Western Regional Technical Analysis for Ozone Standard Planning

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Topics

- selected Western sources
- what the monitoring data are telling us
- interpreting modeling results for ozone planning analysis
Western Interconnect Fossil Fuel Power Plant Emissions

1996 through 2014 data from EPA data for fossil fuel-fired electrical generating units in the 11-state Western Interconnect

* Additional NOx reductions estimate - BART controls from Regional Haze baseline planning

** Further NOx reductions estimate from applying maximum post-combustion controls to all remaining units
2007

6/21 – 9/21
Limited by bounding box

Source: WRAP Fire Tools
2008

6/21 – 9/21
Limited by bounding box

Source: WRAP Fire Tools
Smoke/Fire & the Ozone and PM NAAQS, Regional Haze Rule

Technical Products for air quality planning & management as required by the Clean Air Act

Future emissions, efforts to avert emissions & health/visibility impacts, & adapt to a changing/varying climate

U.S. Wildfire and Prescribed Fires Acres Burned - 1990 through 2014

Data from National Interagency Fire Center, no prescribed fire data before 1998
Example Oil & Gas Study:
Williston Basin 2011 Baseline Results
NOx Emissions By Source Category

Basin-wide NOx Emissions (tons/year): 29,404

Source: BLM/WRAP Oil and Gas Inventory project
Oil & Gas Projections - Methodology

• No standardized methodology for conducting projections
  • Each inventory study has used different approaches (EPA methods, Resource Management Plans, NEPA air quality projects, Western States Air Quality Modeling Study regional inventories)

• WRAP O&G inventories have used a three-step approach:
  1. Activity scaling factors
  2. “Uncontrolled” projections
  3. State and federal regulatory control requirements

• Activity scaling requires input from operators on planned activities, and/or analyzes trends, and/or relies on industry studies

• State and federal regulatory control requirements complex and continuing to evolve
  • National rules focused on new sources
What are (some of) the sources and control issues in the West related to a new Ozone standard?

- Urban and rural reactivity
- Transport and formation – how much / how important?
- Public lands with large biogenic emissions and fire activity
  - How to characterize for effects of drought and climate variation?
- Federal and state mobile fuel and tailpipe controls
- Upstream Gas NSPS rules in place in 2015
  - Industry practices changing rapidly, e.g., green completions
- Point sources (dominated by EGUs for SO$_2$, NO$_x$)
  - Significant NO$_x$ BART by ~2018
  - Less coal-fired electricity supply due to Clean Power Plan?
  - 17+ million acres of public lands leased in last 5 years for O&G exploration and production
Trends in projected emissions - example

State Total Inventory Change: 2020-2011

- Mostly decreases for all sectors/pollutants/states except O&G VOCs
- Plots show differences by for example states (CO, UT, WY)

<table>
<thead>
<tr>
<th></th>
<th>CO</th>
<th>NOX</th>
<th>VOC</th>
<th>NH3</th>
<th>SO2</th>
<th>PM2_5</th>
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<tr>
<td>Colorado</td>
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<td>443</td>
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<td>-4820</td>
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</table>

Source: Western Air Quality Data Warehouse
Numerous sources within and outside the U.S. will continue to contribute to air quality impacts across the West.

Some are further controllable.

Others are less controllable, quasi-natural, and/or less well-understood - these may grow and/or vary significantly within the CAA planning timeframes.
Counties with Monitors Violating Primary 8-Hour Ground-Level Ozone Standard (0.075 ppb)

(Based on 2011-2013 Air Quality Data)

http://www.epa.gov/airquality/greenbook/map8hr_2008.html
3-year Average 4th Highest 8-Hour Ozone value by County 2011-2013

AQS Federal Reference Method data from the monitoring site in each County with the highest Ozone values
3-year Average 4th Highest 8-Hour Ozone value for Rural/Class I Sites 2011-2013

AQS Federal Reference Method data from rural or Class I area monitoring sites
Average Ozone Measurements
April-May 1993-2014

- Canyonlands
- Great Basin
- Linear (Canyonlands)
- Linear (Great Basin)
White Pine County, NV - population ~10,000

Design Values

<table>
<thead>
<tr>
<th></th>
<th>2018 Average (ppb)</th>
<th>2018 Max (ppb)</th>
<th>Other (ppb)</th>
<th>Biogenic (ppb)</th>
<th>Boundary Conditions (ppb)</th>
<th>Total Background (ppb)</th>
<th>Background % of Avg Design Value</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>68.6</td>
<td>70.5</td>
<td>4.9</td>
<td>2.2</td>
<td>52.6</td>
<td>59.7</td>
<td>87%</td>
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</table>
EPA Guidance on Ozone Projections Procedures for 2008 Standard

- Start with a current year observed Design Value (DVC)
  - EPA recommends average of three Design Values (DVs) centered on modeling year (example of 2008) (5-Year DV)

- Use relative changes in 2018 & 2008 modeling results to scale DVC to obtain future year Design Value (DVF)
  - Relative Response Factors (RRFs) based on ratio of 2018 to 2008 modeling results
    \[ \text{DVF} = \text{DVC} \times \text{RRF} \]

- Compare DVF with March 2008 0.075 ppm ozone NAAQS
  - Slight update in 2014 draft EPA guidance to these procedures – will apply to new ozone standard when it is determined in late 2015
Five Ozone Planning Needs related to modeling

1. **Ozone NAAQS planning** – requires photochemical modeling for SIP attainment demonstrations for nonattainment areas.

2. **Ozone transport SIPs** – photochemical source apportionment modeling can be used to quantify U.S. Ozone transport between states and jurisdictions.

3. **Identification of Ozone exceptional events** caused by stratospheric intrusion and wildfires – requires observations & data analysis, supplemented with global/regional scale photochemical models and regression models.

4. **Identification of international transport of Ozone for §179B demonstrations**: requires nested global and regional scale photochemical modeling to evaluate international transport of Ozone.

5. **Identification of §182 Rural Transport Areas** – combination of data analysis and photochemical modeling.

Regional modeling of U.S. sources for air quality planning, to identify sources and assess controls for contributing sources, will be needed within the West.
Contributions to MDA8 Ozone [ppb] at CO_Larimer0007

NAT 2.7%
AR:Rem 0.7%
AR:NM 0.0%
AR:CO 0.0%
AR:UT 0.0%
Can/Mex 1.8%
Fires 0.1%
MV:Rem 4.6%
MV:UT 0.2%
MV:CO 0.0%
MV:NM 0.0%
O&G:NM 0.0%
O&G:CO 0.0%
O&G:UT 0.0%
O&G:Rem 0.2%
O&G:WY 0.3%
PT:Rem 0.9%
PT:CO 0.0%
PT:NM 0.0%
PT:UT 0.1%
PT:WY 0.4%
PT:WY 0.3%

Rank (10) 05/01/08; Model = 68.8 ppb; Obs = 69.9 ppb; Bias = -1.6%; BC = 60.4 ppb (87.9%)

Source: WestJumpAQMS
Contributions to 2008 Ozone at Tuscan Buttes, Tehama County, CA

Source: WestJumpAQMS
Uncertainty in model estimates of U.S. Background

CAMx simulations for 2007 and 2008 at Canyonlands National Park – Eastern UT

EPA 2007 CAMx model:
BC contributions of 36-57 ppb; still substantial U.S. anthropogenic contribution to O3.

WRAP 2008 CAMx model:
BC contributions of 50-72 ppb, much larger than OAQPS modeling.

Same methodology - reasons for modeled differences are not fully understood
O₃ in upper free troposphere is determined primarily by transport from boundaries

O₃ animation in Layer 21 (6-7 km) June 22 through July 4, 2008

Layer 21 1000*O₃a

CAMx v5.41 Mech6 CF westjump.3612K.25L.base08b
a=epa.36km.chain

Min = 0 at (1,1), Max = 112 at (77,95)
Background / Boundary Conditions evaluations:

MOZART
GEOS-Chem
(considering addition of AM3)

Observations vs. Boundary Condition / Background Monthly Mean MDA8 Ozone

Animations of Modeled Daily Max Concentrations

Background contribution
Difference plots for background minus U.S. sources

O3, NOx, CO, PM$_{2.5}$

Animations of Daily Max Concentrations for O3 and Dust Boundary Tracers

Boundary conditions plots:

O3, Ox (O3+NO+NO2+PAN)
Coarse Dust (CCRS), Fine PM (FPRM+FCRS)

http://views.cira.colostate.edu/tsdw/
Applications of global model data as regional modeling boundary conditions need to be codified between the science and regulatory communities.

- Current, clear, and unambiguous scientific findings are needed.
- Address uncertainty, assessment methods, and applications of global modeling products:
  - As boundary conditions
  - To help clarify transport within the U.S.

- Resources and usable tools for applying data and knowledge from global models and monitoring research across the West are likely beyond the scope of most/many air regulatory agencies.
  - How will that work be done and when, and whom will be responsible for communicating those results?