CMAQ Methodologies

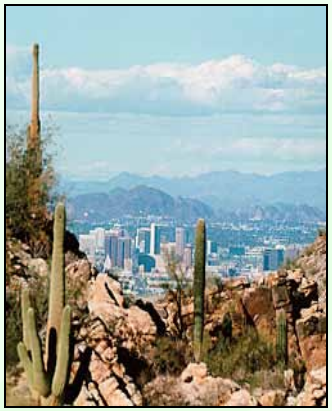
Air Quality Technical Advisory Committee

June 24, 2010

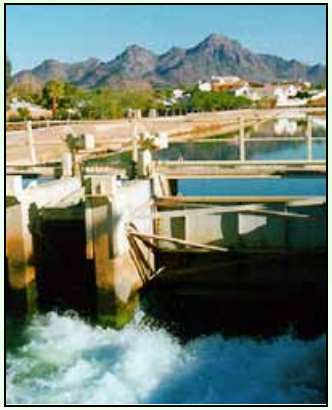
MARICOPA ASSOCIATION of GOVERNMENTS

ENVIRONMENTAL PROGRAMS

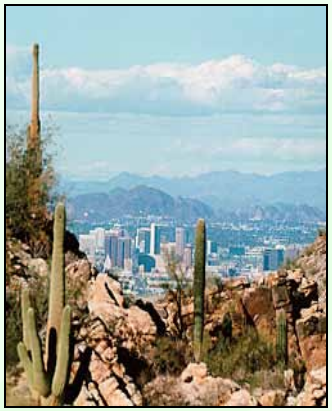
Congestion Mitigation and Air Quality Improvement (CMAQ) Program

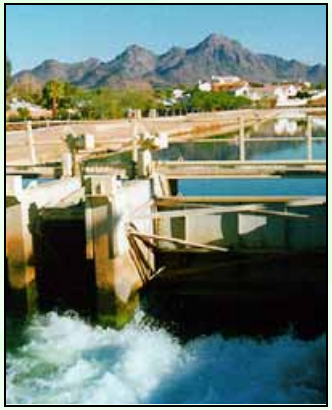


- **Established by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA)**
- **Continued under the Transportation Equity Act for the 21st Century (TEA-21)**
- **Reauthorized by the Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU)**
  - $8.6B authorized over the period 2005-2009



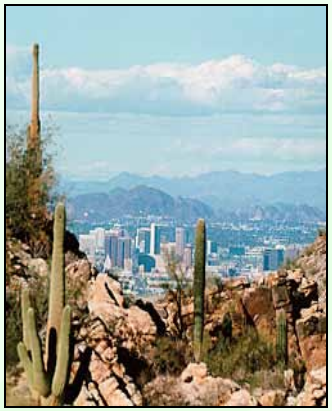
Purpose - *To fund transportation projects or programs that will contribute to attainment or maintenance of the National Ambient Air Quality Standards for ozone, carbon monoxide and particulate matter*

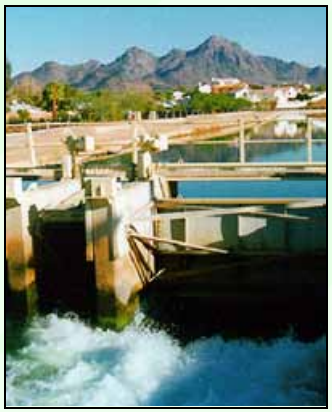




CMAQ Funding

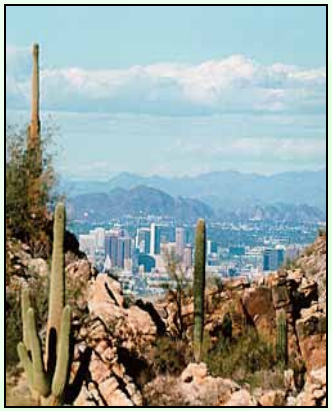
- **CMAQ authorization levels are apportioned annually to states by a federal formula**
- **Apportionment formula considers**
  - County population from U.S. Census
  - Clean Air Act designation and classification at time of apportionment
    - Nonattainment or maintenance areas for carbon monoxide (CO) or ozone
    - Higher priority given to:
      - Nonattainment/maintenance areas for *both* CO and ozone
      - Nonattainment areas classified as Moderate, Serious, Severe or Extreme for ozone

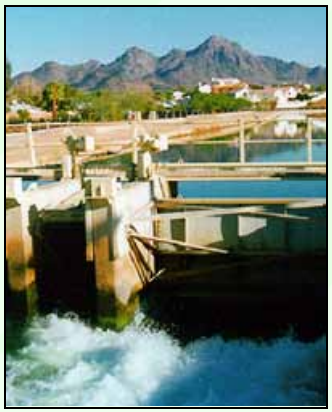




CMAQ Funding

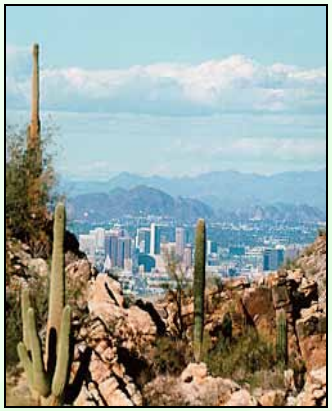
- **Basis for Apportionment**
  - Each state receives a minimum of 0.5% of total annual apportionment of federal CMAQ funds
  - SAFETEA-LU “equity bonus” guarantees states will receive back 90+ percent of their estimated tax contributions to the Highway Trust Fund
    - Donor states, like Arizona, typically receive a higher apportionment of CMAQ (and other federal transportation) funds

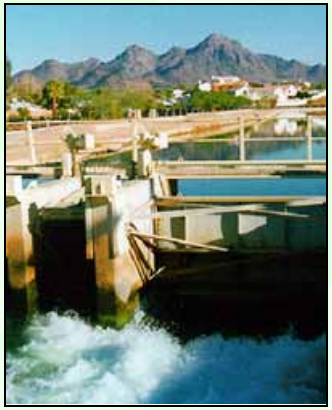




CMAQ Funding

- **Apportionment to Arizona**
  - Based on Maricopa County's designation as a carbon monoxide maintenance area and an ozone nonattainment area
  - Maricopa County 2000 Census population x factor (1.0) for CO maintenance areas x factor (1.0) for ozone nonattainment areas x factor (1.2) for both CO and ozone
- **Arizona was apportioned ≈ $50M in FY 2010**
  - Represents about 2% of annual federal CMAQ appropriation plus increase due to "equity bonus"
  - Obligation authority limits how much of the apportionment may be spent
- **The MAG region receives the CMAQ funds allocated to Arizona**

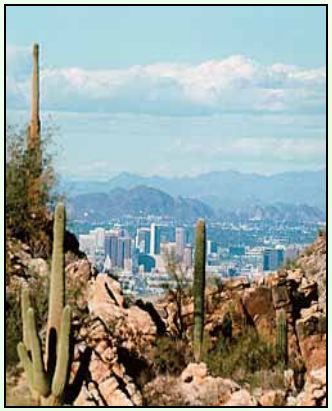


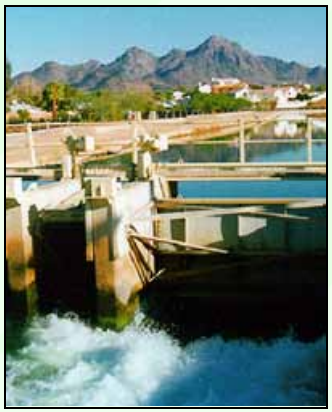


CMAQ Funding

- **Apportionment Issues**
  - Unknowns in new federal transportation reauthorization bill for FY10 and beyond
  - A number of new nonattainment areas for the more stringent eight-hour ozone standard will be designated by EPA in 2010
  - Higher population levels for Maricopa County in the 2010 U.S. Census
  - Lower Arizona tax contributions to the Highway Trust Fund (due to the recession)

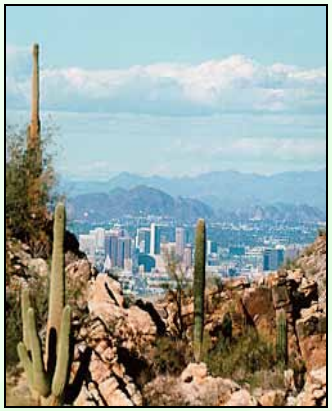
SAFETEA-LU Changes to the CMAQ Program (23 USC §149)

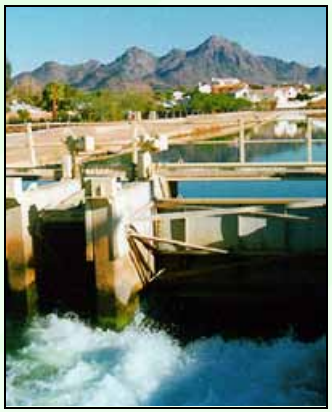




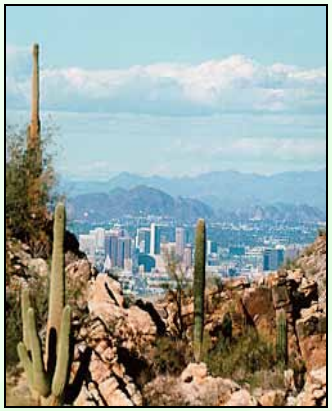
- **Identifies projects eligible for CMAQ**
  - **Advanced truck stop electrification systems**
    - That contribute to attainment of the national ambient air quality standards (NAAQS)
  - **Transportation systems management and operations improvements**
    - That mitigate congestion and improve air quality
  - **Purchase of integrated, interoperable emergency communications equipment**

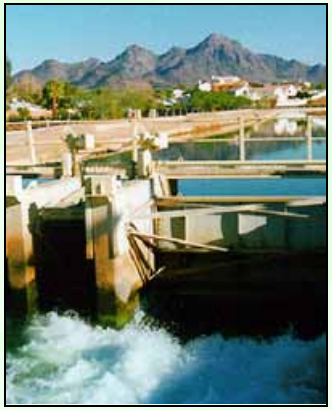
SAFETEA-LU Changes to the CMAQ Program (23 USC §149)





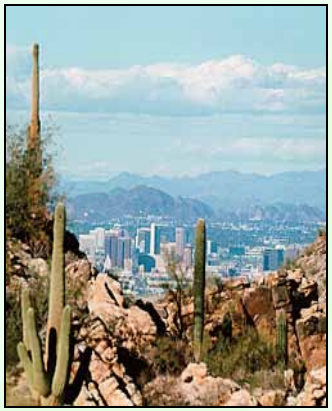
- **Identifies projects eligible for CMAQ**
  - **Diesel retrofits for on-road motor vehicles and non-road vehicles and engines used for construction**
    - Replacement, repowering, rebuilding, after treatment, or other technology approved by EPA
    - EPA's "The Cost Effectiveness of Heavy-Duty Diesel Retrofits and Other Mobile Source Emission Reduction Projects and Programs"
      - http://www.epa.gov/cleandiesel/publications.htm

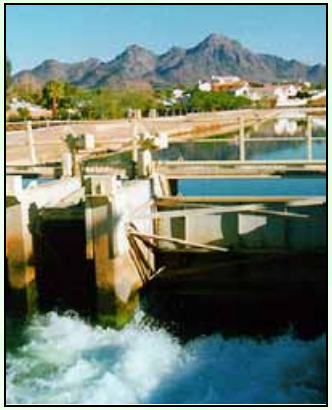




SAFETEA-LU Changes to the CMAQ Program (23 USC §149)

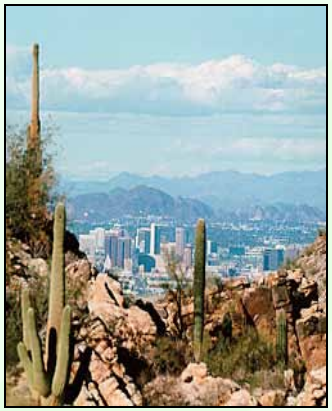
- **Priority consideration should be given to**
  - Diesel retrofits and other cost-effective emission reduction activities, taking into consideration air quality and health effects; and
  - Cost-effective congestion mitigation activities that provide air quality benefits
- **Savings clause –** Above is not intended to disturb the existing authorities and roles of governmental agencies in making final project selections
- **Encourages interagency consultation on estimated emission reductions for proposed CMAQ programs and projects**

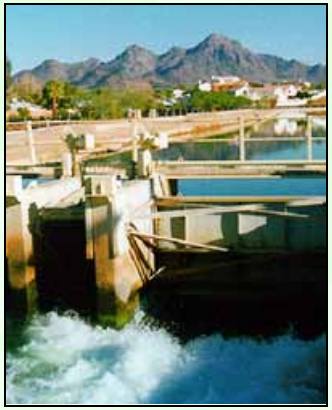




Eligibility for CMAQ Funding

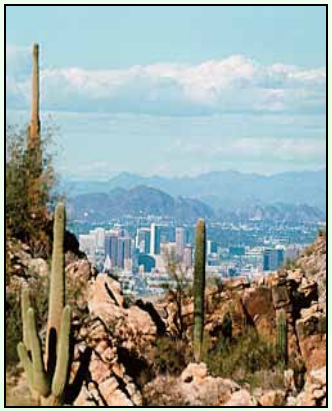
- **Programs/Projects**
  - Must reduce transportation-related carbon monoxide, ozone precursor (TOG, NOx), or particulate matter (PM-10, PM-2.5) emissions
    - SAFETEA-LU emphasizes cost-effectiveness
  - Must be located in (or in proximity to and primarily benefiting) nonattainment or maintenance areas for ozone, carbon monoxide or particulate matter
  - Must come from a conforming TIP and transportation plan
  - Must meet NEPA and federal funding requirements under titles 23 and 49 of the U.S. Code
- **Priority should be given to transportation activities in approved air quality plans and Transportation Control Measures (TCMs)**

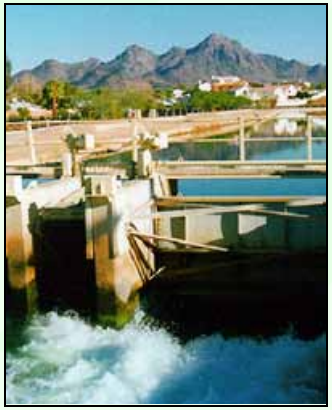




Eligibility for CMAQ Funding

- **Capital Investment**
  - CMAQ funds may be used for new or expanded transportation projects and programs that reduce emissions
- **Operating Assistance**
  - Limited to three years
  - Applies to new transit services, intermodal facilities, and travel demand management strategies (including traffic operation centers); and the incremental cost of expanding existing transit services
  - Intent is to help start up viable new services that will demonstrate air quality benefits and eventually cover their own costs
- **Planning and Project Development**
  - NEPA studies (e.g., preliminary engineering) qualify
  - Planning studies that do not support specific project development do not qualify (e.g., major investment study)

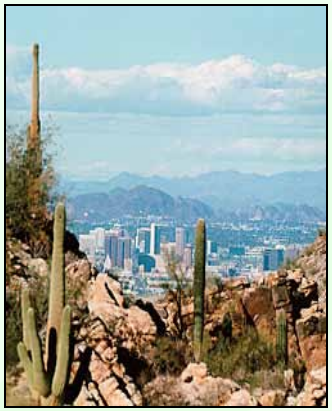


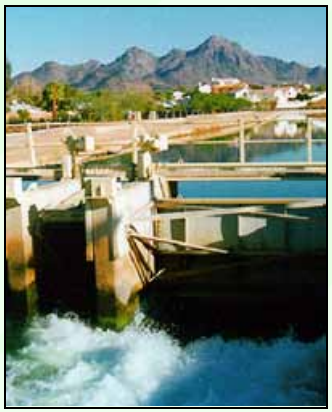


Examples of Programs/Projects Eligible for CMAQ Funding

- Public transit
- Bus or HOV lanes
- Employer-based Transportation Management Plans and trip reduction ordinances
- Traffic flow improvements that reduce emissions
- Park and ride lots
- Bicycle and pedestrian facilities
- Rideshare and telecommuting programs
- Public education and outreach activities
- Vanpooling
- Diesel retrofits
- Idling reduction programs
- Experimental pilot projects

Programs/Projects Not Eligible for CMAQ Funding

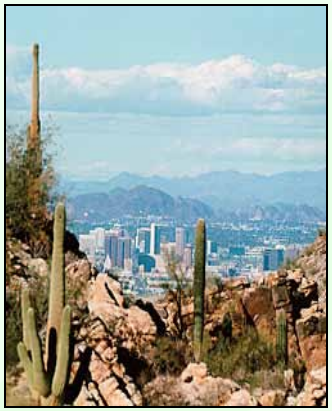


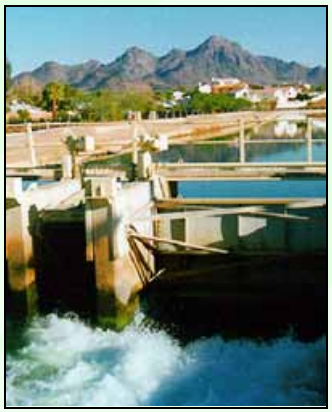


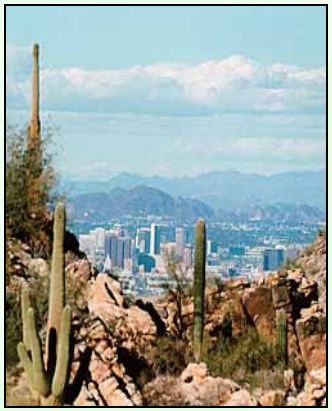
- Light-duty vehicle scrappage programs
- Highway capacity expansion projects (except HOV lanes)
- Routine maintenance and rehabilitation of transportation infrastructure
- Administrative costs of the CMAQ program
- Stand-alone projects to purchase alternative fuels
- Projects that do not meet the eligibility requirements of titles 23 and 49 U.S.C.

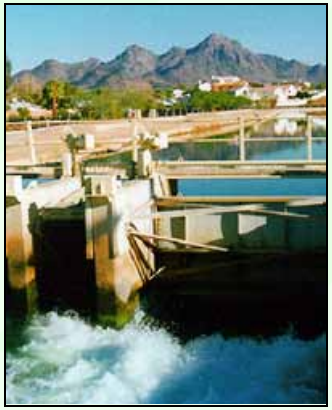
CMAQ Project Selection Process

- **All proposals for CMAQ funding must**
  - Include a precise project/program description
    - Size, scope, location and timetable
  - Include an assessment of expected emission benefits
    - Quantify emission benefits (reductions) and disbenefits (increases)
      - For all pollutants for which the area is in nonattainment or maintenance, including precursor emissions
    - Ensure that the benefits are credible and based on reproducible and logical analytical procedures
    - If impossible to quantify the benefits, provide a qualitative assessment
      - Based on a reasoned and logical determination that the project decreases emissions and contributes to attainment or maintenance of the NAAQS



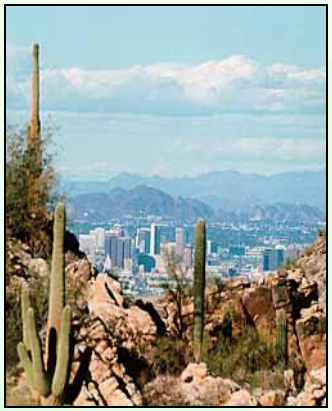


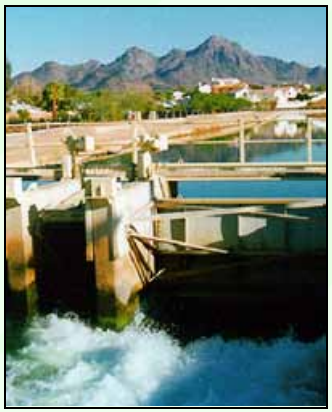




MAG CMAQ Methodologies

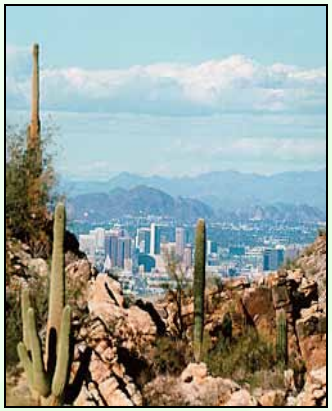
- **Federal CMAQ guidance, 10/20/08**
  - Analytical procedures are needed to quantify the emission benefits and disbenefits of proposed CMAQ projects and programs
- **MAG Quantitative Measures**
  - Emission reductions or increases (in kilograms per day)
  - Cost-effectiveness (in dollars per metric ton of emission reduced annually)
- **MAG "Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects"**
  - First published in 1999; last updated on April 16, 2009
  - Based on input from MAG CMAQ Workshops
    - Last workshop conducted on March 31, 2009

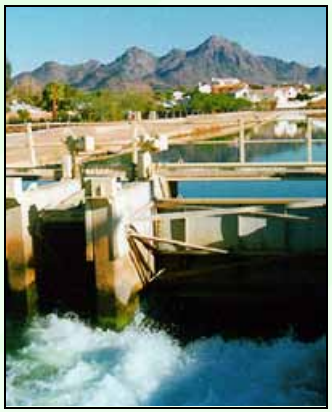




MAG CMAQ Methodologies

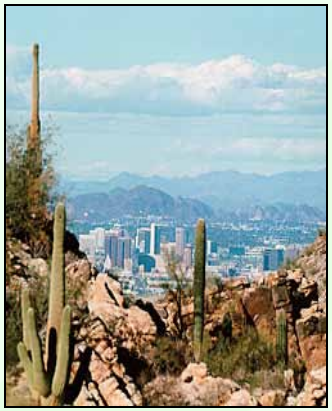
- **MAG guidance on CMAQ project eligibility**
  - Provided in Appendix C of the MAG Transportation Programming Guidebook
  - www.mag.maricopa.gov/detail.cms?item=8074
- **In a typical year, the MAG CMAQ methodologies are applied to evaluate**
  - CMAQ-eligible projects proposed for the last year of the Transportation Improvement Program (TIP)
  - CMAQ-eligible projects proposed for Fiscal Year-End Closeout funds
  - PM-10 certified street sweepers proposed for purchase
  - Proposed projects to pave unpaved roads and alleys
  - Projects implemented with CMAQ funds in the prior calendar year for the annual report required by FHWA

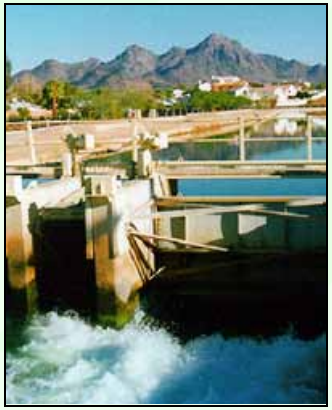




MAG CMAQ Methodologies

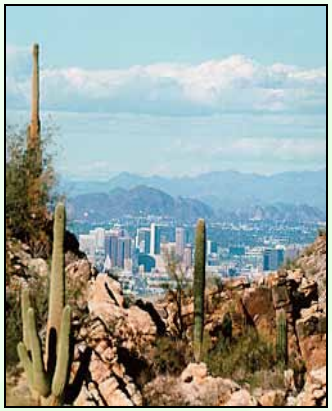
- **Project types** (key factors used to quantify emission reductions**)**
  - **Bicycle and pedestrian facilities** (trips and VMT reduced)
  - **Bus and rail projects** (VMT reduced)
  - **Diesel retrofits** (new vs old technology emission factors)
  - **Anti-idling programs** (idling reduced)
  - **Intersection improvements** (delay reduced)
  - **Ozone education program** (VMT reduced)
  - **Park and ride facilities** (VMT reduced)
  - **Paving projects** (unpaved vs paved road emission factors)

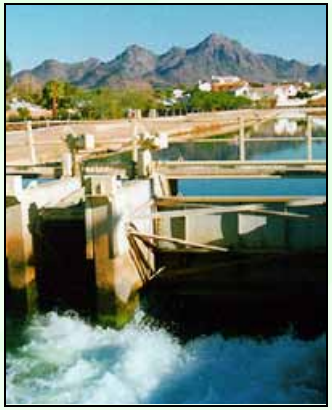




MAG CMAQ Methodologies

- **Project types** (key factors used to quantify emission reductions)
  - **PM-10 certified street sweepers** (emission factors before and after sweeping)
  - **Rideshare programs** (VMT reduced)
  - **Telework program** (VMT reduced)
  - **Traffic signal coordination** (speed increase)
  - **ITS** and **Freeway Management System** (delay reduced)
  - **Trip reduction program** (VMT reduced)
  - **Vanpool vehicles** (VMT reduced)



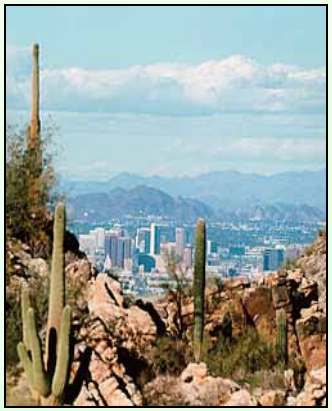


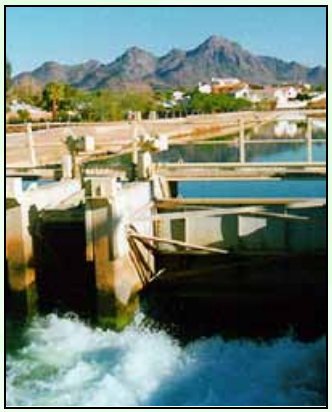
MAG CMAQ Methodologies

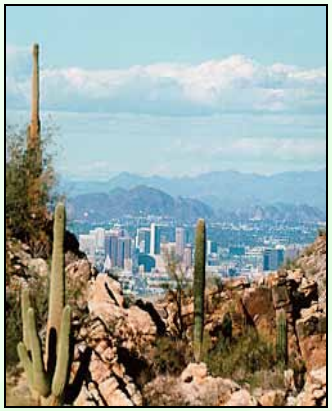
- **In 2008, Sierra Research compared MAG's CMAQ methodologies with those used in other western communities**
  - **Conclusions** - The MAG methodologies adequately address the key issues in the latest transportation legislation (i.e., SAFETEA-LU) with respect to:
    - Evaluation and prioritization of diesel retrofit projects
    - Prioritization of projects based on cost-effectiveness
    - Allows funding of transportation systems management and operations projects that mitigate congestion and improve air quality
  - **"Overall, the methods established by MAG for computing the cost-effectiveness of proposed CMAQ projects are still the most sophisticated of the states and communities surveyed, particularly for fugitive dust emission calculations."**

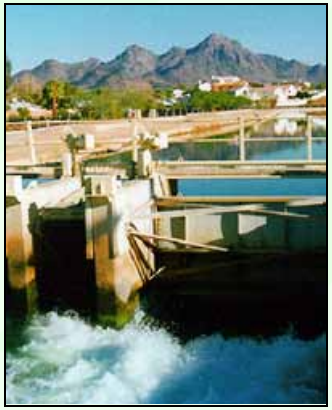
MAG CMAQ Methodologies

- **Revisions to April 2009 methodologies**
  - Emission factors are consistent with the 2007 MAG Ozone and PM-10 Plans
  - Includes a new diesel truck anti-idling methodology (Auxiliary Power Units)
  - Doubles the weights on the ozone precursor emissions in the cost-effectiveness calculation
    - Due to the new, more stringent 8-hr ozone standard
  - Requests project sponsors provide estimates of vehicle hours of delay reduced for Intersection Improvements and ITS and FMS projects







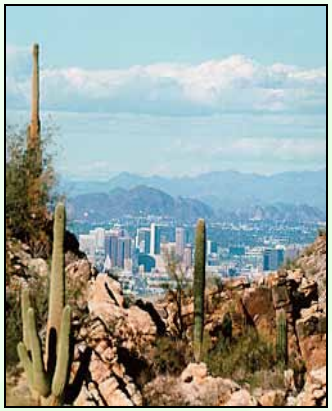


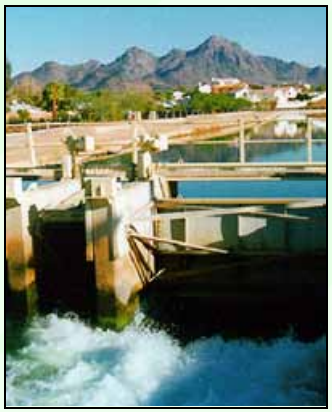
MAG CMAQ Methodologies

- **MAG will update the methodologies in 2010 to incorporate**
  - MOVES2010 emission rates
  - The new methodology for evaluating ITS projects developed by Lee Engineering/TTI
  - Data from the 2008 Household Travel Survey and other local studies
  - Input from the CMAQ Methodologies Workshop to be conducted in August 2010

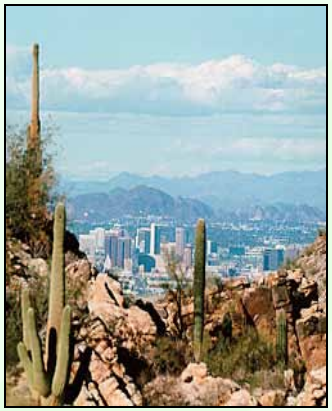
MAG CMAQ Methodologies

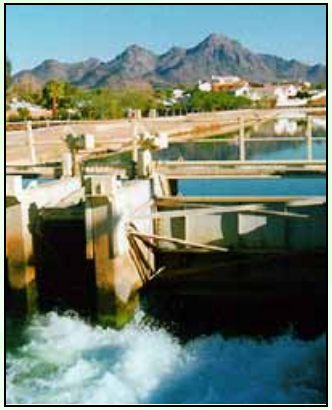
- **Emission benefit calculation**
  - Reductions or increases in carbon monoxide (CO), total organic gases (TOG), nitrogen oxides (NOx), and particulate matter (PM-10) emissions (in kilograms per day)
  - Apply latest EPA emissions model and AP-42 (for reentrained dust from paved and unpaved surfaces) to obtain emission rates
  - Emission rates are calculated for the first year that the project is implemented





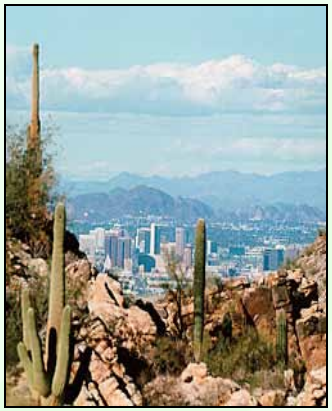
MAG CMAQ Methodologies

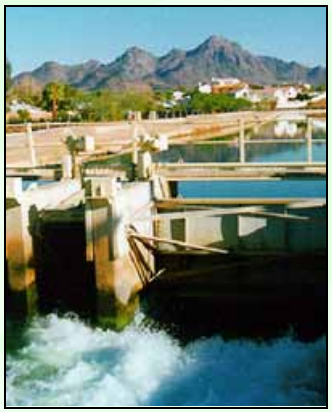




Cost-effectiveness calculation

- 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 six-month ozone season
  - PM-10 is not adjusted seasonally, because violations can occur at any time of year



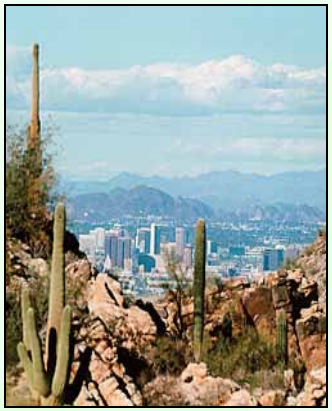


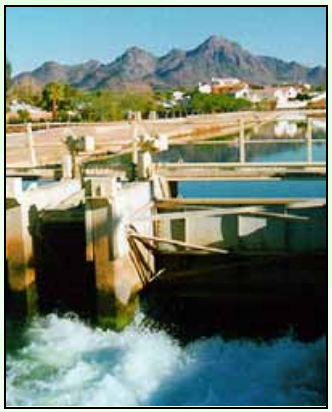
MAG CMAQ Methodologies

Cost-effectiveness calculation

- Priority weights
  - The CO weight is zero, because the CO standard has been attained and monitored concentrations continue to fall
  - The weight for TOG = 0.89, NOx = 1.03, and PM-10 = 1.00
    - These weights equalize the 2008 light duty vehicle emission rates for TOG, NOx and PM-10 (0.68 g/mile)
    - The PM-10 emission rate includes exhaust, tire wear, brake wear, and reentrained dust from paved roads

MAG CMAQ Methodologies

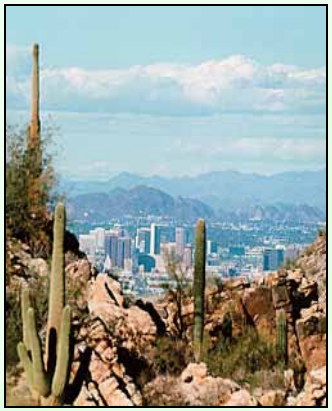


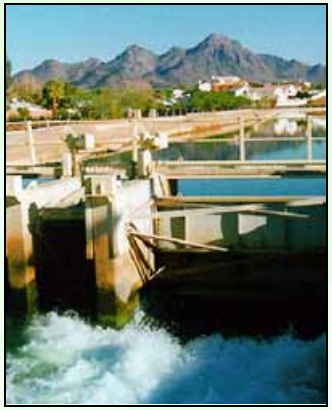


MAG CMAQ spreadsheet model

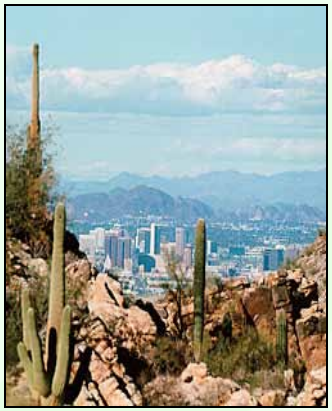
- Calculates CO, TOG, NOx and PM-10 emission reductions in kilograms per day
- Applies seasonal factors and weights to the emissions reduced for each pollutant
- Converts emission reductions to metric tons per year
- Amortizes CMAQ cost over the life of the project, assuming a 3% annual discount rate
- Divides the annualized CMAQ cost by the annual emissions reduction to obtain cost-effectiveness (in dollars per metric ton)

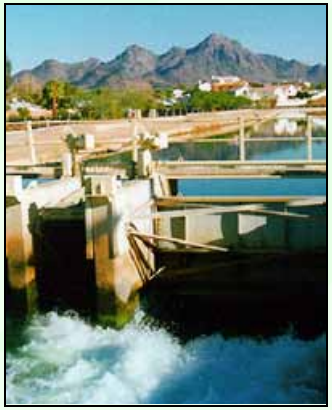
MAG CMAQ Methodologies





- **Cost-effectiveness**
  - The more emissions reduced per CMAQ dollar spent, the higher the ranking of the CMAQ project
- **Time constraints on calculations**
  - Typically, MAG staff has no more than two weeks to apply the methodologies, calculate cost-effectiveness, and rank all CMAQ project requests





MAG CMAQ Methodologies

- **Cost-effectiveness for example projects ($/metric ton)**
  - Purchase a PM-10 certified sweeper - $473
  - Pave unpaved road with curb and gutter - $1,521
  - Telework program - $2,696
  - Ozone education program - $3,222
  - Regional rideshare program - $4,025
  - Trip reduction program - $4,090
  - Bike lane with shoulder paving - $5,648
  - Park and ride lot - $10,461
  - Retrofit diesel vehicles with catalysts and particulate traps - $10,625
  - Truck stop electrification project - $11,802
  - Auxiliary power units on diesel buses - $24,973
  - New light rail service - $30,007
  - New diesel bus for new route - $59,178
  - Purchase a vanpool vehicle - $61,416
  - Freeway Management System - $138,936
  - Bike lane without shoulder paving - $168,288
  - Traffic signal coordination - $310,685
  - Intelligent Transportation System - $433,470
  - Roundabout - $662,795
  - Add turning lanes - $1,142,749

For more information

Contact:
Cathy Arthur
(602) 254-6300

www.mag.maricopa.gov

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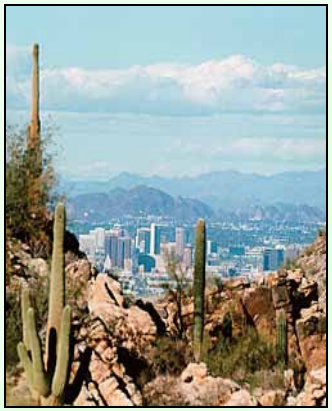
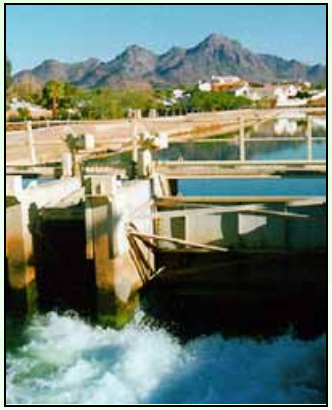
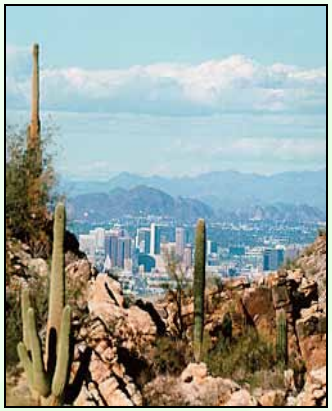
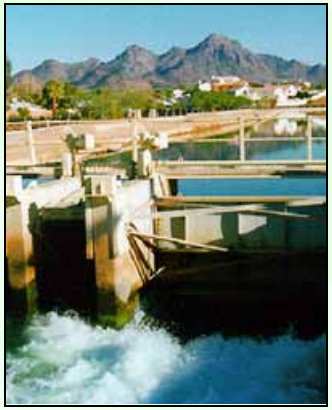




MAG CMAQ Methodologies

- **Example #1**
  - **Traffic Signal Coordination Project**
    - Before: Interconnected, pre-timed signals with actively managed timing
    - After: Advanced computer-based control system
    - CMAQ cost = $135,000
    - Length of project = 3 miles
    - Speed before project = 25 mph
    - ADT = 10,000
  - **Reduces CO, TOG, NOx, but not PM-10**





MAG CMAQ Methodologies

- **Traffic Signal Coordination Project**
  - From Table 6 – Project will increase speeds by 8 percent; from 25 mph to 27 mph

Daily Emission Reduction =

3 miles x 10,000 ADT x 0.91 x 1/1000 x

((0 x 5.65/4 + 0.89 x 0.47/2 + 1.03 x 0.53/2) -

(0 x 5.59/4 + 0.89 x 0.46/2 + 1.03 x 0.52/2)) =

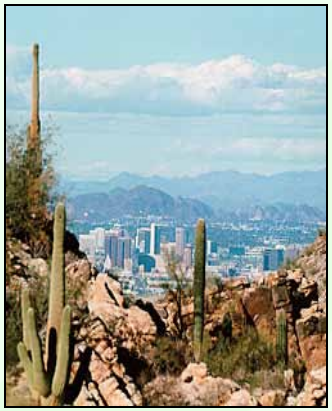
0.26 kg/day

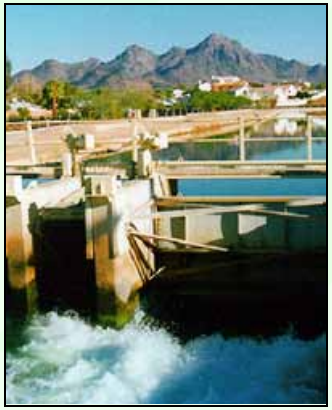
CMAQ Cost-Effectiveness =

0.2184 x $135,000 x 1000/(0.26 x 365) =

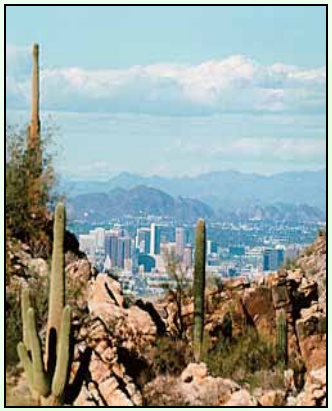
$310,685/metric ton

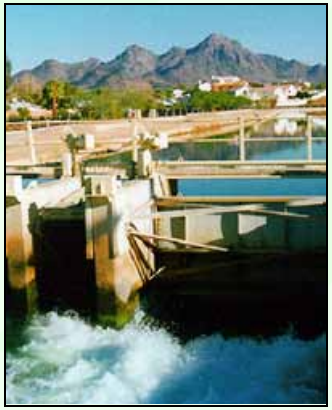
MAG CMAQ Methodologies





- **Example #2**
  - **PM-10 Certified Street Sweeper**
    - To replace a non-certified sweeper
    - No increase in frequency or area swept
    - CMAQ cost = $135,000
    - ADT (per though lane swept) = 5,000
    - Days between sweeping cycles = 14
    - Lane miles swept per cycle = 200
  - **Reduces PM-10 only**





MAG CMAQ Methodologies

- **PM-10 Certified Street Sweeper**
  - Average daily EF for a conventional sweeper with a 14 day sweeping cycle = **0.836 g/mi**
  - Average daily EF for a PM-10 certified sweeper with a 14 day sweeping cycle = **0.714 g/mi**

Daily Emission Reduction

(200 miles x 5,000 ADT x 1/1000 x 1.00 x (**0.836 – 0.714**)) + (1.00 x 200/14 x 0.023) = 111.35 kg/day

CMAQ Cost-Effectiveness

0.1425 x $135,000 x 1000/(111.35 x 365) = $473/metric ton