

# Next Steps in Denver Ozone Modeling – Phase I: Near-Term 2015/2020 Modeling Phase II: Longer-Term Model Improvements

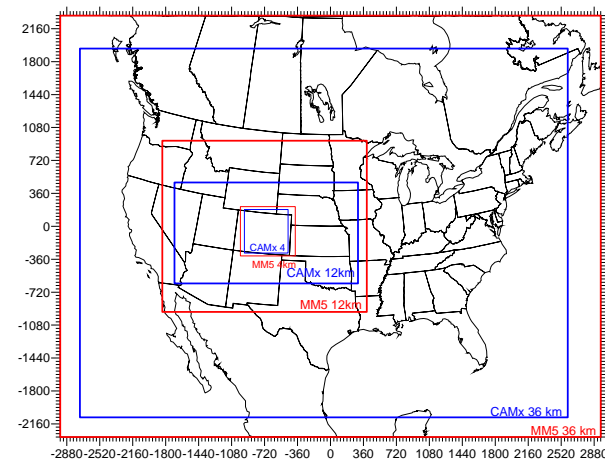
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# Denver SIP Ozone Modeling

- During 2008, ENVIRON/Alpine developed a photochemical modeling database used for 2010 Ozone Attainment Demonstration
  - Addresses the 1997 0.08 ppm (85 ppb) 8-hour ozone NAAQS
  - MM5 meteorological and SMOKE emissions models
    - CONCEPT MV used for Denver on-road mobile sources
  - CAMx photochemical grid model ([www.camx.com](http://www.camx.com))
  - June-July 2006 episode
  - 36/12/4 km modeling
    - 4 km Colorado domain



# Denver SIP Ozone Modeling

- 2006 Base Case and Model Performance Evaluation
  - Reproduced many of the salient features leading to high ozone in the Denver area
  - Achieved EPA's model performance goals on most days
- 2010 sensitivity, source apportionment and attainment demonstration modeling
  - Maximum projected 2010 8-hour ozone Design Value = 84 ppb
    - Passes modeled ozone attainment test

## New 8-Hour Ozone NAAQS

- On March 12, 2008, EPA promulgated a new 0.075 ppm 8-hour ozone NAAQS with SIPs due by March 2013
  - RAQC/CDPHE wish to obtain preliminary estimates of 2015/2020 ozone levels in advance of the 0.075 ppm 8-hour ozone SIP development due March 2013
  - RAQC/CDPHE would also like to use what they have learned from the current SIP process to develop improved photochemical modeling databases for the Denver area

# 2009 Denver Ozone Modeling Work

- Phase I: January – June 2009
  - Obtain a preliminary estimate of projected 2015 and 2020 8-hour ozone concentrations using existing modeling databases and an estimate of most effective VOC/NO<sub>x</sub> controls for reducing ozone by June 2009
    - Costs = \$138,000 (integrated program)
- Phase II: June – November 2009
  - Perform analysis and sensitivity modeling designed to better understand and improve our ozone modeling capability for the Denver region
    - Costs = \$157,000 (Tasks can be funded individually)
- 2010 +
  - Begin 8-hour ozone SIP development process to demonstrate attainment of the new 0.075 ppm 8-hour ozone NAAQS for submission to EPA by March 2013

# Phase I: 2015/2020 Ozone Projections

- 2006 Base Case Updates
  - Oil & Gas Emissions Update (2006/2015/2020)
  - CAMx Base Case modeling with Plume-in-Grid for major stationary NOx and VOC sources
- 2015/2020 Emissions Modeling
  - Non-Colorado Emissions from WRAP (2002/2018)
  - Colorado emissions from CDPHE/APCD
  - CONCEPT MV Denver on-road mobile
- 2015/2020 CAMx Base Case
  - Ozone Projections
  - Ozone Source Apportionment
- 2015/2020 VOC/NOx Emission Sensitivity Tests
- Report, Meetings & Technology Transfer
- Perform during January – June 2009

## Phase II: Identification of Areas for Model Improvement

1. Model underestimation of VOC species suggest possible inventory underestimation of mobile source and oil and gas VOC emissions
  2. Meteorological modeling not capturing all of the meteorological processes for some days
  3. Mobile sources emissions in NFRCOG region not modeled as accurately as in the DRCOG network area
  4. Alternative air quality model (CMAQ) may provide insight into model performance issues
- Denver Phase II work would be initiated ~June 2009 and completed ~November 2009

# Denver 2015/2020 Phase I Schedule

**Figure 1.** Schedule (2009) and cost summary for the Denver 8-hour ozone 2015/2020 modeling and database enhancement study.

Task	Cost	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
<b>Phase I: 2015/2020 Ozone Projections</b>												
Task 1: 2006/2015/2020 WRAP Phase III O&G EI Update	\$10,806		T1	R1								
Task 2: 2006 PiG Sensitivity and Base Case Update	\$5,546			T2 R1								
Task 3: 2015/2020 Non-Colorado Emissions Modeling	\$14,515			T3 R1								
Task 4: 2015/2020 Colorado Emissions Modeling	\$17,951			T4 R1								
Task 5: 2015/2020 DRCOG CONCEPT MV Link Mobile	\$19,275			T5 R1								
Task 6: 2006/2015/2020 CAMx Base Case Modeling	\$19,688				T6 R2							
Task 7: 2015/2020 Ozone Source Apportionment	\$16,043				T7 R2							
Task 8: 2015/2020 VOC/NOx Sensitivity Modeling	\$20,037						T8					
Task 9: Reporting, Meetings and Technology Transfer	\$13,852		M1				T9a	M2 T9b				
Total	\$137,712											
Phase I: 2015/2020 Ozone Projections T1: PPT WRAP Phase III O&G emissions 2006/2015/2020 T2: PPT of revised 2006 CAMx Base Case simulation with PiG and O&G Updates T3: CAMx-ready 2015/2020 emissions on 36/12/4 km domains for non-CO sources T4: CAMx-ready 2015/2020 emissions on 12/4 km domains for Colorado sources T5: CAMx-ready 2015/2020 emissions for on-road mobile sources DRCOG network T6: PPT summarizing 2015/2020 emissions and CAMx modeling T7: PPT summarizing 2015 or 2020 ozone source apportionment modeling T8: PPT summarizing 2015/2020 VOC/NOx sensitivity modeling T9: (a) Draft Report; (b) Final Report				R1: RAQC/CDPHE review of the 2015/2020 emissions modeling end of March R2: RAQC/CDPHE review of ozone projections & source apportionment in early May and select 2015/2020 VOC/NOx sensitivity tests M1: Stakeholder meeting February 4 <sup>th</sup> to discuss proposed work M2: Stakeholder Meeting June								

- **Key Dates:**

- January 20, 2009: 2015/2020 Emission Inventory Development Begins
- March 2009: 2015/2020 emissions ready
- April/May 2009: 2015/2020 Ozone Projections and Source Apportionment
- April - June 2009: 2015/2020 VOC/NOx sensitivity and Draft Report
- July 2009: Final Report

# Denver Phase II Model Improvement Schedule

Task	Cost	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
<b>Phase II: 2006 Base Case Model Improvements</b>												
Task 11: VOC Inverse Modeling for Emissions Shortfall	\$22,486								T11	R3		
Task 12: MOBILE6 Air Toxics VOC Inventory	\$12,778								T12	R3		
Task 13: Increased Nudging MM5 Sensitivity	\$17,164								T13	R3		
Task 14: Weather Research Forecast (WRF) Sensitivity	\$14,651								T14	R3		
Task 15: 2006 WRAP Phase III O&G EI Update	\$10,806									T15	R3	
Task 16: 2006 CMAQ Base Case Modeling	\$11,381									T16	R3	
Task 17: 2006 NFRCOG CONCEPT MV	\$34,625									T17	R3	
Task 18: Final 2006/2015/2020 CAMx Modeling	\$19,314										T18	
Task 19: Reporting and Meetings	\$13,852									M3	T19a	M4 T19b
<b>Total</b>	<b>\$157,058</b>											
Phase II: 2006 Base Case Model Improvements					<p>R3: CDPHE/RAQC Review of various model improvements and selection of final model configuration prior to final 2006 CAMx Base Case (Task 18)</p> <p>M3: Stakeholder meeting in September to discuss results from model improvements activities</p> <p>M4: Stakeholder meeting to discuss CAMx results with model improvements</p>							
<p>T11: PPT on Task 1 VOC Inverse Modeling</p> <p>T12: PPT and Technical Memorandum on Task 1 VOC Inverse Modeling and Task 2 MOBILE6 toxics results plus recommendations for inventory improvements</p> <p>T13: PPT on increased MM5 nudging sensitivity modeling</p> <p>T14: PPT summarizing the results of the WRF sensitivity runs</p> <p>T15: Use of 2018 WRAP Phase III O&amp;G to make 2015/2020 projections</p> <p>T16: PPT Task 8 CMAQ ozone model performance</p> <p>T17: PPT on NFRCOG CONCEPT MV modeling for 2006/2015 and 2020</p> <p>T18: PPT on final CAMx 2006, 2015 and 2020 base case run</p> <p>T19: (a) draft final report; (b) final report</p>												

- Phase II Work Effort currently unfunded
  - Tasks can be funded individually
- Leads into next round of SIP modeling to address 0.075 ppm 8-hour ozone NAAQS

## Phase II: Model Improvement Tasks

- Task 11: VOC inverse modeling using observations
- Task 12: MOBILE6 air toxics VOC inventory
- Task 13: Increased MM5 nudging
- Task 14: WRF alternative met model
- Task 15: Oil & Gas Emissions Update
- Task 16: 2006 CMAQ Base Case modeling
- Task 17: 2006/2015/2020 NFRCOG CONCEPT MV
- Task 18: Final CAMx 2006/2015/2020 run
- Task 19: Report, meetings and technology transfer