Source Screening, Control Analysis, and Communication

1. Identification of Sources for Regional Haze Reasonable Progress Four-Factor Review - Curt Taipale (CO)

2. State Screening and Outreach Examples – Elias Toon (AZ), Jean-Paul Huys (WA), Rebecca Harbage (MT), Curt Taipale (CO)

Key Questions to Consider

- What sources or categories of sources have emissions that might be contributing to light extinction at the IMPROVE monitors?
    - Does your agency have authority to require emission controls at these sources or categories of sources?
- Do you have an existing process to communicate with sources in your state about air quality?
- What steps might you take to open a dialogue with sources about Regional Haze?
    - Have you already started or, if not, when will you start?
- What steps will you take to conduct a four-factor analysis and come to conclusions about reasonable controls?
- About how many sources do you expect to analyze?
- How do you plan to engage sources, FLMs, EPA, and other stakeholders during this process?

Identification of Sources for Regional Haze Reasonable Progress Four-Factor Review

Regional Haze Planning Work Group
Control Measures Subcommittee
March 20, 2019

Curtis Taipale
Colorado Department of Public Health and Environment
Air Pollution Control Division – Planning Policy Program

COLORADO
Air Pollution Control Division
Department of Public Health & Environment

Second 10-year RH Planning Period - Requirements

- States need to identify anthropogenic emission sources that most likely contribute to visibility impairment on the Most Impaired Days (MID) at a Class I Area (CIA)
- Identified sources are subject to a Four-Factor Analysis to determine whether reasonable controls should be implemented as part of Reasonable Progress for the 2nd Round of Regional Haze SIPs due in 2021
  1. Costs of compliance
  2. Time necessary for compliance
  3. Energy and non-air quality environmental impacts of compliance
  4. Remaining useful life

Control Measures Subcommittee – RP Protocol

- WRAP Regional Haze Planning Work Group - Control Measures Subcommittee developed the ***"Reasonable Progress Source Identification and Analysis Protocol"*** document
  - Provides a framework for identifying and screening emission sources potentially impacting Class I area visibility
  - Methodology loosely based on past EPA approved RH SIPs and draft EPA guidance
  - Protocol document does not limit in any way the ability of a state from pursuing alternative approaches or methods for identifying and evaluating emission sources
  - Encourages consistency among WRAP states in identifying sources subject to a four-factor analysis evaluation

Framework for Identifying Sources

- Focus on anthropogenic sources of NOx, SOx and PM emissions
  - States have good emissions information for these haze precursors
  - Elemental Carbon and Fine Soil particles are generally not inventoried by most states
  - Organic Carbon mostly associated with wildfires or Secondary Organic Aerosols from biogenic sources
  - States can include other pollutants for unique circumstances
- Identify sources (stationary or potentially area) that are likely impacting CIA visibility and review these sources for potential emission controls through a four-factor review process
- The number sources and level of emissions assessed by each state will vary, but a "reasonably large fraction" of emissions impacting extinction at each CIA should be assessed
  - Draft EPA guidance (2016) considers 80% to be a reasonably large fraction

Three-step Single-Source Screening Process

- Step 1 – Identify sources with 2014 emissions over 25 tpy of NOx, SOx and PM to determine the “Q” and measure distance “d” to nearest CIA
  - States have flexibility to choose a lower emission threshold
- Step 2 – Calculate Q/d for identified sources and determine whether the Q/d exceeds 10
  - States have flexibility to adjust to a lower “Q/d” level if no sources are identified at 10
- Step 3 – Sources above the Q/d screening criteria are evaluated later using CIA specific Weighted Emissions Potential (WEP) to confirm source impacts for the 20% Most Impaired Days (MID)
  - Some states needing more time to acquire source-specific information may need to identify/notify sources before the WEP analysis is completed
- Contractor conducting a Q/d analysis for the WRAP states
  - A ranked list of sources with Q/d will be provided to each state
- Identified sources would be reviewed for potential controls through a four-factor analysis process.

Ramboll Q/D Analysis for the WRAP States

Task 5

Mar. 20th

Draft Memo Outlining Q/D Analysis

Draft Concept-Level Q/D Excel Pivot Table Spreadsheet and Webinar

Apr. 19th

Final Q/D Excel Pivot Table Spreadsheet

Final Memo on Q/D Spreadsheet

Timeline of Deliverables

Task 6

Apr. 5th

Draft Memo on Source Control Assessment Considerations

Apr. 19th

Final Memo on Source Control Assessment Considerations

Emissions Source Screening Tool

Sources screened based on magnitude of:

$$\frac{Q}{D}$$

Q → Facility-level emissions (tpy)

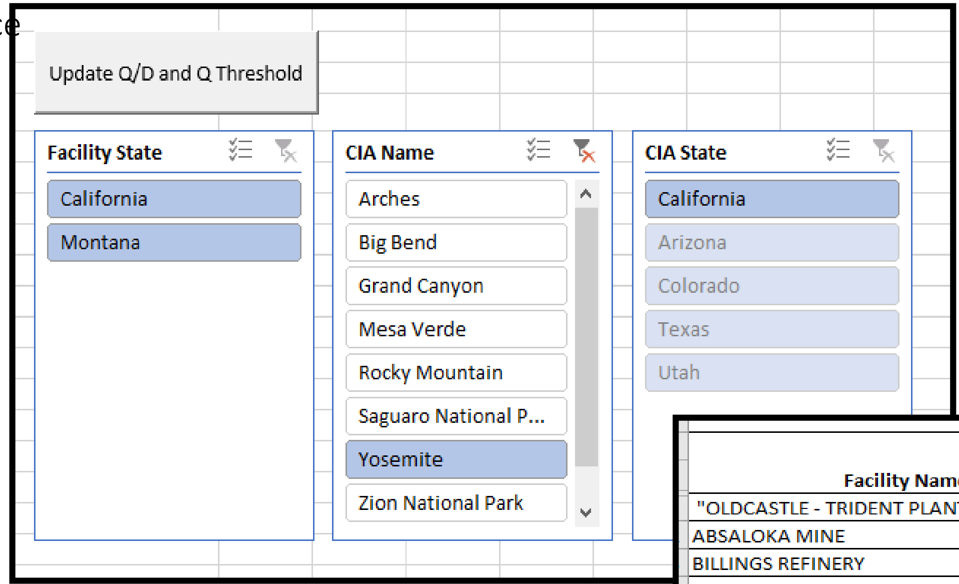
D → Distance from Class I Area (km)

$$Q = QSO_2 + Q_{NO_x} + Q_{PM_{10}}$$

$$Q_{PM_{10}} = Q_{PM_{10}}(\text{fugitive}) + Q_{PM_{10}}(\text{non-fugitive})$$

Precursors can be toggled on/off

For Class I Areas where D ≤ 400 km



Screening Tool can be used to:

- Evaluate use of different Q/D or Q thresholds.
- View captured Q/D and Q values by facility state and Class I Area name or state using pivot table "slicers".
- View percent of Q/D and Q captured by selected threshold.

Facility Name	Maximum Q/D Value: All Pollutants	NO_x	SO_2	PM_{10}
"OLDCASTLE - TRIDENT PLANT"	3.93	3.88	0.05	0.00
ABSALOKA MINE	1.51	0.00	0.00	1.51
BILLINGS REFINERY	7.34	6.17	0.15	1.02
CONTINENTAL PIT	16.21	0.00	0.00	16.21
DECKER MINE	3.37	0.00	0.00	3.37
EXXONMOBIL BILLINGS REFINERY	3.86	3.45	0.14	0.26
MALMSTROM AFB	1.60	1.19	0.35	0.06
PLUM CREEK MANUFACTURING LP COLMB FLS	3.10	2.50	0.00	0.60
PLUM CREEK SAWMILL AT EVERGREEN	3.19	2.93	0.00	0.26
ROSEBUD COUNTY WESTERN ENERGY MINE	4.22	0.08	0.01	4.13
SPRING CREEK MINE	15.90	0.00	0.00	15.90
TRIDENT	50.46	49.63	0.61	0.21

(Placeholder data for demonstration purposes)

Data Sources

Emissions: 2014 NEIv2 Emissions Inventory (with updates by western states)

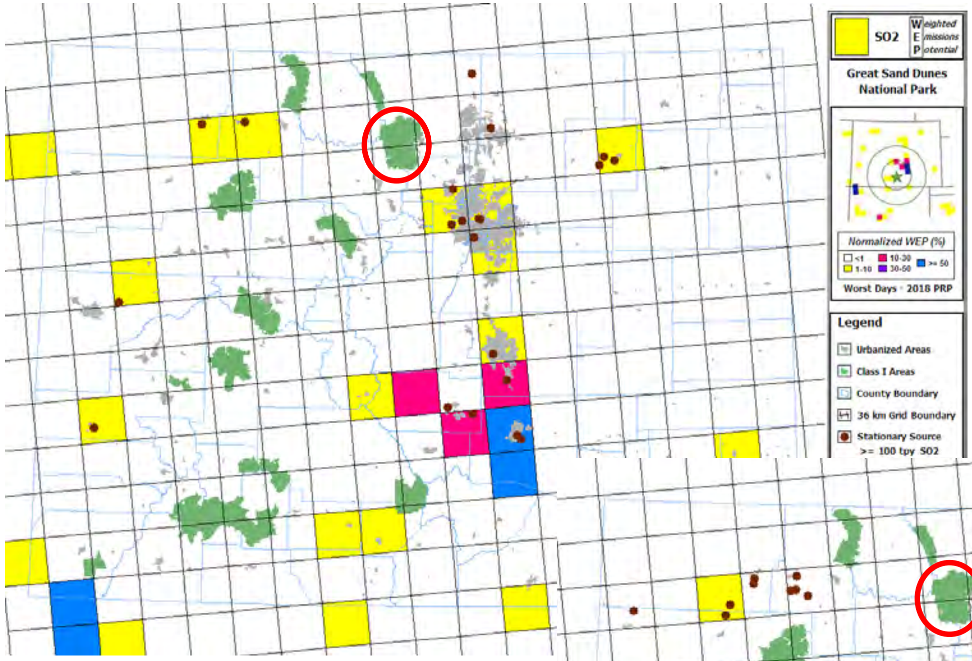
Class I Area boundaries, distance from sources: National Parks Service GIS shapefile

Q/d Screening – Advantages/Disadvantages

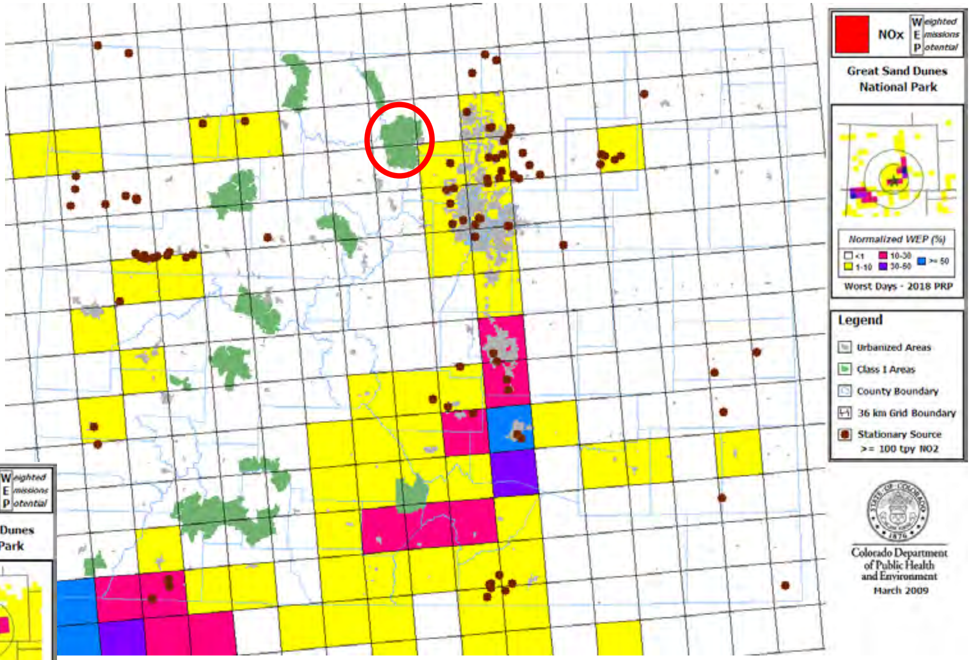
- Advantages
  - Easy to apply
  - Involves information that states have readily available
    - Source Emissions (SO_2, NO_x, PM_{10}, H_2SO_4)
    - Source and CIA locations
  - Can be used as a relative metric to rank sources for each CIA

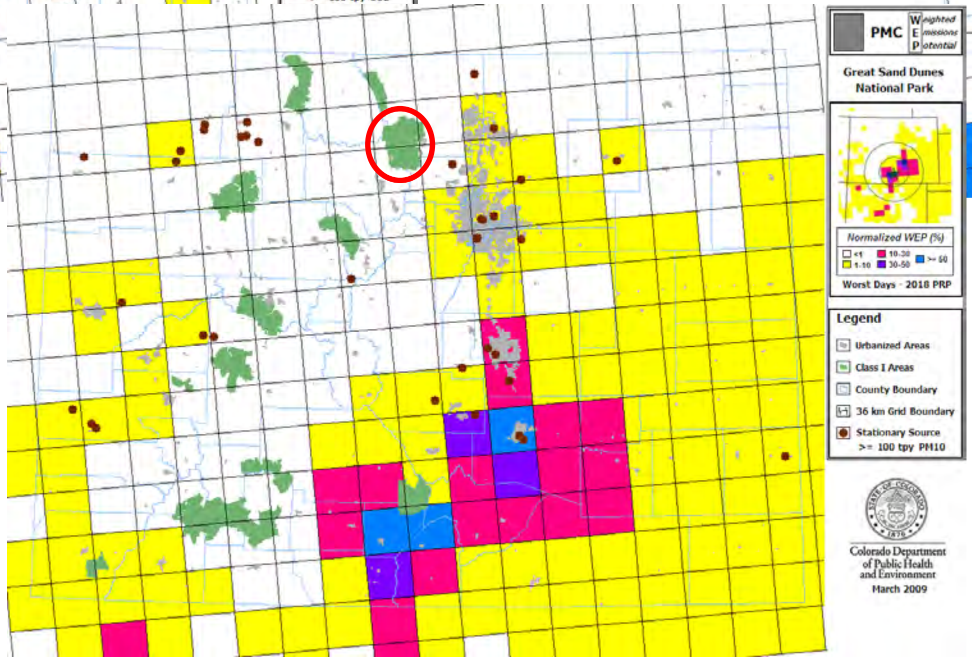
- Disadvantages
  - Does not account for geographic transport path
    - WEP will be used to confirm transport to CIA
  - No accounting for chemical conversion
  - Not based on MIDs
    - WEP will be used to confirm transport on most impaired days
  - Determining the appropriate Q/d threshold
    - 2010 Federal Land Managers' AQRV Work Group (FLAG) used Q/d > 10

RMNP Example Weighted Emissions Potential (WEP) Maps



SO2, NOx & PM WEP maps for Rocky Mt. NP

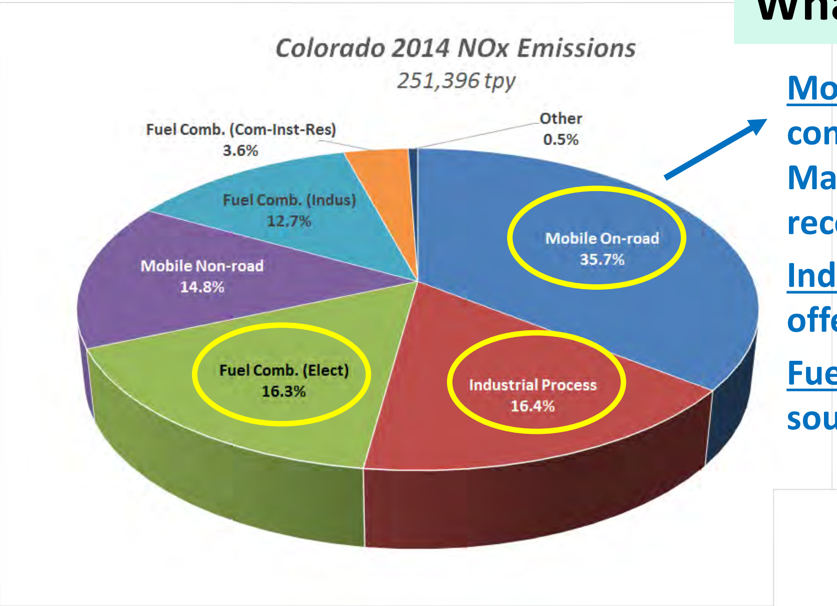




Brown dots denote the location of a stationary source with emissions over 100 tpy for listed pollutant

Emission Inventory - What are significant source categories for NOx, SO2 and PM?

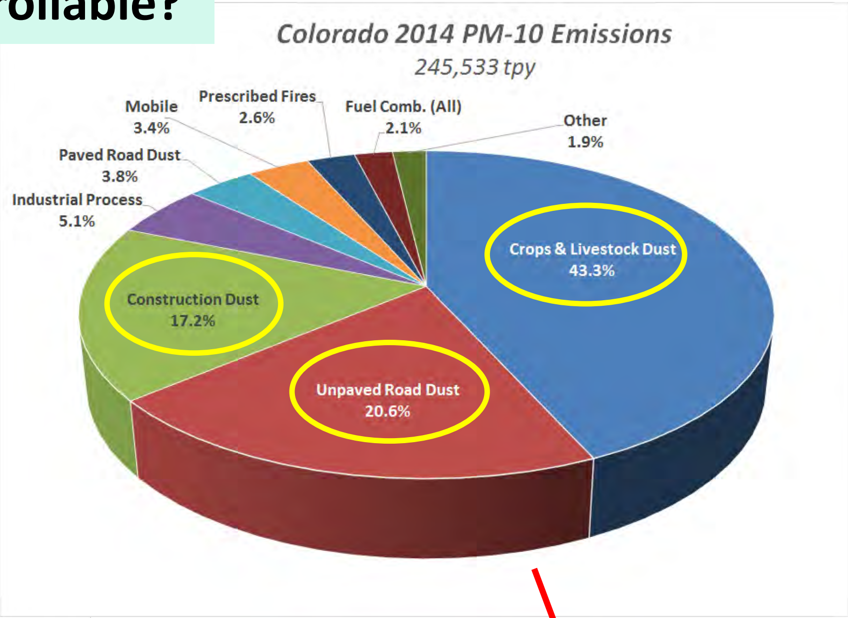
What sources are reasonably controllable?



Mobile On-road: NOx somewhat controllable if state has Inspection Maintenance (IM) Program, but EPA recommends excluding mobile emissions

Industrial Processes: Larger point sources offer more potential NOx reductions

Fuel Combustion (Electric): Larger point sources offer more potential NOx reductions

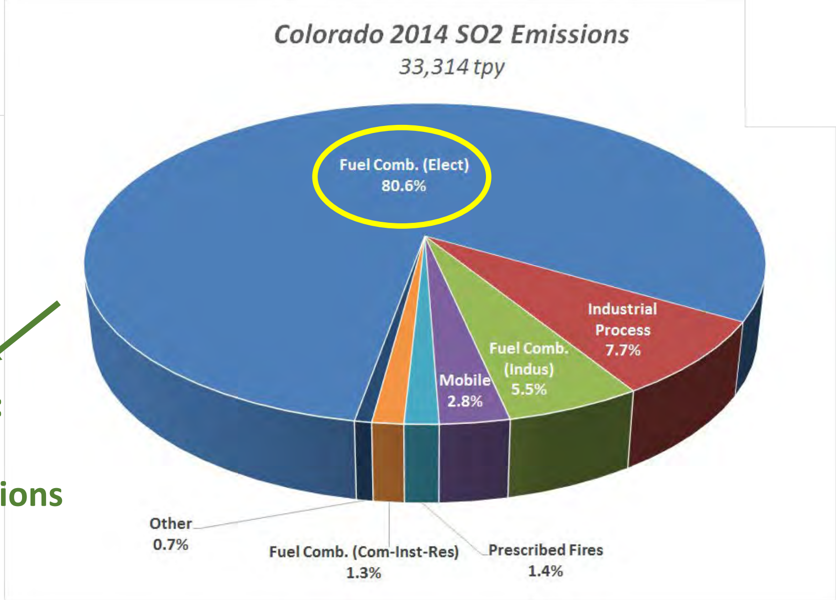


Crop & Livestock Dust: Not regulated in many states

Unpaved Road Dust: Road paving can be cost effective on high traffic roads

Construction Dust: Some states regulate construction activities with dust mitigation plan requirements

Do significant source categories change in 2028?



Fuel Combustion (Electric): Larger point sources offer more potential SO2 reductions

How do we know whether we are evaluating a "reasonably large fraction" of emissions impacting extinction at each CIA? – Step 1

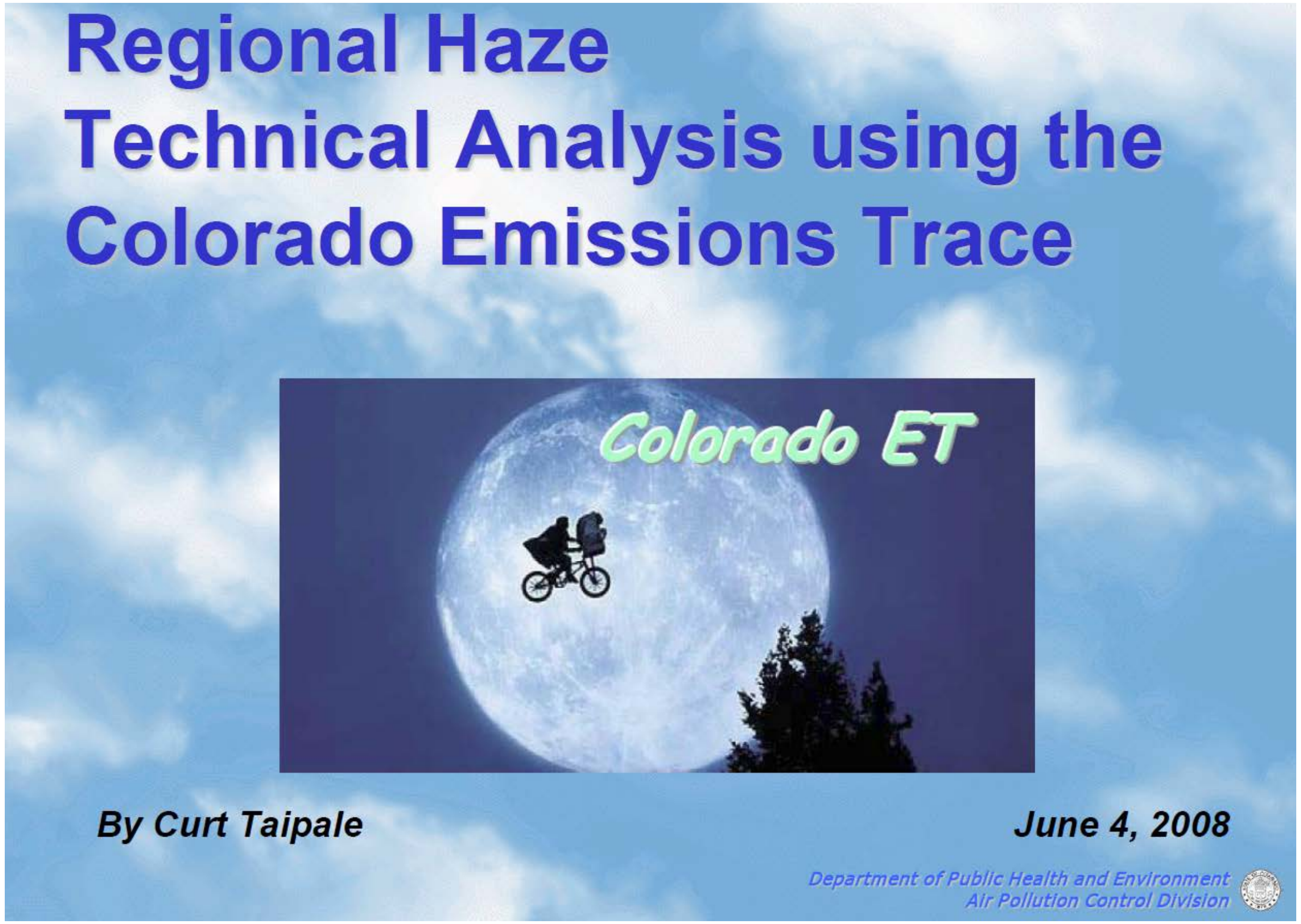
Colorado — ***2014 NEI v2 Emissions Summary***

Category	Sector	Subsector	CO	NH3	NOX	PM10	PM2.5	SO2	VOC
Fuel Combustion		Comm/Institutional - Biomass	18	-	8	4	3	1	8
Fuel Combustion		Comm/Institutional - Coal	30	0	24	1	1	34	0
Fuel Combustion		Comm/Institutional - Natural Gas	848	14	1,080	121	118	102	108
Fuel Combustion		Comm/Institutional - Oil	102	0	267	24	20	79	84
Fuel Combustion		Comm/Institutional - Other	257	-	214	18	18	91	41
		Fuel Combustion - Commerical/Institutional Subtotal:	***1,255***	***14***	***1,592***	***168***	***159***	***305***	***240***
Fuel Combustion		Electric Generation - Coal	13,172	243	39,211	651	368	26,805	403
Fuel Combustion		Electric Generation - Biomass	185	-	116	19	19	19	13
Fuel Combustion		Electric Generation - Natural Gas	594	147	1,472	218	198	33	111
Fuel Combustion		Electric Generation - Oil	9	-	80	2	2	7	1
Fuel Combustion		Electric Generation - Other	0	-	1	0	0	0	0
		Fuel Combustion - Electric Generation Subtotal:	***13,959***	***390***	***40,879***	***890***	***587***	***26,864***	***528***
Fuel Combustion		Industrial Boilers, ICEs - Biomass	7	0	7	3	3	0	0
Fuel Combustion		Industrial Boilers, ICEs - Coal	229	60	798	21	19	1,265	12
Fuel Combustion		Industrial Boilers, ICEs - Natural Gas	18,684	0	25,859	614	610	233	5,558
Fuel Combustion		Industrial Boilers, ICEs - Oil	1,545	0	4,880	211	207	282	350
Fuel Combustion		Industrial Boilers, ICEs - Other	225	0	289	27	22	48	15
		Fuel Combustion - Industrial Subtotal:	***20,689***	***60***	***31,832***	***877***	***861***	***1,828***	***5,935***
Fuel Combustion		Residential - Natural Gas	2,642	1,321	6,209	34	28	40	363
Fuel Combustion		Residential - Oil	3	1	11	1	1	26	0
Fuel Combustion		Residential - Other	236	3	832	3	3	4	32
Fuel Combustion		Residential - Wood	21,732	145	447	3,157	3,142	48	3,773
		Fuel Combustion - Residential Subtotal:	***24,613***	***1,469***	***7,500***	***3,196***	***3,174***	***117***	***4,169***
Industrial Processes		Cement Manuf	2,051	121	3,125	226	154	297	186
Industrial Processes		Chemical Manuf	6	-	40	31	26	100	391
Industrial Processes		Ferrous Metals	1,010	-	142	102	73	76	66
Industrial Processes		Mining	491	2	124	2,255	687	0	15
Industrial Processes		NEC	2,926	16	1,904	5,972	2,226	1,502	2,949
Industrial Processes		Non-ferrous Metals	206	-	68	162	108	6	72
Industrial Processes		Oil & Gas Production	32,132	-	35,224	1,439	1,428	483	93,018
Industrial Processes		Petroleum Refineries	347	1	432	335	251	95	602
Industrial Processes		Pulp & Paper	38	-	38	178	123	8	231
Industrial Processes		Storage and Transfer	368	0	194	1,788	416	2	9,287
		Industrial Processes Subtotal:	***39,575***	***139***	***41,291***	***12,490***	***5,492***	***2,569***	***106,815***

Category	Sector	Subsector	CO	NH3	NOx	PM10	PM2.5	SO2	VOC
Mobile	Non-Road	Equipment - Diesel	10,957	24	18,906	1,551	1,505	37	2,017
Mobile	Non-Road	Equipment - Gasoline	214,672	15	3,119	992	913	20	22,879
Mobile	Non-Road	Equipment - Other	4,938	-	879	33	32	13	190
Mobile	Non-Road	Aircraft	9,199	-	3,571	235	207	405	1,018
Mobile	Non-Road	Locomotives	1,821	6	10,667	337	311	6	545
		Mobile Non-Road Subtotal:	***241,588***	***44***	***37,141***	***3,149***	***2,968***	***482***	***26,648***
Mobile	On-Road	non-Diesel Light Duty Vehicles	462,715	1,721	54,956	3,167	1,382	398	43,021
Mobile	On-Road	non-Diesel Heavy Duty Vehicles	11,754	12	1,143	56	24	6	562
Mobile	On-Road	Diesel Light Duty Vehicles	14,372	33	4,703	290	213	10	1,630
Mobile	On-Road	Diesel Heavy Duty Vehicles	8,660	83	28,992	1,710	1,249	43	2,154
		Mobile On-Road Subtotal:	***497,501***	***1,848***	***89,794***	***5,224***	***2,868***	***457***	***47,366***
Solvent		Consumer & Commercial	-	-	-	-	-	-	26,812
Solvent		Degreasing	-	13	0	4	3	-	98
Solvent		Dry Cleaning	-	-	-	-	-	-	24
Solvent		Graphic Arts	1	-	1	0	0	0	297
Solvent	Industrial	Surface Coating & Solvent Use	91	9	61	110	98	4	3,188
Solvent	Non Industrial	Surface Coating	-	-	-	-	-	-	6,168
		Solvent Subtotal:	***92***	***22***	***62***	***113***	***101***	***4***	***36,587***
Fires	*(not anthro)*	*Wildfires*	*8,932*	*147*	*168*	*950*	*805*	*81*	*2,120*
Fires		Prescribed Fires	64,531	1,058	807	6,499	5,507	462	15,204
Fires		Agricultural Field Burning	271	19	6	47	35	1	16
		Fires Subtotal:	***73,734***	***1,224***	***981***	***7,496***	***6,347***	***545***	***17,340***
Miscellaneous	Non-Industrial	Not Elsewhere Classified (NEC)	3,973	-	92	278	223	1	1,200
Waste Disposal		Waste Disposal	1,988	124	367	1,696	1,364	223	2,727
Gas Stations		Gas Stations	-	-	-	-	-	-	9,787
Commercial Cooking		Commercial Cooking	832	-	0	2,193	2,033	0	290
Bulk Gasoline Terminals		Bulk Gasoline Terminals	100	-	31	-	-	-	952
Agriculture		Livestock Waste	-	38,309	-	231	112	-	2,803
Agriculture		Fertilizer Application	-	10,536	-	-	-	-	-
Dust		Paved Road Dust	-	-	-	9,228	2,235	-	-
Dust		Unpaved Road Dust	-	-	-	50,692	4,995	-	-
Dust		Construction Dust	-	-	-	42,343	4,234	-	-
Dust	Agriculture	Crops & Livestock Dust	-	-	-	106,220	21,346	-	-
		Dust Subtotal:	***-***	***-***	***-***	***208,483***	***32,811***	***-***	***-***
		Statewide Anthropogenic Totals (tpy):	**910,967**	**54,032**	**251,396**	**245,533**	**58,295**	**33,314**	**261,269**
		80% threshold			***201,117***	***196,427***	***46,636***	***26,651***	
		Colorado Review at Q/d >=10 (tpy):			***46,841***	***3,275***		***28,847***	
		Colorado Review of IM240 Program for On-Road Mobile (tpy):			***44,880***				
					36.5%	***1.3%***	***0.0%***	***86.6%***	

Step 1 - Compare statewide anthropogenic emissions with sum of emissions from Q/d sources >=10. Colorado is likely meeting the 80% goal for SO2 (sulfate) but falls short for NOX (nitrate) and PM. The largest source of NOx is on-road Mobile, so Colorado is including our non-Diesel IM240 program which doubles the amount of NOx emissions evaluated.

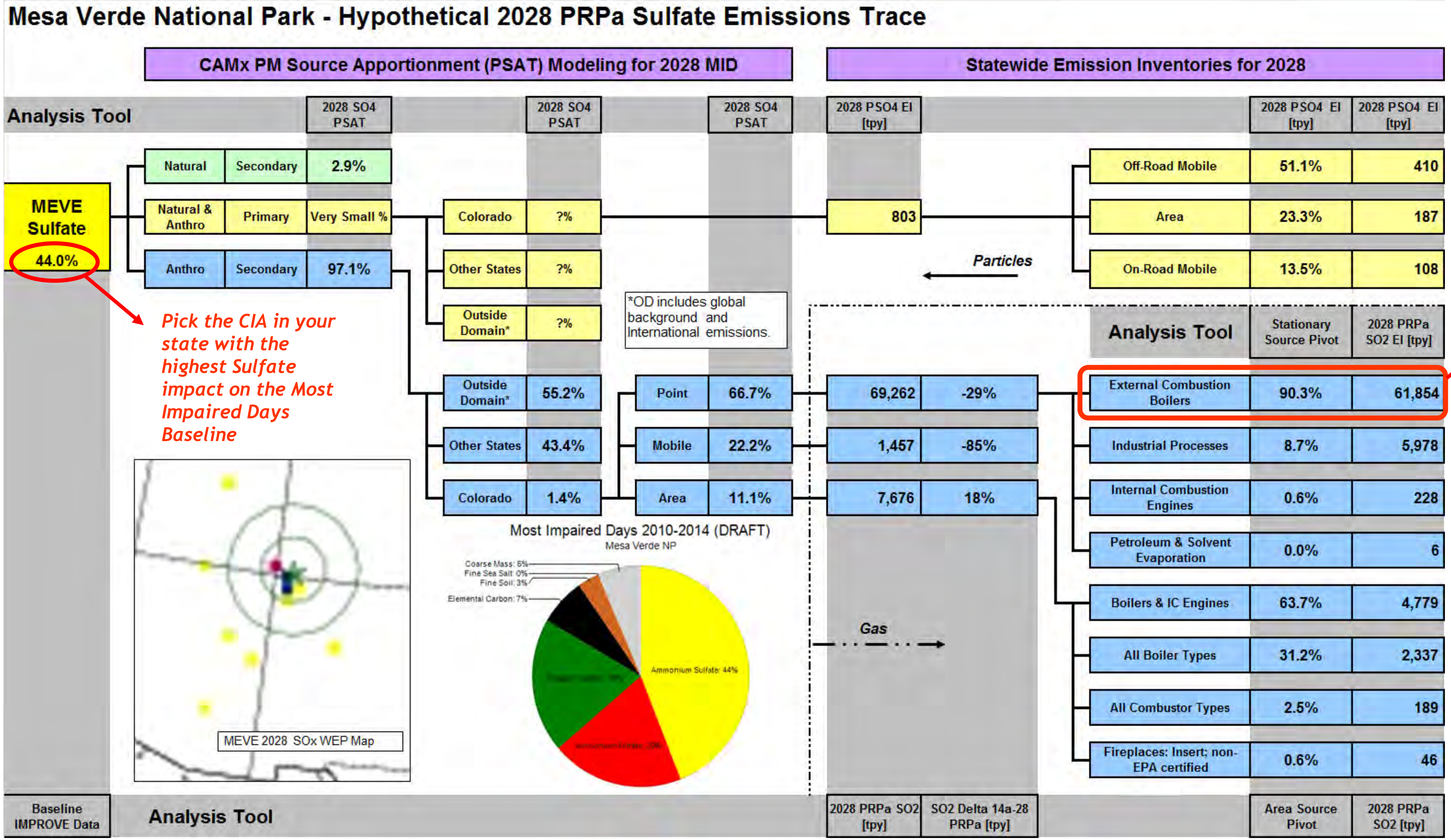
How do we know whether we are evaluating a "reasonably large fraction" of emissions impacting extinction at each CIA? – Step 2



Step 2 – We need to use PM Source Apportionment Technology (PSAT) modeling for each Class I Area to determine the state level impacts and sources.

The "Emissions Trace" is a pictorial method to showing the complex relationship between emissions and sources.

Mesa Verde Sulfate – Hypothetical Emissions Trace



Colorado Point External Combustion Boilers Sulfate impact to MEVE MID visibility is really small: ≈0.36%

*(0.44*0.971*0.014*0.667 *0.903) = 0.0036*

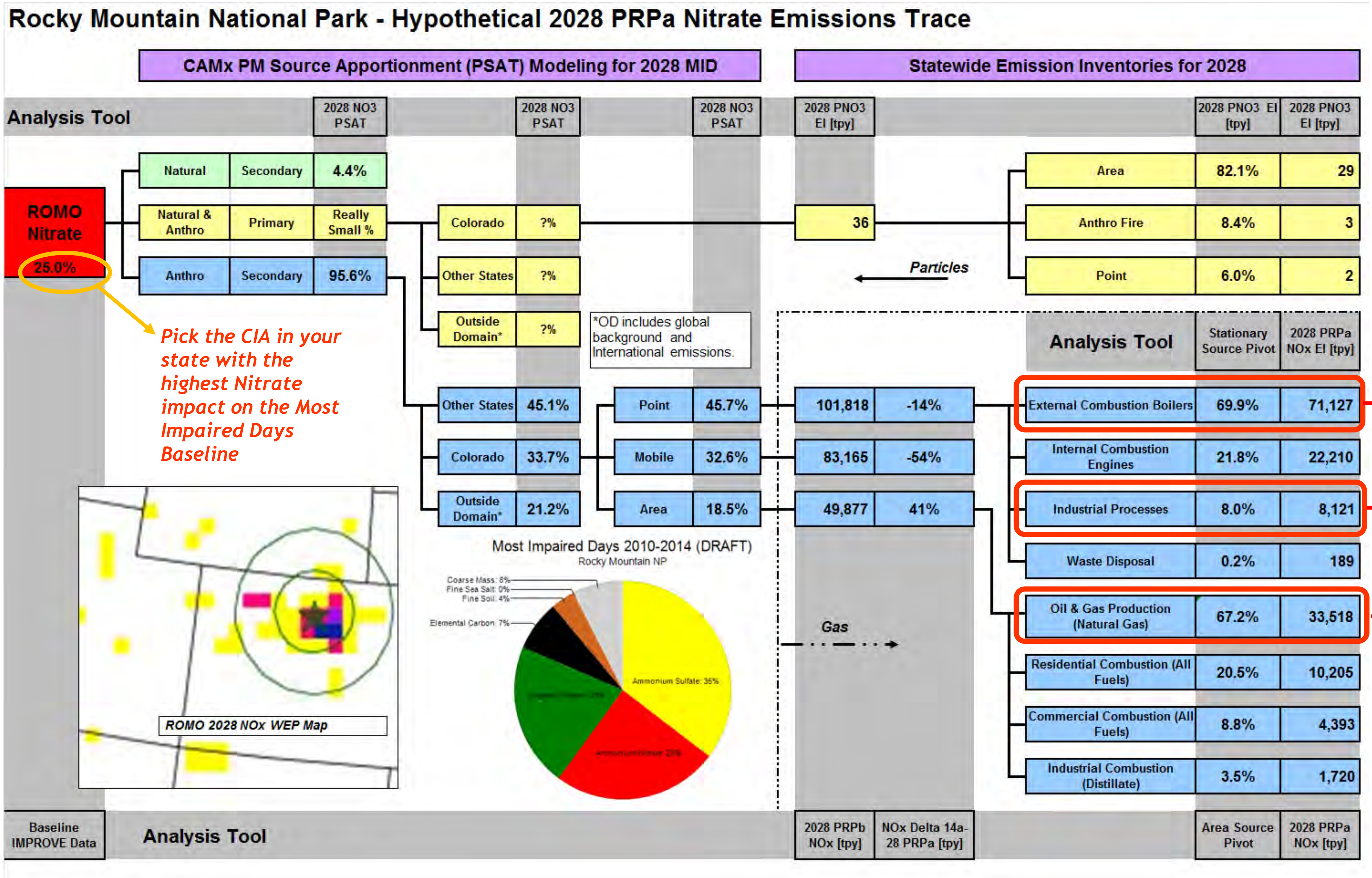
4-factor on SO2 controls for EGUs with Q/d >= 10

Most of MEVE Sulfate impact is from International Transport and other states nearby EGUs

Potential MEVE Sulfate/SO2 Analysis for the MIDs

- MEVE has the highest sulfate concentrations in Colorado that comprises 45% of reconstructed extinction on the MIDs
  - 23.6% of visibility impact is from global background and international transport (0.44*0.971*0.552 = 0.236)
    - Can't control
  - 18.5% is from Other States (0.44*0.971*0.434 = 0.185)
    - Need to consult with states with the highest impacts to see if other states can help with reasonable progress
  - 0.6% is from Colorado (0.44*0.971*0.014 = 0.006)
    - 4-factor analysis on all point sources with Q/d >= 10
- Colorado 2018 SO2 Emissions (base all sources) = 81,837 tpy
  - Colorado 2018 SO2 (point source) = 69,262 tpy
  - Over 84% of SO2 emissions from point sources
- Colorado 2018 Point Source SO2 reviewed under 4-factor = 37,473 tpy
  - Using statewide SO2 (all sources) about 45.8% of Colorado SO2 emissions reviewed under the 4-factor analysis
  - Using statewide SO2 (point sources) about 54.0% of Colorado SO2 emissions reviewed under the 4-factor analysis

Rocky Mountain Nitrate – Hypothetical Emissions Trace



Colorado Point External Combustion Boilers Nitrate impact to ROMO MID visibility is small: ≈2.6%

*(0.25*0.956*0.337*0.457*0.699) = 0.026*

4-factor on NOx controls for EGUs with Q/d >= 10

4-factor on Cement Kilns with Q/d >= 10

Colorado Area O&G Nitrate impact to ROMO MID visibility is pretty small: ≈1%

*(0.25*0.956*0.337*0.185* 0.672) = 0.01*

Potential ROMO Nitrate/NOx Analysis of MIDs

- ROMO has the highest nitrate concentrations in Colorado that comprises 22% of reconstructed extinction on the MIDs
  - 10.8 % of visibility impact is from other States (0.25*0.956*0.451 = 0.108)
    - Need to consult with states with the highest impacts to see if other states can help with reasonable progress
  - 8.1% is from Colorado (0.25*0.956*0.337 = 0.081)
    - 4-factor analysis on all point sources with Q/d = 10
  - 5.1% is from global background and international transport (0.25*0.956*0.212 = 0.051)
    - Can't control
- Colorado 2018 NOx Emissions (base all sources) = 289,799 tpy
  - Colorado 2018 NOx (point sources) = 101,818 tpy
  - Over 35% of NOx emissions is from point sources
- Colorado 2018 NOx reviewed under 4-factor = 66,243 tpy,
  - Using statewide NOx (all sources) about 22.9% of Colorado NOx emissions reviewed under the 4-factor analysis
  - Using statewide NOx (point sources) about 65.1% of Colorado NOx emissions reviewed under the 4-factor analysis

Reasonable Progress Four-Factor Analysis Evaluation

- States may need to reach out to identified sources by **early 2019** to obtain site specific information to inform the four factor analysis
    1) Costs of compliance
    2) Time necessary for compliance
    3) Energy and non-air quality environmental impacts of compliance
    4) Remaining useful life
- Identified sources may need to conduct a technical engineering study of the feasibility and costs of potential emission controls
    - **Extra time may be needed before a state can start the four-factor analysis**
- Goal is to complete the four-factor analysis by late 2019 and determine controls
    - Emission reductions are modeled to establish CIA reasonable progress goals
- States can leverage existing control cost information
    - RACT/BACT/LAER clearinghouse and other states previous RH SIPs

0) Implicit in the Reasonable Progress 4-factor Analysis is the Review of Available Control Technologies

- Develop top-down list of potential control technologies that should be evaluated for each source type and applicable pollutant
- Rank control technologies by potential effectiveness (the control technologies evaluated should be sorted from the highest to lowest control efficiency)
- Evaluate each control option's technological feasibility
    - The determination of technological infeasibility should be based on consideration of emission point specific factors.
    - Any determination of infeasibility should demonstrate that the control technology could not be successfully implemented based on physical, chemical and/or engineering principles

1) Costs of Compliance

- Calculation of Control Technology Cost
  - For each control option determined to be technically feasible, an economic analysis is performed to determine the cost per ton of pollutant reduced using annual emission totals based on allowable emissions.
  - Determine the capital cost of the control equipment, including installation and retrofit costs. Price quotes from manufacturers or vendors where possible should be used. Capital costs may include but are not limited to:
    - Engineering costs, Delivery costs, Labor costs, Incidental costs (i.e. equipment rental, etc), Construction costs, Installation costs, and Start-up and commissioning costs.
- Determine the capital recovery factor using the following equation:
  - Capital Recovery Factor= $\frac{\text{Interest Rate}\times(1+\text{Interest Rate})^{\text{Equipment Life}}}{(1+\text{Interest Rate})^{\text{Equipment Life}}-1}$
  - The equipment life assumption should be a standard for the emission control equipment being evaluated.
  - The equipment life and interest rate assumptions and the basis for those assumptions (e.g., vendor provided information regarding control equipment life) must be documented.

1) Costs of Compliance (continued)

- Estimate the annualized equipment cost by multiplying the capital cost of the control equipment by the capital recovery factor (see EPA's Cost Control Manual).
- Estimate the annual operating costs associated with the control equipment including but not limited to:
  - Energy costs (i.e. electrical load, extra fuel, etc.), Catalyst or other control equipment maintenance costs, Other maintenance costs, Taxes, Insurance costs, Contingency costs, Monitoring, recordkeeping and reporting costs.
- Calculate the total annual cost by adding the annual equipment cost to the annual operating cost
- Estimate the annual pollutant reduction from control technology options using baseline emissions
  - Control effectiveness of each control technology should be documented
- Calculate the cost of the control option in dollars per ton removed by dividing the total annualized control cost by the tons of emissions reduced.

2) Time necessary for compliance

- Estimate the amount of time required to install the emission control
  - Generally, most emission controls can be installed and operating prior to 2028

3) Energy and non-air quality environmental impacts of compliance

- Consider potential impacts from the installation/operation of emission controls
  - Emission control results in decrease fuel efficiency leading to increased fuel consumption
  - Waste stream generated by an emission control, or an increase in resource consumption rates
  - Some examples include:
    - Extra power load required to run higher capacity fans on a selective catalytic reduction (SCR) system
    - Extra water used and sludge generated from installation of flue gas desulfurization (FGD) unit

4) Remaining useful life

- Generally addressed in the control cost analysis

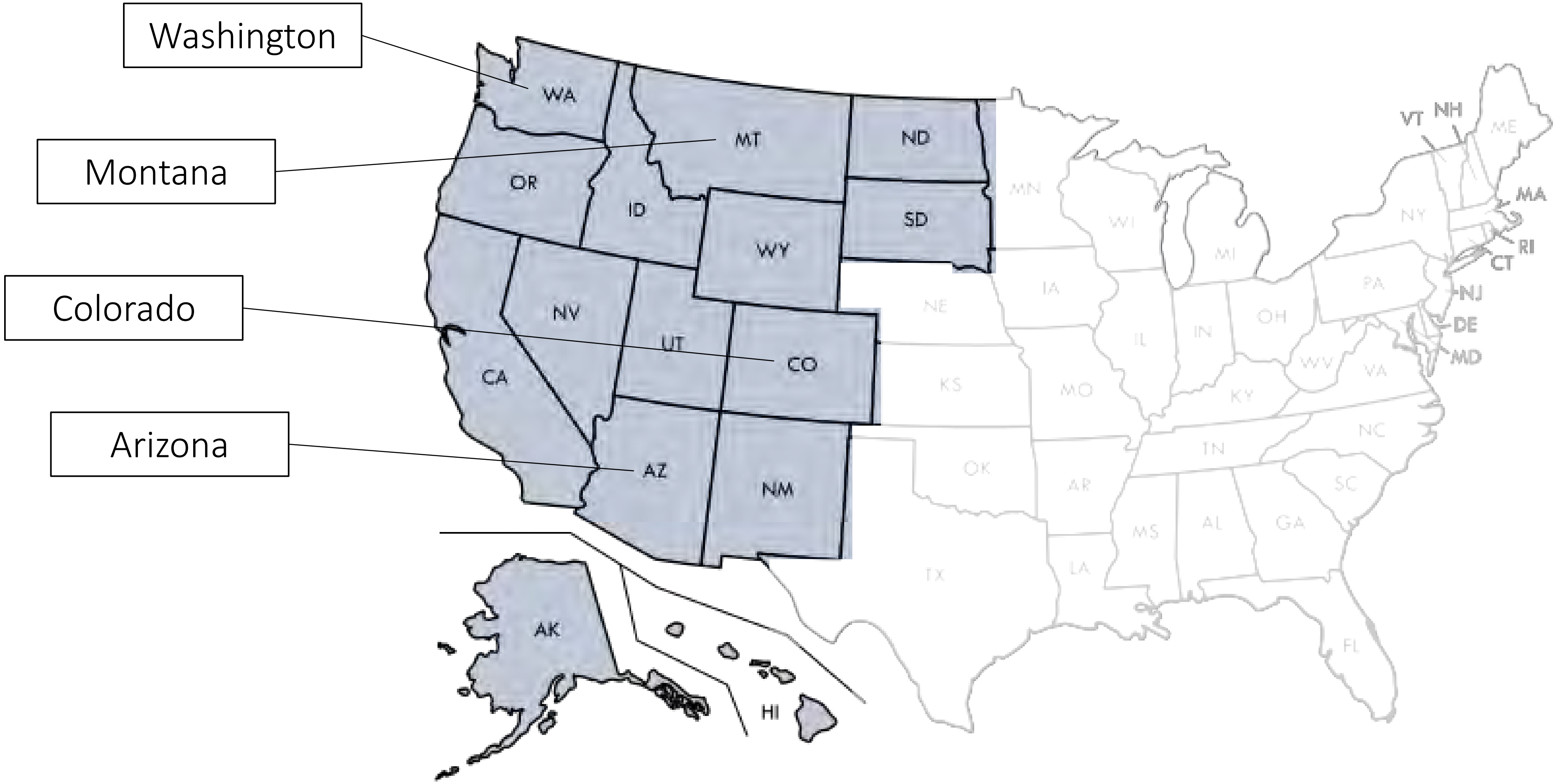
Consideration of the 5th Factor - Visibility

- Visibility could be a potential additional factor for deciding single-source emission controls
  - Evaluation of single-source visibility was required by statue for BART sources
    - In the first RH SIP process, many states used the CALPUFF model to assess visibility impacts and improvements from various emission control options.
  - Not required for RP sources
    - EPA recommends assessing CIA visibility improvement using the Regional Model, but acknowledges the use of single-source visibility modeling, provided it is done in a reasonable fashion
- CM subcommittee unable to reach consensus on single-source visibility modeling for WRAP region
  - Individual states have flexibility to pursue single-source visibility modeling if desired

Control Measure 4-Factor Analysis Questions?

Please call Curt Taipale at: 303-692-3265

State Screening and Outreach Examples



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