of the retrofit technology used. An emissions increase from a retrofit is entered in MOVES as a negative number (e.g., a retrofit that results in a 50% increase in emissions would be entered as -0.50).

For most types of retrofit projects with the exception of replacements (discussed in Section 2.6), the emission reductions for the project are best determined by using two MOVES runs - one with the percentage effectiveness of the retrofit set to zero (to represent the inventory without the project) and one with it set to the appropriate level for the technology used (to represent the inventory with the project). All other parameters in this section would be set identically to describe the affected fleet of vehicles or equipment. The difference in emissions between these two runs is the emission reduction associated with the retrofit project.

2.6 How do you use MOVES to quantify emission reductions from vehicle or engine replacements?

Emission reductions from vehicle or engine replacements should not be modeled using the On-Road Retrofit Strategy (or the retrofit input file) in MOVES. Instead, you will need to do two runs, using the “Fueltype and Technologies” importer in the County Data Manager to define a base case fleet and a control case fleet consisting of different model years. Use of the Fueltype and Technologies importer is discussed in the MOVES User Guide and in Section 4.9 of the MOVES Technical Guidance.

In this case, we strongly recommend that you set up the base case and control case MOVES runs to include only the fleet of vehicles affected in the project. For example, if you are evaluating a retrofit project in 2012 that involved replacing 2005 model year school buses with 2010 model year buses, emission reductions should be calculated in the following way:

1. Set up a base case RunSpec for 2012, selecting only diesel school buses in the Vehicles/Equipment panel.
2. Create the base case input files for the CDM that describe the expected activity of 2005 model year school bus in the analysis year, 2012.
3. Create an age distribution input file for the CDM which only includes 2005 model year school buses.
4. Create a Fueltype and Technologies input file in which all the school buses are 2005 model year diesel buses.
5. Run MOVES to get the emissions of 2005 model year school buses in 2012.
6. Set up a control case RunSpec identical to the base case RunSpec.
7. Use the same input files as in step 2; i.e., assume that the control case buses have the same activity as the base case buses.
8. Create a Fueltype and Technologies input file in which all the school buses are 2010 model year diesel buses.
9. Run MOVES to get the emissions of 2010 model year school buses in 2012.
10. Take the difference between the base case and control case runs to get the benefits of the replacement project.

Note that these reductions should not be used beyond the useful life of the vehicles, engines, or equipment being replaced. In this example, if the useful life of these school buses is 10 years, emission reductions could be applied under this guidance for calendar years 2010 through 2015. However, after 2015, these reductions would be considered part of the normal fleet turnover for these vehicles and would not be available for use in a SIP or in a conformity determination. See Section 1.5 for further information.

2.7 How do you use NMIM to quantify emission reductions from nonroad retrofit projects?

The details of how to use NMIM to estimate the emissions impact of nonroad retrofit projects are described in the NMIM User Guide (available at www.epa.gov/otaq/nmim.htm). This part of this guidance document summarizes some of the key inputs for NMIM and discusses some of the issues that users face when developing input data.

2.7.1 Differences between “fleet specific” and “fleet wide” retrofit projects

NMIM divides retrofit projects into two different categories: "fleet specific" and "fleet wide." A "fleet specific" retrofit project refers to those projects where a well-defined group of nonroad vehicles or engines are the targets for retrofit. A construction company implementing a retrofit project would be an example of a fleet specific project. A fleet specific project could include multiple model years, or multiple equipment types. The key defining characteristic of a fleet specific project is that the actual number of nonroad vehicles or engines, as well as their type, model year, and activity is known.

A "fleet wide" retrofit project refers to situations where the actual nonroad vehicles or engines that will be affected by the retrofit project are not known in advance. One example of a fleet wide retrofit project would be the availability of a low emission diesel fuel that applies to the entire nonattainment area rather than to specific fleets in the nonattainment area. In this case, the actual number of nonroad vehicles or engines, or their type, model year, or activity is not precisely known.

There are important differences between fleet specific and fleet wide projects that affect the kind of information that is needed to run NMIM. It is assumed that for fleet specific projects the precise number of nonroad vehicles or engines in each model year of each class that are to be retrofit
will be known. In addition, it is assumed that the annual average hours accumulated by each model year of each class is also known. In general, retrofit projects that involve the addition of specific equipment to nonroad engines or vehicles, or involve the replacement of nonroad engines, vehicles or equipment, should be modeled as fleet specific projects because the entities involved with this type of project should be able to keep the records of the nonroad vehicles or engines modified or replaced and their average use.

In contrast, fleet wide projects are expected to have no precise information about the individual nonroad vehicles or engines that will be retrofitted. In this case, the NMIM model assumes that the average hours accumulated by retrofit vehicles or engines is the same as for all nonroad vehicles or engines of that model year and vehicle or engine class. Implementation is expressed as a fraction of all nonroad vehicles or engines of that model year and vehicle class. In general, retrofit projects based on fuels available to the general fleet will likely need to be modeled using the fleet wide approach.

As discussed in detail in the NMIM User Guide, the specifics of nonroad retrofit projects are described in an input file called the “Nonroad Retrofit Parameters File.” This file is used for both fleet specific and fleet wide retrofit projects. For nonroad fleet specific projects, an additional input file called the “Nonroad Fleet Information Parameters File” is required. This file describes in detail the specific fleet affected by the retrofit project.

### 2.7.2 The retrofit parameters

The file for nonroad retrofit parameters describes the details of the retrofit project. This includes inputs that specify the pollutants affected by the retrofit project, the nonroad vehicle or engine types affected, the calendar years during which the retrofits occur, the model years of the vehicles or engines that will be retrofitted, the percentage of the fleet retrofit per year, and the percentage effectiveness of the retrofit technology applied to the vehicles or engines. Details on the use of these inputs are described in the NMIM User Guide. Specific guidance on these inputs, where applicable, is given below.

#### 2.7.2.1 Pollutants affected by the retrofit project

While NMIM allows you to enter the entire range of pollutants for which NONROAD2008 provides emissions estimates, EPA and CARB have verified emission reductions from retrofit technologies only for NOx, VOC, CO, PM₁₀, and PM₂.₅ emissions. Therefore, when estimating emission reductions from nonroad retrofit projects for a SIP or conformity determination, only these pollutants should be evaluated. As discussed in Section 2.6.2.3 below, all pollutants for which the project area is nonattainment or maintenance that are affected by the retrofit project, including any that increase as a result of the retrofit technology, should be evaluated for SIP or conformity purposes.
2.7.2.2 Nonroad vehicle or engine types affected

As discussed in Section 1.3 above, this guidance document addresses nonroad retrofit projects only for diesel nonroad vehicles, engines, and equipment. NMIM allows you to enter the full range of vehicle and engine types included NONROAD2008, but only inputs for nonroad diesel vehicles or engines should be used for retrofit emission reductions in SIPs or conformity determinations.

2.7.2.3 Percentage effectiveness of the retrofit

This input is used to describe the effectiveness of the particular vehicle, engine, or equipment retrofit technologies being used in the retrofit project. As mentioned in Section 1.4, EPA has verified the emission reductions for certain retrofit technologies. A list of these EPA-verified retrofit technologies and the emission reductions associated with them can be found at www.epa.gov/cleandiesel/verification/verif-list.htm. A link to retrofit technologies that have been verified by CARB can be found at http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm. Retrofit reductions from these verified retrofit technology lists should be used as inputs for NMIM.

Note that the emission reductions for each verified technology in the EPA and CARB verified technology lists are specific to certain categories of vehicles or engines. The emission reductions in those lists should be applied only to the categories of vehicle or engines for which they have been specifically verified.

Some verified retrofit technologies may result in emission reductions for one pollutant and emissions increases for another. Any analysis of retrofit projects for SIPs or conformity purposes should include all pollutants for which the project area is nonattainment or maintenance that are affected by the retrofit project, including any that increase as a result of the retrofit technology used.

For most types of retrofit projects with the exception of replacements (discussed in Section 2.8), the emission reductions for the project are best determined by using two NMIM runs - one with the percentage effectiveness of the retrofit set to zero (to represent the inventory without the project) and one with it set to that appropriate level for the technology used (to represent the inventory with the project). All other parameters in this section would be set identically to describe the affected fleet of vehicles or equipment. The difference in emissions between these two runs is the emission reduction associated with the retrofit project.

2.7.3 The fleet information parameters

The file for nonroad fleet information is used to provide details of specific fleets of vehicles or engines for which more detailed information is known. Use this file, along with the retrofit parameter file described above, when quantifying the emission reductions from fleet specific retrofit projects. For nonroad equipment, this file includes three inputs needed to specify the engines in the project – source category classification (SCC) code, horsepower bin, and technology type – as well as model year, number of engines, activity in hours per year, and monthly activity allocation.
Details on the use of these inputs are described in the NMIM User Guide. Specific guidance on these inputs, where applicable, is given below. If you are modeling a fleet specific project, you should be able to enter detailed information for all of these inputs. Note that these files only describe characteristics of a fleet of vehicles or engines; they do not describe any details of a retrofit project. When quantifying the reductions for a fleet specific retrofit project, the fleet information parameters files are used to describe the specific fleet, while the retrofit parameter files are used to describe the retrofit project applied to that fleet. When used without retrofit parameter files, the fleet information files can be used to simply quantify the emissions for any specific fleet of vehicles or engines.

### 2.7.3.1 Vehicle class or specific engine parameters

Because this function can be used to quantify the emissions from any specific fleet of vehicles or engines, there is no restriction on the types of vehicles or engines that can be entered here. However, retrofit emission reductions will be applied only to those vehicles or engines specified in the retrofit parameters file, which, as described above, should include only diesel vehicles and engines.

### 2.7.3.2 Number of vehicles or engines

The number of vehicles or engines entered for the specific fleet should be based on the calendar year for which emission estimates are being calculated. When estimating emissions for a specific fleet in the current year, this is the current size of the fleet. However, in future years the fleet of affected vehicles or engines may become smaller as some vehicles or engines in the fleet are scrapped while other newer, non-retrofit vehicles may be added to the fleet. NMIM includes the effects of normal attrition when projecting future emissions for the entire fleet (e.g., the model assumes that the number of 1998 model year vehicles or engines decreases in each future year). However, these effects are not applied to the number of vehicles or engines entered in the fleet information file for a specific fleet (e.g., if your input file indicates that you have twenty 1998 model year vehicles or engines in your retrofit fleet in 2005, NMIM will assume twenty 1998 model year vehicles or engines in any future year that you model). If you have reason to believe that some of the vehicles currently in the specific fleet may no longer be in the fleet by the calendar year that is being evaluated, reduce the input for number of vehicles or engines appropriately.

### 2.7.3.3 Hours of use

The activity level (hours of use) entered for the specific fleet should be based on the activity that actually occurs within the nonattainment or maintenance area that the SIP or conformity analysis applies to. For example, in the case of a retrofit project applied to a fleet of construction equipment, you must not include hours of use when that equipment is taken outside the nonattainment or maintenance area.
The activity level (hours of use) entered for the specific fleet should be based on the calendar year for which emission estimates are being calculated. When estimating emissions for a specific fleet in a current year, this is the current activity level of the fleet. However, in future years, the activity level of the affected vehicles or engines in the fleet may change as older vehicles and engines are often used less than newer ones. NMIM includes the effects of decreased activity with age when projecting future emissions for the entire fleet (e.g., NMIM assumes that the activity of 1998 model year vehicles or engines decreases in each future year). However, these effects are not applied to the activity levels entered in the fleet information file for a specific fleet (e.g., if your input file indicates that 1998 model year tractors are used 1000 hours in 2005, NMIM will assume that 1998 model year tractors are used 1000 hours in any future year that you model). If you have reason to believe that activity levels of vehicles or engines currently in the specific fleet may be lower by the calendar year that is being evaluated, this lowered activity should be accounted for by reducing the input for hours of use appropriately.

Specific information on the hours of use of retrofit vehicles or engines may be available from maintenance records, user logs, or fuel records. In the absence of this kind of information, the interagency consultation process should be used to determine the best available information to account for activity in the calculation of emission reductions from a retrofit project. In the absence of better information, agencies could agree to use local average estimates of vehicle or equipment activity for the class and model year of vehicles or engines included in the retrofit project.

2.8 How do you use NMIM to quantify emission reductions from vehicle, engine, or equipment replacements?

In general, emission reductions from vehicle, engine, or equipment replacements should be modeled using the fleet specific approach described in Section 2.7, with some modifications. Vehicle, engine, or equipment replacement projects will need to run NMIM twice. NMIM should be run once as a base case without the replacement data and then again with the control case that accounts for the new replacement information. For a retrofit project that uses replacements, the percentage effectiveness of the retrofit should be set to zero in both the base case (without the retrofit project) and the control case (with the retrofit project). Instead, the model year of the vehicles or engines affected are varied in the fleet information parameters. For example, if the retrofit project involved replacing 2005 model year excavators with 2010 model year excavators, emission reductions would be calculated as the difference between the following two NMIM runs:

- **Base case** – Engine model year\(^{14}\) set to 2005; all other parameters, including activity, set to describe how the model year 2005 excavators are expected to be used in the analysis year; retrofit effectiveness set to zero.

- **Control case** – Engine model year set to 2010; all other parameters, including activity, set to the same values as in the base case; retrofit effectiveness set to zero.

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\(^{14}\) Engine model year and chassis model year can in some cases be different.
Note that these reductions should not be used beyond the useful life of the vehicles, engines, or equipment being replaced. In this example, if the useful life of these excavators is 10 years, emission reductions could be applied under this guidance for calendar years 2010 through 2015. However, after 2015, these reductions would be considered part of the normal fleet turnover for these vehicles and would not be available for use in a SIP or in a conformity determination. See Section 1.5 for further information.
SECTION 3: USING EMISSION REDUCTIONS IN SIPS

3.1 What are the basic requirements for using emission reductions in SIPs?

In order to be approved as a control measure which provides additional emission reductions in a SIP, a retrofit project would need to be consistent with SIP RFP, attainment, or maintenance requirements and other requirements of the Clean Air Act, as appropriate. The retrofit project must provide emission reductions that meet the basic SIP requirements described below. Information is separated into “SIP Requirement” and “Specific Recommendations”. The “SIP Requirement” heading refers to mandatory requirements under Clean Air Act section 110. The “Specific Recommendations” headings include our recommendations for implementing a retrofit project. While these recommendations are not binding, they may provide appropriate safeguards and considerations for a successful retrofit project.

3.1.1 Quantifiable -

SIP Requirement: The emission reductions from a retrofit project are quantifiable if they are measured in a reliable manner and can be replicated (e.g., the assumptions, methods, and results used to quantify emission reductions can be understood). Emission reductions must be calculated for the time period during which the reductions will occur and will be used for SIP purposes.

Specific Recommendations:

- In general, if you are retrofitting certified vehicles, engines, or equipment with EPA or CARB verified emission control technologies or certified engine configurations, quantifying the emission reductions is fairly straightforward. In these circumstances, you will need to document the emission reductions and provide all relevant data to EPA for review.

Section 2 of this document provides you with a recommended method for quantifying emission reductions.

3.1.2 Surplus -

SIP Requirement: Emission reductions are considered “surplus” if they are not otherwise relied on to meet other applicable air quality attainment or maintenance requirements for that particular NAAQS pollutant (i.e., there can be no double-counting of emission reductions). In the event that the retrofit project is used to meet such air quality related program requirements, they are no longer surplus and may not be used as additional emission reductions. Emissions from the vehicles, engines, or equipment to be retrofitted must be in the applicable mobile source emissions inventory before the emission reductions from a retrofit project can be used for RFP, attainment or maintenance in a SIP.
3.1.3 Federally Enforceable -

**SIP Requirement:** A SIP retrofit project must be enforceable. Depending on how the emission reductions are to be used, control measures must be enforceable through a SIP. Where the emission reductions are part of a rule or regulation for SIP purposes, they are considered federally enforceable only if they meet all of the following criteria:

- They are independently verifiable.
- Violations are defined, as appropriate.
- You and EPA have the ability to enforce the measure if violations occur.
- Those liable for violations can be identified.
- Citizens have access to all the emissions-related information obtained from the responsible party.
- Citizens can file lawsuits against the responsible party for violations.
- Violations are practicably enforceable in accordance with EPA guidance on practicable enforceability.
- A complete schedule to implement and enforce the measure has been adopted by the implementing agency or agencies.

The specific requirements for enforceability vary when submitting a SIP retrofit project as a mandatory\(^{15}\) or voluntary measure. If your retrofit project is mandatory, then there is no cap on the amount of emission reductions that can be claimed as long as such reductions are supported and meet standard SIP enforceability requirements for mandatory measures and the baseline emissions are in the inventory.

If a retrofit control measure is approved under EPA’s VMEP guidance, the state is responsible for assuring that the reductions quantified in the SIP occur. The state would need to make an enforceable SIP commitment to monitor, assess, and report on the emission reductions resulting from the voluntary measure and to remedy any shortfalls from forecasted emission reductions in a timely manner. Under the VMEP guidance, the amount of emission reductions allowed for voluntary mobile source measures, including commuter programs, in a SIP is not expected to exceed three percent of the total reductions needed to meet any requirements for reasonable further progress, attainment or maintenance, as applicable.\(^{16}\) EPA acknowledges that some areas may be able to demonstrate that voluntary measures may achieve credible reductions higher than the three percent cap provided by the VMEP guidance. In that case, EPA will re-evaluate that cap on a case-by-case basis and allow the cap to be exceeded if the cap hinders the implementation of effective voluntary control measures, subject to notice and comment during SIP approval. If you wish to have a retrofit project approved as a voluntary measure, consult the 1997

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\(^{15}\) As stated in Section 1.7 of this guidance, state and local agencies should check with EPA before promulgating any state or local regulations or programs mandating retrofit projects, due to potential issues related to Clean Air Act section 209 requirements.

\(^{16}\) EPA acknowledges that it may be possible to demonstrate that voluntary measures may achieve credible reductions higher than the three percent cap. In that case, EPA will re-evaluate that cap on a case-by-case basis and allow the cap to be exceeded if the cap hinders the implementation of effective voluntary control measures, subject to notice and comment during SIP approval. Interested parties should refer to the VMEP guidance for more information when a specific commuter program is under development.
3.1.4 Permanent -

**SIP Requirement:** The emission reduction produced by the retrofit project must be permanent throughout the time period that the reduction is used in the applicable SIP. The time period that the emission reductions from retrofit projects are used in the SIP can be no longer than the remaining useful life of the retrofitted or replaced engine, vehicle, or equipment.

**Specific Recommendations:**

- Emission reductions can be used from retrofitted vehicles, engines, and equipment that operate exclusively within the nonattainment or maintenance area. Vehicles, engines, and equipment that typically operate within a captive area may include, but are not limited to, the following:
  - School buses
  - Transit buses
  - Waste haulers
  - State/local government owned vehicles and engines (e.g., department of transportation)
  - Nonroad construction and agricultural vehicles, engines, or equipment

Some fleets may travel or some equipment may be used only partially in the nonattainment or maintenance area. Such fleets may be considered as part of a retrofit project for these purposes, but the emission reductions claimed are limited to the activity (and the associated emission reductions) that are expected to occur from such fleets within the nonattainment or maintenance area.

For regulatory or voluntary retrofit projects, you should demonstrate that the retrofitted vehicles, engines, or equipment remain in use within the nonattainment or maintenance area or their remaining useful life, to the extent emission reductions are claimed.

- EPA and CARB provide information on the durability of the verified retrofit technology which allows you to determine the length of time the technology may perform at its verified emission reduction capability. Consequently, you should select retrofit technologies that are verified or certified by EPA, or CARB respectively. For a list of verified technologies, see [http://www.epa.gov/cleandiesel/verification/verif-list.htm](http://www.epa.gov/cleandiesel/verification/verif-list.htm)

3.1.5 Adequately Supported -

**SIP Requirement:** The state must demonstrate that it has adequate funding, personnel, implementation authority, and other resources to implement the retrofit project on schedule.
Specific Recommendations:

- The state should ensure it has allocated appropriate funds from a reliable funding source.

- The state should ensure that the retrofit fleet operators correctly install, operate, and maintain the retrofit technology according to the manufacturer’s recommendations.
  - Example: The city transit fleet has 50 buses retrofitted with PM filters. The state should ensure that the fleet operators are properly trained to operate, maintain, and detect problems with the PM filters.

- The state should assess and verify the status of the retrofitted vehicles, engines, and/or equipment and the associated emission reductions, as applicable.

3.2 How can the estimated emission reductions be used for SIP purposes?

For your RFP, attainment, or maintenance SIP strategy, you can use emission reductions which are expected to be generated from the retrofit project by applying the following criteria:

- Emission reductions would be calculated as required in the SIP process for a given pollutant and NAAQS, either in tons per year, tons per pollutant season, or tons per day. For example, NOx reductions from retrofit projects would be calculated in an ozone SIP for tons reduced per day for a typical summer day. In contrast, PM$_{2.5}$ reductions would be calculated on a tons per year basis for SIP inventories for the annual PM$_{2.5}$ NAAQS; state and local agencies should consult their EPA Region and/or applicable guidance on what is appropriate for SIP inventories for the 24-hour PM$_{2.5}$ NAAQS. Any calculations would consider factors that may affect emission reductions and their surplus status over time, including changing patterns of operations or use, vehicle deterioration factors, equipment useful life, and government emission standards.

- Emission reductions would be commensurate with the level of activity from retrofitted vehicles, engines, or equipment within a given nonattainment or maintenance area as described in Section 3.1.4. For example, if retrofitted vehicles are operated exclusively within the nonattainment or maintenance area, the associated reductions from retrofit technology would also be assumed to occur within such an area. However, some fleets may leave the nonattainment or maintenance area for some portion of their operation. Such fleets may be considered as part of a retrofit project, but the emission reductions claimed are limited to the activity that is expected to occur from such vehicles within the nonattainment or maintenance area, as well as those accounted for in the inventory.
3.3 *What would a state submit to EPA to meet the requirements for incorporating a retrofit project in a SIP?*

A state would submit to EPA a written document which does the following:

- Identifies and describes the retrofit project and its implementation schedule to reduce emissions within a specific time period;

- Contains estimates of emission reductions attributable to the project, including the methodology and other technical support documentation used. EPA requires MOVES for on-road vehicles\(^{17}\) and recommends NMIM for nonroad vehicles and equipment for assessing the emission reductions from retrofit projects for SIP purposes;

- Either contains federally enforceable requirements for you to implement, track, and monitor the measure; or if the measure is developed under the VMEP guidance, the state includes an enforceable commitment to monitor, assess and report the resulting emission reductions;

- If the measure is developed under the VMEP guidance, includes an enforceable commitment to remedy any SIP emission shortfall in a timely manner in the event that the measure does not achieve the estimated emission reductions; and

- Meets all other requirements for SIPs under Clean Air Act sections 110 and 172.

3.4 *Are there any other types of SIPs that could include emission reductions from retrofit projects?*

Yes. As indicated in Section 3.2, state air quality agencies can include retrofit projects in RFP SIPs, attainment demonstrations, and maintenance plans. However, if a state wants to encourage adoption of retrofit projects prior to developing one of these kinds of SIPs, the state could create a SIP submission that contains only retrofit projects, which would be relied upon in a future SIP. The advantage of creating such a SIP submission now is that a state could secure retrofit projects with adequate federal, state, and/or local funding for a future RFP SIP, attainment demonstration, or maintenance plan.

A state air agency that is interested in creating such a SIP submission specifically for a retrofit project or projects must consult with MPOs, the state DOT, and any other state or local transportation agencies in its development. The conformity regulation at 40 CFR 93.105 requires consultation on the development of SIPs.

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Note that a SIP submission that contains only retrofit projects would still have to meet the requirements discussed in this Section. State or local agencies that are interested in this option should consult their EPA Region as well as the MPOs and others involved in the interagency consultation process.

3.5 What monitoring and record keeping should occur to document retrofit emission reductions?

3.5.1 What should the state air agency monitor and record?

Clean Air Act section 110(a)(2)(C) requires that submitted SIPs "include a program to provide for the enforcement of the measures" that the state adopts to reduce emissions. A state's decision about how a measure needs to be enforced will depend on the state's knowledge of the emission reductions achieved by the measure. Therefore, this Clean Air Act requirement for a program that provides for enforcement makes it necessary for states to monitor measures that they include in their SIPs, such as diesel retrofits.

EPA recommends that for each retrofitted vehicle, engine, or piece of equipment generating emission reductions, the state air agency or another responsible party should monitor and record the following information, where applicable, for each time period for which an emission reduction is generated:

- Actual use and operation and maintenance of the retrofitted or repowered vehicles/engines/equipment and retrofit technology
- Proper installation of retrofit technology or repowered engine at project initiation
- Proper training of vehicle operators and technicians at project initiation
- For replacements, document the permanent destruction, disabling, or rebuilding of the engine to meet current emissions standards

Monitoring and recording these data are ways to ensure that the statute is met. A state can propose other methods of monitoring and recording data in its SIP submission, and EPA would consider whether or not it would be sufficient to meet Clean Air Act requirements.

3.5.2 How long should the state air agency maintain records?

Under 28 U.S.C. 2462, the government has five years to bring an enforcement action or suit for the failure to implement a measure in a SIP. Based on this statute of limitations, all information to be monitored and recorded in accordance with this guidance for existing SIP requirements should be maintained by the state air agency or another responsible party for a period of no less than five years, or longer where appropriate.
3.6 *What validation and reconciliation should occur for emission reductions in SIPs approved under the VMEP guidance?*

The SIP submission for a voluntary measure should contain a description of the evaluation procedures and time frame(s) in which the evaluation of SIP reductions will take place. Once the voluntary control measure is in place, emission reductions should be evaluated by the state or local agency as required to validate the actual emission reductions. The state or local agency should submit the results of the evaluation to EPA in accordance with the schedule contained in the SIP. If the review indicates that the actual emission reductions are not consistent with the estimated emission reductions in the SIP, then the amount of emission reductions in the SIP should be adjusted appropriately or applicable remedial measures should be taken under the VMEP guidance. See EPA’s VMEP guidance for further information regarding validation and reconciliation requirements for such measures.

3.7 *What penalties can EPA impose for not complying with Clean Air Act requirements?*

Use of this guidance does not relieve you of any obligation to comply with all otherwise applicable CAA requirements, including those pertaining to the crediting of emission reductions for your SIP, such as for your attainment demonstration or maintenance plan. Violations of CAA requirements are subject to administrative, civil, and/or criminal enforcement under Section 113 of the CAA, as well as to citizen suits under Section 304 of the CAA. The full range of penalty and injunctive relief options would be available to the federal or state government (or citizens) bringing the enforcement action.
SECTION 4: USING EMISSION REDUCTIONS IN TRANSPORTATION CONFORMITY DETERMINATIONS

4.1 What is transportation conformity?

Transportation conformity is required under Clean Air Act section 176(c) (42 U.S.C. 7506(c)) to ensure that federally supported highway and transit project activities are consistent with ("conform to") the purpose of the SIP. Conformity to the purpose of the SIP means that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment of the relevant NAAQS and interim milestones. EPA’s transportation conformity rule (40 CFR Parts 51 and 93) establishes the criteria and procedures for determining whether transportation plans, TIPs or projects conform to the SIP. Transportation conformity applies to areas that are designated nonattainment, and those redesignated to attainment after 1990 ("maintenance areas") for transportation-related criteria pollutants. Some areas that are currently doing transportation conformity could benefit from retrofit project reductions, including ozone, PM$_{2.5}$, and PM$_{10}$ nonattainment and maintenance areas.

In urban areas, transportation planning and conformity determinations are the responsibility of the MPO. MPOs are responsible for updating and revising the transportation plan and TIP on a periodic basis, as well as making transportation plan and TIP conformity determinations. Such a determination includes a regional emissions analysis that shows that the emissions expected from the area’s planned transportation system do not exceed the motor vehicle emissions budget ("budget") set by the SIP for meeting RFP, attainment, or maintenance requirements. In cases where an area does not yet have a SIP in place, a different type of emissions test is used for conformity. After an MPO’s conformity determination, the U.S. DOT must also determine conformity of the transportation plan and/or TIP. The interagency consultation process is required to be used when developing transportation plans, TIPs, conformity determinations, and SIPs, and the process includes MPOs, state departments of transportation, public transit agencies, other transportation agencies, state and local air quality agencies, EPA, and DOT (40 CFR 93.105).

4.2 What kinds of retrofit projects can be used in transportation conformity determinations?

MPOs may use emission reductions in transportation plan and TIP conformity determinations that result from either:

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18 In areas without SIP budgets, an interim emissions test(s) must be met. These tests are the “baseline year test” and the “build/no-build test.” See 40 CFR 93.119 for more on these requirements. In areas with SIP budgets, a budget test must be met, pursuant to 40 CFR 93.118.
• On-road vehicle and engine retrofit projects, or
• Nonroad vehicle, engine, and equipment retrofit projects.

On-road vehicle retrofit projects can be used in regional emissions analyses for transportation conformity determinations, since transportation conformity includes emissions and reductions from on-road sources. Requirements are discussed in Section 4.3.

Although the emissions from nonroad sources are separate from on-road vehicles in a SIP inventory, the emission reductions that result from nonroad retrofits can still be applied in transportation conformity. When appropriate and desired, the transportation conformity rule allows options for including reductions from nonroad retrofit projects, such as the retrofitting of highway construction equipment, in a transportation conformity determination. See Sections 4.4 through the end of this section for further information on options for including the emission reductions from nonroad retrofit projects in transportation conformity determinations.

EPA also notes that reductions from retrofits can be applied as a mitigation or control measure in quantitative PM$_{2.5}$ or PM$_{10}$ hot-spot analyses for project level conformity determinations. See EPA’s Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM$_{2.5}$ and PM$_{10}$ Nonattainment and Maintenance Areas at www.epa.gov/otaq/stateresources/transconf/projectlevel-hotspot.htm#pm-hotspot. For further background on PM hot-spot analyses, the methodology in Section 2 of this guidance can be used for such analyses. The remainder of Section 4 and the Appendices focus on applying retrofit reductions in transportation plan and TIP transportation conformity determinations (and regional emissions analyses).

4.3 How can the emission reductions from on-road retrofit projects be included in transportation conformity determinations?

The transportation conformity rule describes the specific requirements for including emission reductions from on-road retrofit projects in a transportation conformity determination. If the emission reductions from the retrofit project have been accounted for in the SIP’s motor vehicle emissions budget, the MPO would also include the emission reductions from the retrofit project, to the extent it is being implemented, when estimating regional emissions for a transportation conformity determination. Including the emission reductions in both the SIP’s budget and in a conformity determination in this way is not “double-counting,” but correctly accounting for all the control measures that are in place.19

To include the emission reductions from retrofit projects in a conformity analysis, the appropriate jurisdictions must be committed to the measure.20 The appropriate level of commitment

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19 See 40 CFR 93.122(a) for the requirements regarding what must be included when estimating regional emissions in a conformity determination.
20 As stated in Section 1.7 of this guidance, state and local agencies should check with EPA before promulgating any state or local regulations or programs mandating retrofit projects, due to potential issues related to Clean Air Act section 209 requirements.
varies according to the requirements outlined in 40 CFR 93.122(a) which are described as follows:

- If the retrofit project does not require a regulatory action to be implemented and it is included in the transportation plan and TIP with sufficient funding and other resources for its full implementation, it can be included in a transportation conformity determination.

- If the retrofit project requires a regulatory action to be implemented, it can be included in a conformity determination if one of the following has occurred:
  - The regulatory action for the retrofit project is already adopted by the enforcing jurisdiction (e.g., a state has adopted a rule to require such a project);
  - The retrofit project has been included in an approved SIP; or
  - There is a written commitment to implement the retrofit project in a submitted SIP with a motor vehicle emissions budget that EPA has found adequate.  

If the retrofit project is not included in the transportation plan and TIP or the SIP, and it does not require a regulatory action to be implemented, then it can be included in the transportation conformity determination’s regional emissions analysis if the determination contains a written commitment from the appropriate entities to implement the retrofit project.

Whatever the case, any emission reductions can only be applied in a transportation conformity determination for the time period or years in which the retrofit project will be implemented. Written commitments must come from the agency with the authority to implement the retrofit project. The latest emissions model and planning assumptions must also be used when calculating emission reductions, according to 40 CFR 93.110 and 93.111.

The interagency consultation process must be utilized (as required by 40 CFR 93.105) to discuss the methods and assumptions used to quantify the reductions from the retrofit project. Section 2 of this document describes how to quantify emission reductions.

4.4  How can the emission reductions from nonroad retrofit projects be included in transportation conformity determinations?

There are two options that may be used to reflect reductions from nonroad retrofit projects in transportation conformity determinations. The two options are:

- Apply nonroad retrofit emission reductions as a "safety margin" to the SIP’s motor vehicle emissions budgets; or

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21 40 CFR 93.118 describes the process and criteria that EPA considers when determining whether submitted SIP budgets are appropriate for transportation conformity purposes prior to EPA’s SIP approval action.
• Establish a trading mechanism in the SIP to allow emissions to be traded from one emissions sector to another.

Both of these options are allowed by the current transportation conformity rule and are completed through the SIP process with consultation among federal, state, and local air quality and transportation agencies. An area may decide to pursue one of these options if it is anticipated that emission reductions from nonroad retrofit projects may be needed to assure future transportation conformity determinations. Note that nonroad retrofit projects that are reflected in a transportation conformity determination under either option must meet the conformity rule requirements articulated in Section 4.3, in addition to other requirements described below.

4.5 How is EPA supporting the use of emission reductions from nonroad retrofit projects in transportation conformity?

EPA recognizes the importance of nonroad retrofit projects in reducing emissions and wants to support the process for state and local air and transportation agencies to implement them when desired. The remainder of Section 4 and Appendices A through C include additional information for including the emission reductions from nonroad retrofit projects in transportation conformity:

Safety margins. EPA has provided the following:
• Questions and answers about safety margins, beginning with Section 4.6;
• Step-by-step process instructions, including a flowchart, for adopting a safety margin – see Appendix A;
• An example of how a safety margin is applied – see Appendix A;
• A list of areas that have adopted safety margins in the past – see Appendix A;

Trading mechanisms. EPA has provided the following:
• Questions and answers about trading mechanisms, beginning with Section 4.11;
• Step-by-step process instructions, including a flowchart, for adopting a trading mechanism – see Appendix B;
• An example of how a trading mechanism would work – see Appendix B;
• A model trading rule that interested states could adopt through the SIP – see Appendix C.

4.6 What is a safety margin?

Section 93.101 of the transportation conformity rule defines a “safety margin” as

“the amount by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for reasonable further progress, attainment, or maintenance.”

That is, if an area has a safety margin, it has more emission reductions than necessary to meet the
Clean Air Act goal of RFP, attainment, or maintenance. It can meet the goal with room to spare – a margin of safety. Safety margins are calculated for a specific year in the SIP for which a budget is established (e.g., the last year of a maintenance plan).

The conformity rule allows a safety margin to be allocated to the transportation sector, if the SIP explicitly states so (see 40 CFR 93.124(a)). The SIP must state that a specified portion or the entire safety margin is available to the MPO and DOT for conformity purposes. Therefore, the nonroad retrofit project that creates the safety margin allows the motor vehicle emissions budget to increase.

4.7 When can a safety margin be established in a SIP?

An area may include a safety margin from the point at which they develop their SIP submission for RFP, attainment, or maintenance, or it may be developed later as a stand-alone SIP submission. For example, if an area has more emission reductions from the control measures contained in its attainment demonstration than needed to achieve the applicable NAAQS, it could establish a safety margin in that attainment demonstration.

An area could also develop a safety margin after the SIP has been established. For example, if an area’s attainment demonstration contains control measures that are sufficient to attain, then any other measures that reduce emissions adopted later, such as nonroad retrofit projects, would potentially create a safety margin. Alternatively, an area that already has a safety margin in its SIP could add to it by adopting a new nonroad retrofit project.

Whatever the case, any SIP that incorporates a safety margin must meet all applicable SIP requirements, including being based on the most recent emissions estimates available at the time the SIP safety margin is developed. For example, an existing safety margin in an ozone maintenance plan could be increased to account for new retrofit projects in a given year, assuming the existing safety margin is still applicable. Under this example, EPA's approval would be required before the increased SIP safety margin could apply for transportation conformity purposes, since revisions to existing approved SIPs cannot apply until EPA approves them (40 CFR 93.118(e)(1)).

4.8 What are the benefits of establishing a safety margin at the time that an RFP SIP, attainment demonstration, or maintenance plan is initially submitted?

While a safety margin can be developed after a SIP is established, it makes sense for areas that are currently developing a SIP to include a safety margin in that SIP, if possible, instead of adding it later. A safety margin that is included in an initial control strategy SIP (e.g., an RFP SIP or attainment demonstration) or maintenance plan could be used for conformity on the effective date of EPA’s adequacy finding. But if a safety margin is developed later, the state would need to revise the SIP. If EPA has already approved the initial SIP, the revised SIP that includes the safety margin
could not be used in conformity until it is approved, as noted above. Including a safety margin in a SIP submission as it is developed saves time and effort throughout the process.

4.9 Why should an area start developing a safety margin now?

Areas that are currently developing attainment demonstrations or maintenance plans should consider whether they want to adopt programs to retrofit nonroad vehicles, engines, and equipment and include them in these SIP submissions, because doing so now can save time and may allow their use in conformity sooner. The conformity rule requires that consultation occur during the development of a SIP (40 CFR 93.105(a)(1)). State air agencies should consult with the relevant MPOs, DOT, and other agencies as appropriate in order to determine whether a safety margin might be needed for conformity.

Several nonattainment areas have already established safety margins through the SIP process to assist in making future transportation conformity determinations. See Appendix A for further information.

4.10 What are the features of a safety margin?

In order for EPA to approve the allocation of a safety margin to a motor vehicle emissions budget(s), the following SIP and transportation conformity requirements would have to be met:

- The entire SIP must continue to demonstrate its Clean Air Act purpose, pursuant to the statute and 40 CFR 93.124(a). Before the emissions level of a motor vehicle emissions budget is increased, the state air agency would need to determine that there is a safety margin, including any surplus emission reductions from any nonroad retrofit projects. The agency would also need to ensure that emissions inventories of on-road, nonroad and other sources are consistent with the SIP’s demonstration.

- The calculation for the nonroad retrofit projects and any safety margin would be based on the latest information and models available at the time the SIP is developed. The method for calculating a safety margin may vary depending upon whether new air quality modeling is performed or if a less rigorous demonstration is adequate (e.g., maintenance areas that are establishing a safety margin based on staying below the emissions level(s) for a previous year of clean monitoring data for the maintenance demonstration).

- The SIP must clearly allocate the safety margin to the motor vehicle emissions budget(s) for use in transportation conformity determinations, pursuant to 40 CFR 93.124(a);

- Retrofit projects reflected in a safety margin must be assured, permanent, and enforceable, have adequate funding and resource commitments, and be on schedule; and
• The safety margin must meet Clean Air Act section 110(l) and any other applicable SIP statutory and regulatory requirements.

See Section 3 for more information about including a retrofit project in a SIP. See Appendix A for more detailed information on establishing and implementing a safety margin.

EPA notes that the allocation of a safety margin to the on-road transportation sector may limit that area’s ability to allow future growth in emissions from other source sectors (e.g., stationary sources). State and local transportation and air quality agencies and other affected parties should always consult on whether a safety margin is appropriate for transportation conformity in a given area.

4.11 What is a trading mechanism?

A trading mechanism is a process established through the SIP that allows emission reductions achieved in another source sector – such as the nonroad sector – to be used for demonstrating transportation conformity. Before emission reductions can be traded from one sector to another, the SIP must include a trading mechanism to allow the trading to occur.

This option is supported by 40 CFR 93.124(b) as well as preamble language. Section 93.124(b) states:

“A conformity demonstration shall not trade emissions among budgets which the applicable implementation plan (or implementation plan submission) allocates for different pollutants or precursors, or among budgets allocated to motor vehicles and other sources, unless the implementation plan establishes appropriate mechanisms for such trades.”

In the preamble of the November 24, 1993 transportation conformity rule, EPA stated that "[t]he state may choose to revise its SIP emissions budgets in order to reallocate emissions among sources or among pollutants and precursors. For example, if the SIP is revised to provide for greater control of stationary source emissions, the State may choose to increase the motor vehicle emissions budget to allow corresponding growth in motor vehicle emissions (provided the resulting total emissions are still adequate to provide for attainment/maintenance of the NAAQS..." (58 FR 62196). EPA believes that this preamble and 40 CFR 93.124(b) clearly allow trading mechanisms to be established to ensure future transportation conformity determinations, when desired.

EPA’s Economic Incentive Program (EIP) guidance also discusses trading among different sources.\textsuperscript{22} The primary concerns articulated in that guidance are: 1) to ensure that emission reductions are only used in transportation conformity if they are truly reductions to overall air

\textsuperscript{22}\textsuperscript{22}EPA’s January 2001 guidance entitled, "Improving Air Quality with Economic Incentive Programs," provides additional information on developing and implementing economic incentive based control strategies. This guidance is available at: \url{www.epa.gov/ttn/oarpg/t1/memoranda/eipfin.pdf}. See Appendix 16.10 of the 2001 guidance for further information regarding the transportation conformity requirements that need to be met by an EIP trading program.
quality (i.e., are not offset by emissions increases in other emission sources); and 2) to ensure that double-counting does not occur among source categories in the SIP or in transportation conformity. EPA must approve a SIP that creates a trading mechanism before emission reductions can be traded for transportation conformity determinations.

4.12 When can a trading mechanism be established in a SIP?

A trading mechanism can be established by a state and approved by EPA into the SIP for a nonattainment or maintenance area at any time.

- A trading mechanism that would allow trading of emission reductions from nonroad retrofit projects for transportation conformity purposes could be submitted by a state and approved by EPA prior to the submission of an area’s RFP SIP, attainment demonstration, or maintenance plan.

- Alternatively, a state could decide to submit a trading mechanism as part of an RFP SIP, attainment demonstration, or maintenance plan for a given area.

4.13 Why develop a trading mechanism as a stand-alone SIP revision?

The advantage of developing a trading mechanism as a stand-alone SIP instead of including it in a required ozone or a PM$_{2.5}$ SIP is that doing so allows trading to happen sooner than if the trading mechanism was combined with a larger SIP such as an RFP plan, an attainment demonstration, or a maintenance plan. Where developed as a stand-alone SIP, a trading mechanism allows emission reductions from a nonroad retrofit project to be applied in conformity during the time period before one of these larger SIPs is submitted and found adequate. For example, assuming it has a SIP trading mechanism in place, if an ozone area could not pass a NOx budget contained in its ozone attainment demonstration, the area could program funds for a nonroad retrofit project and apply the emission reductions in a conformity determination. A stand-alone SIP based on the model trading rule provided in this guidance document can be developed and approved by EPA through parallel processing the SIP.

4.14 What would a SIP with a trading mechanism look like?

EPA developed a model trading rule to allow states to use nonroad emission reductions in

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23 The term “parallel processing” means that EPA, at the request of the state, begins to process a SIP submission (either to approve it or find its budgets adequate) before the state has finalized it. EPA’s process and the state’s process are occurring “in parallel.” Specifically, EPA would begin to review the SIP trading mechanism while the state’s public comment period is running, but must wait until the state submits its final SIP trading mechanism before taking a final SIP action. See Appendices A and B for more detail on how parallel processing works.
transportation conformity. States that are interested in establishing a trading mechanism merely need to copy the model rule and fill in the blanks as appropriate (e.g., the state would insert the appropriate names of state air quality agencies and MPOs), and can adopt it into their SIPs. The model rule is found in Appendix C of this guidance document. EPA developed this model rule in consultation with DOT and state and local air quality and transportation organizations. States that adopt the model rule can expect a streamlined SIP approval because the model rule meets Clean Air Act requirements. The model rule is just one way to write a regulation for a trading mechanism for conformity. A state could deviate from this model rule, but the more the state deviates from the model rule language, the more time it may take for EPA’s final SIP action.

4.15 What are the features of a trading mechanism?

In order for EPA to approve a trading mechanism, the following SIP and transportation conformity requirements would have to be met:

- The entire SIP must continue to demonstrate its Clean Air Act purpose when trades are allowed, pursuant to the statute and 40 CFR 93.124(b). When the trading mechanism is developed, the state air agency would need to ensure that trades can occur, while ensuring that emissions inventories from all sources continue to be consistent with the SIP’s demonstration.

- A state regulation must be developed that describes in adequate detail the scope and process for making trades so that the trading mechanism can be implemented as intended. Such a regulation would also provide that all trades become enforceable through the trading mechanism approved into the SIP in the event that reductions are not otherwise enforceable.

- Trades must be based on nonroad retrofit projects that result in a net emission reduction, which must consider the emissions produced by the vehicles, engines, and equipment and the impact of any retrofit technology. Individual trades cannot exceed the net emission reductions of a retrofit project.

- The trading mechanism would ensure that individual trades must be made only when surplus emission reductions exist. Trading cannot result in “double-counting” of reductions already accounted for in the SIP and conformity determinations.

- Reductions can be taken only for years of the regional emissions analysis where reductions are achieved.

- The trading mechanism must meet any other applicable SIP and conformity requirements (for example, control programs that produce emission reductions relied on in a conformity determination must be assured and enforceable, have adequate funding and resource commitments, and be on schedule – see 40 CFR 93.122(a)).

24 EPA notes that SIPs that establish a trading mechanism are required to meet Clean Air Act section 110(l) requirements, similar to all other SIPs for other purposes. However, by definition, the trading mechanisms described in
See Appendix B for more information on implementing a trading mechanism and Appendix C for a model trading rule that could be incorporated into the SIP.

4.16 **Does the public have the opportunity to comment on trading?**

Yes, the public does have the opportunity to comment at two distinct points in the process:

- First, the public can comment on the trading mechanism itself at the point when it is incorporated into the SIP. Any time a state prepares a SIP, it must give the public an opportunity to comment on it before the final submission is sent to EPA. In a situation where a state adopts a regulation separately from an RFP or attainment SIP or a maintenance plan, the public will also have the opportunity to comment on the state’s regulation. In addition, when EPA proposes to approve the SIP in the Federal Register, the public again has the opportunity to comment to EPA. The approval process, including these public comment periods, is covered in further detail in Appendix B.

- Second, the public has the opportunity to comment on individual trades that employ the SIP trading mechanism during the public comment period on a transportation plan or TIP conformity determination. The conformity regulation at 40 CFR 93.105(e) requires that the public be given access to technical and policy information considered in a conformity determination at the beginning of the public comment period and prior to taking formal action on a transportation plan/TIP conformity determination. If an MPO relies on nonroad retrofit emission reductions that are the result of a trade, information about that trade would belong in such technical and policy information that is made available for public review. Under the model trading rule in Appendix C of this document, the MPO would be required to document the description of the retrofit project; its enforceability, funding sources, and implementation schedule; and details regarding emission reduction calculations. In addition, the model rule would require that the state air agency document its concurrence (e.g., through a letter), which the MPO could then reference in its transportation plan/TIP conformity determination. If a state adopts any trading mechanism, all of the information described above would be made available to the public as part of any transportation plan/TIP conformity determination.25

4.17 **Are there any examples of transportation conformity-related trading mechanisms that were approved into the SIP?**

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25 Note that if a state decides to substantially alter the model rule or create a different one, the trading mechanism would still need to provide the public with access to information via the conformity determination to meet 40 CFR 93.105(e). EPA would examine any trading mechanism with regard to this point during the SIP process.
Yes, a couple of areas adopted another type of trading mechanism for conformity purposes. The provision of the transportation conformity rule that allows trading among source sectors also allows trading among motor vehicle emissions budgets of pollutants and precursors. Both the San Joaquin Valley and Salt Lake City adopted trading mechanisms that established trading between budgets for directly-emitted PM$_{10}$ and NOx.\textsuperscript{26}

Though these trading mechanisms applied to the trading of on-road mobile precursors and pollutants rather than among source sectors, they have provided EPA with valuable experience in developing a trading mechanism through the SIP process. EPA has applied this experience to the development of the model trading rule found in Appendix C. In addition, Salt Lake City’s trading mechanism was needed as soon as it could be approved, so EPA and the State of Utah worked together to expedite its approval into the SIP.

4.18 *Are there any other ways to establish a trading mechanism for a nonroad retrofit project?*

Yes. Sections 4.11 through 4.17 and Appendices B and C address establishing a trading mechanism that, once adopted into a SIP, would allow emission reductions from any nonroad retrofit project to be traded to the transportation sector. However, another possibility is for a state to adopt a SIP that allows trading of emission reductions from only a specific project (or projects). This type of SIP would look similar to the type of SIP submission described in Section 3.4 in that it would contain the description of, and emission reductions from, a specific project (or projects). It would also explicitly state the portion of the retrofit emission reductions that are available to be used in transportation conformity determinations. The advantage of creating such a SIP submission now is that a state could secure specific retrofit projects with adequate federal, state, local, or private funding for a future conformity determination. Where a SIP specifically states that a certain number of tons of retrofit reductions are to be preserved for use in future conformity determinations, such reductions would not be available for use in any other SIP demonstrations such as RFP or attainment demonstrations.

State or local agencies that are interested in this option should consult with their EPA Region as well as the MPOs and others involved in the interagency consultation process.

4.19 *How can I get additional technical assistance in using the emission reductions from a nonroad retrofit project in transportation conformity?*

\textsuperscript{26} These trading mechanisms differed according to the atmospheric conditions in each area. An interpollutant trading mechanism must include a scientific rationale, as well as comply with Clean Air Act section 110(l) by showing that the trading mechanism will not interfere with any applicable Clean Air Act requirement. See 67 FR 44065 for EPA’s approval of Salt Lake City’s trading mechanism; 69 FR 30006 for EPA’s approval of San Joaquin Valley’s PM$_{10}$ SIP that includes the trading mechanism.
State and local agencies are strongly encouraged to consult early with their respective EPA Region if they are considering applying a safety margin or developing a trading mechanism in the SIP for transportation conformity purposes. EPA is available to provide such technical assistance so that SIP submissions can be processed efficiently. See Section 1.9 for more information regarding EPA contact information.
SECTION 5: USING EMISSION REDUCTIONS IN GENERAL CONFORMITY DETERMINATIONS

5.1 How can the estimated emission reductions be used for general conformity determinations?

General conformity applies in nonattainment and maintenance areas to emissions from all federal actions or activities not covered by the transportation conformity program, such as military base expansions or approval of airport expansion projects. The general conformity regulation (40 CFR 51.851 and 93.150-165) prohibits federal agencies from taking, or supporting in any way, actions in areas that are designated nonattainment or maintenance for any criteria pollutant without demonstrating that the action will not 1) cause or contribute to any new violation of any NAAQS in any area; 2) increase the frequency or severity of any existing violation of any NAAQS in any area; or 3) delay timely attainment of any NAAQS or any required interim emission reductions or other milestones in any area. The general conformity regulation applies to the total foreseeable direct and indirect emissions increases from the action or activity including both construction and operational emissions. Indirect emissions can include those from vehicles servicing a federal facility or activities supported by federal funds.

To reduce the regulatory burden on insignificant actions, the regulation establishes a number of exemptions for categories of actions or activities known to have insignificant emissions increases or whose emissions fall below certain de minimis levels. The general conformity rule establishes de minimis emission levels based on the severity of the nonattainment problem. If the net increase in total direct and indirect emissions from a federal action is below the de minimis levels, the federal agency does not have to make a conformity determination for the action.

If the net increase in emissions is above the de minimis levels and the project is not otherwise exempt, the federal agency must determine that the action or activity will conform to the SIP. Because the general conformity regulation applies to a wide variety of actions or activities, the rule provides a number of methods to demonstrate conformity. Two methods, mitigation and offsetting of emissions increases, require emission reductions from sources which may, or may not be directly connected to the federal action or activity.

5.2 How can retrofit projects be used to meet the general conformity requirements?

There are some fleets of vehicles that are not considered in transportation conformity determinations, and instead considered in general conformity determinations. Some examples include a fleet of trucks at a military base, or vehicles that operate only within the boundary of a commercial airport. Since a retrofit project for such a fleet would not be increasing emissions, the implementation of a retrofit project would not be subject to general conformity requirements. Additionally, in many cases, a federal action would not be needed to implement such a project.
However, emission reductions generated by diesel retrofit projects could be used in a number of ways in general conformity determinations, such as:

- Diesel engine retrofits could be used to mitigate or offset emissions increases caused by a federal action. For example, the retrofitting of diesel airplane tugs at a military air station could be used to mitigate a portion of the emissions increases associated with an expansion project at the military base or the retrofitting of package delivery vehicles could be used to offset the emissions increases caused by a base expansion.

- The Vision 100-Century of Aviation Reauthorization Act of 2003 (P.L. 108-176), directed the FAA to establish a national program to reduce airport ground emissions at commercial service airports located in air quality nonattainment and maintenance areas. The Voluntary Airport Low Emissions (VALE) program allows airport sponsors to use certain funds to finance low emission vehicles, refueling and recharging stations, gate electrification, and other airport air quality improvements (including retrofit projects). The emission reductions generated by these measures are kept by the airport sponsor and may only be used for current or future general conformity determinations. To be used in a general conformity determination, emission reductions must be voluntary and cannot otherwise be used to meet other applicable air quality attainment and maintenance requirements. Emission reductions must also be “permanent” in that they continue to occur at the estimated level throughout the lifetime of the vehicles and infrastructure.

A federal or federally permitted facility which is subject to the general conformity regulation, such as a military base or a commercial airport, could institute an agreement with a state to operate the facility within a facility-wide emissions budget. Emission reductions from a fleet retrofitting project could ensure emissions increases generated by future actions would not exceed the facility-wide budget and thus would conform to the SIP. A demonstration that emissions from a new action do not exceed the facility-wide emissions budget could be used in a general conformity determination.

5.3 **Is a SIP revision required if a source with a facility-wide emissions budget wants to implement a retrofit project at the facility?**

No, a SIP revision would not be required, if a source with a facility-wide emissions budget established for general conformity purposes decided to retrofit vehicles or equipment used at the facility. The facility’s emissions budget would have included emissions of all relevant pollutants and/or precursors from all sources on the facility including the pre-retrofit emissions from the vehicles and/or equipment that are included in the retrofit project. Therefore, the emission reductions from a retrofit project can be used to show that the facility remains within its budget without a SIP revision.
5.4 What requirements would potentially limit the use of retrofit projects in the general conformity program?

Emission reductions used as part of the (1) project design, (2) mitigation measures, (3) offset, or (4) in future conformity determinations, must be surplus, permanent, quantifiable and enforceable as described in the General Conformity rule and Section 3 of this document. In addition, the emission reductions must be reviewed by EPA, state, tribes and local air quality agencies and the public as part of the review of the general conformity determination and meet the following criteria:

- The retrofit project must be identified and the process for implementation and enforcement must be explicitly described.

- Prior to determining conformity, the federal agency making the determination must obtain written commitments from the appropriate entities (e.g., fleet operator, state or city official, private company official or MPO) to implement the retrofit project as a mitigation measure.

- The reductions from the retrofit project must be contemporaneous with the project emissions increases, specifically, the reductions must occur in the same calendar year as the increases.

- The implementing entity/official responsible for implementing the retrofit project and any persons or agencies voluntarily committing to mitigation measures must comply with the obligations of such commitments.

- If the federal action involves licensing, permitting or approving an action of another governmental or private entity, the federal agency must condition its approval action on the other entity meeting all mitigation commitments.

- If the retrofit project is modified resulting in an increase in emissions, the new mitigation measures must continue to support the initial general conformity determination and must undergo public review.

5.5 Why are SIPs required for use of nonroad retrofits in transportation conformity but not required for general conformity?

With regard to nonroad retrofit projects, a SIP establishing either a trading rule or safety margin is required in order for emission reductions from such projects to be used in transportation conformity determinations because nonroad emissions are not included in an area’s on-road motor vehicle emissions budget (40 CFR 93.124(a) and (b)). The SIP provides the authority to use nonroad emission reductions as part of a demonstration that an area is meeting its on-road emissions budgets. In contrast, a facility-wide emissions budget established for general conformity purposes would include emissions from all sources at the facility including the pre-retrofit emissions from the vehicles and/or equipment that are included the retrofit project and the facility budget is within the SIP’s allowable emission budget. Therefore, the emission reductions from the retrofit project can be
used to show that the facility remains within its budget without a SIP revision.
APPENDIX A:

ESTABLISHING AND USING A SAFETY MARGIN TO ALLOW EMISSION REDUCTIONS FROM NONROAD RETROFITS TO BE USED IN TRANSPORTATION CONFORMITY DETERMINATIONS

This appendix provides detail about how a state could apply the emission reductions from a nonroad retrofit project or projects in a conformity determination via a safety margin.

A.1 What is an example of establishing and using a safety margin?

Suppose a 1997 PM$_{2.5}$ nonattainment area develops a draft maintenance plan that shows the area could emit 400 tons per day of NOx from all sources, and still maintain the NAAQS in the last year of the maintenance plan, 2025. The area’s total NOx SIP inventory for 2025 is:

- Nonroad: 100 tons per day
- On-road: 100 tons per day
- Stationary sources: 100 tons per day
- Area sources: 100 tons per day
- Initial total maintenance SIP inventory: 400 tons per day

If the area submitted this draft SIP without a safety margin, this SIP would have a 2025 NOx motor vehicle emissions budget of 100 tons per day, which is the on-road portion of the 2025 NOx inventory.

However, the MPO, in consultation with others, decides to spend some of its CMAQ and other funding to retrofit nonroad transportation construction equipment. The MPO consults with the state air agency, who agrees that the retrofits could be used to create a safety margin, since the area can demonstrate maintenance without these additional reductions. The MPO decides to retrofit a number of bulldozers, front loaders, and backhoes and estimates that the total emission reductions from these retrofits will be 5 tons per day in 2025. The state air agency reviews these calculations and concurs that these reductions are surplus. Therefore, after consultation, it adjusts the NOx inventory in its draft maintenance plan for 2025 as follows:

- Nonroad: 95 tons per day (i.e., 100 minus 5 tons for new retrofit)
- On-road: 105 tons per day (i.e., 100 plus 5 tons for new retrofit)
- Stationary sources: 100 tons per day
- Area sources: 100 tons per day
- Final total maintenance SIP inventory: 400 tons per day
The state submits a final SIP that includes a 5 ton per day safety margin and specifically states in the SIP that it is allocated to the motor vehicle emissions budget. Therefore, the final budget is 105 tons per day:

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<tbody>
<tr>
<td>On-road:</td>
<td>100 tons per day</td>
</tr>
<tr>
<td>Safety margin:</td>
<td>5 tons per day</td>
</tr>
<tr>
<td>Total available for transportation:</td>
<td>105 tons per day (the final budget)</td>
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</tbody>
</table>

Once the SIP has been submitted and found adequate by EPA, the MPO uses the new 2025 NOx budget of 105 tons per day. This new budget would apply to all conformity determinations for all analysis years 2025 and later, for as long as this motor vehicle emission budget is in place without other future budgets. If the MPO later wanted to fund additional nonroad retrofit projects and use the additional reductions for conformity determinations, they would either have to work with the state to revise the safety margin in the SIP or implement a SIP trading mechanism (as discussed in Section 4 and Appendix B).

A.2 What is the most expeditious process for establishing a safety margin that results from a nonroad retrofit project?

An area that wants to include a safety margin in its SIP from a retrofit project or projects would follow the following steps. (See Figure 1 at the end of this appendix for a flowchart that depicts these steps.) These steps assume that EPA has not yet approved a SIP submission that establishes budgets that the safety margin amends, that is, the safety margin is included in the initial RFP SIP, attainment demonstration, or maintenance plan that the state submits. Therefore, the budgets that include the safety margin can be used as soon as EPA finds them adequate. However, if the area has an approved SIP with a motor vehicle emissions budget and the state submits a SIP with a safety margin that would change the budget, the revised budget could not be used until EPA approves the SIP.

- **Agencies consult and decide on the project.** The process would begin with the MPO and state air agency discussing the ability to create a safety margin by retrofitting nonroad vehicles, engines, and equipment and the scope of the retrofit project(s) that could contribute to the safety margin. There may be some areas where a safety margin cannot be created; in these cases nonroad retrofit projects may be even more important for the area’s SIP. Assuming that the nonroad retrofit project is funded at least in part with CMAQ dollars, the MPO (or state DOT) would need to determine the timing of the project, number of vehicles, engines, or equipment to be retrofitted, and the retrofit technology that would be applied because the MPO (or state DOT) determines how CMAQ money is spent. The state air agency also must be involved because that agency prepares the SIP.

- **Agencies quantify the project.** The state air agency, in consultation with the MPO,\(^{27}\) would

\(^{27}\)Note that either the state air agency or the MPO could take the lead role in this step.
quantify emission reductions from the retrofit project in the year(s) for which the budgets are established. (See Section 2 of this guidance for further direction in how a retrofit project can be quantified.)

- **State air agency assures SIP criteria are met.** The state air agency would determine and document that the emission reductions meet all of the criteria necessary for a SIP to include emission reductions from a project, specifically, that emission reductions are surplus, quantifiable, enforceable, permanent, and adequately supported. (See Section 3 of this guidance for further discussion of these criteria.)

- **State air agency prepares the safety margin section of the SIP.** The state air agency would prepare an initial draft of the safety margin section of the SIP; share it with the other parties in the interagency consultation process, including the MPO, DOT, and EPA; and revise it as necessary once it receives comments from the other agencies. This step could take anywhere from one to three months, depending on the nature of the comments that arise through interagency consultation. However, if the nonroad retrofit project is well thought-out and accurately quantified in the initial draft, it is likely that fewer issues would have to be resolved in the consultation process. We believe that the state air agency and the MPO could complete the first four steps in one to three months.

- **State requests that EPA parallel process the SIP.** The state air agency would send the EPA region the proposed SIP and in its transmittal letter, request that EPA use parallel processing to approve the revision and find the budgets adequate.

- **State publishes proposal.** The state must publish its proposal in accordance with its own state’s procedures, which would begin a public comment period. In most cases, a state would give the public one month to comment, but depending on the circumstances, the public comment period could be shortened to 15 days.²⁸

- **EPA begins the adequacy process.** Once EPA receives an initial SIP submission for parallel processing, EPA must review it for adequacy, regardless of whether the safety margin is part of a larger SIP demonstration or whether it is a stand-alone submission. EPA uses the criteria in 40 CFR 93.118(e) to judge whether a SIP submission is adequate, and follows the process described in 40 CFR 93.118(f). EPA begins the adequacy process by notifying the public that we have received a SIP submission and beginning a 30-day public comment period.

- **State revises its proposal.** The state would revise its proposal as necessary, based on the comments it receives during the public comment period. This step may take the state about a month. At this point, the state air agency finalizes the SIP and submits it to EPA for approval and completion of the adequacy process.

- **EPA completes the adequacy process.** After the comment period, EPA must inform the

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²⁸Requirements for public hearings on SIPs can be found at 40 CFR 51.102. Section 51.102(g) allows a state to shorten its public comment period if it submits a written application to EPA in advance.
state of its decision on adequacy and respond to any comments it has received. EPA also must publish a notice in the Federal Register. Usually, EPA completes the adequacy process within three months, but can expedite it if necessary to a month and a half.

- **EPA adequacy finding effective.** The adequacy finding is effective 15 days from the date the Federal Register notice is published. At this point, the MPO can use the motor vehicle emissions budgets in the SIP submission for conformity.

### A.3 Have any areas included safety margins in their SIPs?

Yes. Many areas have included safety margins in their SIPs that have been used in conformity. Below we have listed areas with a safety margin as of the date of this guidance document, as well as the pollutant and the type of SIP that included the safety margin. These safety margins have resulted from a variety of control measures, rather than nonroad retrofit projects. However, the list demonstrates that safety margins have been done with some frequency in the past, and that many states have experience with including safety margins in their SIPs.

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<tr>
<th>Area</th>
<th>Pollutant</th>
<th>Type of SIP</th>
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29 EPA notes that safety margins were also included in maintenance plans for the 1-hour ozone NAAQS by 14 areas.
Flowchart for the Development and Approval of a Safety Margin That Allows Emissions Reductions from CMAQ-funded Nonroad Retrofit Projects to be Used in Transportation Conformity Determinations

State air agency: 1) determines that the emissions reductions are surplus, quantifiable, enforceable and permanent; 2) quantifies the emissions reductions from the retrofit projects for the years for which budgets are established; and 3) what portion of the reductions are available as a safety margin for transportation conformity purposes.

MPO determines the scope of the nonroad retrofit project(s) (e.g. timing, number of vehicles/engines, type of equipment, retrofit technology).

State air agency prepares proposed SIP revision (1 to 3 months to complete all steps to this point).

State air agency requests that EPA parallel process the proposed SIP revision.

EPA begins adequacy review.

EPA agrees to parallel process.

EPA does not agree to parallel process.

EPA processes as a normal SIP revision (1).

State air agency proposes the SIP revision containing the safety margin - starts public comment period (1 month).

State air agency addresses comments and revisions, if necessary (2 months).

State air agency finalizes SIP revision, and submits it to EPA for approval (1 month).

EPA publishes FR notice announcing adequacy of budgets (15 days).

Adapted finding effective (15 days).

Key:
- MPO Action
- State Action
- EPA Action

(1) EPA would not begin the adequacy process until after state submits final SIP revision for approval. Adds 3 months to the process.

(2) Assumes budgets are not affected by any revisions.
APPENDIX B:

Establishing and Using a Trading Mechanism to Allow Emission Reductions from Nonroad Retrofits to Be Used in Transportation Conformity Determinations

This appendix provides detail about how a state could apply the emission reductions from a nonroad retrofit project or projects in a conformity determination via a trading mechanism.

B.1 What is an example of establishing and using a trading mechanism?

Suppose a 2008 ozone nonattainment area develops a draft attainment demonstration that shows the area could emit from all sources 400 tons of NOx per day, and still meet the NAAQS in 2015. The area’s total NOx SIP inventory for 2015 is as follows:

- Nonroad: 100 tons per day
- On-road: 100 tons per day
- Stationary sources: 100 tons per day
- Area sources: 100 tons per day
- Total final attainment SIP NOx inventory: 400 tons per day

This SIP would have a 2015 NOx motor vehicle emissions budget of 100 tons per day, which is the on-road portion of the NOx inventory. The area also includes a trading mechanism in its SIP, and EPA has approved it.

During the development of the SIP, the MPO implements a nonroad retrofit project that will reduce NOx by 5 tons per day in 2015 and 2 tons per day in 2020. The state air agency and MPO concur that these reductions will not be applied to the nonroad inventory used in the SIP, in order to use it in a future transportation plan/TIP conformity determination. The state air agency concurs through a letter to the MPO that the reductions in 2015 and 2020 are surplus.

In this case, the on-road motor vehicle emission budget does not change. In subsequent conformity determinations for 2015, the MPO could offset as much as 5 additional tons of on-road emissions using the reductions from the nonroad retrofit project in 2015 and as much as 2 tons per in 2020, based on the latest information available for the retrofit project’s reductions when transportation plan/TIP conformity is determined. Retrofit reductions from a trade would be estimated based on the latest assumptions and emissions model available at the time of a transportation plan/TIP determination (40 CFR 93.110 and 93.111).
B.2 Does a trading mechanism have to be included in a SIP?

Yes, a state must adopt the trading mechanism (such as the model rule found in Appendix C) into its SIP. A state may choose to develop this type of trading mechanism either as a stand-alone SIP or as part of a larger SIP submission.

EPA believes that the most expeditious process for developing and approving a trading mechanism is for a state to use the model trading rule provided in this guidance document in Appendix C to develop the mechanism as a stand-alone SIP and for EPA to parallel process its approval. As discussed below, it is possible that a trading mechanism based on the model rule may be developed by a state and approved by EPA in as little as eight months if it is submitted as a stand-alone SIP and if EPA parallel processes its approval. The model rule should be used as the basis for a state’s trading rule whether the state submits its rule as a stand-alone SIP or includes it in an RFP SIP, attainment demonstration, or maintenance plan to expedite the development, review and approval of the trading mechanism.

B.3 What is the most expeditious process for establishing a trading mechanism in a SIP, and how long will it take?

To minimize the time needed for the state air agency to develop and EPA to review a SIP addressing a trading rule, EPA developed a model rule that is discussed in detail in Appendix C of this document. States that want to minimize the time necessary to adopt a trading mechanism into their SIP should use EPA’s model rule. If a state decides to draft its own trading rule, it will likely take more time to complete the steps outlined below.

The following paragraphs and the flowchart at the end of this appendix (Figure 2) describe a process that can be used to expedite the approval of a trading rule into a SIP. If a state adopts the model trading rule and EPA approves the rule in parallel with the state’s adoption of the rule, we believe that many states could put a trading rule in place for use in transportation conformity determinations in as little as eight months.\(^\text{30}\)

- **State prepares proposed SIP.** The first step in developing a SIP for a trading rule to allow emission reductions from nonroad retrofit projects to be used in transportation conformity determinations is for the state air agency to prepare the proposed SIP. To expedite this step, the air agency should start with the model trading rule and modify it only to the extent necessary. The air agency would need to fill in the information pertinent to the nonattainment and maintenance areas in its state where the rule would apply. It is also likely that the state air agency would have to format the rule so that it conforms to the state’s requirements for

\(^{30}\)Some states may be able to further reduce the time needed if state law allows them to establish a SIP trading mechanism through a memorandum of agreement (MOA) or memorandum of understanding (MOU). EPA believes that use of an MOA or MOU could save time because an MOA or MOU may require less time for state reviews than a regulation. However, EPA notes that this route may not be available to all states primarily because individual state law may not allow MOAs or MOUs to be binding on future administrations.
regulatory text. The state would also develop language to be included in the preamble of its notice of proposed rulemaking. In drafting its preamble language the state may find it useful to incorporate as much relevant language as possible from the explanatory text in Appendix C that accompanies the model rule.

Once the air agency has drafted its regulation it would share the draft with the interagency consultation partners as required by 40 CFR 93.105(b)(1). The interagency consultation partners include representatives of the MPO(s), state and local air quality and transportation agencies, and the local or regional offices of EPA, FHWA, and FTA. After the interagency consultation partners have reviewed and commented on the draft, the state air agency would make any needed revisions. We believe that a state air agency could accomplish these tasks in about two months, or perhaps even less, if it closely follows the model rule in Appendix C. However, if a state air agency decided to make significant changes or to ignore the model rule, these initial steps could take up to eight months.

• **State submits proposed SIP to EPA and requests parallel processing.** At this point the air agency would transmit the SIP to the EPA Region and request in the transmittal letter that the submission be parallel processed in order to expedite its incorporation into the SIP.

• **State proposes trading rule and solicits public comment.** The air agency would also move forward with publishing its notice of proposed rulemaking, consistent with the state’s requirements. Once published, a public comment period would begin. A typical public comment period is 30 days; however, it may be possible to reduce the comment period to as little as 15 days under some circumstances. We believe that a state air agency could complete these steps in about one month.

• **EPA reviews proposed trading rule.** The EPA Region would begin its formal review of the trading rule as soon as it receives the state’s SIP submission. EPA’s review and the subsequent publication of a notice of proposed rulemaking in the Federal Register would occur while the state was accepting public comments on its notice of proposed rulemaking and addressing any comments received. Because the EPA Region would have reviewed the draft through the interagency consultation process, the EPA Region should be able to complete its review of the submission quickly and prepare its notice of proposed rulemaking. We believe that an EPA Region could complete these steps in as little as one month if the state’s rule closely follows the model rule and if the air agency thoroughly addressed comments offered by the Region during the interagency consultation process. If, however, the submission does not closely follow the model rule or if the Region’s comments were not thoroughly addressed, these steps could take three months or more.

• **EPA proposes approval of the trading rule.** The EPA Region would then publish the notice of proposed rulemaking in the Federal Register. The publication of the notice would start a public comment period. A typical public comment period is 30 days; however, it may be possible to reduce the comment period to as little as 15 days under some circumstances. The EPA Region could complete these steps in about one month.

31Requirements for public hearings on SIPs can be found at 40 CFR 51.102. Section 51.102(g) allows a state to shorten its public comment period if it submits a written application to EPA in advance.
• **EPA addresses comments and prepares final approval.** At the close of the comment period on EPA’s notice of proposed rulemaking, the EPA Region would address any comments received and could draft the Federal Register notice finalizing the approval of the trading rule; however, EPA cannot publish this final rulemaking notice until the state completes its rulemaking process and submits the adopted rule to EPA. We believe that the EPA Region could respond to any comments and draft the final rulemaking notice in about one month.

• **State prepares final rulemaking package.** By this time the state’s public comment period would have closed. The state air agency would address any comments received and prepare its final rulemaking package, making any changes in the rule that are necessary to address any comments that are received. These actions would take about one month. It must be noted that if the state needs to make a significant revision to its trading rule, the EPA Region would not be able to complete its rulemaking through parallel processing because the state’s final rule would not be consistent with the rule that EPA had proposed for approval.

• **State review, if required.** At this point some states may be required to submit the final rule for review within the state before submission to EPA for final approval. These reviews may be carried out by the state legislature, the Governor’s office or other body established by the state. The length of these reviews varies greatly. In most cases these reviews either are not required or last less than six months. However, in some states the review can add up to 18 months to the process, particularly in cases where review is required by the state legislature and the rule is completed just after the end of one legislative session.

• **State submits adopted rule for EPA approval.** After any required state-level review is completed, the air agency would address any comments that resulted from this review process. The air agency would also complete the state rulemaking process which may involve steps such as publishing a final rulemaking notice. The state would then submit the final SIP package to the EPA Region for final approval. We believe that these tasks can be completed in about one month.

• **EPA finalizes approval.** The EPA Region would then complete its final rulemaking notice and have the notice published in the Federal Register. This step could take one month or perhaps less. EPA’s final action would be effective 30 days after publication. If EPA approves the SIP and once EPA’s rulemaking action is effective, the MPO(s) may use the trading rule in conformity determinations. No further rulemaking by the state or EPA would be necessary to allow trades to occur.

**B.4 Has any state adopted a trading mechanism into its SIP this quickly?**

Yes. The following timeline from Utah’s experience illustrates how quickly a trading mechanism can be adopted into a SIP. In this case, the trade was between pollutants rather than between emissions sectors. The fact that the trading mechanism was critical for the area to
demonstrate conformity meant that all of the involved agencies worked quickly to reach resolution:

- In early January 2002, the MPO for Salt Lake City, Utah, recognized that it would not be able to pass the NOx budget in its PM$_{10}$ SIP in its next conformity determination that was required in July 2002. The MPO knew that it would be able to easily pass the PM$_{10}$ budget in the SIP. Through interagency consultation, it was decided that the state and EPA would work together to quickly develop and approve a SIP trading mechanism that would allow the area to trade emission reductions from its PM$_{10}$ budget to its NOx budget as allowed by 40 CFR 93.124(b).

- In early January, Utah and EPA began drafting the trading rule and supporting information. By early February, the initial language for the trading rule and supporting information had been completed. In early March, the regulatory language and supporting information was finalized.

- On March 15, the Governor of Utah submitted the proposed trading rule to EPA Region 8 and asked that parallel processing be used to approve the rule.

- On April 1, the Utah Air Quality Board (UAQB) proposed the trading rule and started a 30-day public comment period.

- On May 1, EPA Region 8 published a Federal Register notice proposing approval of the trading rule that started a 30-day public comment period.

- On May 13, the UAQB adopted the trading rule and submitted the adopted rule to EPA Region 8 for final approval.

- On July 1, EPA Region 8 published a Federal Register notice approving the trading rule into Utah’s SIP.

- On July 31, EPA’s approval became effective and the MPO was then able to use the trading rule in its pending conformity determination.

The entire process from the time that it was recognized that a trading rule was needed to the time that EPA’s approval of the rule became effective was just under seven months. While the specifics of the trading rule developed for Salt Lake City are different than a trading mechanism for nonroad retrofit projects, EPA believes that it would be possible to develop and approve such a trading mechanism in a similar amount of time.
Flowchart for the Development and Approval of a Trading Rule that Allows Emissions Reductions from CMAQ Funded Nonroad Retrofits to be

EPA Begins Review

EPA Completes Review and Prepares NPRM (1 - 3 months)

EPA Publishes NPRM - Starts Comment Period (1 month, could be less)

EPA Addresses Comments and Prepares FRM (1 month)

State Air Agency Prepares Proposed SIP Revision (2 - 8 months)

State Air Agency Requests that EPA Parallel Process the Revision

EPA agrees to parallel process

EPA does not agree to parallel process

Process as a Normal SIP Revision (1)

State Air Agency Proposes the Trading Rule - Starts Public Comment Period (1 month, could be less)

State Air Agency Addresses Comments and Revises if Necessary (1 month)

State Review Process, if Necessary (Legislature, Governor’s Office) (Typically 0 - 6 months, but could be up to 18 months)

State Air Agency Finalizes SIP Revision and Submits It to EPA for Approval (1 month)

Final Approval Effective (1 month)

EPA Finalizes and Publishes FRM (1 month)

Key:

EPA Actions

State Actions

(1) EPA would not propose approval until after the state submits final SIP revision for approval. Would add 3 to 5 months to the process.

(2) Assumes any changes are minor and would not cause EPA to re-propose approval.
APPENDIX C:

Model Rule for Trading Emission Reductions from Nonroad Retrofit Projects for Transportation Conformity

Introduction

In recognition of the importance of nonroad diesel retrofit projects and other mobile source emission reduction strategies, MAP-21 continues to direct states and MPOs to give priority to funding diesel retrofits and other cost-effective mobile strategies under CMAQ. The law also notes that states and MPOs continue to have final CMAQ project selection authority. Furthermore, any state that has a PM_{2.5} nonattainment or maintenance is required to invest a portion of its CMAQ funding on projects that reduce PM_{2.5} emissions and precursor emissions.

This model rule establishes a trading mechanism that would allow emission reductions from nonroad retrofit projects that are eligible to be funded with CMAQ (23 U.S.C. 149(b)) to be used in transportation conformity. The model rule is intended to facilitate states’ adoption of this type of trading mechanism into their SIPs. States would need to modify this model rule to account for any new issues raised by including projects that may not be eligible for CMAQ dollars, as described further below.

Once a trading mechanism is adopted by a state into its SIP, the state air agency, MPO, and other agencies as appropriate would follow its provisions each time the MPO wants to include the emission reductions from a new nonroad retrofit project (or set of projects) in a transportation conformity determination.

Appendix C is divided into two parts that follow a parallel structure. Part 1 provides background information for state and local agencies to consider for each section of the model trading rule. Part 2 provides the model rule itself that states can include in their SIPs. EPA developed the model rule based on existing laws and regulations.

Part 1: Explanatory Notes for Using Model Trading Rule Language

Section 1. Purpose

The purpose of the model rule is to establish a trading mechanism that allows certain nonroad retrofit emission reductions to be used in transportation plan and TIP conformity determinations.

Section 2. Definitions

Examples of definitions that may be needed are listed, but all of them do not need to be included if they are defined elsewhere in the state’s regulations or if they do not apply (e.g., PM_{10} does not need to be defined if a state has no PM_{10} nonattainment or maintenance areas). At a
minimum, the definitions of “CARB,” “CMAQ,” “EPA,” “nonroad retrofit project,” and “surplus” must be included. If you include a definition for a word or phrase that is defined in the conformity rule (40 CFR 93.101), your definition must be consistent with the definition found in that rule.

Section 3. Applicability

(a) This model rule could be tailored to establish individual trading mechanisms for more than one nonattainment or maintenance area within a state. Section 3(a) is intended to ensure that the exchange of emission reductions occurs within the geographic area that the regional emissions analysis covers, rather than between areas covered by separate regional emissions analyses. We believe that this language will cover all possible jurisdictional cases, e.g., where there is one MPO in a nonattainment area, an MPO that has a donut area, multiple MPOs in an area, or a multi-state area.32

States can apply this model rule to one or more MPOs, simply by including the names of the MPOs within the model rule. However, states could also list the MPOs to which the model rule applies and refer to this list in subsequent sections of the model rule. A state may want to choose this approach to be consistent with other parts of its SIP, or simply because doing so avoids repetition of the list in multiple places throughout the trading rule.

(b) As noted above, the model trading rule is intended to target retrofit projects that are eligible for CMAQ dollars. States would need to modify this model rule to account for any new issues raised by including projects that may not be eligible for CMAQ dollars. For example, a trading mechanism could also account for other retrofit projects that are funded or operated by a state or local transportation agency that may not be eligible for CMAQ dollars (e.g., retrofitting diesel mowing tractors that cut vegetation within the rights-of-way of roadway facilities).

(c) This section allows agencies to specify which pollutants and/or precursors are covered by their trading rule (e.g. the rule for an ozone area could specify that it applies to NOx, VOC, or both).

This section also states that the rule applies only to trades of the same pollutant or precursor. That is, the model trading rule does not provide for trading between pollutants or precursors.33,34

32 Please refer to EPA’s guidance, Guidance for Transportation Conformity Implementation in Multi-jurisdictional Nonattainment and Maintenance Areas (EPA-420-B-12-046), for more information regarding how the conformity rule's requirements for conformity determinations apply in areas that contain more than one MPO, a donut area, parts of more than one state, or any combination. See www.epa.gov/otaq/stateresources/transconf/regs/420b12046.pdf.

33 If your SIP allows trading between pollutants and/or precursors that will be included in the retrofit trading rule, you will need to delete the sentence in Section 3(c) that says, “This rule applies only to trades of the same pollutant or precursor” and add a sentence similar to the following: “This rule does not interfere with [name of state regulation] which provides for trading between [insert pollutants/precursors].”

34 If you are interested in allowing inter-pollutant or precursor trading for conformity purposes, you will need to do so within the SIP. Note that you would need to develop an appropriate trading ratio based on a technical justification and consider other factors as appropriate. Please consult your EPA Region if you intend to add inter-pollutant/precursor trading to your SIP.
Section 4. Applying Emission Reductions from Nonroad Retrofit Projects in Transportation Conformity Determinations

(a)(i) The interagency consultation process in the transportation conformity (40 CFR 93.105) would be followed for each nonroad retrofit trade. This part of the model trading rule would require the MPO, state department of transportation, other state and local transportation agencies (when appropriate), and the state air agency to consult on trades. Individual states can further clarify which agencies should be involved in their consultation process, and make any further modifications as appropriate.

(a)(ii) This section specifies that the MPO and the state air quality agency must agree on the quantity of emission reductions from a nonroad retrofit project, or set of projects, that can be used in conformity. The MPO and state air quality agency must work together for a trade to occur because each agency is responsible for part of the process. MAP-21 directs states and MPOs to give priority to projects that reduce PM$_{2.5}$ emissions, including diesel retrofits, in areas designated nonattainment or maintenance for PM$_{2.5}$ (23 US.C. 149(g)(3)). These projects may include both nonroad and on-road diesel equipment that are operated on highway construction projects within PM$_{2.5}$ nonattainment and maintenance areas (23 U.S.C. 149(k)(2)). Ultimately, the state DOTs and MPOs decide how to spend the CMAQ money they receive, in accordance with the CMAQ provisions of MAP-21. On the other hand, the state air agency is responsible for determining which emission control programs an area needs to meet its Clean Air Act obligations. The MPO and the state air quality agency must decide together how much of the emission reductions from a nonroad retrofit project or set of projects are appropriate to use in conformity. These two agencies would make a decision for each project or set of projects being considered for transportation plan and TIP conformity determinations.

State air quality agencies and MPOs need to consider the area’s air quality needs when deciding how much of the emission reductions from a nonroad retrofit project is appropriate to use in conformity. For example, in the time period before a nonattainment area has an attainment demonstration, it may be appropriate to reserve some of the emission reductions generated by a nonroad retrofit project to help demonstrate attainment. Or, a state may decide to reserve some of the emission reductions for improving air quality, regardless of whether or not the attainment demonstration is in place. The state air agency and MPO could also decide that all of the emission reductions from a nonroad retrofit project can be used in the conformity determination. Whatever the case, the state air agency would document its concurrence in a letter to the MPO, which would describe the surplus reductions that are available for transportation conformity.

(b)(i) In order for emission reductions from a nonroad retrofit project to be estimated, NONROAD/NMIM would need the number of vehicles/engines/equipment being retrofitted, the vehicle/engine/equipment type and class being retrofitted, vehicle/engine/equipment model years, the retrofit technology being applied, the activity level of the vehicles/engines/equipment that are used (e.g., hours of usage), and when the retrofits will be implemented. This section requires an MPO to describe the details of the project. While an
MPO may not know all of this information with complete certainty, it should know enough about the project to make reasonable assumptions.

(b)(ii) The model rule relies upon the transportation conformity rule’s requirements for ensuring that emission reductions from retrofit projects have sufficient commitments before they are accounted for in a regional emissions analysis. For example, retrofit projects that result from a state or local regulation or ordinance could be included in a conformity analysis once such a regulation or ordinance is adopted (40 CFR 93.122(a)(3)(i)). Conversely, a retrofit project that does not require a regulatory action to be implemented would meet this requirement if it is included in the transportation plan and TIP with sufficient funding and other resources for its full implementation. See Section 4.3 of this guidance for further information on what level of commitment is necessary to include retrofit reductions in a transportation conformity determination.

Whatever the case, once an entity (e.g., an owner or operator of nonroad equipment or vehicles) provides a commitment for implementing a nonroad retrofit project and the MPO relies on it in a conformity determination, it is an enforceable obligation. That is, under the existing provisions of the transportation conformity rule, an entity that makes a written commitment is subject to civil action if the entity does not fulfill its commitment.

(b)(iii) - (b)(v) These paragraphs are similar to the conformity rule’s requirements for any control measures that are relied upon in a conformity determination.

(c) Emission reductions must be quantified using the latest assumptions available at the start of the regional emissions analysis (40 CFR 93.110). The consultation process would be used to evaluate and choose the model(s) and associated methods and assumptions to be used (40 CFR 93.105(c)(1)(i)). If the emission reductions are calculated using a method that relies on inputs such as temperature that were also used for developing the budgets in a SIP, these factors must be consistent with those used to establish the SIP as required in 40 CFR 93.122(a)(6). Quantification methods and information on the efficacy of retrofit technologies are addressed in more detail in Section 2 of this guidance document.

(d) This requirement for documentation is similar to the conformity rule’s requirements for documenting the transportation plan, the TIP, and any control measures that are included in the regional emissions analysis of a conformity determination. The MPO would document in its conformity determination that the state air agency has concurred on the traded nonroad retrofit emission reductions. This documentation could be completed by referencing the state air agency’s concurrence letter in the transportation plan/TIP conformity determination.

(e) In subsequent determinations, the MPO and state air agency would follow the consultation procedures in 40 CFR 93.105, but would not have to renegotiate the amount of available emission reductions from a nonroad retrofit project that has already been traded for a given year of the regional transportation conformity analysis. However, the MPO must recalculate the emission reductions that result from the project in subsequent conformity determinations. The MPO would also cite and/or include the previous air agency concurrence letter in its new
conformity determination.

For example, suppose an area that is nonattainment for the 2008 ozone NAAQS has a trading mechanism in place, and the MPO is determining transportation plan/TIP conformity in the year 2015. The MPO determines that a new nonroad retrofit project reduces NOx by 5 tons per day in 2015 and 2 tons per day in 2020. After discussion in the interagency consultation process, the MPO and state air agency agree that these reductions are surplus, and the MPO can use some of the reductions in the years 2015 and 2020 of the regional emissions analysis for the transportation plan/TIP conformity determination. Specifically, in this example, the MPO and state air agency agree that the following reductions can be used for conformity purposes: 3 of the 5 tons per day of NOx reductions for the 2015 conformity analysis year and all 2 tons per day of NOx reductions for the 2020 conformity analysis year.

The next time the MPO does transportation plan/TIP conformity, the MPO re-calculates the retrofit project’s reductions based on the latest models and assumptions, and it is found that the project reduces emissions by 6 tons per day in 2015, and 3 tons per day in 2020. In this example, the MPO can continue to use up to 3 tons per day of reductions in 2015 and up to 2 tons of reductions in 2020, based on the previous trade for this nonroad retrofit project. If additional reductions are needed from this project for any years, then the trading mechanism would need to be used to conduct a new trade.

As with any control measure that an MPO includes in its conformity determination, the MPO can only use the emission reductions from the project, or part of the project that is actually occurring. If the nonroad project’s implementation is delayed, the MPO cannot include emission reductions from the project until its implementation is assured.

Section 5. Prohibition on Double-Counting

This section is intended to ensure that there is no double-counting of emission reductions that have already been used in a transportation conformity determination or in meeting any other Clean Air Act purpose. The best way to ensure this is to require that the impact of any trades be accounted for in any subsequent inventory analyses that are done. For example, if the application of this rule results in a decrease in the nonroad emissions inventory and an increase in the allowable on-road emissions, future SIP inventories or regional transportation conformity analyses should reflect those changes as appropriate.
Part 2:  Model Trading Rule

Section 1.  Purpose

This rule establishes the procedures that may be used to trade emission reductions from nonroad retrofit projects, as defined below, to the transportation sector for the purpose of determining conformity of a transportation plan or transportation improvement program.

Section 2.  Definitions

The following definitions apply to this rule:

- **CARB** means the California Air Resources Board.
- **CMAQ** means the Congestion Mitigation and Air Quality Improvement Program, as defined in title 23, U.S.C.
- **EPA** means the U.S. Environmental Protection Agency.
- **Nonroad retrofit project**, for the purpose of this rule, means an undertaking to reduce emissions from nonroad vehicles or engines as described by 23 U.S.C. 149(b), below the emissions level which is currently required by EPA regulations at the time of vehicle or engine certification. For the purposes of this rule, such an undertaking must apply a technology verified by EPA, CARB, or other entity recognized by EPA for verifying retrofit technology, use an EPA-certified engine replacement or early replacement of older vehicles or equipment with cleaner vehicles or equipment; and it must be eligible for funding under CMAQ.
- **NOx** means oxides of nitrogen.
- **PM$_{10}$** means particulate matter that is less than or equal to 10 microns in aerodynamic diameter.
- **PM$_{2.5}$** means particulate matter that is less than or equal to 2.5 microns in aerodynamic diameter.
- **Surplus** means that emission reductions are not otherwise relied on to meet any Clean Air Act air quality related purpose including but not limited to reasonable further progress, attainment, maintenance, or requirements adopted to satisfy Clean Air Act section 110(a)(2)(D). In the event that a nonroad retrofit project is relied on to meet such an air quality requirement, emission reductions are no longer surplus and may not be used in transportation conformity determinations.
- **VOC** means volatile organic compounds.
Section 3. Applicability

(a) Geographic applicability: This trading rule applies to the geographic area covered by the regional emissions analysis done for a transportation conformity determination for a transportation plan or transportation improvement program in [insert name of nonattainment or maintenance area].

(b) Project applicability: This trading rule applies to nonroad retrofit projects as defined in Section 2 of this rule.

(c) Pollutant applicability: This trading rule applies to the following pollutants/precursors: [insert pollutants/precursors; for precursors indicate for which pollutant and standard(s)]. This rule applies only to trades of the same pollutant or precursor.

Section 4. Applying Emission Reductions from Nonroad Retrofit Projects in Transportation Conformity Determinations

Before [insert name of MPO] can include emission reductions from a nonroad retrofit project(s) in a transportation conformity determination, the steps in paragraphs (a) – (d) must be completed.

(a) Interagency Consultation.

(i) [Insert name of MPO], [insert name of state department of transportation], [insert names of other state and local transportation agencies, when appropriate] and [insert name of state air agency] shall follow consultation procedures in [insert “40 CFR 93.105” or state transportation conformity SIP if one has been approved by EPA] throughout the implementation of this rule.

(ii) [Insert name of MPO(s)] and [insert name of state air agency] must concur on the amount of emission reductions from a nonroad retrofit project(s) that can be used in the transportation conformity determination. [Insert name of state air agency] will document this concurrence in a letter to [insert name of MPO]. Concurrence of [insert name of state air agency] also affirms that the emission reductions are surplus and therefore available for the transportation conformity determination.

(b) Description of the Nonroad Retrofit Project(s).

(i) [Insert name of MPO] must fully describe each nonroad retrofit project being relied upon in a conformity determination, including the number of vehicles/engines/equipment being retrofitted, the vehicle/engine/equipment type and class, vehicle/engine/equipment model years, the retrofit technology being applied, the activity level of the vehicles/engines/equipment, and the implementation schedule of the nonroad retrofit project.

(ii) [Insert name of MPO] must provide assurance that the nonroad retrofit project is enforceable by ensuring that any nonroad retrofit project under this rule meets the requirements of 40 CFR 93.122(a);

(iii) [Insert name of MPO] must provide assurance that the nonroad retrofit project has adequate
funding and resource commitments to ensure that emission reductions from the nonroad retrofit project will occur in the years of the regional emissions analysis when emission reductions will be used;

(iv) [Insert name of MPO] must provide assurance that the nonroad retrofit project is on schedule and that the retrofitted vehicles, engines, or equipment will remain in use within the nonattainment or maintenance area in the years of the regional emissions analysis when the emission reductions will be used; and

(v) [Insert name of MPO] must provide assurance that emission reductions will be based only on activity that occurs within the geographic area covered by the regional emissions analyses.

(c) Calculation of Emission Reductions. For each year of the regional emissions analysis in which emission reductions from the nonroad retrofit project(s) will be applied, [insert name of MPO] and [insert name of state air agency] must calculate emission reductions from the nonroad retrofit project(s) using:

(i) the latest EPA-approved emissions model or other method as determined through the interagency consultation process required by 40 CFR 93.105;

(ii) data and assumptions consistent with requirements for use of latest planning assumptions under 40 CFR 93.110, including, but not limited to current data or future projections of numbers and types of nonroad vehicles/engines/equipment being retrofitted, and current data or future projections of hours of use for those vehicles/engines/equipment within the nonattainment or maintenance area;

(iii) the latest verified information available regarding the efficacy of the nonroad retrofit project as provided by EPA and/or CARB; and

(iv) ambient temperatures and other relevant factors consistent with those used to establish the motor vehicle emissions budgets (if they exist) in the applicable implementation plan, as required by 40 CFR 93.122(a)(6), if a method is used that requires such factors as inputs.

Once total emission reductions from the nonroad retrofit project(s) are calculated, [insert name of MPO] can use no more than the amount of emission reductions determined in Section 4(a)(ii) to be available for the conformity determination.

(d) Documentation. [Insert name of MPO] must document in the transportation conformity determination how steps (a) through (c) of this section have been satisfied, consistent with the transportation conformity regulations at 40 CFR Parts 51 and 93.

(e) Subsequent conformity determinations. Once emission reductions from a nonroad retrofit project(s) have been used in a conformity determination, [insert name of MPO] can include emission reductions from those projects for the same analysis years in a subsequent conformity determination without repeating paragraph (a)(ii), provided [insert name of MPO] meets all other requirements of Section 4 of this rule.
Section 5. Prohibition on Double-Counting

Once the emission reductions of the nonroad retrofit project(s) are included in a transportation conformity determination, those specific reductions are no longer surplus and therefore no longer available as new reductions for meeting any Clean Air Act air quality related purpose, including but not limited to, reasonable further progress, attainment, maintenance, or requirements in Clean Air Act section 110(a)(2)(D). Any emissions inventory created after a trade must properly account for the emission impact of the trade.
Appendix F – ARB CMAQ Methods to Find Cost-Effectiveness of Funding Air Quality Projects, 2005
Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

For Evaluating
Motor Vehicle Registration Fee Projects
and
Congestion Mitigation and
Air Quality Improvement (CMAQ) Projects

May 2005
ACKNOWLEDGEMENTS

The methods handbook was initially prepared by the California Air Resources Board (ARB) in cooperation with the California Department of Transportation (Caltrans) and the California Air Pollution Control Officers Association (CAPCOA). Updates have been prepared by Air Resources Board staff. The principal author is Pam Burmich, Air Pollution Specialist. Current ARB staff contact is Jeff Weir, (916) 445-0098, jweir@arb.ca.gov.

FOR COPIES of this handbook, see the ARB or Caltrans websites at www.arb.ca.gov/planning/tsaq/eval/eval.htm or www.dot.ca.gov/hq/transprog/reports/Official_CMAQ_Web_Page.htm, or call the ARB's Transportation Strategies Group at (916) 322-0285. The handbook is also available as a Microsoft Access file that allows the user to enter the appropriate inputs and calculates emission reductions and cost-effectiveness automatically.

The primary changes in this edition of the handbook are the updating of emission factors and example calculations using ARB’s motor vehicle emissions model, EMFAC2002.
Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

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Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

Introduction

Millions of dollars are provided each year to regional and local jurisdictions to help fund projects that reduce emissions from motor vehicles and assist the implementation of transportation measures in regional clean air plans. Two major sources of this funding are the California Motor Vehicle Registration Fee (MV Fees) Program and the federal Congestion Mitigation and Air Quality Improvement (CMAQ) Program.

To ensure that public health benefits are maximized, it is important that projects funded be the most cost-effective at reducing emissions. To achieve this goal, cost-effectiveness evaluations should be used to prioritize projects before final funding decisions are made.

The cost-effectiveness of an air quality project is based on the amount of pollution it eliminates for each dollar spent. This document is a “methods handbook” to help estimate the cost-effectiveness of some of the most widely implemented transportation-related air quality projects:

- Cleaner off-road vehicles
- Cleaner on-road vehicles
- New bus service
- Vanpools and shuttles
- Cleaner street sweepers
- Signal coordination
- Bicycle facilities
- Telecommuting programs
- Ridesharing and pedestrian facilities

For each project type, the methods handbook includes:

- A list of the information needed to evaluate cost-effectiveness.
- “Defaults” that may be used when data are not available.
- Formulas to calculate vehicle emission reductions for three major pollutants:

  - Reactive organic gases (ROG)
  - Nitrogen oxides (NOx)
  - Particulate Matter (PM10)

  Emission factor tables are included for various vehicle and project types.

- Formula to calculate cost-effectiveness
- Sample evaluation to aid in using the method
Cost-Effectiveness

Cost-effectiveness for MV Fees and CMAQ projects should be expressed as dollars spent per pound of pollutant reduced (ROG + NOx + PM10). Cost-effectiveness is typically based on total project costs, including capital investments and operating costs. However, for the purposes of this document, cost-effectiveness is based on clean air funding dollars. Project funding generally covers only the incremental additional costs of a cleaner engine or vehicle.

The funding dollars are amortized over the expected project life using a discount rate. The amortization formula yields a capital recovery factor, which, when multiplied by the funding, gives the annual funding for the project over its expected lifetime. The discount rate reflects the opportunity cost of public funds for the clean air programs. This is the level of earning that could be reasonably expected by investing public funds in various financial instruments, such as U.S. Treasury securities. Cost-effectiveness is determined by dividing annualized funds by annual emission reductions (ROG + NOx + PM10).

The following table gives capital recovery factors that may be used to annualize funding dollars according to project life. The capital recovery factors below are calculated to two decimal places using a discount rate of 3 percent.

<table>
<thead>
<tr>
<th>Project Life</th>
<th>Capital Recovery Factor for discount rate of 3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>1.03</td>
</tr>
<tr>
<td>3 years</td>
<td>0.35</td>
</tr>
<tr>
<td>5 years</td>
<td>0.22</td>
</tr>
<tr>
<td>7 years</td>
<td>0.16</td>
</tr>
<tr>
<td>10 years</td>
<td>0.12</td>
</tr>
<tr>
<td>12 years</td>
<td>0.10</td>
</tr>
<tr>
<td>15 years</td>
<td>0.08</td>
</tr>
<tr>
<td>20 years</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Defaults

The methods in this handbook call for monitored data and information inputs that may not be readily available. Defaults are provided for each method based on local and national travel surveys, surveys conducted by local air districts, research projects funded by the Air Resources Board (ARB) and air districts, and ARB guidance documents. Local data should be used in place of defaults when data are available. Emission factors are based on certification testing and ARB’s statewide mobile source inventory.

Federal CMAQ Reporting Requirements

*Carbon monoxide.* Federal Highway Administration (FHWA) requests that CO emission reductions be reported for CMAQ projects. California's MV Fee Program does not request CO information. CO is a localized pollutant and not a regional pollution problem. Most projects using CMAQ and MV Fee dollars are funded primarily to reduce regional ozone and PM10 and have little impact on localized CO hot spots.
Signal coordination projects, however, may be targeted at specific CO hot spots in CO nonattainment areas. CO emission factors are included in this edition in order to report to FHWA on these types of CMAQ projects. Reporting CO emission reductions should be limited to targeted projects located in CO nonattainment or maintenance areas.

In addition, CO emissions are several orders of magnitude larger than ozone precursors. CO overwhelms cost-effectiveness ratios unless CO emission reductions are scaled back significantly, typically by a factor of seven. This adjustment should be made when using cost-effectiveness ratios as a basis for funding decisions. Another option is to consider CO projects separately from ozone precursor projects.

**Kilograms.** FHWA requests that emission reductions from CMAQ projects be reported in kilograms per day. The methods handbook therefore includes formulas to convert pounds per year of emission reductions to kilograms per day.

**Infrastructure Projects**

Supporting infrastructure may be necessary for some kinds of emission reducing projects to be successful. Examples of infrastructure projects are alternative-fueled vehicle refueling stations, electric vehicle recharging facilities, public education programs, multi-modal transit infrastructure projects, and automated transit schedule information. Because infrastructure projects are difficult to evaluate for cost-effectiveness, they are not included in this handbook. However, they should be evaluated with respect to their consistency with clean air plans. Funding priorities can be structured to include supporting projects.

**Mobile Source Emission Reduction Credits**

The methods handbook should not be used to determine mobile source credits which can be sold or traded. For procedures on how to generate these credits, please refer to the Air Resources Board document, Mobile Source Emission Reduction Credits Guidelines.

Air Resources Board regulations require new motor vehicles (including transit buses) to meet progressively more stringent emission standards. Emission reductions associated with the natural replacement of older vehicles with newer, cleaner models are included in motor vehicle emission inventories in clean air plans, and thus are not surplus emission reductions.

**Contact**

If you have any questions about the methods handbook, air quality cost-effectiveness analysis of transportation-related projects, or the evaluation of future-year projects for which the emission factor tables may not be best suited, please contact Jeff Weir, Transportation Strategies Group, Air Resources Board, at (916) 445-0098 or jweir@arb.ca.gov.
On-Road Cleaner Vehicle Purchases and Repowering

Project definition: The purchase of a motor vehicle that is certified to be less polluting than a typical new vehicle (cleaner purchase) or an engine replacement that transforms a vehicle into a less polluting one (cleaner repower). Since natural replacement of older vehicles or engines with newer, cleaner ones (fleet turnover) is accounted for in clean air plans, in order to claim emission reductions from the project, the vehicles purchased must emit less pollution than conventional new vehicles meeting current emission standards.

Note: Recent but limited studies indicate further PM10 and formaldehyde reductions can be obtained from particulate filters and oxygen catalysts on natural gas vehicles.

How emissions are reduced: Emission reductions are the emissions associated with a new, more polluting vehicle minus the emissions associated with a new, less polluting vehicle.

Need to know:
Funding dollars
Annual vehicle miles traveled (VMT)
Engine certification rates or cleaner vehicle classification

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Dollars (Funding)</td>
<td>dollars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (Life)</td>
<td>years</td>
<td></td>
<td>Suggested defaults are: Cleaner heavy-duty transit or urban bus - 12 Electric bus - 18, School bus - 20, Heavy-duty trucks - 10, Medium-duty vehicles - 10, Light-duty vehicles - 8 Light-duty electric vehicles - 10</td>
</tr>
<tr>
<td>Annual Vehicle Miles Traveled (VMT)</td>
<td>annual miles</td>
<td></td>
<td>Suggested defaults: Transit bus - 40,000 mi/yr School bus - 15,000 mi/yr Heavy-duty truck – 70,000 mi/yr (line haul truck)</td>
</tr>
</tbody>
</table>

Emission Factor Inputs (Example is for Class 8 truck)

<table>
<thead>
<tr>
<th></th>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>Before</td>
<td>g/mi</td>
<td>After</td>
<td>g/mi</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOx Factor</td>
<td>5.8</td>
<td>&quot;</td>
<td>3.74</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.3</td>
<td>&quot;</td>
<td>0.06</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

For heavy-duty emission factors, see Table 5. For medium-duty vehicle and light-duty emission factors, see Table 2 and Table 7. Select the factors that best represent your project.

Benefits for on-road heavy-duty engines are usually based on NOx and PM emissions only. (Defaults: The “Before” emission factors represent a typical new Class 8 truck. The “After” emission factors represent a 1.8 g/bhp-hr NOx + NMHC Class 8 truck. For electric buses use 0 as the default value.)
Formulas

Annual Emission Reductions (ROG, NOx, and PM10) =
(VMT)*[(Before Emission Factor) - (After Emission Factor)]/454

Capital Recovery Factor (CRF) = \( \frac{(1 + i)^n(1)}{(1 + i)^n - 1} \)

where: 
\( i \) = discount rate (Assume 3 percent)
\( n \) = project life

Cost-Effectiveness of Funding Dollars = (CRF * Funding) / (ROG + NOx + PM10) dollars/lb

Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is
(lbs per year) / [(2.2)* (365)] = kilograms/day

On-Road Cleaner Vehicle Purchases and Repowering (Optional Method)

Emissions can also be calculated using emission factors in units of g/bhp-hr multiplied by annual fuel consumption and an energy consumption factor. The default for the energy consumption factor is 18.5 hp-hr/gal. In the formula above, substitute annual gallons of fuel in place of VMT. Substitute emission rates in units of g/bhp-hr multiplied by 18.5 in place of the Before Emission Factor and the After Emission Factor.
Purchase Cleaner Line Haul Trucks
A line haul trucking company proposes to purchase 3 heavy-duty (Class 8) line haul trucks equipped with CNG engines certified to 1.8 g/bhp-hr NOx + NHMC.

Inputs to calculate cost-effectiveness:
Funding Dollars (Funding) = $60,000
(Funding is usually limited to the incremental project cost -- the difference between the cost of the cleaner truck and a typical new truck -- or less, to ensure cost-effectiveness of better than $10/lb.)
Effectiveness Period (Life): 10 years
Annual Vehicle Miles Traveled (VMT): 210,000 miles

Emissions Factors (From Table 5):

<table>
<thead>
<tr>
<th>Emission Factor</th>
<th>&quot;Before&quot; Emission Factor</th>
<th>&quot;After&quot; Emission Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>5.8 grams/mi</td>
<td>3.74 grams/mi.*</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.3</td>
<td>0.06</td>
</tr>
</tbody>
</table>

* From Table 5: Assume 80% NOx for 1.8 NOx + NMHC certification, or 1.44 g/bhp-hr.
1.44 x 2.6 (conversion factor) = 3.74 grams/mi

Calculations:
Annual Emission Reductions (ROG, NOx, and PM10) =
(VMT) * [(Before Emission Factor) - (After Emission Factor)]/454

ROG: 0 lbs. per year reduced
NOx: 210,000 * [(5.80) - (3.74)]/454 = 953 lbs. per year reduced
PM10: 210,000 * [(0.30) - (0.06)]/454 = 111 lbs. per year reduced

Capital Recovery Factor (CRF) = \frac{(1 + i)^n}{(1 + i)^n - 1}
(From Table 8)
where: n = project life (10 years)
\( i \) = discount rate (3%)
CRF = \frac{(1 + .03)^{10}(.03)}{(1 + .03)^{10} - 1} = 0.12

Cost-Effectiveness of Funding Dollars = \frac{(CRF * Funding) / (ROG + NOx + PM10)}{(0 + 953 + 111)}
= \frac{0.12 * 60,000}{6504} = $6.76 per lb.
FOR CMAQ PROJECTS ONLY:

Once emission reductions have been calculated, add them together ($0 + 953 + 111 = 1,064$) and convert emissions reductions per year to kg/day:

\[
\frac{\text{lbs. per year}}{2.2 \text{ lbs./kg} \times 365 \text{ days/year}} = \frac{1,064}{2.2 \times 365} = \frac{1,064}{783} \approx 1.364 \text{ kg/day}
\]
Off-Road Cleaner Vehicle Purchases and Repowering

**Project definition:** Replacing uncontrolled diesel engines in off-road equipment, such as agricultural or construction equipment, with lower-emitting, controlled diesel engines or alternative fueled engines. Repowering vehicles with cleaner new engines is done instead of rebuilding the old engine. Diesel engines, rather than alternative fueled engines, are typically used to meet the needs of these applications.

**How emissions are reduced:** Emission reductions are the difference between the emissions associated with an older rebuilt, more polluting engine minus the emissions associated with the less polluting new engine. Emission reductions are primarily NOx reductions.

**Need to know:**
Funding dollars
Annual vehicle operating hours
Horsepower
Engine load factor

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Dollars (Funding)</td>
<td>dollars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (Life)</td>
<td>10</td>
<td>years</td>
<td></td>
</tr>
<tr>
<td>Annual Vehicle Operating Hours (OperHrs)</td>
<td>annual hours</td>
<td></td>
<td>Operating hours range: Agricultural Equipment 110 - 814 Construction Equipment 130-1836</td>
</tr>
<tr>
<td>Horsepower (HP)</td>
<td>bhp</td>
<td></td>
<td>Load range: Agricultural Equipment 0.38 - 0.7 Construction Equipment 0.43-0.78</td>
</tr>
</tbody>
</table>

**Emission Factor Inputs**

<table>
<thead>
<tr>
<th></th>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Emission Factor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROG Factor</td>
<td>0.88</td>
<td>g/bhp-hr</td>
<td>0.22</td>
<td>g/bhp-hr</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>11.0</td>
<td>&quot;</td>
<td>4.72</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.55</td>
<td>&quot;</td>
<td>0.19</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

For off-road vehicle emission factors, see Table 6. The "Before Emission Factor" represents the old diesel engine. The "After Emission Factor" represents a new diesel or cleaner engine. Select the factors that best represent your project. (Defaults are for replacing a 1985-1987 diesel engine in the 121-175 horsepower range with a cleaner 2004 engine.)
### Formulas

<table>
<thead>
<tr>
<th>Formula</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Emission Reductions (ROG, NOx, and PM10) =</td>
<td>lbs/year</td>
</tr>
<tr>
<td>((\text{OperHrs}) \times (\text{HP}) \times (\text{Load}) \times [(\text{Before Emission Factor}) - (\text{After Emission Factor})]/454)</td>
<td></td>
</tr>
<tr>
<td>Capital Recovery Factor (CRF) =</td>
<td></td>
</tr>
<tr>
<td>(\frac{(1 + i)^n (i)}{(1 + i)^n - 1})</td>
<td></td>
</tr>
<tr>
<td>where: (i = ) discount rate (Assume 3 percent)</td>
<td></td>
</tr>
<tr>
<td>(n = ) project life</td>
<td></td>
</tr>
<tr>
<td>Cost-Effectiveness of Funding Dollars = (\frac{(\text{CRF} \times \text{Funding})}{(\text{ROG + NOx + PM10})})</td>
<td>dollars/lb</td>
</tr>
</tbody>
</table>

**Note:** The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is 
\((\text{lbs per year}) / [(2.2) \times (365)] = \) kilograms/day

**Off-road vehicles are generally not eligible for CMAQ funds, with the exception of off-road construction vehicles used for road projects.**

### Off-Road Cleaner Vehicle Purchases and Repowering (Optional Method)

Annual operating hours (\(\text{OperHrs}\)), horsepower (\(\text{HP}\)), and Load (\(\text{L}\)) can be replaced in the formula with annual fuel consumption in gallons per year multiplied by an energy consumption factor expressed as hp-hr/gal. The default for the energy consumption factor is 18.5 hp-hr/gal. In the formula above, substitute annual gallons of fuel in place of \(\text{OperHrs}\). Substitute 18.5 in place of \(\text{HP} \times \text{Load}\).
**Off-Road Cleaner Vehicle Purchases and Repowering**

**EXAMPLE**

**Agricultural Vehicle Engine Repower**

A company proposes to re-power two 1987 agricultural vehicle engines with new 2004 diesel engines. The new diesel engines will emit 4.72 g/bhp-hr of NOx compared to the old engines rebuilt to emit 11.0 g/bhp-hr. (See Table 6)

**Inputs to calculate cost-effectiveness:**

- Funding Dollars (Funding) = $20,000
- Effectiveness Period (Life): 10 years
- Annual Vehicle Operating Hours (Oper Hrs): 740 hours per year
  - where each engine operates for 370 hrs/year.
- Horse Power (HP): 100 hp
- Load factor: 0.5

**Emissions Factors: (From Table 6)**

<table>
<thead>
<tr>
<th>Factor</th>
<th>&quot;Before&quot; Emission Factor</th>
<th>&quot;After&quot; Emission Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>0.88 grams/bhp-hr</td>
<td>0.22 grams/bhp-hr</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>11.00</td>
<td>4.72</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.55</td>
<td>0.19</td>
</tr>
</tbody>
</table>

**Calculations**

- Annual Emission Reductions (ROG, NOx, and PM10) =
  \[(\text{Oper Hrs}) \times (\text{HP}) \times (\text{Load}) \times [(\text{Before Emission Factor}) - (\text{After Emission Factor})] / 454\]
  - ROG: \([(740) \times (100) \times (0.5) \times (0.88 - 0.22)] / 454 = 54 \text{ lbs. per year reduced}\)
  - NOx: \([(740) \times (100) \times (0.5) \times (11.0 - 4.72)] / 454 = 512 \text{ lbs. per year reduced}\)
  - PM10: \([(740) \times (100) \times (0.5) \times (0.55 - 0.19)] / 454 = 29 \text{ lbs. per year reduced}\)

**Capital Recovery Factor (CRF)**

\[
\text{CRF} = \frac{(1 + i)^n - 1}{(1 + i)^n - 1} \quad \text{where: } \text{i = discount rate (assume 3 percent)}
\]

\[
\text{CRF} = (1 + .03)^{10} \times (0.03) = 0.12
\]

**Cost-Effectiveness of Funding Dollars**

\[
= \frac{(\text{CRF} \times \text{Funding})}{(\text{ROG} + \text{NOx} + \text{PM10})}
\]

\[
= \frac{(0.12 \times 20,000)}{(595)} = $4.03 \text{ per lb.}
\]

**FOR CMAQ PROJECTS ONLY:**

The CMAQ program is for the reduction of on-road motor vehicle emissions, so this agricultural sprayer project would not be eligible for CMAQ funds.
Cleaner Street Sweeper Purchases

Project definition: The purchase of an alternative-fueled street sweeper in lieu of a typical diesel powered street sweeper. Street sweepers frequently have two engines: a main (on-road) engine and a smaller auxiliary (off-road) engine. Both engines can be powered with alternative-fuels. Also, street sweepers that meet the certification requirements of the South Coast Air Quality Management District’s Rule 1186 have improved road dust collection efficiency and generate less PM10 during sweeping activities when compared to non-certified equipment.

How emissions are reduced: Emission reductions are the difference between the emissions associated with operating a typical new diesel sweeper compared to one that uses cleaner, alternative fuels. There are additional PM10 emission reductions associated with sweeper operations if the sweeper is PM10 efficient and certified to Rule 1186. The methodology provides default PM10 benefits to account for Rule 1186-certified sweepers.

(There are additional benefits associated with a reduction in entrained road dust from vehicular traffic subsequent to sweeping operations; however, these benefits are difficult to quantify due to variability in roadway conditions and traffic volumes. Typically, alternative-fueled sweepers will be cost effective without consideration of these benefits.)

Need to know:
Funding dollars
Annual fuel usage
Engine certification rates
Annual miles swept

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Dollars (Funding)</td>
<td></td>
<td>dollars</td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (Life)</td>
<td>10</td>
<td>years</td>
<td></td>
</tr>
<tr>
<td>Annual Gallons of Fuel Used</td>
<td></td>
<td>gallons per year</td>
<td>Fuel usage for the main (on-road) engine. Default is 2/3 of total fuel usage for the vehicle. (Default for total fuel usage is 30 gal/day for 250 days/yr or 7500 annual gallons.)</td>
</tr>
<tr>
<td>for the Main Engine (Main Fuel)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Gallons of Fuel Used</td>
<td></td>
<td>gallons per year</td>
<td>Fuel usage for the auxiliary engine. Default is 1/3 of total fuel usage for the vehicle. If there is no auxiliary engine, enter zero.</td>
</tr>
<tr>
<td>for the Auxiliary Engine (Aux Fuel)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Miles Swept (Miles Swept)</td>
<td></td>
<td>miles per year</td>
<td></td>
</tr>
</tbody>
</table>
### Emission Factor Inputs for the Main Engine

<table>
<thead>
<tr>
<th></th>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main EF Before</strong></td>
<td></td>
<td></td>
<td><strong>Main EF After</strong></td>
<td></td>
</tr>
<tr>
<td><strong>(optional certification rate)</strong></td>
<td></td>
<td></td>
<td><strong>(alternative-fueled)</strong></td>
<td></td>
</tr>
<tr>
<td>ROG Factor</td>
<td>N/A</td>
<td>g/bhp-hr</td>
<td>N/A</td>
<td>g/bhp-hr</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>2.1</td>
<td>g/bhp-hr</td>
<td>1.44</td>
<td>g/bhp-hr</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.1</td>
<td>g/bhp-hr</td>
<td>0.053</td>
<td>g/bhp-hr</td>
</tr>
</tbody>
</table>

Benefits are usually based on NOx and PM10 emissions. The "Main EF Before" factors represent the old diesel engine. The "Main EF After" factors represent a new diesel or cleaner engine. Select the factors that best represent the project. Defaults shown for "Main EF Before" are based on baseline emission factors for heavy-duty trucks 14,001 to 33,000 lbs (see Table 5 -- 4.8 grams per mile / 2.3 conversion factor = 2.1 g/bhp-hr). For "Main EF After," use the g/bhp-hr certification rate of the new, cleaner engine. Defaults for "Main EF After" assume that the new engine is certified to 1.8 g/bhp-hr NOx + NHMC (assume 80% NOx -- 1.44 g/bhp-hr) and 0.053 g/bhp-hr for PM.

Similarly, the emission factors below represent diesel versus alternative-fueled auxiliary engine emissions. The defaults for “Aux EF Before” are from Table 6 and are based on the off-road diesel engine (50 – 175 hp) NOx emission standard of 4.72 g/bhp-hr for year 2004. “Aux EF After” factors assumes an engine that is certified to an optional 4.0 g/bhp-hr NOx + NHMC (assume 95% NOx – 3.8 g/bhp-hr).

The methodology allows for potential benefits from cleaner off-road auxiliary engines to be included should they occur. If the auxiliary engine is an on-road engine, then the defaults are the same as for the main engine shown in the table above.

### Emission Factor Inputs for the Auxiliary Engine

<table>
<thead>
<tr>
<th></th>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aux EF Before</strong></td>
<td></td>
<td></td>
<td><strong>Aux EF After</strong></td>
<td></td>
</tr>
<tr>
<td>Off-Rd</td>
<td></td>
<td>g/bhp-hr</td>
<td>Off-Rd</td>
<td>g/bhp-hr</td>
</tr>
<tr>
<td>On-Rd</td>
<td></td>
<td>N/A</td>
<td>On-Rd</td>
<td>N/A</td>
</tr>
<tr>
<td>ROG Factor</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>g/bhp-hr</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>4.72</td>
<td>N/A</td>
<td>3.80</td>
<td>N/A</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>g/bhp-hr</td>
</tr>
</tbody>
</table>

**Emissions Benefit Factor for Rule 1186-Certified Sweepers**

Rule 1186-certified street sweepers tested in July of 1999 had an average entrainment value of 109 milligrams per meter (mg/meter). During those same evaluations, the non-certified street sweepers had an entrainment value of 340 mg/meter. Based on these evaluations, the net benefit of using a Rule 1186-certified street sweeper is 231 mg/meter; however, this value has been reduced to account for the fact that the silt loadings used in the test are greater than typical paved road loadings. With this reduction factor and the appropriate conversion, the net benefit from using Rule 1186-certified street sweepers is estimated at **0.05 pounds/mile** of street sweeping. This benefit factor is used in the formula below to calculate reductions from sweeping with Rule 1186-certified street sweeping.
Formulas

Annual ROG, NOx, and PM10 Emission Reductions from the Cleaner Engines

(Engine Reductions) =

\[ \text{Main Fuel} \times (\text{Main EF Before} - \text{Main EF After}) + \]
\[ \text{Aux Fuel} \times (\text{Aux EF Before} - \text{Aux EF After}) \times 18.5/454 \text{ lbs/year} \]

(Note: The factor, 18.5 hp-hr/gallons, is the energy consumption factor.)

Additional PM10 Emission Reductions from Rule 1186-Certified Sweepers

(Sweeping Reductions) =

\[ \text{Miles Swept} \times 0.05 \text{ lbs/year} \]

Annual Emission Reductions (ROG, NOx, and PM10) =

Engine Reductions + Sweeping Reductions \text{ lbs/year}

Capital Recovery Factor (CRF) =

\[ \frac{(1 + i)^n \times (i)}{(1 + i)^n - 1} \]

where:

- \( i \) = discount rate (Assume 3 percent)
- \( n \) = project life

Cost-Effectiveness of Funding Dollars = (CRF * Funding) / (ROG + NOx + PM10) \text{ dollars/lb}

Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is

\[ \frac{\text{lbs per year}}{(2.2) \times (365)} = \text{kilograms/day} \]
**Cleaner Street Sweepers**

**EXAMPLE**

**Purchase of Rule 1186-certified, CNG Street Sweeper**

A city purchases a street sweeper certified to Rule 1186 that uses compressed natural gas (CNG). The sweeper has a GVWR of 32,000 lbs with a main on-road engine plus an on-road auxiliary engine (150 hp). The new engines are certified to 1.8 g/bph-hr for NOx + NMHC (assume 80% NOx - 1.44 g/bhp-hr) and 0.053 g/bph-hr PM. The cost difference between a new cleaner sweeper and a new typical diesel sweeper is $40,000.

**Inputs to calculate cost-effectiveness:**

- Funding Dollars (Funding) = $40,000
- Effectiveness Period (Life): 10 years
- Annual Gallons of Fuel Used by the Main Engine (Main Fuel): 5,000 gallons per year
- Annual Gallons of Fuel Used by the Auxiliary Engine (Aux Fue): 2,500 gallons per year
- Annual Miles Swept (Miles Swept): 10,000 miles (40 miles/day * 250 days/year)
- Energy Consumption Factor: 18.5 hp-hr/gallons

**Emissions Factors for Main Engine:**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Main EF Before</th>
<th>Main EF After</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>2.1 grams/bhp-hr</td>
<td>1.44 grams/bhp-hr</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.1 grams/bhp-hr</td>
<td>0.053 grams/bhp-hr</td>
</tr>
</tbody>
</table>

**Emissions Factors for Auxiliary Engine:**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Aux EF Before</th>
<th>Aux EF After</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>not applicable</td>
<td>not applicable</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>2.10 grams/bhp-hr</td>
<td>1.44 grams/bhp-hr</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.10 grams/bhp-hr</td>
<td>0.053 grams/bhp-hr</td>
</tr>
</tbody>
</table>

**Calculations**

Annual ROG, NOx, and PM10 Emission Reductions from the Cleaner Engines (Engine Reductions) =

\[
\text{[Main Fuel} \times (\text{Main EF Before} - \text{Main EF After}) + \text{Aux Fuel} \times (\text{Aux EF Before} - \text{Aux EF After})] \times 18.5/454
\]

- **ROG:** 0
- **NOx:** \([5,000 \times (2.1 - 1.44) + 2,500 \times (2.1 - 1.44)] \times 18.5/454 = 202 \text{ lbs. per year reduced}\)
- **PM10:** \([5,000 \times (0.1 - 0.053) + 2,500 \times (0.1 - 0.053)] \times 18.5/454 = 14 \text{ lbs. per year reduced}\)

Annual PM10 Emission Reductions from Sweeping (Sweeping Reductions) =

\[\text{Miles Swept} \times 0.05\]

- **PM10:** 10,000 \times 0.05 = 500 \text{ lbs. per year reduced}
Annual Emission Reductions (ROG, NOx, and PM10) =
   = Engine Reductions + Sweeping Reductions
ROG = 0 lbs. per year reduced
NOx = 202 lbs. per year reduced
PM10 = 514 lbs. per year reduced

Capital Recovery Factor (CRF) = \((1 + i)^n - 1\)
(From Table 8)
CRF = \((1 + .03)^{10} - 1\) = 0.12

Cost-Effectiveness of Funding Dollars = \((\text{CRF} \times \text{Funding}) / (\text{ROG} + \text{NOx} + \text{PM10})\)
= \((0.12 \times 40,000) / (202 + 514)\)
= $6.70 per lb.

FOR CMAQ PROJECTS ONLY:
Once emissions reductions have been calculated, add them together (0+ 202 + 514 = 716) and convert emissions reductions to kg/day:
\(\text{lbs. per year} \div 2.2 \text{ lbs./kg} \times 365 \text{ days/year} = 716 \times 1 \text{ kg/day} \)
Operation of New Bus Service

Project definition: New, extended, and increased-frequency routes with cleaner vehicles provide new hours of bus service per year and serve additional people. These are fixed-route services implemented by transit agencies or school districts. Cleaner buses should be used in bus service expansions in order to achieve emission reductions from the project. For example, an urban transit bus with a diesel engine (4.0 g/bhp-hr NOx) needs to operate at capacity (40 bus riders) in order to offset the NOx emissions associated with the bus itself. Cleaner buses (i.e., 1.8 g/bhp-hr NOx + NMHC) will offset bus emissions with half as many bus riders.

How emissions are reduced: Emission reductions result from the decrease in emissions associated with auto trips replaced by the new bus service after adjusting for the added bus emissions and auto access to the transit stop.

Need to know:
Funding dollars
Number of operating days per year
Average daily ridership of new service (usually less than 100% occupancy)
Average length of auto trips replaced
Percent of riders who drive to the bus service
Annual VMT for the new bus service

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For the Bus Service</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Dollars (Funding)</td>
<td></td>
<td>dollars</td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (Life)</td>
<td>1</td>
<td>years</td>
<td>Years project is funded.</td>
</tr>
<tr>
<td>Days (D)</td>
<td>260</td>
<td>days (of operation)/year</td>
<td>Suggested defaults are weekday services - 260 days, daily services - 365 days, school bus services - 180 to 200 days</td>
</tr>
<tr>
<td>Ridership (R)</td>
<td></td>
<td>total trips (bus rider trips)/day</td>
<td>If 50 bus riders make a commute round trip each day, that's 100 bus rider trips per day. (50 bus riders x 2 trips)</td>
</tr>
<tr>
<td>Annual Bus VMT (Bus VMT)</td>
<td></td>
<td>annual miles traveled</td>
<td></td>
</tr>
<tr>
<td><strong>For Auto Travel Reduced</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustment (A) on Auto Trips for transit dependent</td>
<td>0.50</td>
<td></td>
<td>This default factor equals the portion of transit riders who reduce a vehicle trip. The default for commuter bus service is 0.83</td>
</tr>
</tbody>
</table>
### Inputs

<table>
<thead>
<tr>
<th>Name</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto Trip Length (L)</td>
<td>9</td>
<td>miles one direction/trip</td>
<td>Length of average auto trips reduced. Other suggested defaults are work trip bus services - 16 mi., school bus - 3 mi.</td>
</tr>
<tr>
<td><strong>For Auto Travel Added to Access Bus Service</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustment (AA) on Auto Trips for Auto Access to and from transit service</td>
<td>0.1*</td>
<td></td>
<td>This default factor equals the portion of riders who drive to the transit service. The default factor for long-distance commuter service is 0.8.</td>
</tr>
<tr>
<td>Trip Length (LL) for Auto Access to and from transit</td>
<td>2</td>
<td>miles one direction/trip</td>
<td>The default for long-distance bus service is 5 miles.</td>
</tr>
</tbody>
</table>

* The Auto Access default has been decreased from 0.25 to 0.1. Recent transit rider surveys conducted in Sacramento, Fresno, and Monterey indicate a lower auto access trip rate for regular transit routes.

### Emission Factor Inputs for Auto Travel

<table>
<thead>
<tr>
<th></th>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.481</td>
<td>grams/trip</td>
<td>0.392</td>
<td>grams/mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.645</td>
<td>&quot;</td>
<td>0.491</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.015</td>
<td>&quot;</td>
<td>0.218</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

For average auto emission factors, see Table 3. Use factors that correspond to the life of the project. Defaults are for a project life of 1-5 years.

### Emission Factor Inputs for Bus Travel

<table>
<thead>
<tr>
<th></th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>0.50</td>
<td>grams/mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>6.20</td>
<td>grams/mile</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.025</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

For typical diesel bus emission factors through model year 2002, see Table 1. For model years after 2002, use actual engine certification factors or, if not available, use Table 5. For buses meeting optional standards, or for alternative fueled buses, see Table 5. For commuter express diesel bus service, see Table 1 -- use appropriate year and “45 mph” column. (Defaults are for a CNG transit bus certified to the 1.8 g/bhp-hr NOx + NMHC standard.)
Formulas

Annual Auto Trips Reduced = \[(D) \cdot (R) \cdot (A) \cdot [1 - (AA)]\] trips/year

Annual Auto VMT Reduced = \[(D) \cdot (R) \cdot (A) \cdot [(L) - (AA) \cdot (LL)]\] miles/year

Annual Emission Reductions (ROG, NOx, and PM10) = \[
\frac{[(\text{Annual Auto Trips Reduced}) \cdot (\text{Auto Trip End Factor})
+ (\text{Annual Auto VMT Reduced}) \cdot (\text{Auto VMT Factor})
- (\text{Bus VMT}) \cdot (\text{Bus VMT factor})]}{454}\]

Capital Recovery Factor (CRF) = \[
\frac{(1 + i)^n \cdot i}{(1 + i)^n - 1}
\]

where: 
- \(i\) = discount rate (Assume 3 percent)
- \(n\) = project life

Cost-Effectiveness of Funding Dollars = \[
\frac{(\text{CRF} \cdot \text{Funding})}{(\text{ROG} + \text{NOx} + \text{PM10})}\] dollars/lb

Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is \[
\text{(lbs per year)}/[(2.2) \cdot (365)] = \text{kilograms/day}\]
**Operation of New Bus Service**

**Commuter Express CNG Bus Service**
An 80-mile subscription commute bus service operates using five, 40-passenger compressed natural gas (CNG) buses.

**Inputs to calculate cost-effectiveness:**
Funding Dollars (Funding): $180,000  
Effectiveness Period (Life): 2 years  
Days of use/year (D): 252  
Daily Ridership (R): 40 passengers * 5 buses * 2 ways = 200 * 2 = 400 bus riders or trips/day  
Annual Bus VMT (Bus VMT): 201,600 (5 buses * 80 miles one-way * 2 ways * 252 days = 201,600 VMT)  
Adjustment (A) on Auto Trips for transit dependent: 0.83  
Auto Trip Length (L): 80 miles in one direction  
Adjustment (AA) on Auto Trips for Auto Access to and from transit: 0.80  
Trip Length (LL) for Auto Access to and from transit: 5 miles one-way.

**Emissions Factors for Auto Travel (From Table 3):**

<table>
<thead>
<tr>
<th></th>
<th>Auto Trip End Factor</th>
<th>Auto VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.481 grams per trip</td>
<td>0.392 grams per mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.645 &quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor*</td>
<td>0.014 &quot;</td>
<td>0.218 &quot;</td>
</tr>
</tbody>
</table>

Note: 1-5 year emission factors are used since project life is 2 years, and "Commute" auto trip end factors are used since this project reduces commute trips.

**Emissions Factors for Clean Bus Travel**
(2004 natural gas buses certified to 1.8 g/bhp-hr standard NOx + NMHC. See Table 5.):

<table>
<thead>
<tr>
<th></th>
<th>Bus VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>0.50 grams per mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>6.20 &quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.025 &quot;</td>
</tr>
</tbody>
</table>

**Calculations:**
Annual Auto Trips Reduced = [(D)*(R)*(A)][1-(AA)]  
= [252 * 400 * 0.83][1-0.80]  
= 16,733 annual auto trips  
Annual Auto VMT Reduced = [(D)*(R)*(A)] * [(L) - (AA) * (LL)]  
= [252 * 400 * 0.83] * [80 - 0.80*5]  
= [83,664] * [80-4]  
= 6,358,464 annual miles
**Operation of New Bus Service, Continued . . .**  

**EXAMPLE**

Annual Emission Reductions = (lbs. per year)

\[
\text{Annual Emission Reductions} = \left(\text{Annual Auto Trips Reduced} \times \text{Auto Trip End Factor}\right) + \left(\text{Annual Auto VMT Reduced} \times \text{Auto VMT Factor}\right) - \left(\text{Bus VMT} \times \text{Bus VMT Factor}\right) / 454
\]

\[
\text{ROG: } \frac{(16,733 \times 1.481) + (6,358,464 \times 0.392) - (201,600 \times 0.50)}{454} = 5,323 \text{ lbs. per year}
\]

\[
\text{NOx: } \frac{(16,733 \times 0.645) + (6,358,464 \times 0.491) - (201,600 \times 6.20)}{454} = 4,147 \text{ lbs. per year}
\]

\[
\text{PM10: } \frac{(16,733 \times 0.014) + (6,358,464 \times 0.218) - (201,600 \times 0.025)}{454} = 3,043 \text{ lbs. per year}
\]

**Capital Recovery Factor (CRF) =**

\[
\text{CRF} = \frac{(1 + i)^n - 1}{(1 + i)^n} = 0.52 \quad n = \text{project life (2 years)}
\]

\[
i = \text{discount rate (3%)}
\]

**Cost-Effectiveness of Funding Dollars = (CRF * Funding) / (ROG + NOX + PM10)**

\[
\frac{(0.52 \times 180,000)}{(12,513)} = $7.48 \text{ per lb.}
\]

**FOR CMAQ PROJECTS ONLY:**

Once emissions reductions have been calculated, add them together (5,323 + 4,147 + 3,043 = 12,513) and convert emissions reductions to kg/day:

\[
\frac{\text{lbs. reduced per year}}{2.2 \text{ lbs./kg} \times 365 \text{ days/year}} = \frac{12,513}{2.2 \times 365} = 16 \text{ kg/day}
\]
Vanpools and Shuttles

**Project definition:** Projects are commuter vanpools; tourist or shopping shuttles; or rail feeders to work sites, homes, or schools. Services are operated by transit agencies, local governments, transportation management associations (TMAs), private businesses, etc. In most cases, the shuttle service must reduce long-distance auto trips or be a cleaner vehicle in order to reduce emissions cost effectively.

**How emissions are reduced:** Emission reductions result from the decrease in emissions associated with auto trips replaced by the vanpool or shuttle service after adjusting for the increase in emissions associated with the shuttle vehicle itself and auto access trips.

**Need to know:**
- Funding dollars
- Number of operating days per year
- Average daily ridership of new service (usually less than 100% occupancy)
- Average length of auto trips replaced
- Percent of riders who drive to the vanpool or shuttle service
- Daily VMT for the new shuttle service

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>For the Vanpool/Shuttle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Dollars (Funding)</td>
<td>dollars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (Life)</td>
<td>1</td>
<td>years</td>
<td>Years project is funded.</td>
</tr>
<tr>
<td>Days (D)</td>
<td>250</td>
<td>days (of operation)/year</td>
<td>Suggested defaults are weekday vanpools - 250 days, weekday shuttles - 260, daily services - 365 days, school services - 180 to 200 days</td>
</tr>
<tr>
<td>Ridership (R)</td>
<td>total trips (riders)/day</td>
<td></td>
<td>One-way trips by riders (or number of boardings) per day</td>
</tr>
<tr>
<td>Annual Van/Shuttle VMT (Van VMT)</td>
<td>annual miles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For Auto Travel Reduced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustment (A) on Auto Trips</td>
<td>0.83</td>
<td></td>
<td>This factor equals the portion of riders who did NOT previously use transit, vanpools, or carpools. The default (0.83) is the adjustment for long-distance, commuter vanpool service. For new rail feeders, use 0.3 for the adjustment factor A.</td>
</tr>
<tr>
<td>Auto Trip Length (L)</td>
<td>35</td>
<td>miles one direction/trip</td>
<td>Suggested defaults are vanpools - 35 mi., shuttle trips - 16 mi.</td>
</tr>
</tbody>
</table>
### Inputs

<table>
<thead>
<tr>
<th>For Auto Travel Added to Access Vanpool/Shuttle</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment (AA) for Auto Access to and from vanpool/shuttle</td>
<td>0.75</td>
<td></td>
<td>Enter the percentage of riders who drive to the vanpool/shuttle service. The default (0.75) is for long-distance vanpools. For rail feeders, use 0.5.</td>
</tr>
<tr>
<td>Trip Length (LL) for Auto Access to and from vanpool/shuttle</td>
<td>5</td>
<td>miles one direction/trip</td>
<td>The default (5 mi) is for long-distance van pools. For rail feeders, use 2 mi.</td>
</tr>
</tbody>
</table>

### Emission Factor Inputs for Auto Travel

<table>
<thead>
<tr>
<th></th>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Auto Trip End Factor</td>
<td>Auto VMT Factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROG Factor</td>
<td>1.719</td>
<td>grams/trip</td>
<td>0.470</td>
<td>grams/mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.721</td>
<td>&quot;</td>
<td>0.602</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.014</td>
<td>&quot;</td>
<td>0.218</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

For auto emission factors, see Emission Factors Menu, Tables 3 and 3A. For projects with a 1-year life, use Table 3A. For projects with a life of 2-20 years, use Table 3. Defaults are for a 1-year project (2004), Table 3A.

### Emission Factor Inputs for Van/Shuttle Travel

<table>
<thead>
<tr>
<th></th>
<th>Example</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Van VMT Factor</td>
<td></td>
</tr>
<tr>
<td>ROG Factor</td>
<td>0.14</td>
<td>grams/mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.20</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.27</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

To select emission factors for van / shuttle travel:
- For model years 1995-2003, refer to Table 7, "Medium-Duty Emission Factors for Vanpools/Shuttles".
- For model years 2004+, refer to Table 2, “Cleaner Vehicle Emission Factors”. Example is for a medium-duty van (weight 8,501 - 10,000 lbs), certified as an ultra-low-emission vehicle (ULEV), model year 2004.
Formulas

Annual Auto Trip Reduced = [(D) * (R) * (A)]*[1-(AA)]  trips/year

Annual Auto VMT Reduced = [(D) * (R) * (A)]*[[(L) - (AA)*(LL)]  miles/year

Annual Emission Reductions (ROG, NOx, and PM10) =[(Annual Auto Trips Reduced)*(Auto Trip End Factor) + (Annual Auto VMT Reduced)*(Auto VMT Factor) - (Van VMT)*(Van VMT Factor)]/454  lbs/year

Capital Recovery Factor (CRF) = \((1 + i)^n (i) \over (1 + i)^n – 1\)

where:  
  \(i\) = discount rate (Assume 3 percent)  
  \(n\) = project life

Cost-Effectiveness of Funding Dollars = (CRF * Funding) / (ROG + NOx + PM10) dollars/lb

Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is
\((lbs\ per\ year) / [(2.2)* (365)] = kilograms/day\)

Suburban Vanpool/Carpool Park-and-Ride Lots (Method Variation)

Provision of park-and-ride lots may encourage the formation of vanpools and carpools. The emission reduction benefits from park-and-ride lots can be calculated using the above Vanpools and Shuttles methodology plus the following calculation to estimate Ridership (R).

Ridership (R) = (Parking)*(Lot Utilization)*(2 commute trips/day)

Where:
Parking is the number of parking spaces for a new parking lot or the number of added spaces to an existing lot. Lot Utilization is the estimated lot utilization rate from monitored data OR use 0.75 as a default. Also, when using the vanpool/shuttle methodology for park-and-ride lots, the default for Adjustment (AA) for Auto Access to and from vanpool/shuttle should be 0.9 instead of 0.5.
Vanpools and Shuttles

**EXAMPLE**

**Long-Distance Commuter Vanpools**
This project subsidizes 10 long-distance commute vanpools. On average, each vanpool carries 11 people to work. The average distance to work is 48 miles. The vans used are 2004 model year ULEVs, 8501-10,000 lbs.

**Inputs to calculate cost-effectiveness:**
- Funding Dollars (Funding): $33,000
- Effectiveness Period (Life): 1 year
- Days of use/year (D): 250
- Daily Ridership (R): 11 passengers * 10 vans * 2 ways = 220 riders or trips/day
- Annual Van VMT (Van VMT): 240,000 (If you don’t know the van mileage, you can estimate it: 10 vans * 2 ways * 250 days * 48 miles one-way = 240,000)
- Adjustment (A) on Auto Trips: 0.83
- Auto Trip Length (L): 48 miles in one direction
- Adjustment (AA) on Auto Trips for Auto Access to and from vanpool: 0.75
- Trip Length (LL) for Auto Access to and from vanpool: 5 miles one-way

**Emissions Factors for Auto Travel (From Table 3):**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Auto Trip End Factor</th>
<th>Auto VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.719 grams per trip</td>
<td>0.470 grams per mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.721</td>
<td>0.602</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.014</td>
<td>0.218</td>
</tr>
</tbody>
</table>

Note: Used 1-year (2004) emission factors from Table 3A since project life is 1 year, and "Commute" auto trip end factors are used since this project reduces commute trips.

**Emissions Factors for Van Travel (From Table 2, ULEV, 8501-10,000 lbs.):**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Van VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>0.14 grams per mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.20</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.27</td>
</tr>
</tbody>
</table>

**Calculations:**

Annual Auto Trips Reduced = \([(D)*(R)*(A))\]*[1-(AA)]
=\([250 * 220 * 0.83]*[1-0.75]\)
=11,413 annual auto trips reduced

Annual Auto VMT Reduced = \([(D)*((R)*(A))\] *[ (L) - (AA) * (LL)]
=\([250 * 220 * 0.83] *[48-0.75*5]\)
=[45,650] *[48-3.75] 
=2,020,013 annual auto VMT reduced
Vanpools and Shuttles, Continued...

**EXAMPLE**

Annual Emission Reductions = (lbs. per year)

\[\text{[(Annual Auto Trips Reduced) * (Auto Trip End Factor)}
\]

\[\quad + (\text{Annual Auto VMT Reduced) * (Auto VMT Factor)}}
\]

\[- (\text{Van VMT)*(Van VMT factor)})]/454\]

ROG: \[((11,413 * 1.719) + (2,020,013 * 0.470) - (240,000 * 0.14))/454 = 2,060 lbs. per year reduced\]

NOx: \[((11,413 * 0.721) + (2,020,013 * 0.602) - (240,000 * 0.20))/454 = 2,591 lbs. per year reduced\]

PM10: \[((11,413 * 0.014) + (2,020,013 * 0.218) - (240,000 * 0.27))/454 = 828 lbs. per year reduced\]

Capital Recovery Factor (CRF) = \((1 + i)^n - 1\)

(From Table 8)

\[\text{where n = project life (1 year) \quad and i = discount rate (3\%)}\]

Cost-Effectiveness of Funding Dollars = \((\text{CRF * Funding}) / (\text{ROG + NOx + PM10})\)

\[= (1.03 * 33,000) / (5,479) = 6.20 \text{ per lb.}\]

FOR CMAQ PROJECTS ONLY:

Once emissions reductions have been calculated, add them together

\(2,060 + 2,591 + 828 = 5,479\) and convert emissions reductions to kg/day:

\[\frac{\text{lbs. reduced per year}}{2.2 \text{ lbs./kg} \times 365 \text{ days/year}} = \frac{5,479}{2.2 \times 365} = 7 \text{ kg/day}\]
Signal Coordination

**Project definition:** Improvements to signal timing that reduce overall vehicle stops and delays and that give transit vehicles priority. These include traffic signal synchronization, interconnection, improved timing projects, and transit signal priority projects. (Signal timing and other actions that increase traffic speeds and flows to the detriment of overall traffic performance or that offer a significant inducement to travel by auto are not air quality beneficial. Speeds higher than 36 mph begin to increase NOx emissions and may also discourage walking and bicycling. These results may be counterproductive to meeting clean air goals.)

**How emissions are reduced:** Emission reductions in reactive organic gases (ROG) and nitrogen oxides (NOx) are associated with increasing average traffic speeds to up to 36 mph. (NOx emissions start increasing when average speeds are over 36 mph.)

Travel growth degrades project performance over time. Traffic flow improvements that occur immediately after implementation of the project decline to no improvement by the end of the effectiveness period. As a result, the methodology averages speed improvements over the effectiveness period by taking one-half of the first day benefits.

**Need to know:**
Funding dollars
Number of operating days per year
Traffic volumes for the congested periods of the day
Length of the roadway segment impacted by the project
Before and after average traffic speeds

The following information may need to be entered separately for each road segment and congested period (i.e. AM peak and PM peak) affected by the project. Vehicle speeds should correspond to the specified traffic volume. If the project includes multiple connected segments entered as one project, traffic volume should be the average volume of the segments, not the aggregate volume.

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Dollars (<strong>Funding</strong>)</td>
<td>dollars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (<strong>Life</strong>)</td>
<td>5</td>
<td>years</td>
<td></td>
</tr>
<tr>
<td>Days (<strong>D</strong>)</td>
<td>250</td>
<td>operating days per year</td>
<td>Default equals weekdays.</td>
</tr>
<tr>
<td>Length (<strong>L</strong>) of congested roadway segment</td>
<td></td>
<td>miles</td>
<td>Length of roadway that is impacted by the project.</td>
</tr>
<tr>
<td>Traffic Volume during congested period (<strong>Congested Traffic</strong>)</td>
<td></td>
<td>trips per day</td>
<td>Traffic volumes during congested period.</td>
</tr>
</tbody>
</table>
Emission Factor Inputs

<table>
<thead>
<tr>
<th></th>
<th>Example (20 mph)</th>
<th>Units</th>
<th>Example (24 mph)</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Speed Factor</td>
<td></td>
<td>After Speed Factor</td>
<td></td>
</tr>
<tr>
<td>ROG Factor</td>
<td>0.37  grams/mile</td>
<td></td>
<td>0.31 grams/mile</td>
<td></td>
</tr>
<tr>
<td>NOx Factor</td>
<td>1.15</td>
<td>&quot;</td>
<td>1.09</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.04</td>
<td>&quot;</td>
<td>0.04</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

Emission Factors are dependent on the before-project and after-project average traffic speeds. To select emission factors for various speeds, refer to Table 4 at the end of the document. The factors above are for before-project speed 20 mph and after-project speed 24 mph for a 1-5 year project.

Use measured “before” and “after” average speeds. If speeds are unknown, average traffic speed can be estimated using the segment length (L) and a travel time (T) for vehicles passing through the segment. (Speed = L/T).

Formulas

Annual Project VMT (VMT) = (D) * (L) * (Congested Traffic) miles/year

Annual Emission Reductions (ROG, NOx, and PM10) = 0.5 * [(VMT)*(Before Speed Factor - After Speed Factor)]/454 lbs/year

Note: Initial speed improvements decline to zero improvement by the end of the effectiveness period. In order to account for this, the emission reduction equation reduces initial emission reduction benefits by one half.

Capital Recovery Factor (CRF) = \( \frac{(1 + i)^n (i)}{(1 + i)^n - 1} \)

where: 
- \( i \) = discount rate (Assume 3 percent)
- \( n \) = project life

Cost-Effectiveness of Funding Dollars = (CRF * Funding) / (ROG + NOx + PM10) dollars/lb

Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is

\( \frac{(lbs \ per \ year)}{(2.2) \times (365)} \) = kilograms/day
Traffic Signal Coordination
The City’s master traffic signal controller was replaced with a new controller with expanded capacity, allowing 15 more intersections to be coordinated.

Inputs to Calculate Cost-Effectiveness:
- Funding Dollars (Funding): $50,000
- Effectiveness Period (Life): 5 years
- Days of use/year (D): 250
- Length of congested roadway segment (L): 2.50 miles
- Traffic Volume during congested period (Congested Traffic): 38,400 trips per day
- Before Speed: 28 mph
- After Speed: 33 mph

Emissions Factor Inputs (From Table 4):

<table>
<thead>
<tr>
<th>Emissions Type</th>
<th>Before Speed Factor</th>
<th>After Speed Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>0.26 grams per mile</td>
<td>0.22 grams per mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>1.04 &quot;</td>
<td>1.01 &quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.03 &quot;</td>
<td>0.03 &quot;</td>
</tr>
</tbody>
</table>

Calculations:
Annual Project VMT (VMT) = (D) * (L) * (Congested Traffic)
= 250 * 2.50 * 38,400 = 24,000,000 annual miles

Annual Emission Reductions (ROG, NOx, and PM10) in lbs. per year
= [(0.50)*(VMT)* (Before Speed Factor - After Speed Factor)]/454 grams per lb.
ROG: [(0.50 * 24,000,000) * (0.26 - 0.22)]/454 = 1,057 lbs. per year
NOx: [(0.50 * 24,000,000) * (1.04 - 1.01)]/454 = 793 lbs. per year
PM10: [(0.50 * 24,000,000) * (0.03 - 0.03)]/454 = 0 lbs. per year

Capital Recovery Factor (CRF) = \( \frac{1 + i}{(1 + i)^n - 1} \) = .22 where \( n \) = project life (5 years)
and \( i \) = discount rate (3%) (From Table 8)

Cost-Effectiveness
of Funding Dollars = (CRF * Funding)/(ROG + NOx + PM10 ) = [.22 * 80,000] / 1,850
= $9.51 per lb.

FOR CMAQ PROJECTS ONLY:
Once emissions reductions have been calculated, add them together (1,057 + 793) and convert emissions reductions to kg/day: lbs. reduced per year = 1,850 = 2 kg/day
2.2 lbs./kg * 365 days/year = 2.2 * 365
Bicycle Facilities

Project definition: Bicycle paths (Class 1) or bicycle lanes (Class 2) that are targeted to reduce commute and other non-recreational auto travel. Class 1 facilities are paths that are physically separated from motor vehicle traffic. Class 2 facilities are striped bicycle lanes giving preferential or exclusive use to bicycles. Bike lanes should meet Caltrans' full-width standard depending on street facility type.

How emissions are reduced: Emission reductions result from the decrease in emissions associated with auto trips replaced by bicycle trips for commute or other non-recreational purposes.

Need to know:

Funding dollars
Number of operating days per year
Average length of bicycle trips
Average daily traffic volume on roadway parallel to bicycle project
City population
Project class (1 or 2)
Types of activity centers in the vicinity of the bicycle project
Length of bicycle path or lane

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Dollars (Funding)</td>
<td></td>
<td>Dollars</td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (Life)</td>
<td>15</td>
<td>Years</td>
<td>Class 1 projects - 20 years Class 2 projects - 15 years</td>
</tr>
<tr>
<td>Days (D)</td>
<td>200</td>
<td>Days of use/year</td>
<td>Consider local climate in number of days used.</td>
</tr>
<tr>
<td>Average Length (L) of bicycle trips</td>
<td>1.8</td>
<td>Miles per trip in one direction</td>
<td>Default is based on the National Personal Transportation Survey</td>
</tr>
<tr>
<td>Annual Average Daily Traffic (ADT)</td>
<td></td>
<td>Trips per day</td>
<td>Two-direction traffic volumes on roadway parallel to bike project. MAXIMUM IS 30,000.</td>
</tr>
<tr>
<td>Adjustment (A) on ADT for auto trips replaced by bike trips from the bike facility.</td>
<td>.0020</td>
<td></td>
<td>See Adjustment Factors table on the next page. Adjustments are based on facility class, ADT, project length, and community characteristics.</td>
</tr>
<tr>
<td>Credit (C) for Activity Centers near the project.</td>
<td>.0005</td>
<td></td>
<td>See Activity Centers table on the next page.</td>
</tr>
</tbody>
</table>
When evaluating the impact of a new bike project, it is important to consider the location of the bike facility. What types of destinations are accessible from the project? How many of these activity centers are within one-half mile of the facility? How many are within a quarter of a mile? Examine the activity centers in the vicinity of the project and compare them to the list below. Select the credit factor that corresponds to the number of activity centers in the surrounding area.

### Activity Centers Credits

**Types of Activity Centers:** Bank, church, hospital or HMO, light rail station (park & ride), office park, post office, public library, shopping area or grocery store, university or junior college.

<table>
<thead>
<tr>
<th>Count your activity centers.</th>
<th>Credit (C) Within 1/2 mile</th>
<th>Credit (C) Within 1/4 mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three (3)</td>
<td>.0005</td>
<td>.001</td>
</tr>
<tr>
<td>More than 3 but less than 7</td>
<td>.001</td>
<td>.002</td>
</tr>
<tr>
<td>7 or more</td>
<td>.0015</td>
<td>.003</td>
</tr>
</tbody>
</table>

### Emission Factor Inputs for Auto Travel

<table>
<thead>
<tr>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.020 grams/trip</td>
<td>0.266 grams/mile</td>
<td></td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.458 &quot;</td>
<td>0.319 &quot;</td>
<td></td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.016 &quot;</td>
<td>0.219 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

For average auto emission factors, see Table 3. Use factors that correspond to the life of the project: 11-15 year factors for Class 2 facilities and 16-20 year factors for Class 1 facilities. Defaults are for a project life of 15 years.
Formulas

Annual Auto Trip Reduced = (D) * (ADT) * (A + C) trips/year

Annual Auto VMT Reduced = (Auto Trips) * (L) miles/year

Annual Emission Reductions (ROG, NOx, and PM10) = lbs./year

\[
\frac{[(\text{Annual Auto Trips Reduced})\times(\text{Auto Trip End Factor})
\quad + \quad (\text{Annual Auto VMT Reduced})\times(\text{Auto VMT Factor})]}{454}
\]

Capital Recovery Factor (CRF) = \( \frac{(1 + i)^n (i)}{(1 + i)^n - 1} \)

where: 
\( i \) = discount rate (Assume 3 percent)
\( n \) = project life

Cost-Effectiveness of Funding Dollars = (CRF * Funding) / (ROG + NOx + PM10) dollars/lb.

Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is

\[(\text{lbs. per year}) / [(2.2)* (365)] \quad = \text{kilograms/day}\]

Documentation: Adjustment factors were derived from a limited set of bicycle commute mode split data for cities and university towns in the southern and western United States (Source: FHWA National Bicycling And Walking Study, 1992). This data was then averaged and multiplied by 0.7 to estimate potential auto travel diverted to bikes. On average, about 70% of all person trips are taken by auto driving (Source: 2000-01 Statewide Travel Survey), and it is these trips that can be considered as possible auto trips reduced. Finally, this number was multiplied by 0.65 to estimate the growth in bicycle trips from construction of the bike facility. Sixty-five percent represents the average growth in bike trips from a new bike facility as observed in before and after data for bike projects in U.S. DOT’s “A Compendium of Available Bicycle and Pedestrian Trip Generation Data in the United States.” Benefits are scaled to reflect differences in project structure, length, traffic intensity, community size, and proximity of activity centers. The scale has been adapted from a method developed by Dave Burch of the Bay Area Air Quality Management District (BAAQMD).

Note 1: Because ADT represents vehicles passing a single point, it may neglect vehicles that travel only a short distance on the corridor and, as a result, underestimate total vehicle trips. Therefore, the number of vehicles diverted to bicycles may be underestimated in this method. If actual vehicle trips in the corridor are known, this number should be used in place of ADT.

Note 2: Bicycle usage data is limited. From the data currently available, a positive correlation has been observed between the percentage of an area’s arterials that have full width bike lanes, and the percentage of commuters who bike to work. Simply put, more bike lanes are associated with more bike commuting. More specifically, for an area with a given ratio of bike lanes to arterials, we observe that roughly one-fourth of that ratio is equal to the percentage of commuters that bike to work. More research and data are needed to confirm this relationship and to clarify the causes of this positive correlation.
Bicycle Facilities

Class 2 Bikeway Facility
The new Class 2 bike lanes are a critical link in the city bike system, allowing residents bicycle access to education, employment, shopping, and transit. Within one-quarter mile of the project, there is a college, a shopping center, a light rail station, and an office building. The project includes installation of new pavement, signage, and Class 2 bike lane striping along both sides of 1.13 miles of arterials. This is primarily a college town, with a population of 128,000.

Inputs to Calculate Cost-Effectiveness:
Funding Dollars (Funding): $40,000
Effectiveness Period (Life): 15 years
Days (D): 200
Average Length (L) of bicycle trips: 1.8 miles
Annual Average Daily Traffic (ADT): 20,000
Adjustment (A) on ADT for auto trips replaced by bike trips from the bike facility: 0.0109
Credit (C) for Activity Centers near the project: 0.002

Emissions Factors (From Table 3, for a 15-year Life):

<table>
<thead>
<tr>
<th>Emissions Factor</th>
<th>Auto Trip End Factor</th>
<th>Auto VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.020 grams/trip</td>
<td>0.266 grams/mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.458</td>
<td>0.319</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.016</td>
<td>0.219</td>
</tr>
</tbody>
</table>

Calculations:
Annual Auto Trip Reduced = (D) * (ADT) * (A + C)
= (200) * (20,000) * (0.0109 + 0.002)
= 51,600

Annual Auto VMT Reduced = (Auto Trips) * (L)
= (51,600) * (1.8)
= 92,880

Annual Emission Reductions (ROG, NOx and PM10) in lbs. per year
= [(Annual Auto Trips Reduced) * (Auto Trips End Factor) + (Annual Auto VMT Reduced) * (Auto VMT Factor)] / 454

ROG: 
=(51,600 * 1.020) + (92,880 * 0.266))/454 = 170 lbs. per year

NOx: 
=(51,600 * 0.458) + (92,880 * 0.319))/454 = 117 lbs. per year

PM10: 
=(51,600 * 0.016) + (92,880 * 0.219))/454 = 47 lbs. per year
EXAMPLE

Capital Recovery Factor (CRF): \( (1 + i)^n = 0.08 \)
\[ \text{(From Table 8)} \] \( (1 + i)^n - 1 \) \( \text{Where } n = \text{project life (15 years)} \)
\( i = \text{discount rate (3%)} \)

Cost-Effectiveness of Funding Dollars: \( \frac{(CRF \times \text{Funding})}{(ROG + NOx + PM10)} \)
\[ = \frac{[0.08 \times 40,000]}{334} \]
\[ = \$9.58 \text{ per lb.} \]

FOR CMAQ PROJECTS ONLY:

Once emissions reductions have been calculated, add them together \( (170 + 117 + 47 = 334) \) and convert lbs. of emissions reductions per year to kg/day:

\[ \frac{\text{lbs. reduced per year}}{2.2 \text{ lbs./kg} \times 365 \text{ days/year}} = \frac{334}{2.2 \times 365} = 1 \text{ kg/day} \]
Telecommunications

**Project definition:** Programs and equipment that enable teleconferencing, or telecommuting from home or a neighborhood center.

**How emissions are reduced:** Emissions are reduced when auto trips are replaced with (1) home-based telecommuting, (2) teleconferencing, or (3) shorter auto trips to a neighborhood telecommuting center.

**Need to know:**
- Funding dollars
- Work weeks per year
- Weekly one-way auto trips eliminated (i.e., home-work trips or work-meeting trips)
- Average length of auto trips eliminated (i.e., distance from home to work or from work to meeting)
- Weekly one-way auto trips to telesite
- Average length of auto trips to telesite

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Dollars <em>(Funding)</em></td>
<td></td>
<td>dollars</td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period <em>(Life)</em></td>
<td>5</td>
<td>years</td>
<td>If no equipment was purchased, enter the number of years funding is available.</td>
</tr>
</tbody>
</table>

**Inputs for Trips Eliminated**

<p>| Auto Trips <em>(T)</em> eliminated               |         | trips one-way/week | Examples: (1) For home-based telecommute projects--the number of auto trips eliminated to and from the workplace per week. (2) For teleconferencing projects--the number of auto trips eliminated to and from the meeting site during an average week. (3) For telecommute center--the number of auto trips that had been made to the worksite before using the telecenter. |</p>
<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (L) of Auto Trips eliminated</td>
<td>16</td>
<td>miles one direction/trip</td>
<td>Examples: (1) For telecommuting--average distance from home to work (default is 16 miles), (2) For teleconferencing--average distance from work to meeting site. (3) For telecenter--average distance from home to worksite before using telecenter</td>
</tr>
<tr>
<td>Weeks (W)</td>
<td>50</td>
<td>weeks (of operation)/year</td>
<td>Examples: (1) Home-based telecommute --50 weeks, (2) Teleconferencing--52 weeks. (3) Telecenter--50 weeks.</td>
</tr>
<tr>
<td><strong>Inputs for Trips Added</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Auto Trips (New T)</td>
<td></td>
<td>trips one-way/week</td>
<td>Examples: (1) For home-based telecommuting, enter 0. (2) For teleconference, enter number of auto trips to and from the teleconference site. (3) For telecenter, enter the number of auto trips to and from the telecenter for a week.</td>
</tr>
<tr>
<td>New Auto Trip Length (New L)</td>
<td></td>
<td>miles one direction/trip</td>
<td>Examples: (1) For home-based telecommuting, enter 0. (2) For teleconference--average distance from home to center. (3) For telecenter--average distance from work to teleconference center.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Emission Factor Inputs for Auto Travel</th>
<th>Default</th>
<th>Units</th>
<th>Default</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Auto Trip End Factor</td>
<td>grams/trip</td>
<td>0.392</td>
<td>grams/mile</td>
</tr>
<tr>
<td>ROG Factor</td>
<td>1.481</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.645</td>
<td>&quot;</td>
<td>0.491</td>
<td>&quot;</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.015</td>
<td>&quot;</td>
<td>0.218</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

For auto emission factors, see Emission Factors Menu, Tables 3 and 3A. For projects with a 1-year life, use Table 3A. For projects with a life of 2-20 years, use Table 3. Defaults are for a project life of 5 years, using the "1-5 Years" column of Table 3.
Formulas

Annual Auto Trips Reduced = \(W \times [(T) - (New\ T)]\) 

Annual Auto VMT Reduced = \(W \times [(T)\times(L) - (New\ T)\times(New\ L)]\) 

Annual Emission Reductions (ROG, NOx, and PM10) = 
\[
\frac{[(Annual\ Auto\ Trips\ Reduced)\times(Auto\ Trip\ End\ Factor) + (Annual\ Auto\ VMT\ Reduced)\times(Auto\ VMT\ Factor)]}{454}
\]

Capital Recovery Factor (CRF) = \(\frac{(1 + i)^n \times (i)}{(1 + i)^n - 1}\)

where:  
\(i\) = discount rate (Assume 3 percent)  
\(n\) = project life

Cost-Effectiveness of Funding Dollars = (CRF * Funding) / (ROG + NOx + PM10) 

Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is 
\(\frac{(lbs\ per\ year) \times (2.2) \times (365)}{lbs\ per\ year} = kilograms/day\)

(Note: If the project includes both home-based telecommuting as well as teleconferencing or telecenters, then the formula should be run separately for each aspect of the project.)
Telecommunications

EXAMPLE

County Probation Videophone Project
A videophone-interviewing project is implemented by the County Probation Department. Videophone equipment is installed for $33,000 at the branch probation offices and two detention centers. Videophone interviewing of 5,000 inmates per year saves 200 one-way trips per week to and from detention centers (a distance of 29 miles on average).

Inputs to calculate cost-effectiveness:
- Funding Dollars (Funding): $33,000
- Effectiveness Period (Life): 5 years
- One-Way Auto Trips Eliminated Per Week (T): 200
- Length (L) of Auto Trips Eliminated: 29 miles one-way
- Weeks (W) = 50 weeks
- New Auto Trips (New T): 0
- New Auto Trip Length (New L): not applicable

Emissions Factors for Auto Travel (From Table 3):

<table>
<thead>
<tr>
<th>Auto Trip End Factor</th>
<th>Auto VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.481 grams per trip</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.645</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.015</td>
</tr>
</tbody>
</table>

Note: 1-5 year emission factors are used since project life is 5 years, and "Commute" auto trip end factors are used since this project reduces commute trips.

Calculations:
Annual Auto Trips Reduced = (W)*[(T) - (New T)]
= 50 * (200-0) = 10,000
Annual Auto VMT Reduced = (W)*[(T)*(L) - (New T)*(New L)]
= (50)*[(200)*(29) - 0] = 290,000

Annual Emission Reductions (ROG, NOx, and PM10)
= [[(Annual Auto Trips Reduced) * (Auto Trip End Factor)]
+ (Annual Auto VMT Reduced) * (Auto VMT Factor)]/454

ROG: [(10,000 * 1.481) + (290,000 * 0.392)]/454 = 283 lbs. per year
NOx: [(10,000 * 0.645) + (290,000 * 0.491)]/454 = 328 lbs. per year
PM10: [(10,000 * 0.015) + (290,000 * 0.219)]/454 = 140 lbs. per year
EXAMPLE

Capital Recovery Factor (CRF) = \( (1 + i)^n \)  = 0.22
(From Table 8) \( (1 + i)^n - 1 \)
where \( n \) = project life (5 years)
and \( i \) = discount rate (3%)

Cost-Effectiveness of Funding Dollars = \( \frac{\text{CRF} \times \text{Funding}}{\text{ROG} + \text{NOx} + \text{PM10}} \)
\[ = \frac{(0.22 \times 33,000)}{750} = \$ 9.68 \text{ per lb.} \]

FOR CMAQ PROJECTS ONLY:
Once emissions reductions have been calculated, add them together (283 + 328 + 140 = 750)
and convert emissions reductions to kg/day:

\[
\text{lbs. reduced per year} = \frac{750}{2.2 \text{ lbs/kg} \times 365 \text{ days/year}} = 1 \text{ kg/day}
\]
Ridesharing and Pedestrian Facilities

**Project definition:** Ridesharing programs replace drive-alone auto trips by encouraging carpooling and other less polluting modes of travel. Pedestrian facilities replace auto trips by providing or improving pedestrian access. An example is a pedestrian passageway over several lanes of heavy traffic providing safe walking access to adjacent activity centers.

**How emissions are reduced:** Ridesharing reduces emissions when drive-alone auto trips are replaced with less polluting modes of travel. Pedestrian facilities reduce emissions when auto trips are replaced by walking.

**Need to know:**
- Funding dollars
- Work weeks or operating weeks per year
- Weekly one-way auto trips eliminated
- Average length of auto trips eliminated

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Default</th>
<th>Units</th>
<th>Text Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Dollars (<strong>Funding</strong>)</td>
<td></td>
<td>dollars</td>
<td></td>
</tr>
<tr>
<td>Effectiveness Period (<strong>Life</strong>)</td>
<td>1</td>
<td>year</td>
<td>Ridesharing: Enter 1 year. Pedestrian: Enter 20 years.</td>
</tr>
<tr>
<td><strong>Inputs for Trips Eliminated</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto Trips (<strong>T</strong>) eliminated</td>
<td></td>
<td>trips one-way/week</td>
<td>The number of auto trips eliminated per week to and from workplace (for ridesharing) or to and from activity center (for pedestrian projects).</td>
</tr>
<tr>
<td>Length (<strong>L</strong>) of Auto Trips eliminated</td>
<td>16</td>
<td>miles one direction/trip</td>
<td>Default (16 mi.) is for ridesharing projects and equals the average distance from home to work. Pedestrian projects should use the average distance of auto trip to adjacent activity center -- one mile is suggested. This is the average distance of pedestrian trips.</td>
</tr>
<tr>
<td>Weeks (<strong>W</strong>)</td>
<td>52</td>
<td>weeks (of operation)/year</td>
<td>If trips eliminated (<strong>T</strong>) is based on employee numbers that exclude workers on sick leave, vacations, etc. then (<strong>W</strong>) equals 52. Otherwise (<strong>W</strong>) typically equals 50.</td>
</tr>
</tbody>
</table>
### Inputs for Trips Added

<table>
<thead>
<tr>
<th>Inputs for Trips Added</th>
<th>Default</th>
<th>Units</th>
<th>Text Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustment (A) for Auto Access Trips to transit, vanpools, and carpools</td>
<td>0.7</td>
<td></td>
<td>Adjustment (A) equals the portion of employees who do NOT drive to transit, vanpools, or carpools. Default 0.7 equals the adjustment (A) for areas with average transit use. Use 0.6 for high transit use (i.e., commute transit mode split &gt;10%). Use 1.0 if Method 2 was used to determine Auto Trips (T) eliminated. Use 1.0 for pedestrian projects.</td>
</tr>
</tbody>
</table>

### Emission Factor Inputs for Auto Travel

<table>
<thead>
<tr>
<th></th>
<th>Auto Trip End Factor</th>
<th>Auto VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.719 grams/trip</td>
<td>0.470 grams/mile</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.721</td>
<td>0.602</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.014</td>
<td>0.218</td>
</tr>
</tbody>
</table>

For auto emission factors, see Emission Factors Menu, Tables 3 and 3A. For projects with a 1-year life, use Table 3A. For projects with a life of 2-20 years, use Table 3. Defaults are for 1-year project life (2002) from Table 3A.

### Formulas

- **Annual Auto Trips Reduced** = \( W \times T \times A \) trips/year
- **Annual Auto VMT Reduced** = \( W \times T \times L \) miles/year
- **Annual Emission Reductions (ROG, NOx, and PM10)** = \[ (\text{Annual Auto Trips Reduced}) \times \text{(Auto Trip End Factor)} + (\text{Annual Auto VMT Reduced}) \times \text{(Auto VMT Factor)} \] / 454 lbs/year
- **Capital Recovery Factor (CRF)** = \[ \frac{(1 + i)^n}{(1 + i)^n - 1} \]
  - where:  
    - \( i \) = discount rate (Assume 3 percent)
    - \( n \) = project life
- **Cost-Effectiveness of Funding Dollars** = \( \frac{(\text{CRF} \times \text{Funding})}{(\text{ROG} + \text{NOx} + \text{PM10})} \) dollars/lb

*Note: The Federal Highway Administration requests that emission reductions from CMAQ projects be reported as kilograms/day. The conversion is*  
\[ \frac{\text{lbs per year}}{[(2.2) \times (365)]} = \text{kilograms/day} \]
This method can also be adapted to evaluate Transportation Management Organizations (TMOs) if the number of auto trips eliminated by the program is known.

**Ridesharing**  
*(Optional Method 1)*

For *ridesharing programs* where the average number of daily peak-period employees and Average Vehicle Ridership (AVR) are known, you can use the following formula to find Auto Trips Eliminated (T). Auto Trips Eliminated (T) is needed in the above formulas to calculate Annual Auto Trips Reduced and Annual Auto VMT Reduced.

\[
T \text{ trips/week} = 2 \text{ trips/day} \times 5 \text{ days/week} \times \text{Peak-Period Employees} \times \left[ \frac{1}{\text{Baseline AVR}} - \frac{1}{\text{New AVR}} \right]
\]

**Notes:**  
(1) The New AVR is the AVR for the current year. The Baseline AVR occurred before the ridesharing program was implemented. (2) The number of days/week should be adjusted to the appropriate operating schedule for the company or agency. (3) Sometimes the number of employees in the work force changes over time. In these situations, use the most current number of employees in the formula. (4) The formula is based on the assumption that AVR will revert back to the baseline without an ongoing ridesharing program. Therefore, the benefits of the program include trip reductions from previous years that are maintained, as well as additional new trip reductions. (5) If you want to evaluate a ridesharing program over several years, you should determine trips eliminated (T) separately for each year of the analysis period and use the average for (T). To do this, you need to know the AVR for each year.

**Ridesharing**  
*(Optional Method 2)*

For *ridesharing programs* where a week-long commute travel survey is used, you can use the worksheets provided on the following pages to determine Annual Auto Trips Reduced and Annual Auto VMT Reduced.

- Calculate (A) number of commute employees, (B) weekly trips, and (C) weekly VMT by plugging your commute travel survey data into the "Weekly Trips and VMT Worksheet" on the next page.

- Calculate Annual Auto Trips Reduced and Annual Auto VMT Reduced by plugging the totals from the "Weekly Trips and VMT Worksheet" into the "Annual Auto Trips and VMT Reduced Worksheet."

- Enter Annual Auto Trips Reduced and Annual Auto VMT Reduced in the formulas provided in the original methodology on the previous pages to calculate emission reductions and cost-effectiveness.
### Employer Rideshare Programs

**Weekly Trips and VMT Worksheet**

<table>
<thead>
<tr>
<th>Commute mode</th>
<th>Employee days/week (from survey)</th>
<th>Trips/day factor</th>
<th>=</th>
<th>Trips/week subtotal</th>
<th>x</th>
<th>Access trip correction factor</th>
<th>=</th>
<th>Trips/week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycle</td>
<td>0.0</td>
<td></td>
<td></td>
<td>0.0</td>
<td>--</td>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>Walk</td>
<td>0.0</td>
<td></td>
<td></td>
<td>0.0</td>
<td>--</td>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>Telecommute</td>
<td>0.0</td>
<td></td>
<td></td>
<td>0.0</td>
<td>--</td>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>Telecommute work day off</td>
<td>0.0</td>
<td></td>
<td></td>
<td>0.0</td>
<td>--</td>
<td></td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>Solo drive (&amp; motorcycle)</td>
<td>x 2.0</td>
<td></td>
<td></td>
<td></td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public transportation</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>1.0</td>
<td>=</td>
<td></td>
</tr>
<tr>
<td>Carpool (default avo = 2.5)</td>
<td>x 0.8</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>1.25</td>
<td>=</td>
<td></td>
</tr>
<tr>
<td>Vanpool (default avo = 8.5)</td>
<td>x 0.24</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>5.25</td>
<td>=</td>
<td></td>
</tr>
</tbody>
</table>

\[
\frac{\pm 5 = (A) \text{ Commute Employees}}{\times 16.0 \text{ mi.} = (B) \text{ VMT/week}} = (C) \text{ Trips/week}
\]

* Average commute trip length.
avo = average vehicle occupancy
Employer Rideshare Programs
Annual Auto Trips and VMT Reduced Worksheet

Use Totals (A), (B), and (C) from Weekly Trip and VMT Worksheet

### Annual Auto Trips Reduced

<table>
<thead>
<tr>
<th>Trips/week (C)</th>
<th># of commute employees (A)</th>
<th>Weekly trips/commute employee</th>
<th>Baseline weekly trips/commute employee (Default: 8.7)</th>
<th>Weekly trips/commute employee reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{Weekly trips/commute employee reduced} = \frac{\text{Trips/week (C)}}{\# \text{ of commute employees (A)}} - \text{Baseline weekly trips/commute employee (Default: 8.7)} = \text{Weekly trips/commute employee reduced}
\]

<table>
<thead>
<tr>
<th>Weekly trips/commute employee reduced (from row above)</th>
<th>x</th>
<th>50 weeks*</th>
<th>=</th>
<th>Annual trips/employee reduced</th>
<th>x</th>
<th>Total # of employees**</th>
<th>=</th>
<th>Annual Auto Trips Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>50</td>
<td>=</td>
<td></td>
<td></td>
<td></td>
<td>=</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Annual Auto VMT Reduced

<table>
<thead>
<tr>
<th>VMT/week (B)</th>
<th># of commute employees (A)</th>
<th>Weekly VMT/commute employee</th>
<th>Baseline weekly VMT/commute employee (Default: 139)</th>
<th>Weekly VMT/commute employee reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{Weekly VMT/commute employee reduced} = \frac{\text{VMT/week (B)}}{\# \text{ of commute employees (A)}} - \text{Baseline weekly VMT/commute employee (Default: 139)} = \text{Weekly VMT/commute employee reduced}
\]

<table>
<thead>
<tr>
<th>Weekly VMT/commute employee reduced (from row above)</th>
<th>x</th>
<th>50 weeks*</th>
<th>=</th>
<th>Annual VMT/employee reduced</th>
<th>x</th>
<th>Total # of employees**</th>
<th>=</th>
<th>Annual Auto VMT Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>50</td>
<td>=</td>
<td></td>
<td></td>
<td></td>
<td>=</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* A 50-week default is used since the number of commute employees excludes workers on sick leave and vacation. If the worksite is not in operation year-round, adjust the number accordingly.

** If the weekly travel survey includes part-time employees, count them proportionately to their commute days, e.g., an employee working two days a week counts as 0.40 employee (2/5 = 0.40).

Baseline weekly VMT and trips per commute employee is generally calculated from survey data the year before the program started. If baseline figures are not available, use the defaults provided.

Use the Annual Auto Trips Reduced and the Annual Auto VMT Reduced totals from this worksheet in the formula for calculating emission reductions from ridesharing programs.
Worksheet Calculations

Auto trips and VMT reduced equal the difference between the trips and VMT per employee before and after the program has been implemented, multiplied by the number of employees at the worksite(s).

Calculating Annual Auto Trips Reduced

Using "Weekly Trips and VMT Worksheet," add “employee days/week” for each commute mode and divide the sum by 5 (days) to get “# of commute employees.”

Multiply "employee days/week" for each commute mode by the "trips/day factor," and multiply that total by the "access trip correction factor" to get "trips/week" for each commute mode.

Using "Annual Auto Trips and VMT Reduced Worksheet," add the "trips/week" for each commute mode to get total "trips/week." Divide "trips/week" by the "# of commute employees" to get "weekly trips/commute employee."

Subtract “weekly trips/commute employee” from the “baseline weekly trips/commute employee” to obtain “weekly trips/commute employee reduced.”

Multiply “weekly trips/commute employee reduced” by 50 weeks to get “annual trips/commute employee reduced.”

Multiply “annual trips/commute employee reduced” by the “total # of employees” at the worksite(s) to obtain “annual auto trips reduced.”

Calculating Annual Auto VMT Reduced

Multiply "employee days/wk" for each commute mode by the "trips/day factor" to get "trips/week subtotal" for each commute mode.

Add "trips/week subtotal" for each commute mode and multiply the sum by the "average commute distance" to get "VMT/week." Divide "VMT/week" by the "# of commute employees" to get "weekly VMT/commute employee."

Subtract “weekly VMT/commute employee” from the “baseline weekly VMT/commute employee” to obtain “weekly VMT/commute employee reduced.”

Multiply “weekly VMT/commute employee reduced” by 50 weeks to get “annual VMT/commute employee reduced.”

Multiply “annual VMT/commute employee reduced” by the “total # of employees” at the worksite(s) to obtain “annual auto VMT reduced.”

Worksheet Assumptions

Average one-way commute trip length: The 1995 National Personal Transportation Survey indicated the average home-to-work trip is 11-12 miles. Recent commute surveys conducted by the Southern California Association of Governments and RIDES for Bay Area Commuters have estimated the average home-to-work trip to be 16-17 miles. Since surveys of employer Transportation Demand Management (TDM) programs (100+ employees) have also shown a commute distance closer to 16-17 miles, a 16-mile average is used for this methodology.
**Ridesharing, Continued . . .** *(Optional Method 2)*

*Trips/day factor*: It is assumed that bicycle, telecommute, compressed work week day off, and walk commute modes do not generate any commute-related vehicle trips. Solo driving and motorcycles generate 2 commute trips per day. Carpools and vanpools generate varying trips/day based on the number of passengers. For example, a person in a carpool that averages 2.5 occupants generates 0.8 trips per day (1 vehicle divided by 2.5 occupants equals 0.4 trips, multiplied by 2 trips equals 0.8 trips per day).

*Default carpool and vanpool factors*: Based on average vehicle occupancy of 2.5 for a carpool and 8.5 for a vanpool. *(Source: 1996 Southern California State of the Commute Survey)*

*Access trip correction factor*: It is assumed that 50% of public transportation commuters, 50% of vanpoolers, and 10% of carpoolers drive a personal vehicle to the mode access point. *(Source: Percentages developed by California Air Resources Board, using 1999 Southern California State of the Commute Survey, Bay Area Air Quality Management District data, and emission reduction analyses of California motor vehicle fee TDM projects.)*

Example: A vanpool averaging 8.5 occupants generates 5.25 one-way vehicle trips because 1 van is driven and 4.25 passengers (50%) drive to the vanpool access point. Over five times more one-way trips are generated (5.25 instead of 2) than if there were no access trips, so 5.25 is the access trip correction factor. Access trips are included in trips/week calculations but not VMT/week calculations because they add a significant amount of trips to overall commute travel but a fairly insignificant amount of VMT.

*Default baseline weekly trips and VMT per employee*: 8.7 trips/week, 139 VMT/week. The 1995 National Personal Transportation Survey indicates the average daily commute vehicle trip rate is 1.75. 1.75 multiplied by 5 days per week equals 8.7 trips per week. 8.7 trips per week multiplied by a 16-mile average commute distance equals 139 VMT per week. *(Note: Weekly trip and VMT rates per employee are calculated in order to compensate for not having completed surveys from every employee and/or for having a different number of employees in the baseline and current years.)*
**Ridesharing EXAMPLE**

**County Trip Reduction Program**
A county conducts a comprehensive employee trip reduction program, which includes vanpool and carpool programs, telecommuting, compressed work schedules, and guaranteed emergency transportation.

**Inputs to Calculate Cost-Effectiveness:**
Funding Dollars (Funding): $140,000
Effectiveness Period (Life): 1 year

**One-Way Auto Trips Eliminated Per Week (T) Using Optional Method 1:**
\[ T = 2 \text{ trips/day} \times 5 \text{ days/week} \times \text{peak period employees} \times \left[ \frac{1}{\text{Baseline AVR}} - \frac{1}{\text{New AVR}} \right] \]
where baseline AVR is 1.13, new AVR is 1.19, and there are 15,750 peak period employees.
Therefore, \[ T = 2 \text{ trips/day} \times 5 \text{ days/week} \times 15,750 \text{ peak period employees} \times \left[ \frac{1}{1.13} - \frac{1}{1.19} \right] = 6300 \text{ trips} \]

**Length (L) of Auto Trips Eliminated:** 16 miles

**Weeks (W) = 52 weeks**

**Adjustment (A): 0.7 For auto access trips to transit, vanpools, and carpools**

**Emissions Factors for Auto Travel (From Table 3):**

<table>
<thead>
<tr>
<th>Auto Trip End Factor</th>
<th>Auto VMT Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG Factor</td>
<td>1.719 grams per trip</td>
</tr>
<tr>
<td>NOx Factor</td>
<td>0.721</td>
</tr>
<tr>
<td>PM10 Factor</td>
<td>0.014</td>
</tr>
</tbody>
</table>

Note: 1-5 year emission factors are used since project life is 1 year, and "Commute" auto trip end factors are used since this project reduces commute trips.

**Calculations:**

**Annual Auto Trips Reduced**
\[ = (W) \times (T) \times (A) \]
\[ = 52 \times 6300 \times .7 = 229,320 \]

**Annual Auto VMT Reduced**
\[ = (W) \times (T) \times (L) \]
\[ = 52 \times 6300 \times 16 \text{ miles} \]
\[ = 5,241,600 \text{ annual VMT reduced} \]

**Annual Emission Reductions (ROG, NOx, and PM10)**
\[ = \left[ \frac{\text{Annual Auto Trips Reduced} \times \text{Auto Trip End Factor} + \text{Annual Auto VMT Reduced} \times \text{Auto VMT Factor}}{454} \right] \]

- **ROG:** \[ [(229,320 \times 1.719) + (5,241,600 \times 0.470)]/454 = 6,295 \text{ lbs. per year} \]
- **NOx:** \[ [(229,320 \times 0.721) + (5,241,600 \times 0.602)]/454 = 7,314 \text{ lbs. per year} \]
- **PM10:** \[ [(229,320 \times 0.014) + (5,241,600 \times 0.219)]/454 = 2,524 \text{ lbs. per year} \]

**Capital Recovery Factor (CRF)**
\[ (1 + i)^n \times (1 + i)^n - 1 \]
where \( n \) = project life (1 year)
\[ (1 + i)^n = 1.03 \]
and \( i \) = discount rate (3%)

**Cost-Effectiveness of Funding Dollars**
\[ = \frac{(CRF \times \text{Funding})}{(ROG + NOx + PM10)} \]
\[ = \frac{(1.03 \times 140,000)}{(16,133)} = \$8.94 \text{ per lb.} \]
Ridesharing, Continued...

**EXAMPLE**

FOR CMAQ PROJECTS ONLY:

Once emissions reductions have been calculated, add them together

\[
6,295 + 7,314 + 2,524 = 16,133
\]

and convert emissions reductions to kg/day:

\[
\text{lbs. reduced per year} = \frac{16,133}{2.2 \text{ lbs./kg} \times 365 \text{ days/year}} = \frac{16,133}{2.2 \times 365} \approx 20 \text{ kg/day}
\]
Table 1 Diesel Bus Emission Factors  
(through Model Year 2002)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Calendar Year</th>
<th>Model Year</th>
<th>VMT Emission Factor in g/mi Average</th>
<th>45 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG</td>
<td>2004</td>
<td>Entire Fleet</td>
<td>1.10</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1973-83</td>
<td>1.16</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1984-90</td>
<td>1.15</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1991-93</td>
<td>1.14</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1994-95</td>
<td>1.12</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1996-2001</td>
<td>1.13</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>2002</td>
<td>1.14</td>
<td>0.66</td>
</tr>
<tr>
<td>CO</td>
<td>2004</td>
<td>Entire Fleet</td>
<td>4.47</td>
<td>2.36</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1973-83</td>
<td>6.50</td>
<td>3.43</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1984-90</td>
<td>6.05</td>
<td>3.20</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1991-93</td>
<td>3.47</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1994-95</td>
<td>2.35</td>
<td>1.23</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1996-2001</td>
<td>1.83</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>2002</td>
<td>1.78</td>
<td>0.96</td>
</tr>
<tr>
<td>NOx</td>
<td>2004</td>
<td>Entire Fleet</td>
<td>22.79</td>
<td>20.40</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1973-83</td>
<td>29.22</td>
<td>26.16</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1984-90</td>
<td>26.77</td>
<td>23.95</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1994-95</td>
<td>18.87</td>
<td>16.90</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1996-2001</td>
<td>19.84</td>
<td>17.77</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>2002</td>
<td>12.81</td>
<td>11.55</td>
</tr>
<tr>
<td>PM10 - Exhaust</td>
<td>2004</td>
<td>Entire Fleet</td>
<td>0.41</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1973-83</td>
<td>0.47</td>
<td>0.27</td>
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<tr>
<td></td>
<td>2004</td>
<td>1984-90</td>
<td>0.44</td>
<td>0.26</td>
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<td></td>
<td>2004</td>
<td>1991-93</td>
<td>0.39</td>
<td>0.24</td>
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<td></td>
<td>2004</td>
<td>1994-95</td>
<td>0.51</td>
<td>0.29</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>1996-2001</td>
<td>0.43</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>2004</td>
<td>2002</td>
<td>0.16</td>
<td>0.12</td>
</tr>
<tr>
<td>PM10 - Tire Wear</td>
<td>All Years</td>
<td>All Years</td>
<td>0.009</td>
<td>Not Speed Dependent</td>
</tr>
<tr>
<td>PM10 - Brake Wear</td>
<td>All Years</td>
<td>All Years</td>
<td>0.013</td>
<td>Not Speed Dependent</td>
</tr>
<tr>
<td>PM10 - Road Dust*</td>
<td>All Years</td>
<td>All Years</td>
<td>0.184</td>
<td>Not Speed Dependent</td>
</tr>
</tbody>
</table>

Source: EMFAC2002, Version 2.2 (Apr03), average annual emissions, statewide urban diesel bus fleet, running exhaust emissions only, humidity 50%, temperature 75 degrees F.

*PM10 Road Dust (paved) emission factor is based on US EPA's Compilation of Air Pollutant Emission Factors (AP-42, January 1995).

For Model Year 2003+ emission factors, use actual engine certification factors or, if not available, use Table 5.
### Table 2 Cleaner Vehicles Emission Factors (2004+)
For Light-Duty and Medium-Duty Vehicles (Chassis Certified)
Based on LEV II Exhaust Emission Standards

#### Baseline Vehicles
Low-emission light-duty and medium-duty vehicle (LEV) emission factors in grams per mile with 120,000 mile durability

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>ROG</th>
<th>NOx</th>
<th>PM10 Exh</th>
<th>CO Exh</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8500</td>
<td>0.08</td>
<td>0.06</td>
<td>0.01</td>
<td>0.22</td>
<td>3.87</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>0.20</td>
<td>0.20</td>
<td>0.12</td>
<td>0.33</td>
<td>6.40</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>0.23</td>
<td>0.40</td>
<td>0.12</td>
<td>0.33</td>
<td>7.30</td>
</tr>
</tbody>
</table>

#### Cleaner Vehicles
Ultra low-emission light-duty and medium-duty vehicle (ULEV) emission factors in grams per mile with 120,000 mile durability

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>ROG</th>
<th>NOx</th>
<th>PM10 Exh</th>
<th>CO Exh</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-8500</td>
<td>0.05</td>
<td>0.06</td>
<td>0.01</td>
<td>0.22</td>
<td>1.93</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>0.14</td>
<td>0.20</td>
<td>0.06</td>
<td>0.27</td>
<td>6.40</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>0.17</td>
<td>0.40</td>
<td>0.06</td>
<td>0.27</td>
<td>7.30</td>
</tr>
</tbody>
</table>

Super ultra low-emission vehicle (SULEV) factors in grams per mile with 120,000 mile durability
Partial zero emission vehicle (PZEV) with 150,000 mile durability
Advanced technology zero emission vehicle (AT-PZEV) with 150,000 mile durability

#### Zero-emission light-duty and medium-duty vehicle (ZEV) emission factors in grams per mile

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>ROG</th>
<th>NOx</th>
<th>PM10 Exh</th>
<th>CO Exh</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All weights</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.21</td>
<td>0</td>
</tr>
</tbody>
</table>

**Source:** Based on California Vehicle Exhaust Standards ("LEV II") for chassis certified vehicles. Factors represent a weighted average of emission standards over a 120,000-mile life; the first 50,000 miles are assessed at the 50,000-mile standard, and the remaining 70,000 miles are assessed at the 120,000-mile standard. The SULEVs exhaust standards apply over the full 120,000 mile life. PZEVs and AT-PZEVs must comply to SULEV standards over 150,000 miles and have near zero evaporative emissions. AT-PZEV must also make use of additional “ZEV-enabling” clean technology such as alternative fuel, electric drive, or other advanced technology systems. The PM10 exhaust factors are based on standards; tire wear and brake wear factors are based on EMFAC2002, version 2.2 (Apr03). The road dust portion of the PM10 factor is based on U.S. EPA’s Compilation of Air Pollutant Emission Factors (AP-42, January 1995). Silt loading and vehicle weight data used as inputs to EPA’s equation are from Improvement of Specific Emission Factors (BACM Project No. 1), Final Report, Midwest Research Institute, March 1996. Vehicle trip reductions may have little, if any effect on road dust emissions from high volume facilities thought to be in equilibrium, i.e., the dust is fully entrained due to the heavy traffic. The road dust PM10 factor, however, may be multiplied times total VMT reductions as it has been scaled down to reflect emissions from lower-volume local and collector roads only.

---

1 Gross vehicle weights can be associated with passenger capacity as follows: 5751-8500, roughly 8 passengers; 8501-10,000, roughly 10-15 passengers; 10,001-14,000, roughly 20 passengers or more.

2 PM10 factors are based on standards for diesel vehicles only. There is no applicable standard for gasoline vehicles; gasoline vehicles are known to emit significantly less PM10.

3 Total PM10 factors include motor vehicle exhaust, tire wear (0.008 g/m), brake wear (0.013 g/m), and entrained road dust (0.184 g/m).
Table 3  Average Auto Emission Factors  
(Fleet of Light-Duty Passenger Vehicles, Light-Duty Trucks, and Motorcycles)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ROG</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>0.392</td>
<td>0.318</td>
<td>0.266</td>
<td>0.229</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>1.481</td>
<td>1.223</td>
<td>1.020</td>
<td>0.866</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>1.054</td>
<td>0.860</td>
<td>0.714</td>
<td>0.606</td>
</tr>
<tr>
<td><strong>NOx</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>0.491</td>
<td>0.390</td>
<td>0.319</td>
<td>0.269</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>0.645</td>
<td>0.547</td>
<td>0.458</td>
<td>0.387</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>0.577</td>
<td>0.489</td>
<td>0.411</td>
<td>0.348</td>
</tr>
<tr>
<td><strong>PM10</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>0.218</td>
<td>0.219</td>
<td>0.219</td>
<td>0.219</td>
</tr>
<tr>
<td>running exhaust only (g/mile)</td>
<td>0.014</td>
<td>0.014</td>
<td>0.014</td>
<td>0.015</td>
</tr>
<tr>
<td>tire and brake wear (g/mile)</td>
<td>0.021</td>
<td>0.021</td>
<td>0.021</td>
<td>0.021</td>
</tr>
<tr>
<td>road dust (g/mile)</td>
<td>0.184</td>
<td>0.184</td>
<td>0.184</td>
<td>0.184</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>0.015</td>
<td>0.015</td>
<td>0.016</td>
<td>0.016</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>0.008</td>
<td>0.008</td>
<td>0.008</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>CO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>4.680</td>
<td>3.795</td>
<td>3.146</td>
<td>2.672</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>13.160</td>
<td>11.120</td>
<td>9.412</td>
<td>8.056</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>9.324</td>
<td>7.762</td>
<td>6.525</td>
<td>5.563</td>
</tr>
</tbody>
</table>

Source: EMFAC2002, Version 2.2 (Apr03), statewide, average annual emissions, light-duty cars and trucks plus motorcycles. The rate summary model output report (rts) used for commute trip end calculations is based on temperature 75 degrees F and 50% humidity. The VMT factors equal running exhaust plus running losses divided by daily VMT. The average trip end factors equal statewide start emissions plus hot soak emissions divided by daily trips. The commute trip end factors do not reflect the soak distribution used in EMFAC2002. Instead, the factors are calculated using a special commute-type pre-start soak distribution based on an analysis of the 1991 Statewide Travel Survey for all day home-work and work-home trips.

The commute trip end factors are based on an “off-model” calculation that equals statewide start emissions for a commute-type pre-start soak distribution plus hot soak emissions divided by daily trips. The commute trip end factors do not reflect the soak distribution used in EMFAC2002. Instead, the factors are calculated using a special commute-type pre-start soak distribution based on an analysis of the 1991 Statewide Travel Survey for all day home-work and work-home trips.

PM10 VMT factor includes motor vehicle exhaust, tire wear, brake wear, and entrained road dust. The road dust portion of the PM10 factor is based on U.S. EPA’s Compilation of Air Pollutant Emission Factors (AP-42, January 1995). Silt loading and vehicle weight data used as inputs to EPA’s equation are from Improvement of Specific Emission Factors (BACM Project No. 1), Final Report, Midwest Research Institute, March 1996. Vehicle trip reductions may have little, if any effect on road dust emissions from high volume facilities thought to be in equilibrium, i.e., the dust is fully entrained due to the heavy traffic. The road dust PM10 factor, however, may be multiplied times total VMT reductions as it has been scaled down to reflect emissions from lower-volume local and collector roads only.

NOTES: (1) The factors do not include medium-duty vehicles (5751 to 8500 GVW); however, emissions from medium-duty vehicles used as passenger vehicles have an insignificant effect on the average emission factor (1% or less) when added to the emission factors given for light-duty vehicles. (2) Light-duty vehicle emission standards require progressively cleaner fleet average emissions. This accounts for the gradual decrease in fleet average emission factors over time.

TO USE THE TABLE to find annual emissions related to travel: 1) select the time period that corresponds to the life of project, 2) multiply annual miles traveled by the VMT factor, 3) multiply the annual number of trips by the trip end factor, 4) add VMT emissions to trip end emissions, 5) divide by 454 grams/lb to get lbs of emissions per year, 6) repeat for each pollutant. (Note: Use the commute trip end factor when analyzing work trips. Use the average trip end factor when analyzing a variety of trip types. The VMT factor is the same in both instances.)
Table 3A  Average Auto Emission Factors
For use with projects with a 1-year project life
(Fleet of Light-Duty Passenger Vehicles, Light-Duty Trucks, and Motorcycles)

<table>
<thead>
<tr>
<th>Analysis Period or Project Life</th>
<th>1 Year 2003</th>
<th>1 Year 2004</th>
<th>1 Year 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>0.523</td>
<td>0.470</td>
<td>0.424</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>1.873</td>
<td>1.719</td>
<td>1.577</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>1.364</td>
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Source: EMFAC2002, Version 2.2 (Apr03), statewide, average annual emissions, light-duty cars and trucks plus motorcycles. The rate summary model output report (rts) used for commute trip end calculations is based on temperature 75 degrees F and 50% humidity. The VMT factors equal running exhaust plus running losses divided by daily VMT. The average trip end factors equal statewide start emissions plus hot soak emissions divided by daily trips.

The commute trip end factors are based on an “off-model” calculation that equals statewide start emissions for a commute-type pre-start soak distribution plus hot soak emissions divided by daily trips. The commute trip end factors do not reflect the soak distribution used in EMFAC2002. Instead, the factors are calculated using a special commute-type pre-start soak distribution based on an analysis of the 1991 Statewide Travel Survey for all day home-work and work-home trips.

PM10 VMT factor includes motor vehicle exhaust, tire wear, brake wear, and entrained road dust. The road dust portion of the PM10 factor is based on U.S. EPA’s Compilation of Air Pollutant Emission Factors (AP-42, January 1995). Silt loading and vehicle weight data used as inputs to EPA’s equation are from Improvement of Specific Emission Factors (BACM Project No. 1), Final Report, Midwest Research Institute, March 1996. Vehicle trip reductions may have little, if any effect on road dust emissions from high volume facilities thought to be in equilibrium, i.e., the dust is fully entrained due to the heavy traffic. The road dust PM10 factor, however, may be multiplied times total VMT reductions as it has been scaled down to reflect emissions from lower-volume local and collector roads only.

NOTES: (1) The factors do not include medium-duty vehicles (5751 to 8500 GVW); however, emissions from medium-duty vehicles used as passenger vehicles have an insignificant effect on the average emission factor (1% or less) when added to the emission factors given for light-duty vehicles. (2) Light-duty vehicle emission standards require progressively cleaner fleet average emissions. This accounts for the gradual decrease in fleet average emission factors over time.

TO USE THE TABLE to find annual emissions related to travel: 1) select the time period that corresponds to the life of project, 2) multiply annual miles traveled by the VMT factor, 3) multiply the annual number of trips by the trip end factor, 4) add VMT emissions to trip end emissions, 5) divide by 454 grams/lb to get lbs of emissions per year, 6) repeat for each pollutant. (Note: Use the commute trip end factor when analyzing work trips. Use the average trip end factor when analyzing a variety of trip types. The VMT factor is the same in both instances.)
### Table 4  Emission Factors by Speed

Analysis Period 1-5 years (2004-2008)

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<th>PM10 Ex</th>
<th>Speed (mph)</th>
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Source: EMFAC2002 Version 2.2 (Apr03), annual average emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F. ROG includes running exhaust and running evaporative emissions. PM10 Ex includes running exhaust emissions only.
### Table 4  Emission Factors by Speed (Continued)

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<td>4.38</td>
<td>0.85</td>
<td>0.03</td>
<td>59</td>
<td>0.15</td>
<td>3.72</td>
<td>1.14</td>
<td>0.02</td>
</tr>
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<td>0.19</td>
<td>4.29</td>
<td>0.85</td>
<td>0.03</td>
<td>60</td>
<td>0.15</td>
<td>3.76</td>
<td>1.17</td>
<td>0.02</td>
</tr>
<tr>
<td>31</td>
<td>0.18</td>
<td>4.23</td>
<td>0.84</td>
<td>0.03</td>
<td>61</td>
<td>0.15</td>
<td>3.84</td>
<td>1.21</td>
<td>0.02</td>
</tr>
<tr>
<td>32</td>
<td>0.18</td>
<td>4.16</td>
<td>0.84</td>
<td>0.03</td>
<td>62</td>
<td>0.16</td>
<td>3.91</td>
<td>1.25</td>
<td>0.02</td>
</tr>
<tr>
<td>33</td>
<td>0.17</td>
<td>4.09</td>
<td>0.84</td>
<td>0.02</td>
<td>63</td>
<td>0.16</td>
<td>3.99</td>
<td>1.29</td>
<td>0.02</td>
</tr>
<tr>
<td>34</td>
<td>0.17</td>
<td>4.03</td>
<td>0.83</td>
<td>0.02</td>
<td>64</td>
<td>0.17</td>
<td>4.07</td>
<td>1.33</td>
<td>0.02</td>
</tr>
<tr>
<td>35</td>
<td>0.17</td>
<td>4.14</td>
<td>1.37</td>
<td>0.02</td>
<td>65</td>
<td>0.17</td>
<td>4.14</td>
<td>1.37</td>
<td>0.02</td>
</tr>
</tbody>
</table>

**Source:** EMFAC2002 Version 2.2 (Apr03), annual average emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F. ROG includes running exhaust and running evaporative emissions. PM10 Ex includes running exhaust emissions only.
Table 5  On-Road Emission Factors
for Heavy-Duty Cleaner Vehicle Projects (2004-2006)

BEFORE PROJECT Baseline Emission Factors
New Diesel Vehicles

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Gross Vehicle Weight Rating (lbs)</th>
<th>Model Year</th>
<th>Emission Factors (g/mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOx</td>
</tr>
<tr>
<td>Urban transit buses</td>
<td>&gt; 33,000</td>
<td>2004 - 2006</td>
<td>8.3</td>
</tr>
<tr>
<td>Transit buses, School buses, and trucks</td>
<td>14,001 – 33,000</td>
<td>2004 - 2006</td>
<td>4.8</td>
</tr>
<tr>
<td>Class 8 trucks</td>
<td>&gt; 33,000</td>
<td>2004 - 2006</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Source: EMFAC2002, version 2.2, zero-mile emission rates based on chassis tests including off-cycle emissions and  The Carl Moyer Program Guidelines, September 2003, pp. 17-18, 29-31, and 142-145. All factors have been adjusted for California diesel fuel. Following the Moyer Guidelines, NOx rates were multiplied by 0.87, and PM rates were multiplied by 0.9. As diesel buses have not yet demonstrated achievement of the 2004 diesel NOx standard 0.5 g/bhp-hr, baseline buses are expected to be alternative fueled vehicles that achieve 2.4 g/bhp-hr NOx + NMHC (i.e., 1.9 g/bhp-hr NOx + 0.5 g/bhp-hr NMHC).

AFTER PROJECT Emission Factors
New Cleaner Vehicle Purchases or Re-powers (Typically Alternative-Fueled Vehicles)

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Gross Vehicle Weight Rating (lbs)</th>
<th>Engine Certification Emission Rates (g/bhp-hr)</th>
<th>Conversion Factors* (bhp-hr/mi)</th>
<th>Emission Factors (g/mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>NOx</td>
<td>PM</td>
<td>Conversion Factors* (bhp-hr/mi)</td>
</tr>
<tr>
<td>Urban transit buses</td>
<td>&gt; 33,000</td>
<td>0.5</td>
<td>1.5</td>
<td>4.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5</td>
<td>4.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Buses and trucks</td>
<td>14,001 – 33,000</td>
<td>1.5</td>
<td>0.023***</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0</td>
<td>2.3</td>
<td>&quot;</td>
</tr>
<tr>
<td>Class 8 trucks</td>
<td>&gt; 33,000</td>
<td>1.5</td>
<td>0.023****</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0</td>
<td>2.6</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

For emission certification to 1.8 NOx + NMHC, assume 80% is NOx for alternative fuel engines or 1.44 g/bhp-hr.

** The Carl Moyer Program Guidelines, September 2003, page 142. Based on in-use data for natural gas urban buses.
*** PM emission rate is assumed to be the same as for Class 8 trucks because school buses and trucks with GVWR 14,001– 33,000 lbs are certified to the same PM standard (0.10 g/bhp-hr) as Class 8 trucks.
**** Based on ARB Memorandum from Ms. Cindy Sullivan to Air Pollution Control and Air Quality Management Districts, February 21, 2001.

Cleaner vehicles could be compressed natural gas (CNG), liquefied natural gas (LNG), or cleaner diesel with after-treatment technology to reduce NOx and PM. The “After Project” emission factors are based on typical CNG vehicles; however, after-treatment applied to CNG vehicles has been shown to reduce even more PM and also, formaldehyde.

If the project's NOx engine certification rate is not shown in the table, multiply the appropriate rate times the conversion factor corresponding to the vehicle class to get grams per mile. For refuse vehicles or retrofit projects, see Carl Moyer Program Guidelines for emission rates.
Find the horsepower (hp) and model year for the engine that best describes the engine being replaced to determine the “before project” baseline emission factors. Find the hp and model year for the newer engine. These factors represent the “after project” cleaner engine emission factors.

**Table 6  Off-Road Emission Factors for Cleaner Vehicle Projects (2004 – 2005)**

Find the horsepower (hp) and model year for the engine that best describes the engine being replaced to determine the “before project” baseline emission factors. Find the hp and model year for the newer engine. These factors represent the “after project” cleaner engine emission factors.

<table>
<thead>
<tr>
<th>HP Range</th>
<th>Model Year</th>
<th>ROG (g/hp-hr)</th>
<th>CO (g/hp-hr)</th>
<th>NOx (g/hp-hr)</th>
<th>PM (g/hp-hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51-120</td>
<td>1987 or older</td>
<td>1.44</td>
<td>4.80</td>
<td>13.00</td>
<td>0.84</td>
</tr>
<tr>
<td>51-120</td>
<td>1988 - 1997</td>
<td>0.99</td>
<td>3.49</td>
<td>8.75</td>
<td>0.69</td>
</tr>
<tr>
<td>51-120</td>
<td>1998 - 2003</td>
<td>0.99</td>
<td>3.49</td>
<td>6.90</td>
<td>0.69</td>
</tr>
<tr>
<td>51-120</td>
<td>2004</td>
<td>0.46</td>
<td>3.23</td>
<td>5.64</td>
<td>0.39</td>
</tr>
<tr>
<td>51-120</td>
<td>2005</td>
<td>0.28</td>
<td>3.14</td>
<td>5.22</td>
<td>0.29</td>
</tr>
<tr>
<td>121-175</td>
<td>1969 or older</td>
<td>1.32</td>
<td>4.40</td>
<td>14.00</td>
<td>0.77</td>
</tr>
<tr>
<td>121-175</td>
<td>1970 - 1971</td>
<td>1.10</td>
<td>4.40</td>
<td>13.00</td>
<td>0.66</td>
</tr>
<tr>
<td>121-175</td>
<td>1972 - 1979</td>
<td>1.00</td>
<td>4.40</td>
<td>12.00</td>
<td>0.55</td>
</tr>
<tr>
<td>121-175</td>
<td>1980 - 1984</td>
<td>0.94</td>
<td>4.30</td>
<td>11.00</td>
<td>0.55</td>
</tr>
<tr>
<td>121-175</td>
<td>1985 - 1987</td>
<td>0.88</td>
<td>4.20</td>
<td>11.00</td>
<td>0.55</td>
</tr>
<tr>
<td>121-175</td>
<td>1988 - 1996</td>
<td>0.68</td>
<td>2.70</td>
<td>8.17</td>
<td>0.38</td>
</tr>
<tr>
<td>121-175</td>
<td>1997 - 2002</td>
<td>0.68</td>
<td>2.70</td>
<td>6.90</td>
<td>0.38</td>
</tr>
<tr>
<td>121-175</td>
<td>2003</td>
<td>0.33</td>
<td>2.70</td>
<td>5.26</td>
<td>0.24</td>
</tr>
<tr>
<td>121-175</td>
<td>2004</td>
<td>0.22</td>
<td>2.70</td>
<td>4.72</td>
<td>0.19</td>
</tr>
<tr>
<td>121-175</td>
<td>2005</td>
<td>0.16</td>
<td>2.70</td>
<td>4.44</td>
<td>0.16</td>
</tr>
<tr>
<td>176-250</td>
<td>1969 or older</td>
<td>1.32</td>
<td>4.40</td>
<td>14.00</td>
<td>0.77</td>
</tr>
<tr>
<td>176-250</td>
<td>1970 - 1971</td>
<td>1.10</td>
<td>4.40</td>
<td>13.00</td>
<td>0.66</td>
</tr>
<tr>
<td>176-250</td>
<td>1972 - 1979</td>
<td>1.00</td>
<td>4.40</td>
<td>12.00</td>
<td>0.55</td>
</tr>
<tr>
<td>176-250</td>
<td>1980 - 1984</td>
<td>0.94</td>
<td>4.30</td>
<td>11.00</td>
<td>0.55</td>
</tr>
<tr>
<td>176-250</td>
<td>1985 - 1987</td>
<td>0.88</td>
<td>4.20</td>
<td>11.00</td>
<td>0.55</td>
</tr>
<tr>
<td>176-250</td>
<td>1988 - 1995</td>
<td>0.68</td>
<td>2.70</td>
<td>8.17</td>
<td>0.38</td>
</tr>
<tr>
<td>176-250</td>
<td>1996 - 2002</td>
<td>0.32</td>
<td>0.92</td>
<td>6.25</td>
<td>0.15</td>
</tr>
<tr>
<td>176-250</td>
<td>2003</td>
<td>0.19</td>
<td>0.92</td>
<td>5.00</td>
<td>0.12</td>
</tr>
<tr>
<td>176-250</td>
<td>2004</td>
<td>0.14</td>
<td>0.92</td>
<td>4.58</td>
<td>0.11</td>
</tr>
<tr>
<td>176-250</td>
<td>2005</td>
<td>0.12</td>
<td>0.92</td>
<td>4.38</td>
<td>0.11</td>
</tr>
<tr>
<td>251-500</td>
<td>1969 or older</td>
<td>1.26</td>
<td>4.20</td>
<td>14.00</td>
<td>0.74</td>
</tr>
<tr>
<td>251-500</td>
<td>1970 - 1971</td>
<td>1.05</td>
<td>4.20</td>
<td>13.00</td>
<td>0.63</td>
</tr>
<tr>
<td>251-500</td>
<td>1972 - 1979</td>
<td>0.95</td>
<td>4.20</td>
<td>12.00</td>
<td>0.53</td>
</tr>
<tr>
<td>251-500</td>
<td>1980 - 1984</td>
<td>0.90</td>
<td>4.20</td>
<td>11.00</td>
<td>0.53</td>
</tr>
<tr>
<td>251-500</td>
<td>1985 - 1987</td>
<td>0.84</td>
<td>4.10</td>
<td>11.00</td>
<td>0.53</td>
</tr>
<tr>
<td>251-500</td>
<td>1988 - 1995</td>
<td>0.68</td>
<td>2.70</td>
<td>8.17</td>
<td>0.38</td>
</tr>
<tr>
<td>251-500</td>
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<td>0.92</td>
<td>6.25</td>
<td>0.15</td>
</tr>
<tr>
<td>251-500</td>
<td>2001</td>
<td>0.19</td>
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<td>0.12</td>
</tr>
<tr>
<td>251-500</td>
<td>2002</td>
<td>0.14</td>
<td>0.92</td>
<td>4.51</td>
<td>0.11</td>
</tr>
<tr>
<td>251-500</td>
<td>2003 - 2004</td>
<td>0.12</td>
<td>0.92</td>
<td>4.29</td>
<td>0.11</td>
</tr>
<tr>
<td>251-500</td>
<td>2005</td>
<td>0.10</td>
<td>0.92</td>
<td>4.00</td>
<td>0.11</td>
</tr>
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</table>
Table 6  Off-Road Emission Factors for Cleaner Vehicle Projects (2004 – 2005) (continued)

<table>
<thead>
<tr>
<th>HP</th>
<th>Model Year</th>
<th>ROG</th>
<th>CO</th>
<th>NOx</th>
<th>PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>501-750</td>
<td>1969 or older</td>
<td>1.26</td>
<td>4.20</td>
<td>14.00</td>
<td>0.74</td>
</tr>
<tr>
<td>501-750</td>
<td>1970 - 1971</td>
<td>1.05</td>
<td>4.20</td>
<td>13.00</td>
<td>0.63</td>
</tr>
<tr>
<td>501-750</td>
<td>1972 - 1979</td>
<td>0.95</td>
<td>4.20</td>
<td>12.00</td>
<td>0.53</td>
</tr>
<tr>
<td>501-750</td>
<td>1980 - 1984</td>
<td>0.90</td>
<td>4.20</td>
<td>11.00</td>
<td>0.53</td>
</tr>
<tr>
<td>501-750</td>
<td>1985 - 1987</td>
<td>0.84</td>
<td>4.10</td>
<td>11.00</td>
<td>0.53</td>
</tr>
<tr>
<td>501-750</td>
<td>1988 - 1995</td>
<td>0.68</td>
<td>2.70</td>
<td>8.17</td>
<td>0.38</td>
</tr>
<tr>
<td>501-750</td>
<td>1996 - 2001</td>
<td>0.32</td>
<td>0.92</td>
<td>6.25</td>
<td>0.15</td>
</tr>
<tr>
<td>501-750</td>
<td>2002</td>
<td>0.19</td>
<td>0.92</td>
<td>4.95</td>
<td>0.12</td>
</tr>
<tr>
<td>501-750</td>
<td>2003</td>
<td>0.14</td>
<td>0.92</td>
<td>4.51</td>
<td>0.11</td>
</tr>
<tr>
<td>&gt;750</td>
<td>2004 - 2005</td>
<td>0.12</td>
<td>0.92</td>
<td>4.29</td>
<td>0.11</td>
</tr>
<tr>
<td>&gt;750</td>
<td>1969 or older</td>
<td>1.26</td>
<td>4.20</td>
<td>14.00</td>
<td>0.74</td>
</tr>
<tr>
<td>&gt;750</td>
<td>1970 - 1971</td>
<td>1.05</td>
<td>4.20</td>
<td>13.00</td>
<td>0.63</td>
</tr>
<tr>
<td>&gt;750</td>
<td>1972 - 1979</td>
<td>0.95</td>
<td>4.20</td>
<td>12.00</td>
<td>0.53</td>
</tr>
<tr>
<td>&gt;750</td>
<td>1980 - 1984</td>
<td>0.90</td>
<td>4.20</td>
<td>11.00</td>
<td>0.53</td>
</tr>
<tr>
<td>&gt;750</td>
<td>1985 - 1987</td>
<td>0.84</td>
<td>4.10</td>
<td>11.00</td>
<td>0.53</td>
</tr>
<tr>
<td>&gt;750</td>
<td>1988 - 1999</td>
<td>0.68</td>
<td>2.70</td>
<td>8.17</td>
<td>0.38</td>
</tr>
<tr>
<td>&gt;750</td>
<td>2000 - 2005</td>
<td>0.32</td>
<td>0.92</td>
<td>6.25</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Source: Air Resources Board Emission Inventory for Off-Road Large Compression-Ignited Engines Using the New Off-Road Emissions Model (Mail Out MSC #99-32)

Other information needed to estimate emissions are operating hours and load factor. Operating hours for construction equipment can range from 535 to 1641 hours per year and the load factor can vary between 0.43 and 0.78. Operating hours for agricultural equipment can range from 90 to 790 hours per year and the load factor can vary between 0.43 to 0.70.
Table 7  Medium-Duty Vehicle Emission Factors  
For Vanpool and Shuttle Evaluations  
(Model Years 1995 - 2003)

<table>
<thead>
<tr>
<th>Weight (lbs.)*</th>
<th>ROG</th>
<th>NOx</th>
<th>PM10</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exhaust</td>
<td>Total**</td>
</tr>
<tr>
<td>5751-8500</td>
<td>0.24</td>
<td>0.77</td>
<td>0.12</td>
<td>0.33</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>0.29</td>
<td>0.88</td>
<td>0.12</td>
<td>0.33</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>0.38</td>
<td>1.29</td>
<td>0.12</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Ultra low-emission medium-duty vehicle (ULEV) emission factors in grams per mile

<table>
<thead>
<tr>
<th>Weight (lbs.)*</th>
<th>ROG</th>
<th>NOx</th>
<th>PM10</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exhaust</td>
<td>Total**</td>
</tr>
<tr>
<td>5751-8500</td>
<td>0.15</td>
<td>0.77</td>
<td>0.06</td>
<td>0.27</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>0.17</td>
<td>0.88</td>
<td>0.06</td>
<td>0.27</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>0.23</td>
<td>1.29</td>
<td>0.06</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Super ultra low-emission medium-duty vehicle (SULEV) emission factors in grams per mile

<table>
<thead>
<tr>
<th>Weight (lbs.)*</th>
<th>ROG</th>
<th>NOx</th>
<th>PM10</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exhaust</td>
<td>Total**</td>
</tr>
<tr>
<td>5751-8500</td>
<td>0.07</td>
<td>0.39</td>
<td>0.06</td>
<td>0.27</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>0.09</td>
<td>0.44</td>
<td>0.06</td>
<td>0.27</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>0.11</td>
<td>0.62</td>
<td>0.06</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Zero-emission medium-duty vehicle (ZEV) emission factors in grams per mile

<table>
<thead>
<tr>
<th>Weight (lbs.)*</th>
<th>ROG</th>
<th>NOx</th>
<th>PM10</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Exhaust</td>
<td>Total**</td>
</tr>
<tr>
<td>All weights</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.21</td>
</tr>
</tbody>
</table>

If vanpool/shuttle project is using 2004+ model year vehicles, refer to Table 2.

Source: Based on California Vehicle Exhaust Standards ("LEV I"), January 1999. (LEV II went into effect in 2004.) Factors represent a weighted average of emission standards over a 120,000-mile life; the first 50,000 miles are assessed at the 50,000-mile standard, and the remaining 70,000 miles are assessed at the 120,000-mile standard.

*Gross vehicle weights can be associated with passenger capacity as follows: 5751-8500, roughly 8 passengers; 8501-10,000, roughly 10-15 passengers; 10,001-14,000, roughly 20 passengers or more.

** Total PM10 factors include motor vehicle exhaust, tire wear (0.008 g/m for all), brake wear (0.013 g/m for all), and entrained road dust (0.184 g/m for all). The PM10 exhaust factors are based on engine standards; tire wear and brake wear factors are based on EMFAC2002, version 2.2. The road dust portion of the PM10 factor is based on U.S. EPA's Compilation of Air Pollutant Emission Factors (AP-42, January 1995). Silt loading and vehicle weight data used as inputs to EPA's equation are from Improvement of Specific Emission Factors (BACM Project No. 1), Final Report, Midwest Research Institute, March 1996. Vehicle trip reductions may have little, if any, effect on road dust emissions from high volume facilities thought to be in equilibrium, i.e., the dust is fully entrained due to the heavy traffic. The road dust PM10 factor, however, may be multiplied times total VMT reductions as it has been scaled down to reflect emissions from lower-volume local and collector roads only.
Table 8  Capital Recovery Factors

The following table gives capital recovery factors that may be used to annualize funding dollars according to project life. Below are the capital recovery factors calculated to two decimal places for a discount rate of 3 percent.

<table>
<thead>
<tr>
<th>Project Life</th>
<th>Capital Recovery Factor for discount rate of 3%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>1.03</td>
</tr>
<tr>
<td>3 years</td>
<td>0.35</td>
</tr>
<tr>
<td>5 years</td>
<td>0.22</td>
</tr>
<tr>
<td>7 years</td>
<td>0.16</td>
</tr>
<tr>
<td>10 years</td>
<td>0.12</td>
</tr>
<tr>
<td>12 years</td>
<td>0.10</td>
</tr>
<tr>
<td>15 years</td>
<td>0.08</td>
</tr>
<tr>
<td>20 years</td>
<td>0.07</td>
</tr>
</tbody>
</table>

The formula for the capital recovery factor is:

\[ \text{Capital Recovery Factor (CRF)} = \frac{(1 + i)^n - 1}{(1 + i)^n - 1} \text{ where: } i = \text{discount rate} \]

For example, if the project life is 1 year and the discount rate is 3%, then the capital recovery factor equals 1.03.

\[ = \frac{(1 + 0.03)^1 - 1}{(1 + 0.03)^1 - 1} = \frac{0.0309}{0.0300} = 1.03 \]

To determine cost-effectiveness, funding dollars are amortized over the expected project life using a discount rate. The amortization formula yields a capital recovery factor, which, when multiplied by the funding, gives the annualized funding for the project over its expected lifetime. The discount rate reflects the opportunity cost of public funds for the clean air programs. This is the level of earnings that could be reasonably expected by investing public funds in various financial instruments, such as U.S. Treasury securities. Cost-effectiveness is determined by dividing annualized funds by annual emission reductions (ROG + NOx + PM10).
Appendix G – ARB CMAQ Emission Factor Tables, 2013
Methods to Find the Cost-Effectiveness of Funding Air Quality Projects

For Evaluating
Motor Vehicle Registration Fee Projects
and
Congestion Mitigation and Air Quality Improvement (CMAQ) Projects

Emission Factor Tables

May 2013

California Air Resources Board
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Preface

This document contains updated emission factors to be used with the “Methods to Find the Cost-Effectiveness of Funding Air Quality Projects” document published in May 2005 (the Methods document). The emission factors below are the latest available as of the publication date, and in most cases are based on the Air Resources Board’s on-road emission factor model EMFAC, or in the case of off-road emissions data, the Board’s emission rate model OFFROAD.

Please note that even though the emission factors have changed since the original publication of the Methods document, the actual methods to apply the rates in that document remain valid.

Summary of Changes by Table.

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Updated emission rates to EMFAC 2011. Added 2013 model year and calendar year. Updated re-entrained dust rates to reflect latest U.S. EPA and ARB methodologies. For bus emission factors through model year 2013, use Table 1. For emission rates for buses newer than 2013, use emission rates from Table 5E</td>
</tr>
<tr>
<td>Table 2</td>
<td>Reworded table headings to make it clearer for the user where to find the appropriate rates for existing and replacement technologies. Emission rates are now expressed in milligrams per mile. Modified formatting to improve readability. PM2.5 rates updated to reflect statewide averages and most recent methodology.</td>
</tr>
<tr>
<td>Table 3/3A</td>
<td>Updated emission rates to EMFAC 2011. Added 2013 to project life column headings. Updated re-entrained dust rates to reflect latest U.S. EPA and ARB methodologies.</td>
</tr>
<tr>
<td>Table 4</td>
<td>Updated emission rates to reflect EMFAC 2011.</td>
</tr>
<tr>
<td>Table 5</td>
<td>The original Table 5 has been replaced by Tables 5A through 5F. These tables provide the user with more detail and the ability to choose the rate format to better match the data available to the analyst for completing the calculation. Sources for the emission rates are either engine certification data or EMFAC 2011 (see notes in the individual tables). Yellow border added to help the user navigate the document without getting lost.</td>
</tr>
<tr>
<td>Table 6</td>
<td>Updated rates from ARB OFFROAD model.</td>
</tr>
</tbody>
</table>
Table 7  The rates in the original table were too old (1995-2003) to be useful for current cost effectiveness analysis. Emission rates for 2004 and newer vehicles should be taken from Tables 2 or 5A-5F, as appropriate. If emission rates for older vehicles are needed contact your local air pollution or air quality management district for guidance.

Other Changes

With this revision of emission rates we are no longer adding the rate tables to the Access database tool. This change will enable a faster update process when new rates are released.

There will now be only one version of the database tool on the ARB website available for download. Previously, a version of the Access database tool was created for the South Coast Air Quality Management District which calculated PM2.5, while another version was used in the remaining areas of the state using PM10. With the revisions to the CMAQ program emphasizing PM2.5 contained in MAP-21, there is no longer a need to maintain a separate version of the Access database tool for PM10.
<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Calendar Year</th>
<th>Model Year</th>
<th>Emission Factor (g/mi)</th>
<th>Average</th>
<th>45 MPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROG</td>
<td>2013</td>
<td>Entire Fleet</td>
<td>0.64</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>1973-83</td>
<td>0.84</td>
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<td>2013</td>
<td>1984-90</td>
<td>0.83</td>
<td>0.75</td>
<td></td>
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<tr>
<td></td>
<td>2013</td>
<td>1991-93</td>
<td>0.82</td>
<td>0.59</td>
<td></td>
</tr>
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<td></td>
<td>2013</td>
<td>1994-95</td>
<td>0.81</td>
<td>0.69</td>
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<td></td>
<td>2013</td>
<td>1996-2001</td>
<td>0.80</td>
<td>0.46</td>
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<td></td>
<td>2013</td>
<td>2002</td>
<td>0.80</td>
<td>0.43</td>
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<td></td>
<td>2013</td>
<td>2003 - 2006</td>
<td>0.15</td>
<td>0.07</td>
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<td></td>
<td>2013</td>
<td>2007 - 2009</td>
<td>0.03</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>2010 - 2013</td>
<td>0.03</td>
<td>0.01</td>
<td></td>
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<td>2013</td>
<td>1973-83</td>
<td>6.50</td>
<td>11.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>1984-90</td>
<td>6.05</td>
<td>7.18</td>
<td></td>
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<tr>
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<td>2013</td>
<td>1991-93</td>
<td>3.47</td>
<td>4.98</td>
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<td>0.92</td>
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<td></td>
<td>2013</td>
<td>2003 - 2006</td>
<td>1.25</td>
<td>0.54</td>
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</tr>
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<td>2013</td>
<td>2007 - 2009</td>
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<td>0.41</td>
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<td>0.33</td>
<td></td>
</tr>
<tr>
<td>NOx</td>
<td>2013</td>
<td>Entire Fleet</td>
<td>16.40</td>
<td>12.09</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2013</td>
<td>1973-83</td>
<td>29.79</td>
<td>23.37</td>
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<td>2013</td>
<td>1984-90</td>
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<td>22.06</td>
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<td>2013</td>
<td>1991-93</td>
<td>16.44</td>
<td>14.21</td>
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<td>2013</td>
<td>1996-2001</td>
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<td>13.87</td>
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<td>2013</td>
<td>2002</td>
<td>13.15</td>
<td>10.36</td>
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</tr>
<tr>
<td></td>
<td>2013</td>
<td>2003 - 2006</td>
<td>3.55</td>
<td>2.28</td>
<td></td>
</tr>
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<td>2013</td>
<td>2007 - 2009</td>
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<td></td>
<td>2013</td>
<td>2010 - 2013</td>
<td>0.59</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>PM2.5 - Exhaust</td>
<td>2013</td>
<td>Entire Fleet</td>
<td>0.25</td>
<td>0.12</td>
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</tr>
<tr>
<td></td>
<td>2013</td>
<td>1973-83</td>
<td>0.38</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
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<td>2013</td>
<td>1984-90</td>
<td>0.37</td>
<td>0.19</td>
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</tr>
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<td>1996-2001</td>
<td>0.29</td>
<td>0.15</td>
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<td>2013</td>
<td>2002</td>
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<td>2003 - 2006</td>
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<tr>
<td></td>
<td>2013</td>
<td>2010 - 2013</td>
<td>0.03</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

PM2.5 - Tire Wear  All Years All Years 0.002  Not Speed Dependent
PM2.5 - Brake Wear All Years All Years 0.361  Not Speed Dependent
PM2.5 - Road Dust* All Years All Years 0.022  Not Speed Dependent

See notes next page.
Notes for Table 1 - Diesel Bus Emission Factors:

* Statewide average annual PM2.5 emission factor, weighted by VMT per road category.

Source: EMFAC2011-LDV, average annual emissions, statewide urban diesel bus fleet, running exhaust emissions only, humidity 50%, temperature 75 degrees F.

Average factors for ROG (MY 2007) and PM2.5 (MY 2007) exhaust were estimated using proportional analysis relative to 45 mph factors because exhaust emissions were too small to show up in EMFAC model output file.


April 2013
Table 2 Emission Factors for Cleaner Vehicles
For Light-Duty and Medium-Duty Trucks (Chassis Certified)
Based on LEV II Exhaust Emission Standards

**Baseline (Older) Technology Vehicles:**

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>ROG</th>
<th>NOx</th>
<th>PM2.5</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 8500</td>
<td>205</td>
<td>775</td>
<td>9</td>
<td>49</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>242</td>
<td>875</td>
<td>86</td>
<td>144</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>316</td>
<td>1292</td>
<td>86</td>
<td>150</td>
</tr>
</tbody>
</table>

**Replacement (Newer) Technology Cleaner Vehicles:**

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>ROG</th>
<th>NOx</th>
<th>PM2.5</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 8500</td>
<td>55</td>
<td>70</td>
<td>9</td>
<td>49</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>143</td>
<td>200</td>
<td>54</td>
<td>112</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>167</td>
<td>400</td>
<td>54</td>
<td>117</td>
</tr>
</tbody>
</table>

Super-ultra-low-emission vehicle (SULEV) factors in milligrams per mile with 120,000 mile durability

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>ROG</th>
<th>NOx</th>
<th>PM2.5</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Up to 8500</td>
<td>10</td>
<td>20</td>
<td>9</td>
<td>49</td>
</tr>
<tr>
<td>8501-10,000</td>
<td>100</td>
<td>100</td>
<td>54</td>
<td>112</td>
</tr>
<tr>
<td>10,001-14,000</td>
<td>117</td>
<td>200</td>
<td>54</td>
<td>117</td>
</tr>
</tbody>
</table>

Zero-emission light-duty and medium-duty vehicle (ZEV) NOTE: Emission factor units are milligrams/mile

<table>
<thead>
<tr>
<th>Weight (lbs.)</th>
<th>ROG</th>
<th>NOx</th>
<th>PM2.5</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All weights</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
</tr>
</tbody>
</table>

See notes next page.

---

1. Gross vehicle weights can be associated with passenger capacity as follows: 5751-8500, roughly 8 passengers; 8501-10,000, roughly 10-15 passengers; 10,001-14,000, roughly 20 passengers or more.
2. PM2.5 factors are based on standards for diesel vehicles only. There is no applicable standard for gasoline vehicles; gasoline vehicles are known to emit significantly less PM.
3. Total PM2.5 factors include exhaust, brake wear, tire wear, and entrained road dust.
Notes for Table 2, Emission Factors for Cleaner Vehicles:

Sources:

Baseline is California Vehicle Exhaust Standards ("LEV I") for chassis certified vehicles for model year 2003. Factors assume emissions at 50,000 mile standard for the first 50,000 miles of the car's life (assumed to be 120,000 miles) and emission at the 120,000 mile standard for the last 70,000 miles of the car's life.

Cleaner Vehicle Emission Factors are from the California Vehicle Exhaust Standards for MYs after 2004 ("LEV II"). The PM2.5 factors have been adjusted from total PM by the fraction of the size distribution less than 2.5 um. These were taken from EPA size distribution measurements tabulated in EPA's PART5 model. See the EMFAC 2000 Technical Support Document Table 4.12-5. The brake wear emission factors came from a review of recent non-asbestos brake emissions (Section 9 of EMFAC2011 Technical Documentation). The road dust portion of the PM2.5 emission factors based on US EPA’s Compilation of Air Pollutant Emission Factors, Vol. 5 (AP-42, Chapter 13.2.1, Jan. 2011), 2008 VMT from EMFAC2011-SG, and ARB’s Miscellaneous Process Methodology 7.9, Entrained Paved Road Travel, Paved Road Dust (updated Jan. 2013).

Vehicle Trip reductions may have little if any effect on road dust emissions from high volume facilities thought to be in equilibrium, i.e., the dust is fully entrained due to the heavy traffic. The road dust PM factor, however, may be multiplied by the total VMT reductions as it has been scaled down to reflect emissions from lower-volume local and collector roads only.

April 2013
<table>
<thead>
<tr>
<th>Analysis Period or Project Life</th>
<th>1-5 Years (2011-2015)</th>
<th>6-10 Years (2011-2020)</th>
<th>11-15 Years (2011-2025)</th>
<th>16-20 Years (2011-2030)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ROG</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>0.191</td>
<td>0.153</td>
<td>0.132</td>
<td>0.119</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>0.764</td>
<td>0.614</td>
<td>0.521</td>
<td>0.462</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>0.584</td>
<td>0.470</td>
<td>0.399</td>
<td>0.353</td>
</tr>
<tr>
<td><strong>NO\textsubscript{x}</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>0.217</td>
<td>0.172</td>
<td>0.146</td>
<td>0.130</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>0.303</td>
<td>0.233</td>
<td>0.189</td>
<td>0.162</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>0.298</td>
<td>0.231</td>
<td>0.189</td>
<td>0.162</td>
</tr>
<tr>
<td><strong>PM\textsubscript{2.5}</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>VMT (g/mile)</td>
<td>0.087</td>
<td>0.087</td>
<td>0.087</td>
<td>0.087</td>
</tr>
<tr>
<td>running exhaust only (g/mile)</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td>tire and brake wear (g/mile)</td>
<td>0.018</td>
<td>0.018</td>
<td>0.018</td>
<td>0.018</td>
</tr>
<tr>
<td>road dust (g/mile)</td>
<td>0.022</td>
<td>0.022</td>
<td>0.022</td>
<td>0.022</td>
</tr>
<tr>
<td>commute trip ends (g/trip end)</td>
<td>0.006</td>
<td>0.004</td>
<td>0.004</td>
<td>0.004</td>
</tr>
<tr>
<td>average trip ends (g/trip end)</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003</td>
<td>0.004</td>
</tr>
<tr>
<td><strong>CO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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Source: EMFAC2011-LDV, statewide average annual emissions
EMFAC2011 RTS Output runs use 50% relative humidity and 75 degrees Fahrenheit temperature.
PM2.5, road dust: statewide average annual PM2.5 emission factor, based on US EPA’s Compilation of Air
Miscellaneous Process Methodology 7.9, Entrained Paved Road Travel, Paved Road Dust (updated Jan. 2013).

April 2013
Table 3A Average Auto Emission Factors

(Fleet of Light-Duty Passenger Vehicles, Light-Duty Trucks, and Motor Cycles)

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<th>1 Year 2013</th>
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Source: EMFAC2011-LDV, statewide average annual emissions
EMFAC2011 RTS Output runs use 50% relative humidity and 75 degrees Fahrenheit temperature.
PM$_{2.5}$, road dust: statewide average annual PM$_{2.5}$ emission factor, based on US EPA’s Compilation of
Air Pollutant Emission Factors, Vol. 5 (AP-42, Chapter 13.2.1, Jan. 2011), 2008 VMT from EMFAC2011-
SG, and ARB’s Miscellaneous Process Methodology 7.9, Entrained Paved Road Travel, Paved Road

April 2013
Table 4 Emission Factors by Speed

Project Life 1-5 years (2011-2015)

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<th>PM2.5</th>
<th>Speed (mph)</th>
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Source: EMFAC2011LDV, average annual emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F.
ROG includes running exhaust and running evaporative emissions. PM2.5 Ex includes running exhaust emissions only.

April 2013
Table 4  Emission Factors by Speed (Continued)

Project Life 6-10 years (2011-2020)

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<th>NOx</th>
<th>PM2.5 Ex</th>
<th>Speed (mph)</th>
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<td>0.004</td>
<td>57</td>
<td>0.06</td>
<td>1.69</td>
<td>0.32</td>
<td>0.002</td>
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<td>28</td>
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<td>2.08</td>
<td>0.27</td>
<td>0.004</td>
<td>58</td>
<td>0.07</td>
<td>1.71</td>
<td>0.32</td>
<td>0.002</td>
</tr>
<tr>
<td>29</td>
<td>0.08</td>
<td>2.04</td>
<td>0.27</td>
<td>0.003</td>
<td>59</td>
<td>0.07</td>
<td>1.73</td>
<td>0.33</td>
<td>0.002</td>
</tr>
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<td>30</td>
<td>0.07</td>
<td>2.00</td>
<td>0.27</td>
<td>0.003</td>
<td>60</td>
<td>0.07</td>
<td>1.74</td>
<td>0.34</td>
<td>0.002</td>
</tr>
<tr>
<td>31</td>
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<td>1.97</td>
<td>0.27</td>
<td>0.003</td>
<td>61</td>
<td>0.07</td>
<td>1.78</td>
<td>0.35</td>
<td>0.002</td>
</tr>
<tr>
<td>32</td>
<td>0.07</td>
<td>1.94</td>
<td>0.27</td>
<td>0.003</td>
<td>62</td>
<td>0.07</td>
<td>1.81</td>
<td>0.36</td>
<td>0.003</td>
</tr>
<tr>
<td>33</td>
<td>0.07</td>
<td>1.91</td>
<td>0.27</td>
<td>0.003</td>
<td>63</td>
<td>0.08</td>
<td>1.85</td>
<td>0.37</td>
<td>0.003</td>
</tr>
<tr>
<td>34</td>
<td>0.07</td>
<td>1.88</td>
<td>0.26</td>
<td>0.003</td>
<td>64</td>
<td>0.08</td>
<td>1.88</td>
<td>0.38</td>
<td>0.003</td>
</tr>
<tr>
<td>35</td>
<td>0.07</td>
<td>1.85</td>
<td>0.26</td>
<td>0.003</td>
<td>65</td>
<td>0.08</td>
<td>1.92</td>
<td>0.39</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Source: EMFAC2011LDV, average annual emissions, statewide vehicle fleet, 50% humidity, temperature 75 degrees F.
ROG includes running exhaust and running evaporative emissions. PM2.5 Ex includes running exhaust emissions only.

April 2013
Tables 5A through 5F. Emission Rates for Medium-Heavy and Heavy-Heavy Duty Trucks and Buses.

The original Table 5 has been replaced by Tables 5A through 5F. These tables provide the user with more detail and the ability to choose the rate format (e.g. grams per mile, grams per gallon of fuel or grams per brake-horsepower-hour) to better match the data available to the analyst for completing the calculation. Sources for the emission rates are either engine certification data or EMFAC 2011 (see notes in the individual tables). Rates are provided for diesel or natural gas fuel.

To use these tables, find the emission rate of the model year (or certification rate, if known) of the engine that is to be replaced expressed in the units desired. Second, find the emission rate of the new engine based on its model year or certification rate (if known) expressed in the units desired (usually the same units as for the existing engine). Calculate the cost effectiveness using the rates and appropriate method as described in the Methods document.
<table>
<thead>
<tr>
<th>Model Year</th>
<th>EO Certification Standards g/bhp-hr</th>
<th>NOx</th>
<th>ROG(^{(a)}) g/gal(^{(b),(c),(d)})</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-1990</td>
<td>6.0 NOx</td>
<td>0.6 PM10</td>
<td>103.23</td>
<td>5.33</td>
</tr>
<tr>
<td>1990</td>
<td>6.0 NOx</td>
<td>0.6 PM10</td>
<td>103.23</td>
<td>5.33</td>
</tr>
<tr>
<td>1991 - 1993</td>
<td>5.0 NOx</td>
<td>0.25 PM10</td>
<td>86.03</td>
<td>4.44</td>
</tr>
<tr>
<td>1994 - 1997</td>
<td>5.0 NOx</td>
<td>0.1 PM10</td>
<td>86.03</td>
<td>4.44</td>
</tr>
<tr>
<td>1998 - 2001</td>
<td>4.0 NOx</td>
<td>0.1 PM10</td>
<td>68.82</td>
<td>3.55</td>
</tr>
<tr>
<td>2002 - 2006</td>
<td>2.5 NOx + NMHC</td>
<td>0.1 PM10</td>
<td>40.86</td>
<td>2.11</td>
</tr>
<tr>
<td>2007-2009</td>
<td>1.8 NOx + NMHC</td>
<td>0.01 PM10</td>
<td>29.42</td>
<td>1.52</td>
</tr>
<tr>
<td>2007-2009</td>
<td>1.5 NOx + NMHC</td>
<td>0.01 PM10</td>
<td>24.52</td>
<td>1.27</td>
</tr>
<tr>
<td>2007-2009</td>
<td>1.2 NOx + NMHC</td>
<td>0.01 PM10</td>
<td>19.61</td>
<td>1.01</td>
</tr>
<tr>
<td>2007-2009</td>
<td>0.84 NOx + NMHC</td>
<td>0.01 PM10</td>
<td>13.73</td>
<td>0.71</td>
</tr>
<tr>
<td>2007-2009</td>
<td>0.5 NOx</td>
<td>0.01 PM10</td>
<td>8.60</td>
<td>0.44</td>
</tr>
<tr>
<td>2010 +</td>
<td>0.2 NOX</td>
<td>0.01 PM10</td>
<td>3.44</td>
<td>0.18</td>
</tr>
</tbody>
</table>

\(a\) - ROG = HC * 1.26639.
\(b\) - Fuel based emissions factors were calculated using fuel consumption rate factors from Table D-24 of the Moyer guidelines.
\(c\) - Fuel based factors are for engines less than 750 horsepower only.
\(d\) - Emission standards were converted where appropriate, using the NMHC and NOx fraction default values and the ultra low-sulfur diesel fuel correction factors listed in Tables D-25 and D-26, respectively.
<table>
<thead>
<tr>
<th>Model Year</th>
<th>EO Certification Standards</th>
<th>NOx</th>
<th>ROG(^{(b)})</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre-1990</td>
<td>6.0 NOx 0.6 PM10</td>
<td>111.00</td>
<td>35.14</td>
<td>10.212</td>
</tr>
<tr>
<td>1990</td>
<td>6.0 NOx 0.6 PM10</td>
<td>111.00</td>
<td>35.14</td>
<td>4.255</td>
</tr>
<tr>
<td>1991 - 1993</td>
<td>5.0 NOx 0.25 PM10</td>
<td>92.50</td>
<td>29.29</td>
<td>1.702</td>
</tr>
<tr>
<td>1994 - 1997</td>
<td>5.0 NOx 0.1 PM10</td>
<td>92.50</td>
<td>29.29</td>
<td>1.702</td>
</tr>
<tr>
<td>1998 - 2001</td>
<td>4.0 NOx 0.1 PM10</td>
<td>74.00</td>
<td>23.43</td>
<td>1.702</td>
</tr>
<tr>
<td>2002 - 2006</td>
<td>2.5 NOx + NMHC 0.1 PM10</td>
<td>37.00</td>
<td>11.71</td>
<td>0.170</td>
</tr>
<tr>
<td>2007-2009</td>
<td>1.8 NOx + NMHC 0.01 PM10</td>
<td>26.64</td>
<td>8.43</td>
<td>0.170</td>
</tr>
<tr>
<td>2007-2009</td>
<td>1.5 NOx + NMHC 0.01 PM10</td>
<td>22.20</td>
<td>7.03</td>
<td>0.170</td>
</tr>
<tr>
<td>2007-2009</td>
<td>1.2 NOx + NMHC 0.01 PM10</td>
<td>17.76</td>
<td>5.62</td>
<td>0.170</td>
</tr>
<tr>
<td>2007-2009</td>
<td>0.84 NOx + NMHC 0.01 PM10</td>
<td>12.43</td>
<td>3.94</td>
<td>0.170</td>
</tr>
<tr>
<td>2007-2009</td>
<td>0.5 NOx 0.01 PM10</td>
<td>9.25</td>
<td>2.93</td>
<td>0.170</td>
</tr>
<tr>
<td>2010 +</td>
<td>0.2 NOX 0.01 PM10</td>
<td>3.70</td>
<td>1.17</td>
<td>0.170</td>
</tr>
</tbody>
</table>

\(^{(a)}\) ROG = HC * 1.26639.
\(^{(b)}\) Fuel based emissions factors were calculated using fuel consumption rate factors from Table D-24 of the Moyer guidelines.
\(^{(c)}\) Fuel based factors are for engines less than 750 horsepower only.
\(^{(d)}\) Emission standards were converted where appropriate, using the NMHC and NOx fraction default values listed in Table D-25.
<table>
<thead>
<tr>
<th>Model Year</th>
<th>Diesel(b)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOx</td>
<td>ROG(c)</td>
<td>PM2.5</td>
</tr>
<tr>
<td>Pre-1987</td>
<td>14.52</td>
<td>0.75</td>
<td>0.64</td>
</tr>
<tr>
<td>1987-1990</td>
<td>14.31</td>
<td>0.59</td>
<td>0.69</td>
</tr>
<tr>
<td>1991-1993</td>
<td>10.70</td>
<td>0.26</td>
<td>0.38</td>
</tr>
<tr>
<td>1994-1997</td>
<td>10.51</td>
<td>0.20</td>
<td>0.21</td>
</tr>
<tr>
<td>1998-2002</td>
<td>10.33</td>
<td>0.20</td>
<td>0.23</td>
</tr>
<tr>
<td>2003-2006</td>
<td>6.84</td>
<td>0.13</td>
<td>0.14</td>
</tr>
<tr>
<td>2007-2009</td>
<td>4.01</td>
<td>0.11</td>
<td>0.02</td>
</tr>
<tr>
<td>2007-2009 (0.5 g/bhp-hr NOx or Cleaner)(d)</td>
<td>1.73(d)</td>
<td>0.10(d)</td>
<td>0.02(d)</td>
</tr>
<tr>
<td>2010+</td>
<td>0.74</td>
<td>0.09</td>
<td>0.02</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model Year</th>
<th>Diesel(b)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOx</td>
<td>ROG(c)</td>
<td>PM2.5</td>
</tr>
<tr>
<td>Pre-1987</td>
<td>21.37</td>
<td>1.09</td>
<td>1.15</td>
</tr>
<tr>
<td>1987-1990</td>
<td>21.07</td>
<td>0.86</td>
<td>1.25</td>
</tr>
<tr>
<td>1991-1993</td>
<td>18.24</td>
<td>0.56</td>
<td>0.52</td>
</tr>
<tr>
<td>1994-1997</td>
<td>17.92</td>
<td>0.42</td>
<td>0.34</td>
</tr>
<tr>
<td>1998-2002</td>
<td>89</td>
<td>0.43</td>
<td>0.37</td>
</tr>
<tr>
<td>2003-2006</td>
<td>11.64</td>
<td>0.27</td>
<td>0.23</td>
</tr>
<tr>
<td>2007-2009</td>
<td>6.62</td>
<td>0.23</td>
<td>0.03</td>
</tr>
<tr>
<td>2007-2009 (0.5 g/bhp-hr NOx or Cleaner)</td>
<td>2.88(d)</td>
<td>0.20(d)</td>
<td>0.03(d)</td>
</tr>
<tr>
<td>2010+</td>
<td>1.27</td>
<td>0.19</td>
<td>0.03</td>
</tr>
</tbody>
</table>

---

a - EMFAC 2011 Zero-Mile Based Emission Factors.
b - Emission factors incorporate the ultra low-sulfur diesel fuel correction factors listed in Table D-26 of the Moyer guidelines.
c - ROG = HC * 1.26639.
d - These values are interpolated between 1.2 g/bhp-hr NOx standard for 2007-2009 model years and 0.2 g/bhp-hr NOx standard for 2010+ model years.
### Table 5-E
**Diesel Urban Buses**

<table>
<thead>
<tr>
<th>EO Certification Standards&lt;sup&gt;(f)&lt;/sup&gt;</th>
<th>NOx</th>
<th>ROG&lt;sup&gt;a&lt;/sup&gt;</th>
<th>PM2.5</th>
<th>NOx</th>
<th>ROG&lt;sup&gt;a&lt;/sup&gt;</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g/bhp-hr</td>
<td>g/mile&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>g/gal&lt;sup&gt;c(d)(e)&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0 NOx</td>
<td>0.6 PM10</td>
<td>22.32</td>
<td>1.15</td>
<td>1.59</td>
<td>103.23</td>
<td>5.33</td>
</tr>
<tr>
<td>5.0 NOx</td>
<td>0.1 PM10</td>
<td>18.60</td>
<td>0.96</td>
<td>0.26</td>
<td>86.03</td>
<td>4.44</td>
</tr>
<tr>
<td>5.0 NOx</td>
<td>0.07 PM10</td>
<td>18.60</td>
<td>0.96</td>
<td>0.19</td>
<td>86.03</td>
<td>4.44</td>
</tr>
<tr>
<td>4.0 NOx</td>
<td>0.05 PM10</td>
<td>14.88</td>
<td>0.77</td>
<td>0.13</td>
<td>68.82</td>
<td>3.55</td>
</tr>
<tr>
<td>2.5 NOx + NMHC</td>
<td>0.05 PM10</td>
<td>8.84</td>
<td>0.46</td>
<td>0.13</td>
<td>40.86</td>
<td>2.11</td>
</tr>
<tr>
<td>1.20 NOx</td>
<td>0.01 PM10</td>
<td>4.46</td>
<td>0.23</td>
<td>0.03</td>
<td>20.65</td>
<td>1.07</td>
</tr>
<tr>
<td>0.20 NOx</td>
<td>0.01 PM10</td>
<td>0.74</td>
<td>0.04</td>
<td>0.03</td>
<td>3.44</td>
<td>0.18</td>
</tr>
</tbody>
</table>

* a - ROG = HC * 1.26639.
* b - Mileage based emissions factors were calculated using conversion factors from Table D-28 of the Moyer guidelines.
* c - Fuel based emissions factors were calculated using fuel consumption rate factors from Table D-24 of the Moyer guidelines.
* d - Fuel based factors are for engines less than 750 horsepower only.
* e - Emission standards were converted where appropriate using the NMHC and NOx fraction default values listed in Table D-25 of the Moyer guidelines.
* f - No diesel buses have been certified to the 0.5 g/bhp/hr for the 2004-2006 model year emission standard.

### Table 5-F
**Natural Gas Urban Buses**

<table>
<thead>
<tr>
<th>EO Certification Standards&lt;sup&gt;(f)&lt;/sup&gt;</th>
<th>NOx</th>
<th>ROG&lt;sup&gt;a&lt;/sup&gt;</th>
<th>PM2.5</th>
<th>NOx</th>
<th>ROG&lt;sup&gt;a&lt;/sup&gt;</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g/bhp-hr</td>
<td>g/mile&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>g/gal&lt;sup&gt;c(d)(e)&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0 NOx</td>
<td>0.10 PM10</td>
<td>20.00</td>
<td>6.33</td>
<td>0.37</td>
<td>92.50</td>
<td>29.29</td>
</tr>
<tr>
<td>5.0 NOx</td>
<td>0.07 PM10</td>
<td>20.00</td>
<td>6.33</td>
<td>0.26</td>
<td>92.50</td>
<td>29.29</td>
</tr>
<tr>
<td>4.0 NOx</td>
<td>0.05 PM10</td>
<td>16.00</td>
<td>5.07</td>
<td>0.18</td>
<td>74.00</td>
<td>23.43</td>
</tr>
<tr>
<td>2.5 NOx + NMHC</td>
<td>0.05 PM10</td>
<td>8.00</td>
<td>2.53</td>
<td>0.18</td>
<td>37.00</td>
<td>11.71</td>
</tr>
<tr>
<td>1.8 NOx + NMHC&lt;sup&gt;(f)(g)&lt;/sup&gt;</td>
<td>0.02 PM10</td>
<td>5.76</td>
<td>1.82</td>
<td>0.07</td>
<td>26.64</td>
<td>8.43</td>
</tr>
<tr>
<td>1.2 NOx</td>
<td>0.01 PM10</td>
<td>4.80</td>
<td>1.52</td>
<td>0.04</td>
<td>22.20</td>
<td>7.03</td>
</tr>
<tr>
<td>0.2 NOx</td>
<td>0.01 PM10</td>
<td>0.80</td>
<td>0.25</td>
<td>0.04</td>
<td>3.70</td>
<td>1.17</td>
</tr>
</tbody>
</table>

* a - ROG = HC * 1.26639.
* b - Mileage based emissions factors were calculated using conversion factors from Table D-28 of the Moyer guidelines.
* c - Fuel based emissions factors were calculated using fuel consumption rates from Table D-24 of the Moyer guidelines.
* d - Fuel based factors are for engines less than 750 horsepower only.
* e - Emission standards were converted where appropriate, using the NMHC and NOx fraction default values listed in Table D-25 of the Moyer guidelines.
* f - A majority of the natural gas urban buses have been certified to the optional standards. Therefore, these values are based on the optional standards.
* g - Many natural gas urban buses have been certified to optional standards below this level.
Table 6  Off-Road Emission Factors for Cleaner Vehicle Projects

Find the horsepower and model year for the engine that best describes the engine being replaced to determine the “before project” baseline emission factors. Find the horsepower and model year for the newer engine. These factors represent the “after project” cleaner engine emission factors.

<table>
<thead>
<tr>
<th>Horsepower</th>
<th>Model Year</th>
<th>HC</th>
<th>CO</th>
<th>NOx</th>
<th>PM2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>26 - 50</td>
<td>1987 or older</td>
<td>1.32</td>
<td>5.00</td>
<td>6.51</td>
<td>0.50</td>
</tr>
<tr>
<td>26 - 50</td>
<td>1988 - 1998</td>
<td>1.30</td>
<td>5.00</td>
<td>6.42</td>
<td>0.50</td>
</tr>
<tr>
<td>26 - 50</td>
<td>1999 - 2003</td>
<td>1.04</td>
<td>4.10</td>
<td>5.26</td>
<td>0.44</td>
</tr>
<tr>
<td>26 - 50</td>
<td>2004</td>
<td>0.46</td>
<td>2.27</td>
<td>4.83</td>
<td>0.32</td>
</tr>
<tr>
<td>26 - 50</td>
<td>2005</td>
<td>0.27</td>
<td>3.00</td>
<td>4.69</td>
<td>0.28</td>
</tr>
<tr>
<td>26 - 50</td>
<td>2006 - 2007</td>
<td>0.17</td>
<td>2.86</td>
<td>4.63</td>
<td>0.26</td>
</tr>
<tr>
<td>26 - 50</td>
<td>2008 - 2010</td>
<td>0.07</td>
<td>2.72</td>
<td>4.55</td>
<td>0.12</td>
</tr>
<tr>
<td>26 - 50</td>
<td>2011-2012</td>
<td>0.07</td>
<td>2.72</td>
<td>4.55</td>
<td>0.13</td>
</tr>
<tr>
<td>26 - 50</td>
<td>2013 and newer</td>
<td>0.07</td>
<td>2.72</td>
<td>2.75</td>
<td>0.01</td>
</tr>
<tr>
<td>51 - 120</td>
<td>1987 or older</td>
<td>1.04</td>
<td>4.80</td>
<td>12.09</td>
<td>0.56</td>
</tr>
<tr>
<td>51 - 120</td>
<td>1988 - 1997</td>
<td>0.71</td>
<td>3.49</td>
<td>8.14</td>
<td>0.46</td>
</tr>
<tr>
<td>51 - 120</td>
<td>1998 -2003</td>
<td>0.71</td>
<td>3.49</td>
<td>8.14</td>
<td>0.46</td>
</tr>
<tr>
<td>51 - 120</td>
<td>2004</td>
<td>0.33</td>
<td>3.23</td>
<td>5.35</td>
<td>0.29</td>
</tr>
<tr>
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Sources: Air Resources Board, OFFROAD Modeling Change Technical Memo, OFF-ROAD EXHAUST EMISSIONS INVENTORY FUEL CORRECTION FACTORS, 2005
http://www.arb.ca.gov/msei/offroad/techmemo/arb_offroad_fuels.pdf
OFFROAD2007 Off-Road Emissions Inventory. Software and instructions can be downloaded at http://www.arb.ca.gov/msei/offroad/offroad.htm

Other information needed to estimate emissions are operating hours and load factor. Operating hours for construction equipment can range from 535 to 1641 hours per year and the load factor can vary between 0.43 and 0.78. Operating hours for agricultural equipment can range from 90 to 790 hours per year and the load factor can vary between 0.43 to 0.70.

April 2013
Table 7  Medium-Duty Vehicle Emission Factors
For Vanpool and Shuttle Evaluations
(Model Years 1995 - 2003)

Note: Table 7 is now obsolete and has been deleted.
Please refer to Table 2 or Tables 5-A through 5-F, as appropriate for medium and heavy-duty emission factors.
Appendix H – ARB CMAQ PM10 Size Fractions Referenced to PM2.5 Table, 2013
PM10 Size Fractions Referenced to PM2.5
For use in calculating cost effectiveness of on-road vehicle projects
PM10 = PM2.5 X Factor

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From: Table 4.12-5 in http://www.arb.ca.gov/msei/onroad/downloads/tsd/TotalPM_Emfac00.pdf
Note that original table contains factors referenced to Total Suspended Particulate (PM30).

July 2013