Overview of CMAQ Air Quality Evaluation for Street Sweeper and Paving Projects

MAG Street Committee
June 9, 2015

MARICOPA ASSOCIATION of GOVERNMENTS

FHWA Congestion Mitigation and Air Quality (CMAQ) Program

- Moving Ahead for Progress in the 21st Century Act reauthorized the CMAQ Program
- Purpose: To fund transportation projects and programs that will contribute to attainment or maintenance of the federal air quality standards for ozone, carbon monoxide, and particulate matter (PM-10, PM-2.5)
- MAP-21 continues requirement for MPOs to give priority to cost-effective projects

FHWA Guidance Overview

- **FHWA published Interim Program Guidance – November 12, 2013**
  - **Eligible activities include treating dirt or gravel roads and purchasing street sweeping equipment**
  - **Proposals for CMAQ funding should include a precise description of the project (e.g. information on its size, scope, location, and timetable.)**
  - **Assessment of the project's expected emission reduction benefits and cost-effectiveness should be completed prior to project selection to better inform the selection of CMAQ projects**

ENVIRONMENTAL PROGRAMS

MAG CMAQ Methodologies

- **MAG CMAQ Methodologies, first published in 1999, was last updated in September 2011**
  - **Quantifies proposed project emission reductions in kilograms per day**
  - **Cost-effectiveness for project in dollars per metric ton of emissions reduced annually**
  - **Available at: http://www.azmag.gov/Documents/CMAQ_2011-04-05_Final-CMAQ-Methodologies_3-31-2011.pdf**

MAG CMAQ Methodologies

ENVIRONMENTAL PROGRAMS

- **Emissions benefit calculations**
  - Reductions in carbon monoxide (CO), total organic gases (TOG), nitrogen oxides (NOx), and particulate matter (PM) emissions in kilograms per day
  - Apply EPA-approved emissions model MOVES2014 and EPA AP-42 equations for reentrained dust from paved and unpaved roads to obtain emission rates
  - Emission rates are calculated for the first year that the project is implemented

ENVIRONMENTAL PROGRAMS

MAG CMAQ Methodologies

- **Emissions benefit calculations**
  - **Seasonal adjustments**
    - **The CO emission rate is divided by four to represent the 3-month winter season**
    - **The TOG and NOx emission rates are divided by two to reflect the 6-month ozone season**
    - **PM is not adjusted seasonally, because violations can occur at any time of year**
  - **Priority weights**
    - **The CO weight is set to zero, since the CO standard has been attained**
    - **The weights for TOG, NOx, and PM are set to one**

ENVIRONMENTAL PROGRAMS

MAG CMAQ Methodologies

- Calculates CO, TOG, NOx, and PM emission reductions in kilograms per day
- Applies seasonal factors and weights to the emissions reduced for each pollutant
- Converts emission reductions to metric tons per year
- Amortizes CMAQ cost over the life of the project, assuming a 3 percent annual discount rate
- Divides the annualized CMAQ cost by the annual emissions reduction to obtain cost-effectiveness (in dollars per metric ton)

ENVIRONMENTAL PROGRAMS

Street Sweeper Projects

- **Emission reductions from reducing PM-10 reentrained by vehicles on paved roads**
  - **Replace an older sweeper not on the list of Certified Street Sweepers under South Coast AQMD Rule 1186**
  - **Replace an older certified sweeper that:**
    - **At least eight years old**
    - **Recorded 12,000 hours in service**
    - **96,000 miles of operation**
  - **Increase the frequency of sweeping**
  - **Expand the area swept**
  - **Any combination of the above**

ENVIRONMENTAL PROGRAMS

Street Sweeper Projects

- **Project application provides inputs to the emission reduction calculation**
  - CMAQ funding requested
  - Sweeping cycle length measured in days between sweeping by road type to be swept (e.g. arterial, collector, residential) or other
  - Number of lane miles to be swept per cycle by road type
  - Average weekday traffic on streets by road type
  - If expanding service area, specify unswept lane miles to be swept
  - If increasing sweeping frequency, specify previous cycle length
  - If replacing an older certified sweeper, an estimate of the percent of time the older sweeper was out of service due to repairs
  - Indicate whether the project is located in the Salt River Area, or if the project is within 4 miles of a PM-10 monitor

ENVIRONMENTAL PROGRAMS

Street Sweeper Example Calculation

$$CEF = \frac{0.21 + 0.24 + 0.26 + 0.29 + 0.31 + 0.34 + (8 * 0.35)}{14} = 0.318$$

$$PEF = \frac{0.10 + 0.14 + 0.17 + 0.21 + 0.23 + 0.26 + 0.29 + 0.31 + 0.34 + (5 * 0.35)}{14} = 0.271$$

$$Daily\ Emissions\ Reduction\ for\ Reentrainment = 2 * 200 * (5{,}000 * 0.93) * (0.318 - 0.271) * \frac{1}{1000} = 87.42\ \frac{kilograms}{day}$$

$$Daily\ Emissions\ Reduction\ for\ the\ Sweeping\ Process = 2 * \frac{200}{14} * 0.023 = 0.66\ \frac{kilograms}{day}$$

$$Total\ Daily\ Emissions\ Reduction = 87.42 + 0.66 = 88.08\ \frac{kilograms}{day}$$

$$CRF = \frac{(1+0.03)^8 * (0.03)}{(1+0.03)^8 - 1} = 0.1425$$

$$Cost\text{-}Effectiveness = \frac{0.1425 * 135{,}000 * 1000}{88.08 * 365} = 598\ \frac{dollars}{metric\ ton}$$

ENVIRONMENTAL PROGRAMS

Paving Unpaved Road Projects

- **Project application provides inputs to the emission reduction calculation**
  - CMAQ funding requested
  - Number of segments to be paved
  - Average weekday traffic per segment
  - Length of each segment to be paved in miles
  - Length of shoulders, curb and gutter to be paved and whether the improvements are on one or both sides of the roadway
  - Number of access points to be paved
  - Current roadway surface (e.g. gravel or stabilized with dust suppressants)
  - Indicate whether the project is located in the Salt River Area, or if the project is within 4 miles of a PM-10 monitor

ENVIRONMENTAL PROGRAMS

Paving Project Example Calculation

$$\textit{Daily Emissions Reduction} = 1.0 * 658.69 * 1.0 * 120 * 0.93 * \frac{1}{1000} = 73.51 \frac{\textit{kilograms}}{\textit{day}}$$

$$\textit{Daily Emissions Reduction} = 1.0 * 0.76 * 1.0 * 120 * 0.93 * \frac{1}{1000} = 0.08 \frac{\textit{kilograms}}{\textit{day}}$$

$$\textit{Daily Emissions Reduction} = 1.0 * 343 * 4 * \frac{1}{1000} = 1.37 \frac{\textit{kilograms}}{\textit{day}}$$

$$\textit{Total Daily Emissions Reduction} = 73.51 + 0.08 + 1.37 = 74.96 \frac{\textit{kilograms}}{\textit{day}}$$

$$\textit{Capital Recovery Factor } (\textbf{\textit{CRF}}) = \frac{(1+0.03)^{20} * (0.03)}{(1+0.03)^{20} - 1} = 0.0672$$

$$\textit{Cost-Effectiveness} = \frac{0.0672 * 600{,}000 * 1000}{74.96 * 365} = 1{,}474 \frac{\textit{dollars}}{\textit{metric ton}}$$

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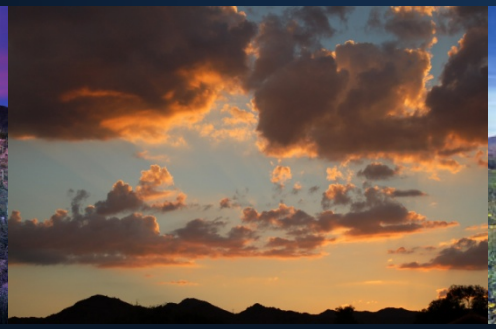


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