Risk and Exposure Assessment to Support the Review of the CO Primary NAAQS – First External Review Draft

Clean Air Scientific Advisory Committee (CASAC) Review Meeting

US Environmental Protection Agency
Office of Air Quality Planning and Standards

November 16-17, 2009

OAQPS CO NAAQS Review Team

Lydia Wegman, Division Director
Karen Martin, Ambient Standards Group Leader

Deirdre Murphy
Ines Pagan
Souad Benromdhane
Stephen Graham
Harvey Richmond
Pradeep Rajan
Dave McKee
Meredith Lassiter

Overview

- Previous assessments
- Developments since previous assessments
- Current assessment
  - Design
  - Results
  - Variability and uncertainty
  - Summary

<u>Current Primary NAAQS for CO</u>

- 9 ppm, 8-hour average, not to be exceeded more than once per year
- 35 ppm, 1-hour average, not to be exceeded more than once per year

Previous CO Risk/Exposure Assessments

Year	Risk Metric	At-risk Population	Study Area/ Monitors	Models	Key Assessment Features
1992-1994	% At-risk population with COHb levels above potential health benchmarks	Adults with ischemic heart disease	Denver Area/ 5 Monitors	pNEM/CO, CFK (cohort approach)	<u>Both Assessments</u> - Indoor and in-vehicle microenvironments (MEs) based on mass balance modeling - Simulations with and without indoor sources (gas stoves & passive smoking) <u>1999-2000 Assessment</u> - MEs modeled: 15 - Outdoor ambient and microenvironmental concentration relationships supporting inputs to mass balance model based on statistical analyses of 1992 California ambient residential and 1982-83 Denver personal exposure monitoring studies
1999-2000			Denver-Boulder Area/ 7 Monitors and Greater Los Angeles Area/ 10 Monitors	pNEM/CO, CFK (v. 2.1) (cohort approach)	

Developments Since the Previous Assessments

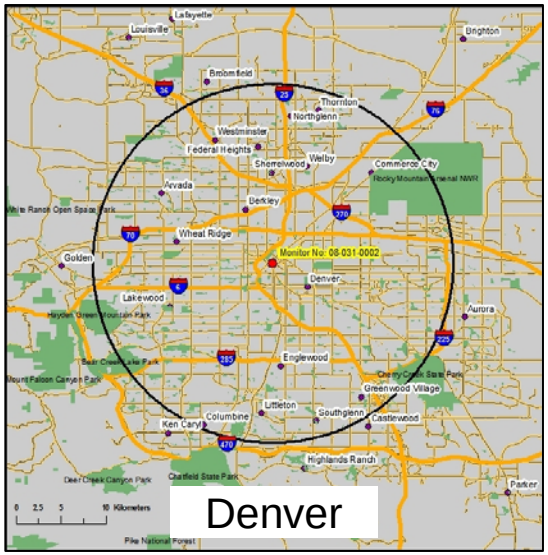
- Significant enhancements to exposure models (APEX) and human activity related inputs (CHAD)
- Less robust data to represent spatial and temporal heterogeneity in ambient and microenvironmental concentrations
  - Monitoring network has been reduced
  - Declines in ambient CO concentrations and increased number of measurements below detection level
  - Personal exposure field study used in previous assessments to relate fixed site monitors to ME concentrations has not been updated
- Limited additional evidence to support alternative risk metric
  - Epidemiological evidence, while expanded, not judged adequate for use in quantitative risk analysis, and will be addressed in policy assessment
  - Clinical evidence from controlled exposures continues to support use of COHb levels with potential health benchmarks as risk metric

Current Assessment Approach

- In planning this assessment, current data limitations raised questions regarding utility of conducting REA
  - To avoid the potential for overcasting what can be supported by the current data, we considered a much simpler approach
- Basic Study Design for Current Assessment
  - Simplified, screening-level exposure modeling approach using a single near-road monitor for air quality and factors-based MEs
  - Attempt to estimate a reasonable upper bound of current CO exposures/doses
- In considering findings, we revisit question of assessment's utility for our needs in current review

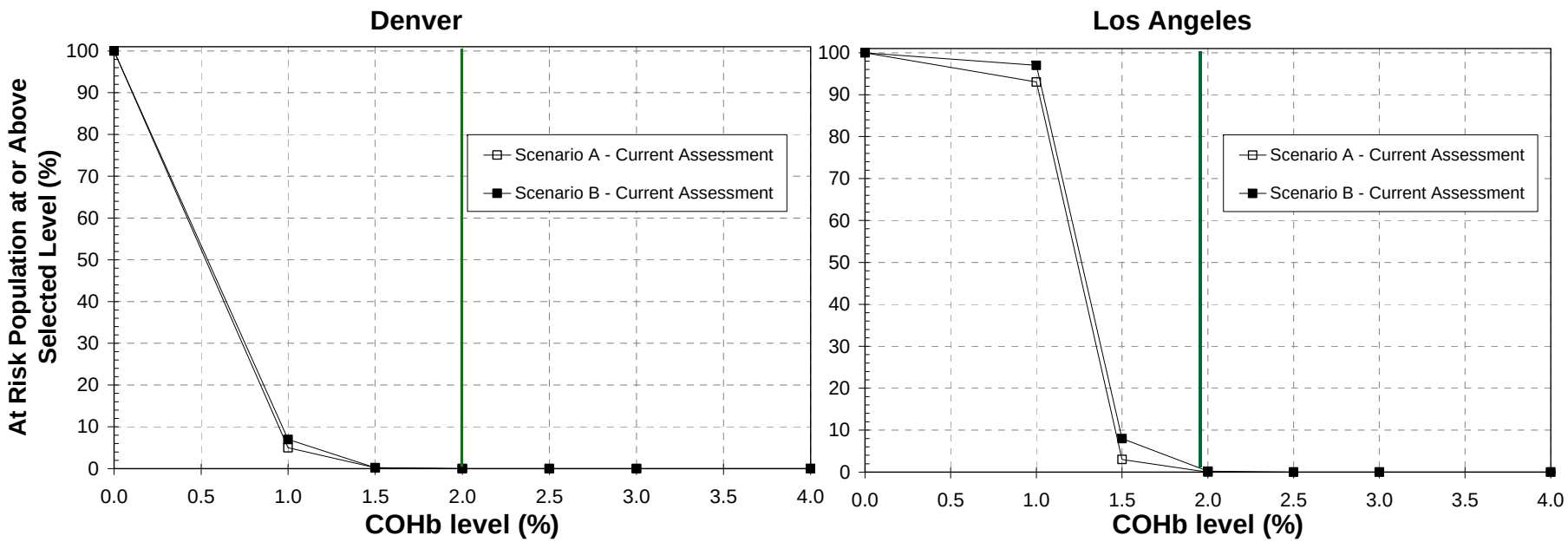
Risk/Exposure Assessment Approach for Current CO Review

- Study Areas
  - Portions of Denver and Los Angeles counties
- Air Quality
  - Single near-road monitor
  - Applied to all census tracts within 20km radius
- Population of Concern & Dose Metric
  - Adults with coronary heart disease (CHD)
  - Number and percent above COHb benchmarks
- Model Used
  - APEX4.3 with updated input data & COHb module
- Air Quality Conditions
  - "As Is" and "Just Meeting" current 8-hour CO NAAQS
- Exposure Scenarios
  - A: all ME CO = ambient CO
  - B: in-vehicle CO = 2x ambient CO
    all other ME's = ambient CO



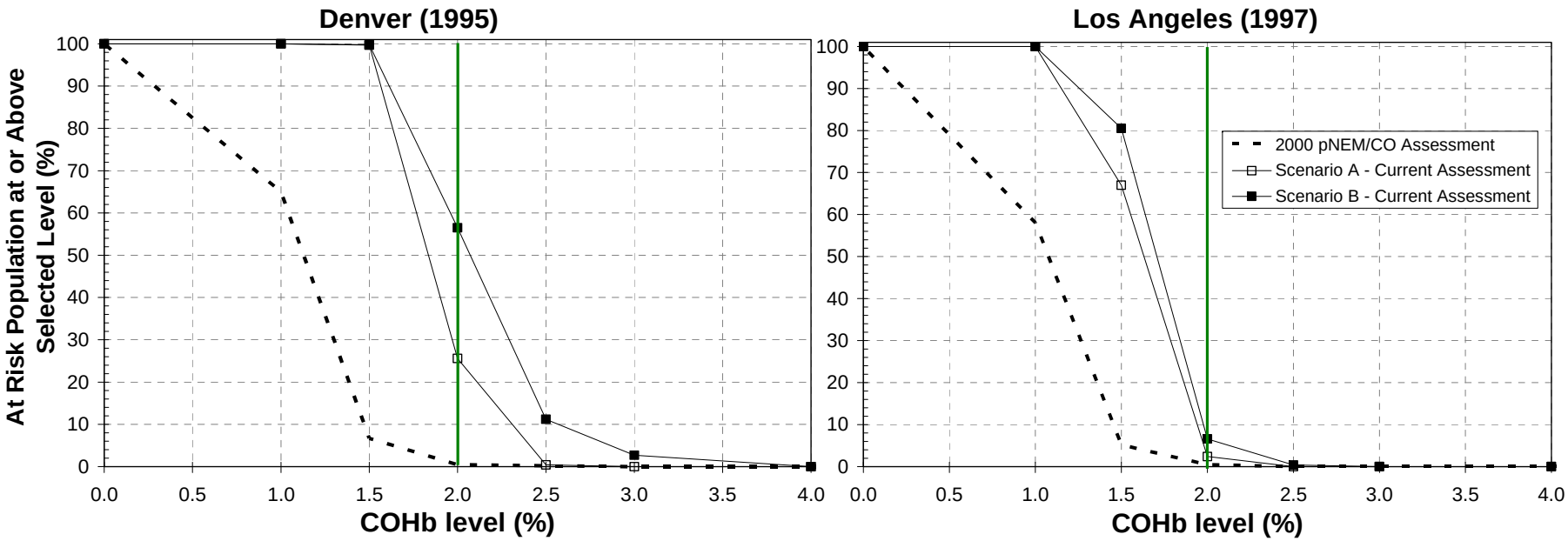
Results for "As Is" (2006) Air Quality

(from REA Tables 6-13 and 6-20)



- Both cities exhibit low percent at-risk population with COHb at or above 2%
- These estimates are higher for Los Angeles (LA) than Denver, reflecting higher current CO levels in LA

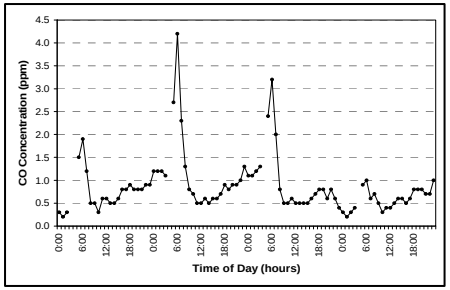
Results for Just Meeting the Current 8-hour CO NAAQS (from REA Figure 6-3)



- Percent at-risk population with COHb at or above 2% in both study areas is substantially higher than under "as is" conditions
- These estimates for Denver are much higher than for Los Angeles, reflecting higher "just meeting the standard" CO levels in Denver
- While recognizing differences in various aspects of methodological approach from that used in 2000 assessment, results from current assessment are much higher

Incorporating Variability in Estimating Exposure and Dose

- Simulated Individuals
  - Population data, activity patterns, coronary heart disease (CHD) prevalence
- Ambient CO Input
  - Hourly measured ambient CO concentrations, meteorological data
- Physiological Factors
  - Resting metabolic rate (RMR), metabolic equivalents (METS), body weight, height, blood volume & hemoglobin content, pulmonary CO diffusion rate, endogenous CO production rate



Characterization of Uncertainty in the Assessment

- Approach
  - Qualitative characterization of identified sources of uncertainty
    - Staff rated the potential magnitude and direction of influence each source exerted on exposure/risk estimates and the uncertainty in overall knowledge-base for each source
- Results
  - Influence
    - Direction: over-estimation
    - Magnitude: medium (proportional)
  - Knowledge base
    - Varied, though many sources judged as low

Summary

- Limitations of currently available data create challenges in estimating
  - Spatial variability of CO across study area
  - Microenvironmental CO concentrations across study area
- These limitations led to simplified, screening-level approach for exposure and dose assessment
  - Assumptions made likely overestimate CO exposure and COHb dose levels for much of the simulated population
  - Assessment does not indicate COHb levels of concern associated with “As Is” air quality
  - Utility of current assessment for purpose of considering the adequacy of the current CO standards is called into question
- Charge questions solicit CASAC views on characterization of results and role of CO REA in the current NAAQS review