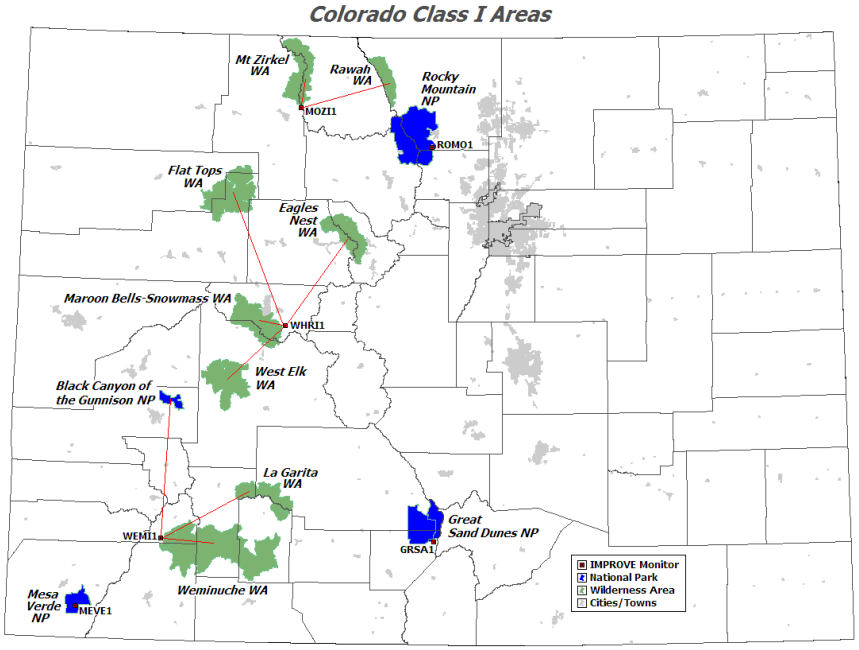
Identification of Significant Sources and Categories Contributing to Regional Haze in Colorado



November 16, 2017

Regional Haze Teach-In #5

Curt Taipale – Planning and Policy Program

COLORADO
Air Pollution Control Division
Department of Public Health & Environment

RP Analysis of Significant Sources and Categories Contributing to Visibility Impairment at Colorado CIAs

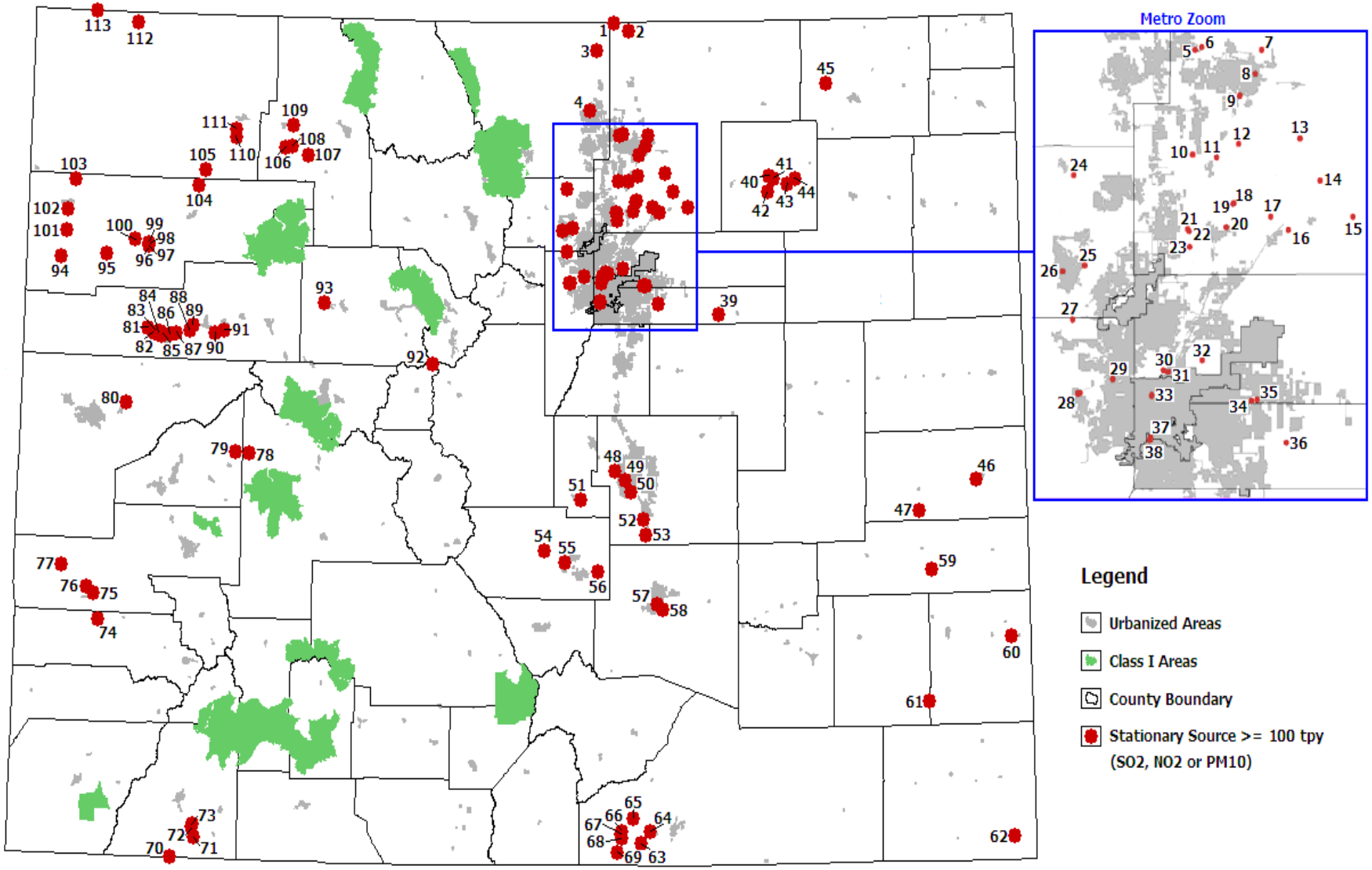
- *Colorado developed a methodology for evaluating all <u>significant</u> point sources of <u>pollutants</u> contributing to RH at Colorado Class I Areas (CIAs).*
- *"<u>Significant RP Point Source</u>" is determined from comparing different Q/d ratios with the Δ dv sensitivity of BART source CALPUFF modeling.*
  - *Q/d ≥ 20 was selected because the delta deciview (Δdv) sensitivity was about 0.3 Δdv*
  - *EPA recommended that RP should be at least as stringent or more stringent than the 0.5 Δdv threshold used in determining the subject-to-BART sources.*
  - *"Q/d ratio" is defined as: the mathematical sum of uncontrolled actual SO2, NOx, and PM emissions in tpy (denoted "Q") divided by the distance in kilometers from the point source to the nearest edge of a Class I area (denoted "d").*
- *"<u>Pollutants</u>" determined from analysis of Colorado CIAs IMPROVE Monitoring data and statewide emission inventories.*
  - ***2010 Conclusion**: evaluate SO2, NOx and PM sources with Q/d ≥ 20 for RP controls, other pollutants – OC, EC, and Soil deferred until science and emission inventories are improved for consideration in future RH SIPs*

Significant Source Categories Contributing to Sulfate, Nitrate & Coarse Mass at Colorado Class I areas

Conclusions:

- *For SO2: Q/d ≥ 20 captures <u>all</u> significant point sources*
  - *Majority of significant SO2 sources have controls*
  - *One EGU evaluated for SO2 controls (CSU - Nixon)*
  - *Area & Mobile sources - not practical to impose further controls*
- *For NOx: Q/d ≥ 20 captures <u>most</u> significant point sources (~73%)*
  - *40 RICE > 100 tpy, majority (36) are subject to Reg. 7 requirements ($5k off-ramp or lean burn)*
  - *Significant mobile source reductions anticipated through federal emission standards*
  - *Area sources dominated by O&G sector*
  - *O&G Heaters is the largest category - no practical controls (emissions based on well counts)*
  - *O&G Drill Rigs - 2018 statewide NOx emission projections = 4,413 tpy.*
- *Coarse PM: Q/d ≥ 20 captures <u>some</u> point sources (~21%)*
  - *Point Sources account for 11% of total PM10 emissions*
  - *Three mining operations with Q/d ≥ 20 excluded because most of the PM was fugitive*
  - *Windblown & Fugitive Dust account for over 80% of PM10*
  - *Colorado has low permit thresholds that result in most sources have permits for activities such as construction sand & gravel operations, mining, coal handling and other industrial processes*

Site Emission >= 100 tpy for SO2, NO2 or PM10
Number of Sources = 113



List of Point Sources with Q/d ≥ 20

ArcGIS DATA - Statewide Sources over 100 tpy for SO2, NOx and PM10 (based on 2007 data)

Count	FACILITY NAME	SO2 [tpy]	NO2 [tpy]	PM10 [tpy]	Q [tpy]	Closest CIA	d [km]	Q/d
1	PLATTE RIVER POWER AUTHORITY - RAWHIDE	854	1,808	134	2,796	Rocky Mnt NP	56.0	49.9
2	CEMEX INC. - LYONS CEMENT	87	2,479	418	2,984	Rocky Mnt NP	24.8	120.3
3	PUBLIC SERVICE CO - VALMONT	749	2,355	58	3,162	Rocky Mnt NP	34.8	90.9
4	COLORADO ENERGY NATIONS CORPORATION	2,626	1,786	42	4,453	Rocky Mnt NP	54.5	81.7
5	PUBLIC SERVICE CO - CHEROKEE	7,116	10,205	261	17,581	Rocky Mnt NP	65.3	269.2
6	PUBLIC SERVICE CO - ARAPAHOE	2,496	2,922	178	5,595	Rocky Mnt NP	73.3	76.3
7	PUBLIC SERVICE CO - PAWNEE	13,073	4,645	193	17,911	Rocky Mnt NP	155.7	115.0
8	COLORADO SPRINGS UTILITIES - DRAKE	8,431	3,826	251	12,507	Great Sand Dunes NP	114.0	109.7
9	COLORADO SPRINGS UTILITIES - NIXON	3,883	2,656	129	6,668	Great Sand Dunes NP	104.4	63.9
10	AQUILA INC. - W.N. CLARK STATION	1,480	869	44	2,393	Great Sand Dunes NP	58.7	40.8
11	HOLCIM (US) INC. PORTLAND CEMENT	372	2,589	288	3,250	Great Sand Dunes NP	66.0	49.2
12	PUBLIC SERVICE CO - COMANCHE	13,854	8,415	178	22,447	Great Sand Dunes NP	84.5	265.6
13	TRI STATE GENERATION - NUCLA	1,509	1,716	101	3,327	Black Canyon NP	70.6	47.1
14	PUBLIC SERVICE CO - CAMEO	2,586	1,051	112	3,750	Black Canyon NP	70.5	53.2
15	PUBLIC SERVICE CO - HAYDEN	2,657	7,694	284	10,634	Mt Zirkel WA	31.6	336.5
16	TRI STATE GENERATION - CRAIG	3,586	16,807	235	20,628	Flat Tops WA	47.7	432.4
	Totals:	65,358	71,821	2,906				

RP Emission Control Evaluation

- *Technical Review – Five Step Analysis Process*
  - *Identify All Available Control Technologies*
  - *Eliminate Technically Infeasible Options*
  - *Evaluate Control Technology Effectiveness*
  - *Evaluate Impacts and Document Results*
    - *Costs of Compliance*
    - *Time Necessary for Compliance*
    - *Energy and Non-Air Impacts*
    - *Remaining Useful Life of the source*
  - *Evaluate Visibility Impacts*
    - *Visibility improvement associated with controls*
- *State focused on SO2, NOx and PM emissions*

RP 4-factors used in Deciding Appropriate Emission Controls

5th factor –Colorado Added

EGU – Evaluation Criteria for NOx

- *For coal-fired electric generating units (EGUs),*
  - *Colorado decided that two factors should be given more weight in deciding NOx controls*
  - *Selective Catalytic Reduction (SCR):*
    - *Cost of control must be <$5,000/ton*
    - *Visibility Improvement must be ≥ 0.5 Δ deciview*
  - *Selective Non-Catalytic Reduction (SNCR):*
    - *Cost of control must be <$5,000/ton of NOx removed*
    - *Visibility Improvement must be ≥ 0.2 Δ deciview*
  - *EGUs not meeting the above criteria*
    - *Other NOx control technologies were evaluated*

Balancing Visibility Improvement with Emission Controls

Facility	Unit	Review Type	NOx Final Determinations				SO2 Final Determinations			
			Emission Reduction [tons/year]	Assumed Control Technology (*Italics-Existing* / **Bold-new**)	Control Costs [$/ton]	CALPUFF Visibility Improvement [Δ dv]	Emission Reduction [tons/year]	Assumed Control Technology (*Italics-Existing* / **Bold-new**)	Control Costs [$/ton]	CALPUFF Visibility Improvement [Δ dv]
PSCo Cameo	1 & 2	RP	1,140	**Shutdown**	-	not modeled	2,618	**Shutdown**	-	not modeled
Cemex	Kiln	BART	846	**SNCR**	$ 1,934	0.41	-	-	-	-
CENC (TriGen)	3	RP	-	-	-	not modeled	-	-	-	not modeled
	4	BART	214	**LNB-SOFA**	$ 3,234	0.08	-	-	-	-
	5	BART	354	**LNB-SOFA-SNCR**	$ 4,918	0.26	-	-	-	-
PSCo Comanche	1	BART	-	*LNB*	-	-	-	*Semi-Dry FGD*	-	-
	2	BART	-	*LNB*	-	-	-	*Semi-Dry FGD*	-	-
TriState Craig	1	BART	~~727~~ 4,048	*ULNB* -~~SNCR~~ **SCR**	~~$4,877~~ $6,187	~~0.31~~ 0.98	-	*Wet FGD*	-	0.03
	2	BART	3,975	*ULNB* -**SCR**	$ 6,299	0.98	-	*Wet FGD*	-	0.03
	3	RP	853	*ULNB* -**SNCR**	$ 4,887	0.32	-	*Semi-Dry FGD*	-	-
Holcim-Florence	Kiln	RP	1,028	*SNCR*	$ 2,293	0.29	-	*Wet Lime Scrubber*	-	-
CSU Drake	5	BART	~~215~~ 768	~~ULNB-OFA~~ **Shutdown**	~~$ 1,342~~	~~0.08~~ 0.62	~~762~~ 1,269	~~DSI~~ **Shutdown**	~~$ 1,760~~	~~0.12~~ 0.94
	6	BART	509	**ULNB-OFA**	$ 664	0.20	2,368	**FGD**	$ 2,808	0.24
	7	BART	749	**ULNB-OFA**	$ 616	0.26	3,764	**FGD**	$ 2,345	0.39
PSCo Hayden	1	BART	3,032	*LNB* -**SCR**	$ 3,385	1.12	61	*Semi-Dry FGD*	$ 2,317	0.10
	2	BART	3,120	*LNB* -**SCR**	$ 4,064	0.85	39	*Semi-Dry FGD*	$ 3,626	0.21
CSU Nixon	1	RP	707	**ULNB-OFA**	$ 1,372	0.16	3,215	**Semi-Dry FGD**	$ 3,744	0.46
TriState Nucla	1	RP	-	*SNCR* -**Study**	-	-	-	*LI*- **Study**	-	-
PRP Rawhide	1	RP	448	*LNCFS-SOFA* -**ECC**	$ 644	0.45	-	*Semi-Dry FGD*	-	-
PSCo Arapahoe	3	BART Alt	1,770	**Shutdown**	-	not modeled	925	**Shutdown**	-	not modeled
	4	BART Alt	~~248~~ 1,148	~~Convert to NG~~ **Shutdown**	-	not modeled	1,765	~~Convert to NG~~ **Shutdown**	-	not modeled
PSCo Cherokee	1	BART Alt	1,556	**Shutdown**	-	not modeled	2,221	**Shutdown**	-	not modeled
	2	BART Alt	2,895	**Shutdown**	-	not modeled	1,888	**Shutdown**	-	not modeled
	3	BART Alt	1,866	**Shutdown**	-	not modeled	743	**Shutdown**	-	not modeled
	4	BART Alt	2,211	**Convert to NG**	-	not modeled	2,127	**Convert to NG**	-	not modeled
PSCo Pawnee	1	BART Alt	3,135	**LNB-SCR**	<$5,000	0.32	11,066	**Semi-Dry FGD**	<$ 3,000	0.68
PSCo Valmont	5	BART Alt	2,314	**Shutdown**	-	not modeled	758	**Shutdown**	-	not modeled
Black Hills Clark	1 & 2	RP	861	**Shutdown**	-	not modeled	1,457	**Shutdown**	-	not modeled
		Total:	**39,547**				**36,284**			

COLORADO
Air Pollution Control Division
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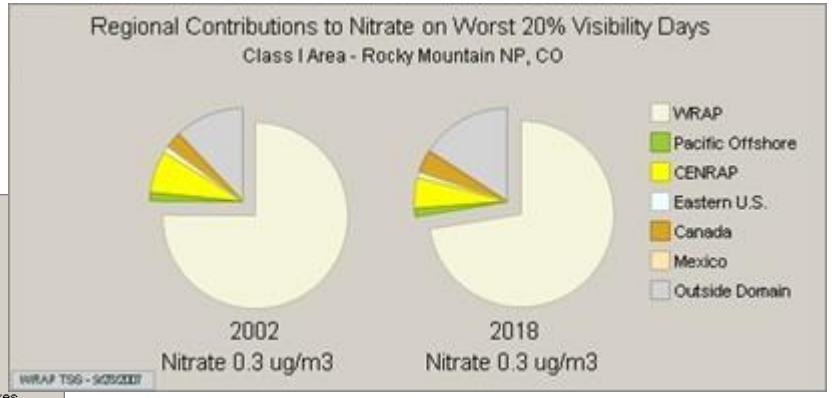
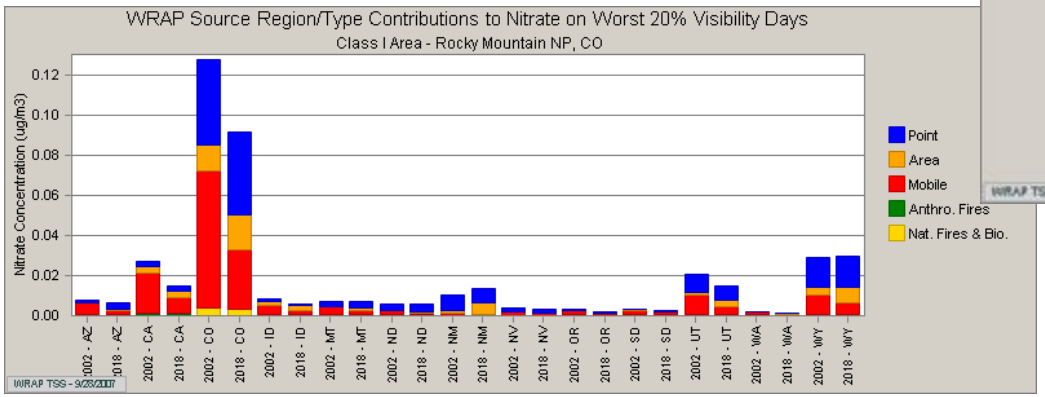
Balancing Visibility with Costs

- *Differences in Visibility Models*
  - *BART and RP sources modeled using CALPUFF*
    - *Each source modeled separately to determine impacts*
  - *CIA RPGs established using Regional Model – CMAQ*
    - *IMPROVE data used to calibrate model visibility estimates*
    - *Visibility benefit of final controls not known*
      - *Emission reductions beyond 2018(b) baseline were not modeled*
        - » *NOx = 35,452 tpy (13% of 2018 NOx statewide)*
        - » *SO2 = 14,315 tpy (25% of 2018 SO2 statewide)*
- *Total Emission Control Costs of Colorado RH SIP:*
  - *$1.75 Billion on 16 Facilities with 30 BART/RP Units*

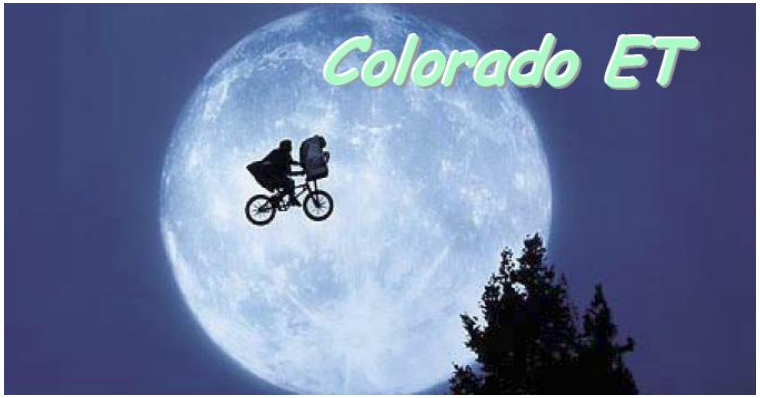
ROMO Nitrate PSAT

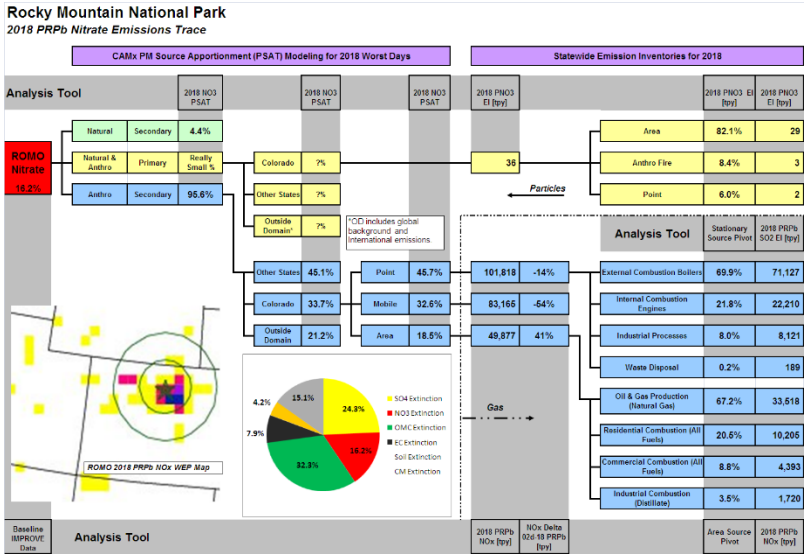
- *Nitrate PM Source Apportionment (PSAT) – includes all states/regions*
  - *About 96% of nitrate is anthropogenic on worst days*
  - *WRAP States ~39%; Colorado ~34%; Outside Model Domain ~21%, CENRAP ~5%, Eastern US ~1%*
  - *Colorado Point Sources are the largest source category ~46%*
  - *Colorado Mobile Sources ~33% and Area Sources ~19%,*
- *PSAT is good for showing attribution and relative source contribution*
  - *Difficult to understand how it relates to specific source categories & emissions*
- *Colorado developed an analysis tool to bridge the gap – the "ET" or Emissions Trace*





Understanding the Colorado ET





- *Read from left to right*
- *Top bar (purple) denotes general source of information*
- *Colors denote different types particulates/sources*
  - *Lt Green: secondary particulate from natural sources*
  - *Lt Yellow: primary particulate from anthropogenic/natural sources*
  - *Lt Blue: secondary particulate from anthropogenic sources*
- *Gray color bars provide specific detail on source of data*
- *WEP map provides information on likely source areas*

ROMO Nitrate - ET

*Colorado share is 32.2% (95.6*33.7/100)*

*Impact of CO Point Sources is 14.7% (95.6*33.7*45.7/100)*

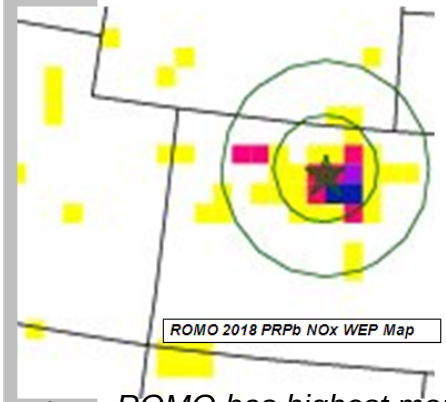
Rocky Mountain National Park

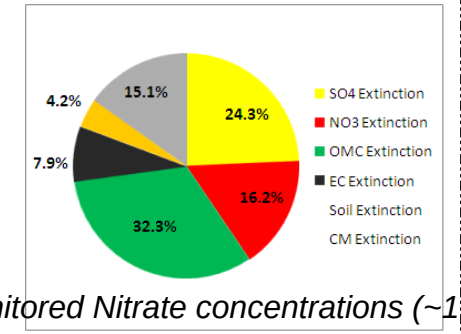
2018 PRPb Nitrate Emissions Trace

CAMx PM Source Apportionment (PSAT) Modeling for 2018 Worst Days									Statewide Emission Inventories for 2018				
Analysis Tool		2018 NO3 PSAT		2018 NO3 PSAT			2018 NO3 PSAT		2018 PNO3 EI [tpy]			2018 PNO3 EI [tpy]	2018 PNO3 EI [tpy]
ROMO Nitrate 16.2%	Natural	Secondary	4.4%								Area	82.1%	29
	Natural & Anthro	Primary	Really Small %	Colorado	?%				36		Anthro Fire	8.4%	3
	Anthro	Secondary	95.6%	Other States	?%					Particles	Point	6.0%	2
				Outside Domain*	?%								
				Other States	45.1%	Point	45.7%		101,818	-14%	Analysis Tool	Stationary Source Pivot	2018 PRPb SO2 EI [tpy]
				Colorado	33.7%	Mobile	32.6%		83,165	-54%	External Combustion Boilers	69.9%	71,127
				Outside Domain	21.2%	Area	18.5%		49,877	41%	Internal Combustion Engines	21.8%	22,210
											Industrial Processes	8.0%	8,121
											Waste Disposal	0.2%	189
										Gas	Oil & Gas Production (Natural Gas)	67.2%	33,518
											Residential Combustion (All Fuels)	20.5%	10,205
											Commercial Combustion (All Fuels)	8.8%	4,393
											Industrial Combustion (Distillate)	3.5%	1,720
Baseline IMPROVE Data	Analysis Tool								2018 PRPb NOx [tpy]	NOx Delta 02d-18 PRPb [tpy]		Area Source Pivot	2018 PRPb NOx [tpy]

*OD includes global background and International emissions.

Source categories potentially identified as significant





- *ROMO has highest monitored Nitrate concentrations (~16%) in State*

NOx Emissions Comparison: Original - Base 2018b (used in PSAT Modeling) vs Latest WRAP EI - 2018 PRPb

Region	Scenario	Year	Point [tpy]	Anthro Fire [tpy]	Natural Fire [tpy]	Biogenic [tpy]	Area [tpy]	WRAP Area O&G [tpy]	Off-Shore [tpy]	On-Road Mobile [tpy]	Off-Road Mobile [tpy]	Road Dust [tpy]	Fugitive Dust [tpy]	WB Dust [tpy]	Total [tpy]
Nitrogen Oxides (gas and particulate)															
CO	Plan02c	2002	117,869	520	9,377	37,349	11,645	23,351		141,883	62,447	1	13		**404,455**
CO	Base18b	2018	112,241	408	9,377	37,349	16,360	27,993		45,249	40,804	-	17		**289,799**
		Delta:	(5,628)	(111)	0	-	4,715	4,642	-	(96,634)	(21,643)	(1)	4	-	(114,657)
		Reduction Percentage:	***-4.8%***	***-21.4%***	***0.0%***	***0.0%***	***40.5%***	***19.9%***	***0.0%***	***-68.1%***	***-34.7%***	***-100.0%***	***29.2%***	***0.0%***	
		Source Category % of Total:	**39%**	**0%**	**3%**	**13%**	**6%**	**10%**	**0%**	**16%**	**14%**	**0%**	**0%**	**0%**	

Region	Scenario	Year	Point [tpy]	Anthro Fire [tpy]	Natural Fire [tpy]	Biogenic [tpy]	Area [tpy]	WRAP Area O&G [tpy]	Off-Shore [tpy]	On-Road Mobile [tpy]	Off-Road Mobile [tpy]	Road Dust [tpy]	Fugitive Dust [tpy]	WB Dust [tpy]	Total [tpy]
Nitrogen Oxides (gas and particulate)															
CO	Plan02d	2002	118,667	520	9,377	37,349	11,729	23,518		141,883	62,448	1	16		**405,507**
CO	Prp18b	2018	101,818	408	9,377	37,349	16,360	33,517		45,249	37,916	1	14		**282,010**
		Delta:	(16,848)	(111)	0	-	4,630	10,000	-	(96,634)	(24,532)	0	(2)	-	(123,497)
		Reduction Percentage:	***-14.2%***	***-21.4%***	***0.0%***	***0.0%***	***39.5%***	***42.5%***	***0.0%***	***-68.1%***	***-39.3%***	***32.3%***	***-12.9%***	***0.0%***	
		Source Category % of Total:	**36%**	**0%**	**3%**	**13%**	**6%**	**12%**	**0%**	**16%**	**13%**	**0%**	**0%**	**0%**	

Colorado NOx Emission Comparison: 2018 PRPb is 2.7% lower than Base 2018b

Colorado Point Source NOx

Stationary Source Pivot Table - 2018 PRPb Date: 07-23-09					
State	CO				
Sum of SumOfNOX_ANN					
SCC1_DESC	SCC3_DESC	SCC6_DESC	PLANT	BART_FLAG	Total
External Combustion Boilers	Electric Generation				64,405
	Industrial				3,819
	Commercial/Institutional				2,874
	Space Heaters				29
Internal Combustion Engines	Industrial				16,730
	Electric Generation				4,323
	Commercial/Institutional				1,152
	Engine Testing				5
Industrial Processes	Mineral Products				5,422
	Miscellaneous Manufacturing Industries				991
	Petroleum Industry				770
	Primary Metal Production				375
	Oil and Gas Production				308
	Secondary Metal Production				165
	Food and Agriculture				36
	Chemical Manufacturing				19
	Fabricated Metal Products				17
	Pulp and Paper and Wood Products				10
	In-process Fuel Use				3
	Rubber and Miscellaneous Plastics Products				2
	Electrical Equipment				1
	Photo Equip/Health Care/Labs/Air Condit/SwimPools				*
	Transportation Equipment				*
	Cooling Tower				*
	Building Construction				*
Waste Disposal					189
Petroleum and Solvent Evaporation					171
Grand Total					101,818

Significant Point Source Categories

External Combustion Boiler Sources

External Combustion Boilers	Electric Generation	Bituminous/Subbituminous Coal	62,154
		Natural Gas	2,209
		Distillate Oil	22
		Anthracite Coal	9
		Liquid Waste	7
		Wood/Bark Waste	4
		Liquified Petroleum Gas (LPG)	0
	Industrial	Natural Gas	1,857
		Bituminous/Subbituminous Coal	1,619
		Process Gas	286
		Distillate Oil	23
		Liquified Petroleum Gas (LPG)	15
		Residual Oil	10
		Wood/Bark Waste	8
	Commercial/Institutional	Natural Gas	2,666
		Distillate Oil	152
		Bituminous/Subbituminous Coal	38
		Process Gas	16
		Residual Oil	1
		Wood/Bark Waste	0

Significant External Combustion Boiler Categories

External Combustion Boiler Sources > 100 tpy

Electric Generation	Bituminous/Subbituminous Coal	TRI STATE GENERATION CRAIG	16,799
		PUBLIC SERVICE CO CHEROKEE PLT	10,315
		PUBLIC SERVICE CO COMANCHE PLT	8,743
		PUBLIC SERVICE CO HAYDEN PLT	7,307
		PUBLIC SERVICE CO PAWNEE PLT	3,942
		PLATTE RIVER POWER AUTHORITY - RAWHIDE	3,912
		COLORADO SPRINGS UTILITIES-DRAKE PLT	3,669
		COLORADO SPRINGS UTILITIES - NIXON PLT	2,331
		PUBLIC SERVICE CO - VALMONT	2,279
		TRI STATE GENERATION NUCLA	1,753
		AQUILA, INC. - W.N. CLARK STATION	1,090
	Natural Gas	Zuni	1,378
		COLORADO SPRINGS UTILITIES-BIRDSALL PLT	278
		PUBLIC SERVICE CO CHEROKEE PLT	269
		AQUILA, INC. - PUEBLO POWER PLANT	102

RP Sources with Q/d ≥ 20

Industrial	Natural Gas	CF&I STEEL L P DBA ROCKY MTN STEEL MILLS	231
		PUBLIC SERVICE CO DENVER STEAM PLT	152
		EASTMAN KODAK CO	116
	Bituminous/Subbituminous Coal	TRIGEN - COLORADO ENERGY CORPORATION	1,344
		WESTERN SUGAR CO	274

Commercial/Institutional	Natural Gas	LAMAR UTILITIES BOARD	394
		U.S. DEPT OF ENERGY - RFETS	171
		COLORADO STATE UNIV CSU FACILITY SVCS	151
		GOODRICH CORPORATION	136
		UNIV OF COLO - HEALTH SCIENCES CENTER	124
		WESTERN SUGAR CO	118
		AMERICAN SODA LLP - PICEANCE FACILITY	108

Colorado Point Source NOx

Stationary Source Pivot Table - 2018 PRPb Date: 07-23-09					
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	Miscellaneous Manufacturing Industries				991
	Petroleum Industry				770
	Primary Metal Production				375
	Oil and Gas Production				308
	Secondary Metal Production				165
	Food and Agriculture				36
	Chemical Manufacturing				19
	Fabricated Metal Products				17
	Pulp and Paper and Wood Products				10
	In-process Fuel Use				3
	Rubber and Miscellaneous Plastics Products				2
	Electrical Equipment				1
	Photo Equip/Health Care/Labs/Air Condit/SwimPools				*
	Transportation Equipment				*
	Cooling Tower				*
	Building Construction				*
Waste Disposal					189
Petroleum and Solvent Evaporation					171
Grand Total					101,818

Significant Point Source Categories

Internal Combustion Engine Sources > 100 tpy

RP Source with Q/d ≥ 20

Industrial	Natural Gas	WILLIAMS FIELD SERVICES IGNACIO B PLT	812
		KERR-MCGEE ROCKY MOUNTAIN CORP. - HUDSON	674
		COLORADO INTERSTATE GAS CO KIT CARSON	598
		THERMO COGEN PARTNERSHIP FT LUPTON	547
		BP AMERICA PRODUCTION CO. WATTENBERG PLT	445
		THERMO POWER & ELEC INC	418
		NORTHWEST PIPELINE CORP RANGELY STA	390
		EL PASO NATURAL GAS CO BONDAD COMP STA	300
		KERR-MCGEE ROCKY MOUNTAIN CORP.-BRIGHTON	297
		COLORADO INTERSTATE GAS CO CHEYENNE STN	294
		BP AMERICA PRODUCTION CO. [MISC. ENGINES	270
		WILLIAMS PROD. RMT CORP. - PARACHUTE	269
		BRUSH COGENERATION PARTNERS/COLO POWER	255
		KERR-MCGEE FREDERICK CS	245
		COLORADO INTERSTATE GAS CO WATKINS STA	228
		COLORADO INTERSTATE GAS CO SPRINGFIELD	226
		STERLING ENERGY CO. - YENTER C.S. & G.P.	208
		DUKE ENERGY FIELD SERVICES - SPINDLE	201
		ENCANA OIL & GAS (USA), INC-DRAGON TRAIL	198
		TRI-STATE GENERATION & TRANS.-RIFLE STAT	183
		DUKE ENERGY - LADDER CREEK HELIUM PLANT	176
		KERR-MCGEE FT LUPTON COMPRESSOR STATION	166
		COLORADO INTERSTATE GAS CO LATIGO C & S	164
		CANYON GAS RESOURCES - RIFLE C.S.	160
		QUESTAR GAS MANAGEMENT COMPANY	158
		DUKE ENERGY FIELD SERVICES -MEWBOURN	136
		DUKE ENERGY FIELD SERVICES - PLATTEVILLE	129
		CANYON GAS RESOURCES-FOUNDATION CREEK	125
		UNIV OF COLO - BOULDER BUFFALO POWER	125
		BITTER CREEK PIPELINES - BEECHER ISLAND	125
		DUKE ENERGY FIELD SERVICES - MARLA	125
		WILLIAMS FIELD SVCS PLA 9 STA	121
		DUKE ENERGY FIELD SERVICES - GREELEY	120
		EL PASO NATURAL GAS CO FLORIDA RIVER CS	120
		KERR-MCGEE ROCKY MOUNTAIN CORP. - DOUGAN	117
		SOUTHERN STAR CENTRAL GAS PIPELINE YUMA	116
		DUKE ENERGY FIELD SERVICES - ROGGEN	113
		BITTER CREEK PIPELINES - BUCKBOARD C.S.	107
		DUKE ENERGY FIELD SERVICES - ENTERPRISE	106
		SOUTHERN STAR CENTRAL GAS PIPELINE CHEYE	103

Internal Combustion Engine Sources > 100 tpy

Continued

Plant retired in 2013

RP Sources with Q/d ≥ 20

Electric Generation	Natural Gas	PUBLIC SERVICE CO FORT SAINT VRAIN PLT	494
		PUBLIC SERVICE CO - ARAPAHOE	425
		Front Range Power Plant	336
		PLATTE RIVER POWER AUTHORITY - RAWHIDE	269
		MANCHIEF POWER COMPANY LLC	235
		FOUNTAIN VALLEY POWER, L.L.C.	197
		Blue Spruce Energy Center	193
		COLORADO INTERSTATE GAS CO KIT CARSON	165
		PLAINS END, LLC	154
		MONFORT FINACE COMPANY, INC. - GILCREST	139
		BRUSH COGENERATION PARTNERS/COLO POWER	113
		Rocky Mountain Energy Center	102
Commercial/Institutional	Natural Gas	ENCANA OIL & GAS (USA), INC-DRAGON TRAIL	488
		WILLIAMS FIELD SERVICES IGNACIO B PLT	332

Colorado Point Source NOx

Stationary Source Pivot Table - 2018 PRPb Date: 07-23-09					
State	CO				
Sum of SumOfNOX_ANN					
SCC1_DESC	SCC3_DESC	SCC6_DESC	PLANT	BART_FLAG	Total
External Combustion Boilers	Electric Generation				64,405
	Industrial				3,819
	Commercial/Institutional				2,874
	Space Heaters				29
Internal Combustion Engines	Industrial				16,730
	Electric Generation				4,323
	Commercial/Institutional				1,152
	Engine Testing				5
Industrial Processes	Mineral Products				5,422
	Miscellaneous Manufacturing Industries				991
	Petroleum Industry				770
	Primary Metal Production				375
	Oil and Gas Production				308
	Secondary Metal Production				165
	Food and Agriculture				36
	Chemical Manufacturing				19
	Fabricated Metal Products				17
	Pulp and Paper and Wood Products				10
	In-process Fuel Use				3
	Rubber and Miscellaneous Plastics Products				2
	Electrical Equipment				1
	Photo Equip/Health Care/Labs/Air Condit/SwimPools				*
	Transportation Equipment				*
	Cooling Tower				*
	Building Construction				*
Waste Disposal					189
Petroleum and Solvent Evaporation					171
Grand Total					101,818

Significant Point Source Categories

Industrial Process Point Sources > 100 tpy

⊟Mineral Products	⊟Cement Manufacturing (Wet Process)	⊞HOLCIM (US) INC. PORTLAND PLANT	1,859
	⊟Cement Manufacturing (Dry Process)	⊞CEMEX, INC. - LYONS CEMENT PLANT	917
		⊞HOLCIM (US) INC - FORT COLLINS PLANT	664
	⊟Glass Manufacture	⊞ROCKY MOUNTAIN BOTTLE CO	524
	⊞Asphalt Concrete		465
	⊞Stone Quarrying - Processing (See also 305		300
	⊞Clay and Fly Ash Sintering		221
	⊞Fuel Fired Equipment		152
	⊞Brick Manufacture		101
⊟Miscellaneous Manufacturing Industries	⊟Miscellaneous Industrial Processes	⊞U.S. AIR FORCE - BUCKLEY AIR FORCE BASE	464
		⊞CRIPPLE CREEK & VICTOR GOLD MINING CO	124
⊟Petroleum Industry	⊟Process Heaters	⊞SUNCOR ENERGY - DENVER REFINERY	223
		⊞COLORADO REFINING CO TOTAL PETROLEUM	187

Plant Shutdown in 2002

RP Source with Q/d ≥ 20

Colorado Area Source NOx

Area Source Pivot Table - 2018 PRPb Date: 07-23-09				
Pollutant	NOX			
State	CO			
Sum of Emissions				
SCC1_DESC	SCC3_DESC	SCC6_DESC	SCC8_DESC	Total
Industrial Processes	Oil and Gas Production	Natural Gas		29,093
		All Processes		4,413
		Crude Petroleum		12
		Natural Gas Liquids	Tanks - Flashing & Standing/Worki	0
Stationary Source Fuel Combustion	Residential			10,205
	Commercial/Institutional			4,393
	Industrial			1,723
Miscellaneous Area Sources	Other Combustion			10
Grand Total				49,849

Significant Area Source Categories

Industrial Processes & Stationary Source Fuel Combustion Area Sources

Industrial Processes

⊟Oil and Gas Production	⊟Natural Gas	Heaters	22,901
		Compressor Engines	4,006
		Completion - Flaring and venting	1,786
		CBM - Dewatering pump engines	400
		Pneumatic Devices	0
		Dehydrators	0
	⊟All Processes	Drill rigs	4,413

Stationary Source Fuel Combustion

⊟Residential	⊟Natural Gas	Total: All Combustor Types	8,528
	⊞Wood		956
	⊟Liquified Petroleum Gas (LPG)	Total: All Combustor Types	666
	⊟Bituminous/Subbituminous Coal	Total: All Combustor Types	41
	⊟Distillate Oil	Total: All Combustor Types	15
⊟Commercial/Institutional	⊟Natural Gas	Total: Boilers and IC Engines	2,700
	⊟Bituminous/Subbituminous Coal	Total: All Boiler Types	1,074
	⊟Distillate Oil	Total: Boilers and IC Engines	509
	⊟Liquified Petroleum Gas (LPG)	Total: All Combustor Types	87
	⊟Anthracite Coal	Total: All Boiler Types	18
	⊟Kerosene	Total: All Combustor Types	4
⊟Industrial	⊟Distillate Oil	Total: Boilers and IC Engines	1,720
	⊟Kerosene	Total: All Boiler Types	3

Summary Controlling ROMO Nitrate

- *<u>Colorado Point Sources</u> (~36% or 101,818 tpy of NOx)*
  - *NOx Sources in Q/d ≥ 20 list capture most significant point sources*
    - *Q/d list includes 73% of the point source NOx emissions (74,085/101,818*100)*
  - *36 of 40 NG-fired RICE over 100 tpy are subject to Reg. 7 requirements*
    - *All NG RICE >500 HP statewide are subject to the requirements of Reg.7*
      - *Rich burn RICE subject to NOx control evaluation with a cost off-ramp of $5000/ton of NOx reduced*
    - *All RICE >100 HP subject to Reg. 7 emission standards by 2011*
  - *Point sources have a 14.7% nitrate impact at ROMO*
- *<u>Colorado Mobile Sources</u> (~30% or 83,165 tpy of NOx)*
  - *On-road NOx expected to ↓ 68% by 2018*
  - *Off-road NOx expected to ↓ 39% by 2018*
  - *Mobile sources have a 10.5% nitrate impact at ROMO*

Summary Controlling ROMO Nitrate

continued

- *<u>Colorado Area Sources</u> (~18% or 49,877 tpy of NOx)*
  - *O&G Heaters (~8% or 22,901 tpy) – largest single category*
    - *Inventory assumes 0.88 tpy NOx per gas well heater and ~ 26,000 gas wells in 2018*
    - *EPA Gas Star lists lowering heater temperature as a potential control*
    - *No other practical controls for ~26,000 small heaters*
  - *Residential Combustion (~3% or 8,528 tpy) – Natural Gas Fuel*
    - *No practical approach to controlling 1000's of sources*
  - *O&G Drill Rigs (~1.6% or 4,413 tpy)*
    - *Considered Non-Road engines (regulated by EPA), except if state adheres to CA approach*
    - *Drill Rig projections not updated with most current O&G inventories – thus projections are low*
  - *O&G Compressor Engines (~1.4% or 4,006 tpy)*
    - *Numerous small RICE below APEN thresholds or exempt – not practical to control*
  - *Area sources have a 6% nitrate impact at ROMO*

Questions

- *More information on Colorado's RH SIP documents can be found at following link:*

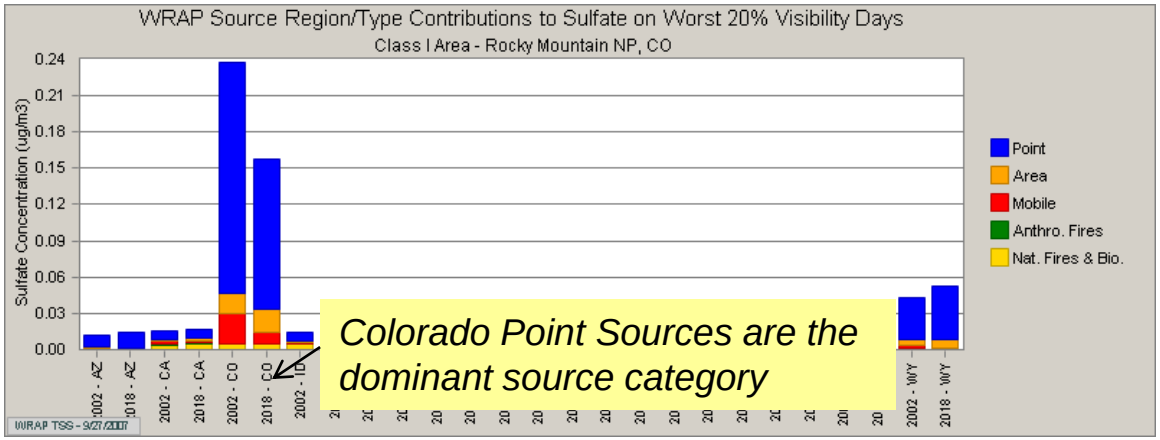
  https://www.colorado.gov/pacific/cdphe/regional-haze

Continuation of ROMO Analysis

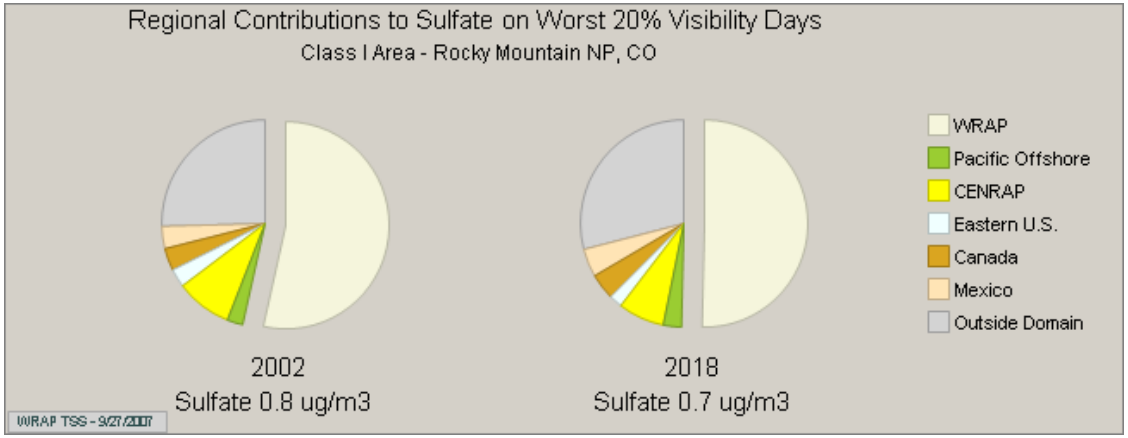
- *Following slides provide Emissions Trace analysis for Sulfate and Coarse PM*

ROMO Sulfate PSAT

- *Sulfate PM Source Apportionment (PSAT) – includes all states/regions*
  - *About 96% of sulfate is anthropogenic on worst days*
  - *Outside Model Domain ~40%; WRAP States ~27%; Colorado ~24%; CENRAP ~7%; and Eastern US ~2%*



Colorado Point Sources are the dominant source category



ROMO Sulfate - ET

*Colorado share is 22.5% (95.9*23.5/100)*

*Impact of CO Point sources is 17.7% (95.9*23.5*78.6/100)*

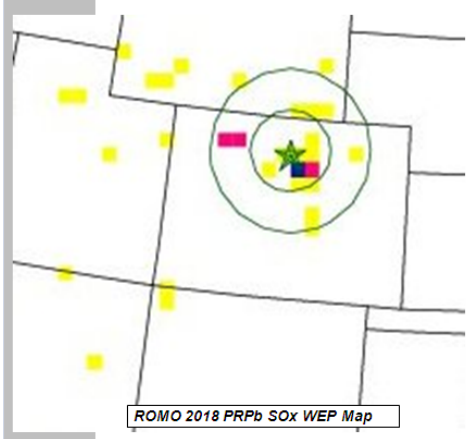
Rocky Mountain National Park

2018 PRPb Sulfate Emissions Trace

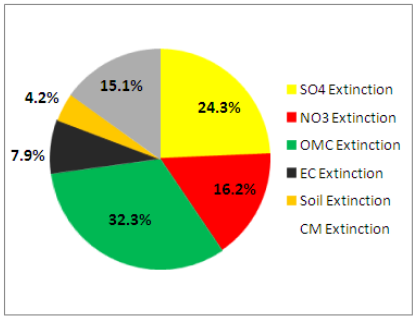
CAMx PM Source Apportionment (PSAT) Modeling for 2018 Worst Days									Statewide Emission Inventories for 2018				
Analysis Tool		2018 SO4 PSAT		2018 SO4 PSAT		2018 SO4 PSAT			2018 PSO4 EI [tpy]			2018 PSO4 EI [tpy]	2018 PSO4 EI [tpy]
ROMO Sulfate 24.3%	Natural	Secondary	4.1%								Off-Road Mobile	51.1%	410
	Natural & Anthro	Primary	Very Small %	Colorado	?%				803		Area	23.3%	187
	Anthro	Secondary	95.9%	Other States	?%					*Particles*	On-Road Mobile	13.5%	108
				Outside Domain*	?%								
				Outside Domain	40.3%	Point	78.6%		44,062	-55%	External Combustion Boilers	84.7%	37,322
				Other States	36.3%	Area	11.9%		7,655	17%	Industrial Processes	13.7%	6,045
				Colorado	23.5%	Mobile	6.3%		1,431	-80%	Internal Combustion Engines	1.0%	457
											Waste Disposal	0.5%	228
										Gas	Industrial Boilers & IC Engines (Distillate)	48.9%	3,665
											Commerical Boilers All Types (Coal)	30.1%	2,260
											Commerical Boilers & IC Engines (Distillate)	14.8%	1,108
											Residential Fuel Combustion (All Fuels)	4.9%	364
Baseline IMPROVE Data	Analysis Tool								2018 PRPb SO2 [tpy]	SO2 Delta 02d-18 PRPb [tpy]		Area Source Pivot	2018 PRPb SO2 [tpy]

*OD includes global background and International emissions.

Analysis Tool	Stationary Source Pivot	2018 PRPb SO2 EI [tpy]



ROMO 2018 PRPb SOx WEP Map



SO2 Emissions Comparison: Original - Base 2018b (used in PSAT Modeling) vs Latest WRAP EI - 2018 PRPb

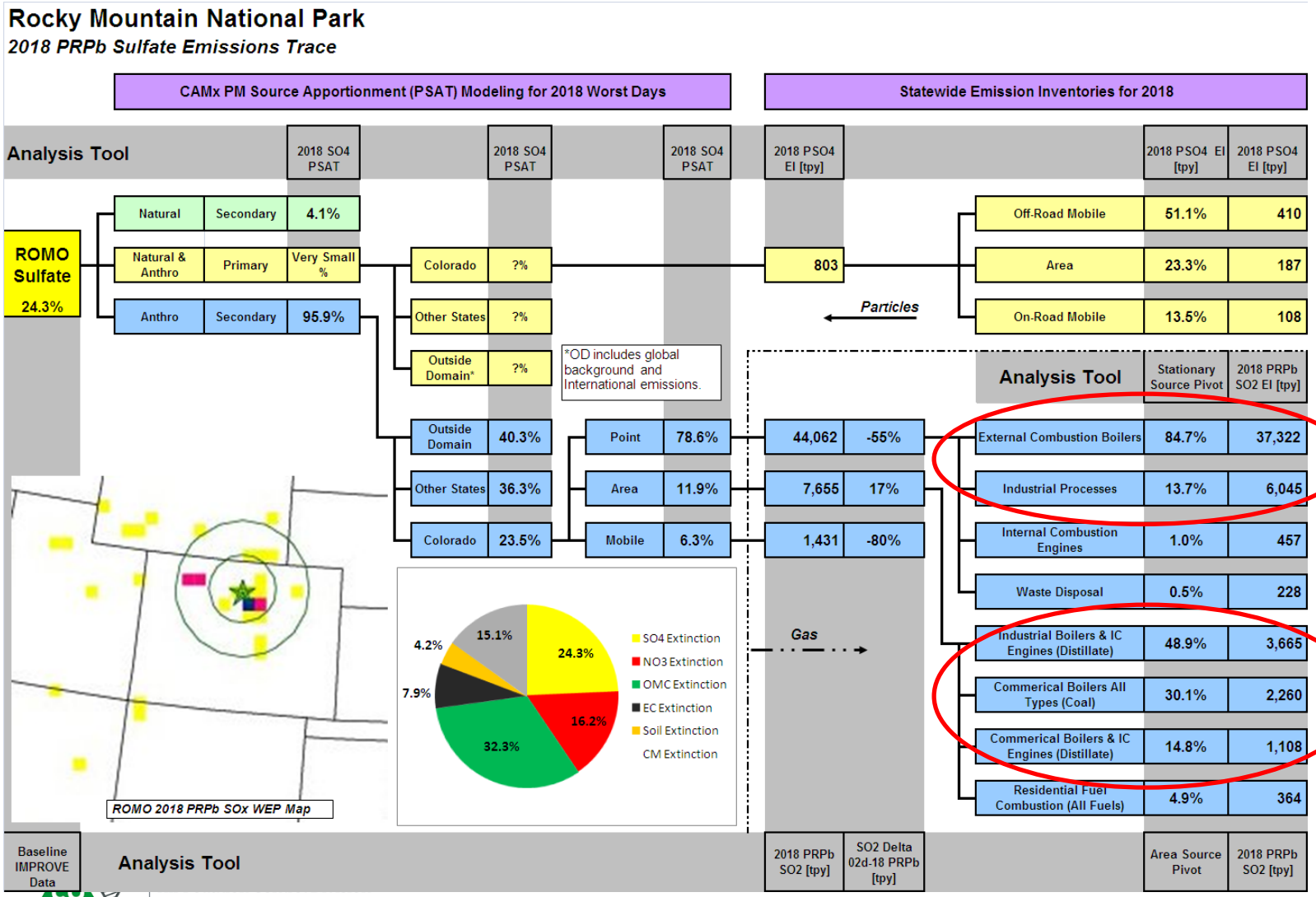
Region	Scenario	Year	Point [tpy]	Anthro Fire [tpy]	Natural Fire [tpy]	Biogenic [tpy]	Area [tpy]	WRAP Area O&G [tpy]	Off-Shore [tpy]	On-Road Mobile [tpy]	Off-Road Mobile [tpy]	Road Dust [tpy]	Fugitive Dust [tpy]	WB Dust [tpy]	Total [tpy]
Sulfur Oxides (gas and particulate)															
CO	Plan02c	2002	97,016	108	3,335		6,504	260		4,389	3,015	4	5		**114,636**
CO	Base18b	2018	69,262	91	3,335		7,676	9		677	781	-	6		**81,837**
		Delta:	(27,754)	(16)	0	-	1,172	(251)	-	(3,713)	(2,234)	(4)	1	0	(32,799)
		Reduction Percentage:	***-28.6%***	***-15.1%***	***0.0%***	***0.0%***	***18.0%***	***-96.7%***	***0.0%***	***-84.6%***	***-74.1%***	***-100.0%***	***29.1%***	***0.0%***	
		Source Category % of Total:	**85%**	**0%**	**4%**	**0%**	**9%**	**0%**	**0%**	**1%**	**1%**	**0%**	**0%**	**0%**	

Region	Scenario	Year	Point [tpy]	Anthro Fire [tpy]	Natural Fire [tpy]	Biogenic [tpy]	Area [tpy]	WRAP Area O&G [tpy]	Off-Shore [tpy]	On-Road Mobile [tpy]	Off-Road Mobile [tpy]	Road Dust [tpy]	Fugitive Dust [tpy]	WB Dust [tpy]	Total [tpy]
Sulfur Oxides (gas and particulate)															
CO	Plan02d	2002	97,984	108	3,335		6,533	118		4,389	3,015	4	6		**115,492**
CO	Prp18b	2018	44,062	91	3,335		7,644	11		677	754	6	5		**56,585**
		Delta:	(53,922)	(16)	0	-	1,111	(108)	-	(3,713)	(2,261)	1	(1)	-	(58,907)
		Reduction Percentage:	***-55.0%***	***-15.1%***	***0.0%***	***0.0%***	***17.0%***	***-91.0%***	***0.0%***	***-84.6%***	***-75.0%***	***33.8%***	***-12.8%***	***0.0%***	
		Source Category % of Total:	**78%**	**0%**	**6%**	**0%**	**14%**	**0%**	**0%**	**1%**	**1%**	**0%**	**0%**	**0%**	

Colorado SO2 Emission Comparison: 2018 PRPb is 30% lower than Base 2018b

ROMO Sulfate - ET

- *ROMO has highest monitored Sulfate concentrations (~24%) in State*



Source categories potentially identified as significant

Colorado Point Source SO2

Stationary Source Pivot Table - 2018 PRPb Date: 07-23-09					
State	CO				
Sum of SumOfSO2_ANN					
SCC1_DESC	SCC3_DESC	SCC6_DESC	PLANT	BART_FLAG	Total
⊟External Combustion Boilers	⊞Electric Generation				34,212
	⊞Industrial				2,872
	⊞Commercial/Institutional				236
	⊞Space Heaters				2
⊟Industrial Processes	⊞Mineral Products				2,804
	⊞Chemical Manufacturing				1,322
	⊞Petroleum Industry				1,274
	⊞Primary Metal Production				378
	⊞Food and Agriculture				100
	⊞Miscellaneous Manufacturing Industries				78
	⊞Oil and Gas Production				68
	⊞Pulp and Paper and Wood Products				11
	⊞Secondary Metal Production				10
	⊞Electrical Equipment				0
	⊞In-process Fuel Use				0
	⊞Fabricated Metal Products				0
	⊞Rubber and Miscellaneous Plastics Products				0
	⊞Photo Equip/Health Care/Labs/Air Condit/SwimPools				*
	⊞Transportation Equipment				*
	⊞Building Construction				*
	⊞Cooling Tower				*
⊞Internal Combustion Engines					457
⊞Waste Disposal					228
⊞Petroleum and Solvent Evaporation					6
Grand Total					44,058

Significant Point Source Categories

External Combustion Boiler Sources

⊟Electric Generation	⊟Bituminous/Subbituminous Coal	⊞PUBLIC SERVICE CO CHEROKEE PLT	6,964
		⊞PUBLIC SERVICE CO COMANCHE PLT	6,936
		⊞COLORADO SPRINGS UTILITIES - NIXON PLT	4,073
		⊞TRI STATE GENERATION CRAIG	3,940
		⊞PUBLIC SERVICE CO HAYDEN PLT	2,898
		⊞COLORADO SPRINGS UTILITIES-DRAKE PLT	2,701
		⊞PUBLIC SERVICE CO PAWNEE PLT	2,225
		⊞TRI STATE GENERATION NUCLA	1,325
		⊞AQUILA, INC. - W.N. CLARK STATION	1,322
		⊞PLATTE RIVER POWER AUTHORITY - RAWHIDE	927
		⊞PUBLIC SERVICE CO - VALMONT	879
		⊞RAKHRA MUSHROOM FARM CORP	0
		⊞OAK CREEK HIGH SCH S ROUTT CNTY SD	0
		⊞SOUTH ROUTT ELEMENTARY SCH	0
		⊞OAK CREEK JUNIOR HIGH S ROUTT CNTY SD	0
		⊞PUBLIC SERVICE CO - ARAPAHOE	0
		⊞PUBLIC SERVICE CO CAMEO PLT	0
	Bituminous/Subbituminous Coal Total		34,190

All have SO2 controls, except Drake 5, Nixon, Trigen & Clark
RP Sources with Q/d ≥ 20

⊟Industrial	⊟Bituminous/Subbituminous Coal	⊞TRIGEN - COLORADO ENERGY CORPORATION	2,794
		⊞WESTERN SUGAR CO	12
		⊞COLORADO LIME COMPANY DBA CALCO	4

Colorado Point Source SO2

Stationary Source Pivot Table - 2018 PRPb Date: 07-23-09					
State	CO				
Sum of SumOfSO2_ANN					
SCC1_DESC	SCC3_DESC	SCC6_DESC	PLANT	BART_FLAG	Total
External Combustion Boilers	Electric Generation				34,212
	Industrial				2,872
	Commercial/Institutional				236
	Space Heaters				2
Industrial Processes	Mineral Products				2,804
	Chemical Manufacturing				1,322
	Petroleum Industry				1,274
	Primary Metal Production				378
	Food and Agriculture				100
	Miscellaneous Manufacturing Industries				78
	Oil and Gas Production				68
	Pulp and Paper and Wood Products				11
	Secondary Metal Production				10
	Electrical Equipment				0
	In-process Fuel Use				0
	Fabricated Metal Products				0
	Rubber and Miscellaneous Plastics Products				0
	Photo Equip/Health Care/Labs/Air Condit/SwimPools				*
	Transportation Equipment				*
	Building Construction				*
	Cooling Tower				*
Internal Combustion Engines					457
Waste Disposal					228
Petroleum and Solvent Evaporation					6
Grand Total					44,058

Significant Point Source Categories

Industrial Process Sources

Plant shutdown in 2002

Mineral Products	Cement Manufacturing (Dry Process)	HOLCIM (US) INC - FORT COLLINS PLANT	618
		CEMEX, INC. - LYONS CEMENT PLANT	151
	Glass Manufacture	ROCKY MOUNTAIN BOTTLE CO	542
	Brick Manufacture	ROBINSON BRICK CO	294
		SUMMIT PRESSED BRICK MFG PLT	92
		ACME BRICK COMPANY	89
		LAKEWOOD BRICK & TILE CO	55
	Cement Manufacturing (Wet Process)	HOLCIM (US) INC. PORTLAND PLANT	393
	Asphalt Concrete	AGGREGATE INDUSTRIES - WCR, INC.	83
		LAFARGE WEST, INC. - SPEC. AGG. QUARRY	37
		LAFARGE WEST, INC. - GORDON ASPHALT	35
		LAFARGE WEST, INC. - STROMQUIST	25
		ASPHALT SPECIALITIES CO INC	22
		KIEWIT WESTERN CO	22
		DON KEHN CONSTRUCTION INC	22
		KIEWIT WESTERN	22
		LAFARGE DBA LAFARGE WEST, INC.	20
		LAFARGE WEST, INC.	14
		LAFARGE WEST, INC. - 35TH AVE PLANT	13
		AGGREGATE INDUSTRIES-WCR	12
		OLDCASTLE SW GROUP DBA UNITED CO OF MESA	10
		BRANNAN SAND & GRAVEL	5
		TONY J BELTRAMO & SONS INC	3

All have some form of SO2 Control
RP Sources with Q/d ≥ 20

Chemical Manufacturing	Elemental Sulfur Production	SUNCOR ENERGY - DENVER REFINERY	1,159
		COLORADO REFINING CO TOTAL PETROLEUM	161
Petroleum Industry	Catalytic Cracking Units	SUNCOR ENERGY - DENVER REFINERY	553
		COLORADO REFINING CO TOTAL PETROLEUM	158
	Process Heaters	SUNCOR ENERGY - DENVER REFINERY	389
		COLORADO REFINING CO TOTAL PETROLEUM	7
	Blowdown Systems	SUNCOR ENERGY - DENVER REFINERY	152
		COLORADO REFINING CO TOTAL PETROLEUM	14

Colorado Area Source SO2

Area Source Pivot Table - 2018 PRPb Date: 07-23-09				
Pollutant	SO2			
State	CO			
Sum of Emissions				
SCC1_DESC	SCC3_DESC	SCC6_DESC	SCC8_DESC	Total
Stationary Source Fuel Combustion	Industrial	Distillate Oil	Total: Boilers and IC Engines	3,665
		Kerosene	Total: All Boiler Types	6
	Commercial/Institutional	Bituminous/Subbituminous Coal	Total: All Boiler Types	2,260
		Distillate Oil	Total: Boilers and IC Engines	1,108
		Anthracite Coal	Total: All Boiler Types	71
		Kerosene	Total: All Combustor Types	9
		Natural Gas	Total: Boilers and IC Engines	7
		Liquified Petroleum Gas (LPG)	Total: All Combustor Types	1
	Residential			364
Industrial Processes	Oil and Gas Production			10
Grand Total				7,501

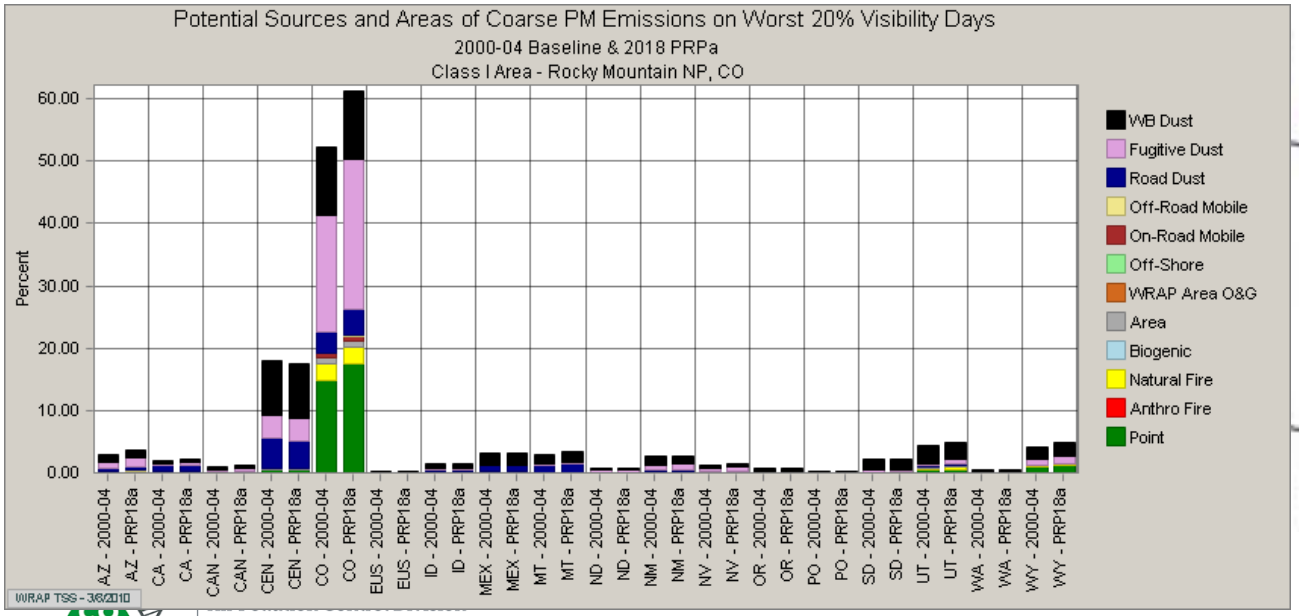
Significant Area Source Categories

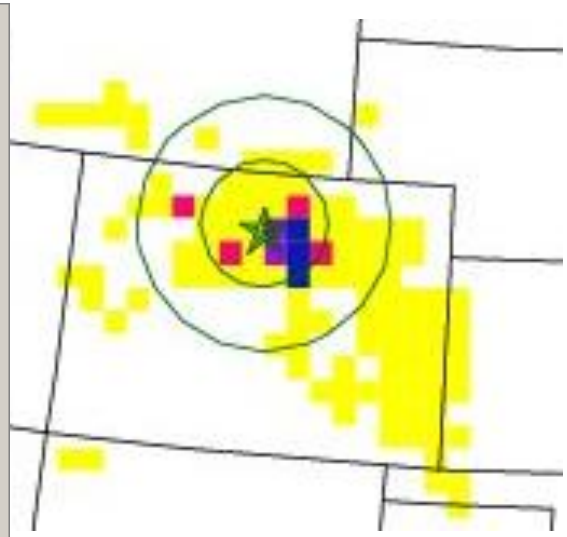
Controlling Sulfate

- *<u>Colorado Point Sources</u> (~78% or 44,062 tpy of SO2)*
  - *SO2 Sources in Q/d ≥ 20 list capture all significant sources*
  - *Majority of SO2 sources have controls*
  - *Division to evaluate SO2 controls on CSU Nixon*
  - *Point sources have 17.7% sulfate impact at ROMO*
- *<u>Colorado Area Sources</u> (~14% or 7,655 tpy of SO2)*
  - *Boilers & IC Engines (~7% or 3,665 tpy) - distillate fueled*
    - *Largest sub-category because of sulfur in fuel*
    - *No practical approach to controlling 1000's of small boilers and RICE*
  - *Area sources have 2.7% sulfate impact at ROMO*
- *<u>Colorado Mobile Sources</u> (~3% or 1,431 tpy of SO2)*
  - *From diesel-fueled engines*
    - *Low-Sulfur Diesel Fuel Requirements are applicable for on/off road vehicles*
  - *Mobile sources have 1.4% sulfate impact at ROMO*

Sources of ROMO Coarse PM (CM)

- *CM over 13% at all Class I Areas*
  - *15% at ROMO, 3rd highest in state after Sand Dunes & Mesa Verde*
- *PSAT modeling not available for CM*
  - *Must use Weighted Emissions Potential (WEP)*
- *WEP indicates that Coarse PM origins are widespread*
  - *Colorado Share ~55%*





ROMO CM - ET

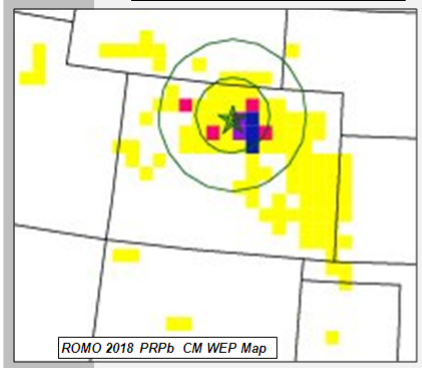
Colorado share is 54.6%

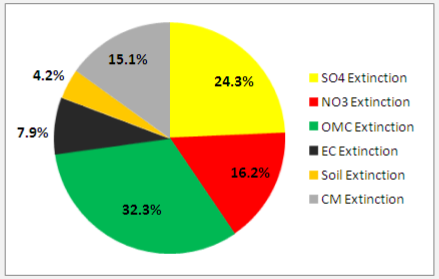
*Impact of CO Point sources is 15.5% (1*54.6*28.3/100)*

Rocky Mountain National Park

2018 PRPb Coarse Mass Emissions Trace

2018 PM Coarse (Coase Mass) Weighted Emissions Potential for 2018 Worst Days									Statewide Emission Inventories for 2018						
Analysis Tool				2018 CM WEP		2018 CM WEP	2018 PRPb PM10 EI [tpy]	PM10 Delta 02d-18 PRPb [tpy]		Stationary Source Pivot	2018 PRPb PM10 [tpy]		Stationary Source Pivot	2018 PRPb PM10 [tpy]	
ROMO Coarse Mass 15.1%	Natural	Secondary	Really small ?0%	Colorado	54.6%	Fugitive Dust	39.3%	67,910	0.4%	64.5%	17,356	Industrial Process - Mineral Products	46.9%	8,145	Construction Sand & Gravel
	Anthro	Secondary	Really small ?0%	Other WRAP States	25.3%	Point	28.3%	26,828	27.2%	7.6%	2,047	External Combustion Boilers -Electric Generation	25.1%	4,356	Coal Mining & Handling
	Natural & Anthro	Primary	100%	Other States (CENRAP)	15.9%	WB Dust	17.9%	135,945	0.0%	6.2%	1,662	Waste Disposal - Site Remediation	99.5%	2,030	Electric Generation - Coal-fired
				PO, Mex, Can	4.2%	Road Dust	7.1%	11,826	32.4%	50.5%	93,467	Agriculture Production - Tilling	99.6%	1,655	Excavation/Soils Handling





Source categories potentially identified as controllable and significant

Baseline IMPROVE Data	Analysis Tool	Area Source Pivot	2018 PRPb PM10 [tpy]

CM Emissions Comparison: Original - Base 2018b vs Latest WRAP EI - 2018 PRPb

Region	Scenario	Year	Point [tpy]	Anthro Fire [tpy]	Natural Fire [tpy]	Biogenic [tpy]	Area [tpy]	WRAP Area O&G [tpy]	Off-Shore [tpy]	On-Road Mobile [tpy]	Off-Road Mobile [tpy]	Road Dust [tpy]	Fugitive Dust [tpy]	WB Dust [tpy]	Total [tpy]
Coarse Particulate Matter															
CO	Plan02c	2002	21,096	51	5,973		1,360	-		794	-	8,857	48,470	135,945	**222,546**
CO	Base18b	2018	28,390	32	5,973		1,388	-		917	-	13,414	78,073	135,945	**264,132**
		Delta:	7,294	(19)	0	-	28	-	-	123	-	4,558	29,602	-	41,586
		Reduction Percentage:	***34.6%***	***-37.2%***	***0.0%***	***0.0%***	***2.1%***	***0.0%***	***0.0%***	***15.5%***	***0.0%***	***51.5%***	***61.1%***	***0.0%***	
		Source Category % of Total:	**11%**	**0%**	**2%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**5%**	**30%**	**51%**	

Region	Scenario	Year	Point [tpy]	Anthro Fire [tpy]	Natural Fire [tpy]	Biogenic [tpy]	Area [tpy]	WRAP Area O&G [tpy]	Off-Shore [tpy]	On-Road Mobile [tpy]	Off-Road Mobile [tpy]	Road Dust [tpy]	Fugitive Dust [tpy]	WB Dust [tpy]	Total [tpy]
Coarse Particulate Matter															
CO	Plan02d	2002	21,096	51	5,973		1,363	-		794	-	8,930	67,642	135,945	**241,794**
CO	Prp18b	2018	26,828	32	5,973		1,388	-		917	-	11,826	67,910	135,945	**250,818**
		Delta:	5,732	(19)	0	-	25	-	-	123	-	2,896	268	-	9,024
		Reduction Percentage:	***27.2%***	***-37.2%***	***0.0%***	***0.0%***	***1.8%***	***0.0%***	***0.0%***	***15.5%***	***0.0%***	***32.4%***	***0.4%***	***0.0%***	
		Source Category % of Total:	**11%**	**0%**	**2%**	**0%**	**1%**	**0%**	**0%**	**0%**	**0%**	**5%**	**27%**	**54%**	

Colorado CM Emission Comparison: 2018 PRPb is 5% lower than Base 2018b

PM10 Point Sources > 100 tpy

RP Sources with Q/d ≥ 20

Stationary Source Pivot Table - 2018 PRPb Date: 07-23-09

State: CO

Sum of SumOfPM10_ANN					
SCC1_DESC	SCC3_DESC	SCC6_DESC	PLANT	BART_FLAG	Total
⊟Industrial Processes	⊟Mineral Products	⊟Construction Sand and Gravel	⊞MIDWESTERN FARMS		176
			⊞OLDCASTLE SW GROUP DBA UNITED CO OF MES		174
			⊞MOFFAT COUNTY ROAD DEPARTMENT		171
			⊞LAFARGE WEST, INC. - HOWE PIT		161
			⊞LAFARGE WEST, INC. - FOUNTAIN PIT		147
			⊞VARRA COMPANIES INC		129
			⊞ROCKY MOUNTAIN ARSENAL USARMY		124
			⊞LAFARGE WEST, INC. - SPEC. AGG. QUARRY		120
			⊞LAFARGE WEST, INC. - EAST RIGDEN PIT		109
		⊟Coal Mining, Cleaning, and Material Handling	⊞COLOWYO COAL CO		1,271
			⊞TRAPPER MINING INC		598
			⊞BOWIE RESOURCES, LLC - BOWIE NO 2 MINE		352
			⊞LORENCITO COAL CO		272
			⊞CEMEX, INC. - LYONS CEMENT PLANT		260
			⊞SENECA COAL CO SENECA II W		251
			⊞SENECA COAL CO		233
			⊞TWENTYMILE COAL CO.- FOIDEL CREEK		178
			⊞SENECA COAL COMPANY		118
			⊞MOUNTAIN COAL CO. LLC (WEST ELK MINE)		107
		⊟Cement Manufacturing (Dry Process)	⊞CEMEX, INC. - LYONS CEMENT PLANT		467
			⊞HOLCIM (US) INC - FORT COLLINS PLANT		164
		⊟Stone Quarrying - Processing	⊞HOLCIM (US) INC. PORTLAND PLANT		118
			⊞TEZAK HEAVY EQUIPMENT CO INC		110
		⊞Concrete Batching			588
		⊞Stone Quarrying - Processing	⊞CRIPPLE CREEK & VICTOR GOLD MINING CO		485
		⊞Fugitive Emissions			419
		⊞Mining and Quarrying of Nonmetallic Minerals			332
		⊞Asphalt Concrete			283
		⊞Other Not Defined			209
		⊞Lime Manufacture	⊞PETE LIEN & SONS OWL CANYON COMPLEX		103
		⊞Diatomaceous Earth	⊞UMETCO MINERALS CORP		182
		⊞Brick Manufacture			126
		⊞Cement Manufacturing (Wet Process)	⊞HOLCIM (US) INC. PORTLAND PLANT		123
⊟Waste Disposal	⊟Site Remediation	⊟Excavation/Soils Handling	⊞ROCKY MOUNTAIN ARSENAL USARMY		1,644
	⊟Solid Waste Dispos	⊟Landfill Dump	⊞WASTE MANAGEMENT OF COLORADO DEN ARA		678
			⊞WASTE MGMT OF CO DENVER ARAPAHOE		174
			⊞LARIMER COUNTY LANDFILL		108
	⊞Solid Waste Disposal - Commercial/Institutional		⊞DENVER REGIONAL LANDFILL		126
	⊞Solid Waste Disposal - Industrial				99
⊟External Combustion Boile	⊟Electric Generation	⊟Bituminous/Subbituminous Coal	⊞PUBLIC SERVICE CO PAWNEE PLT		592
			⊞PUBLIC SERVICE CO COMANCHE PLT		400
			⊞TRI STATE GENERATION CRAIG		394
			⊞PUBLIC SERVICE CO CHEROKEE PLT		251
			⊞PUBLIC SERVICE CO HAYDEN PLT		199
			⊞PLATTE RIVER POWER AUTHORITY - RAWHIDE		100
⊟Petroleum and Solvent Eva	⊞Surface Coating Operations				119
⊞Internal Combustion Engines					99
Grand Total					26,923

PM10 Area Sources

Area Source Pivot Table - 2018 PRPb Date: 07-23-09				
Pollutant	PM10-PRI			
State	CO			
Sum of Emissions				
SCC1_DESC	SCC3_DESC	SCC6_DESC	SCC8_DESC	Total
⊟Miscellaneous Area Sources	⊟Agriculture Production - Crops	⊟Agriculture - Crops	Tilling	93,467
	⊞Other Combustion			78
⊟Industrial Processes	⊟Construction: SIC 15 - 17	⊟Road Construction	Total	42,097
		⊟Industrial/Commercial/Institutional	Total	27,974
		⊟Residential	Total	5,746
	⊞Food and Kindred Products: SIC 20			2,197
	⊞Food and Kindred Products: SIC 21			6
⊟Stationary Source Fuel Combustion	⊟Residential	⊟Wood	Fireplaces: Insert; non-EPA certified	3,491
			Woodstoves: General	3,110
			Fireplaces: General	2,449
			Fireplaces: Insert; EPA certified; non-catalytic	1,056
			Non-catalytic Woodstoves: EPA certified	940
			Fireplaces: Insert; EPA certified; catalytic	443
			Catalytic Woodstoves: General	395
		⊟Natural Gas	Total: All Combustor Types	47
		⊟Bituminous/Subbituminous Coal	Total: All Combustor Types	33
		⊟Liquified Petroleum Gas (LPG)	Total: All Combustor Types	2
		⊟Distillate Oil	Total: All Combustor Types	2
	⊟Commercial/Institutional	⊟Bituminous/Subbituminous Coal	Total: All Boiler Types	1,270
		⊟Distillate Oil	Total: Boilers and IC Engines	185
		⊟Anthracite Coal	Total: All Boiler Types	30
		⊟Natural Gas	Total: Boilers and IC Engines	22
		⊟Kerosene	Total: All Combustor Types	0
		⊟Liquified Petroleum Gas (LPG)	Total: All Combustor Types	0
	⊟Industrial	⊟Distillate Oil	Total: Boilers and IC Engines	198
		⊟Kerosene	Total: All Boiler Types	0
Grand Total				185,238

Controlling ROMO Coarse Mass

- *Colorado Fugitive Dust (~27% or 67,910 tpy of PM10)*
  - *Generally not controllable at higher wind speeds*
  - *Controls include limiting surface disturbance & frequency*
  - *Fugitive dust sources have a 21.5% CM impact at ROMO*
- *Colorado Point Sources (~11% or 26,828 tpy of PM10)*
  - *PM_{10} emissions based on permits for activities such as construction sand & gravel operations, mining, coal handling and other industrial processes*
  - *Existing permits contain basic PM_{10} mitigation requirements*
  - *Point sources have a 15.5% CM impact at ROMO*
- *Colorado Windblown Dust (~54% or 135,945 of PM10)*
  - *About 50% from agricultural tilling*
  - *Windblown dust sources have a 9.8% CM impact at ROMO*
- *Colorado Road Dust (~5% or 11,826 tpy of PM10)*
  - *From mechanical entrainment of dust from paved and unpaved roads*
  - *Controls for paved roads include sweeping up debris, control trackout*
  - *Controls for unpaved roads include paving, chemical stabilization, speed control*
  - *Road dust sources have a 3.9% CM impact at ROMO*