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Four Corners Air Quality Modeling 2018 Oil & Gas Emissions and 2005/2018 Total Emissions Summaries

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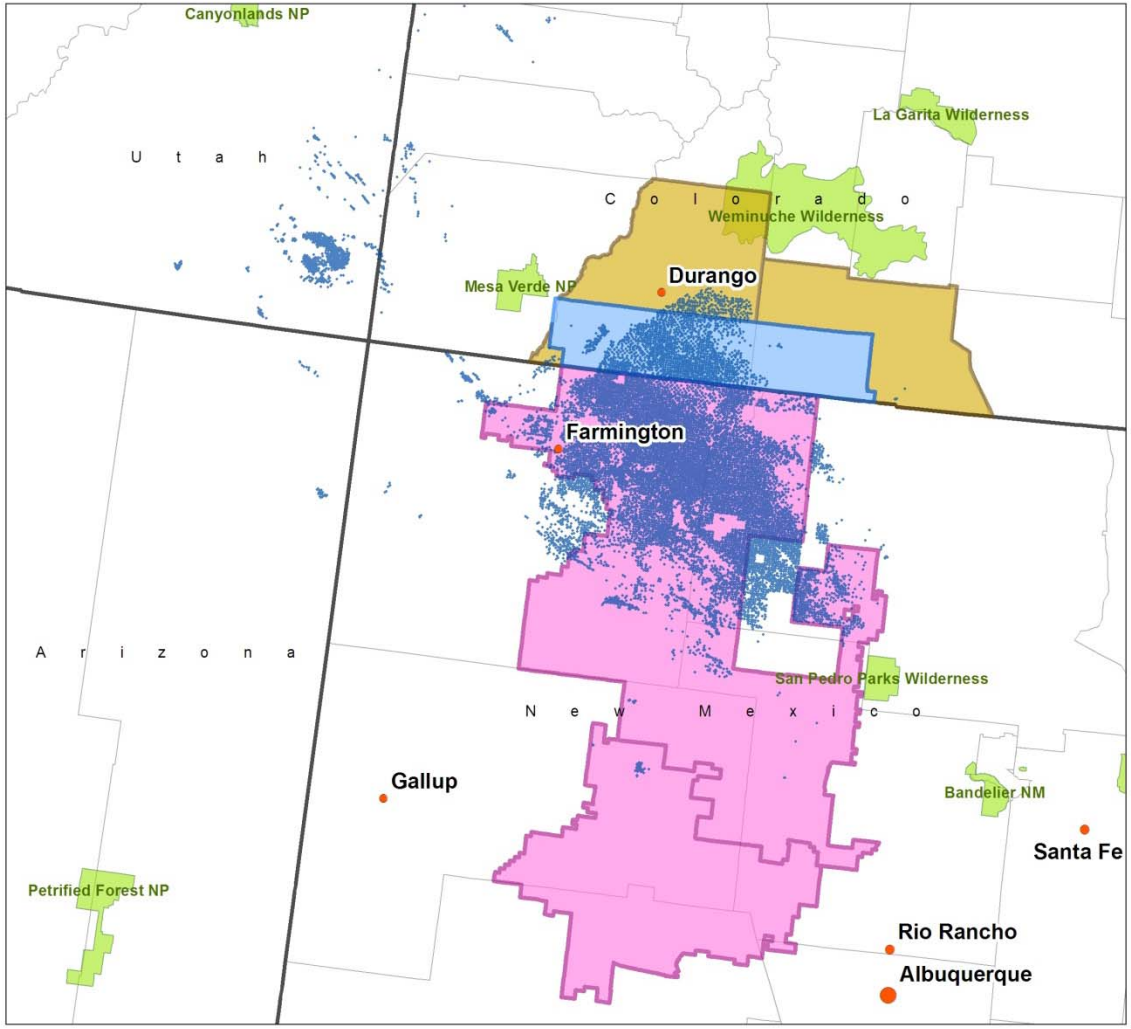
Four Corners Oil & Gas Project Areas



- N. San Juan Coal Bed Methane Project
- Farmington RMP Area
- Southern Ute Indian Tribe
- 2002 Wells
- Class I areas

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Oil & Gas Emissions: Source Documents

- Farmington Resource Management Plan (RMP), Record of Decision (ROD) December 2003 – 9,942 new wells by 2018 and BLM Farmington Field Office Supplemental ROD Final – Specify emission levels for new engines
- Northern San Juan Basin Coal Bed Methane Project, ROD April 2007 – 273 new wells - Specify emission levels for new engines
- NSPS for SI engines, December 2007. NOx emission levels for new, modified or reconstructed SI engines:
  - 25<HP<100: 2.8 g/HP-hr NOx as of Jul 2008
  - HP≥100: 2.0 g/HP-hr as of Jul 2007 or 08, then 1.0 g/HP-hr as of Jul 2010 or Jan 2011 (date depends on HP)
- Department of Energy Annual Energy Outlook (AEO), 2007 is most recent available. Regional estimates only. Rocky Mountain region projections:
  - Gas production – 21% increase from 2005->2018
  - Oil production – 55% increase from 2005->2018
  - Drilling – 7% increase from 2005->2018

  2008 AEO currently scheduled for release end of June, 2008

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2018 Oil & Gas Emissions: New Mexico 4k domain, Farmington RMP area

- WRAP 2005 II area sources + WRAP 2005 large point sources + Doug's growth inventory (models everything as point sources with unique coordinates and appropriate stack parameters)
- Doug's growth inventory includes NOx from compressors (with NSPS incorporated), separators and dehydrators
- O&G sources in Doug's file outside Farmington RMP area were distributed evenly within the RMP boundaries
- Add sources not in Doug's spreadsheet:
  - VOC emissions: grow using EIA factors
  - Drill rigs: use WRAP 2005 emissions; grow based on ratio of number of wells drilled in 2018 (per the RMP) to the number of wells drilled in 2005; adjust for assumed 90% success rate
  - Smaller NOx sources grown using EIA factors

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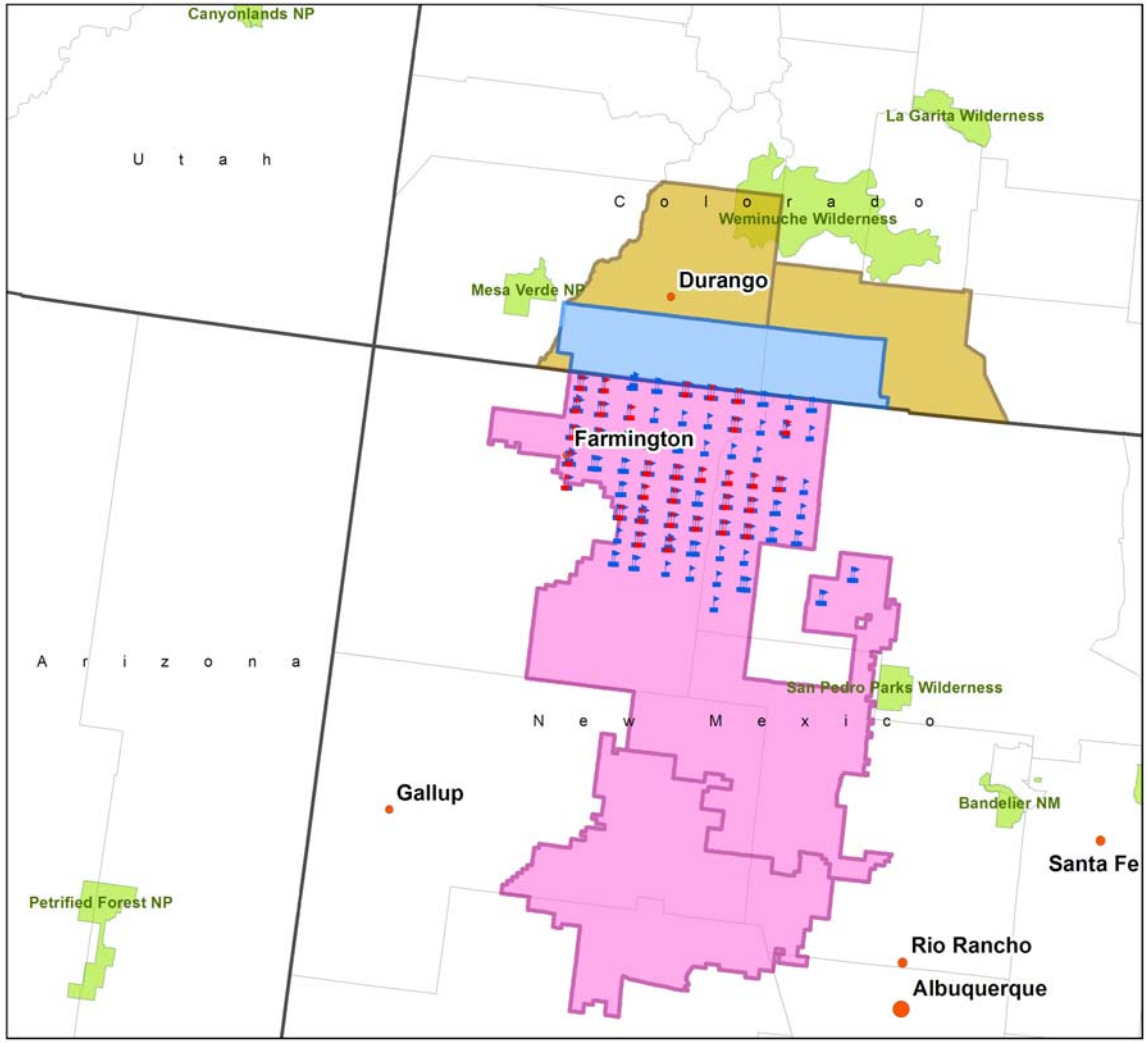
Farmington RMP O&G Growth Inventory

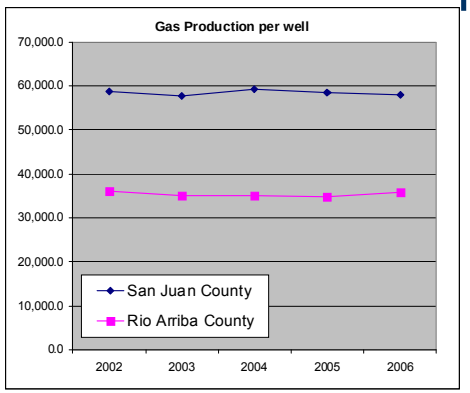


- N. San Juan Coal Bed Methane Project
- Farmington RMP Area
- Southern Ute Indian Tribe
- Central Compression
- Small Engines & Separators
- Class I areas

2018 Oil & Gas Emissions:

New Mexico 4k domain, outside Farmington RMP area

- WRAP 2005 II area sources + WRAP 2005 large point sources, all grown using EIA projection factors
- Reduce area source NOX to account for Dec 2007 NSPS
  - Assume small wellhead compressor engines are installed on 50% of new wells, each 69hp, 54% load, 2 g/hp-hr NOx (0.71 tons/year per compressor engine)
  - To calculate number of new wells:
    - Calculate San Juan and Rio Arriba average production per well for 2002 - 2005.
    - Grow gas production by EIA factor (1.21)
    - Estimate number of wells required to sustain that production using calculated production/well.

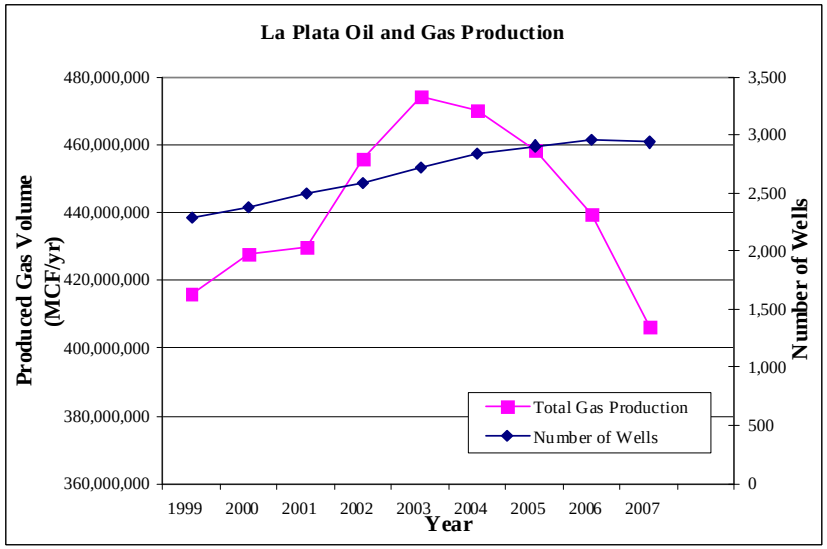


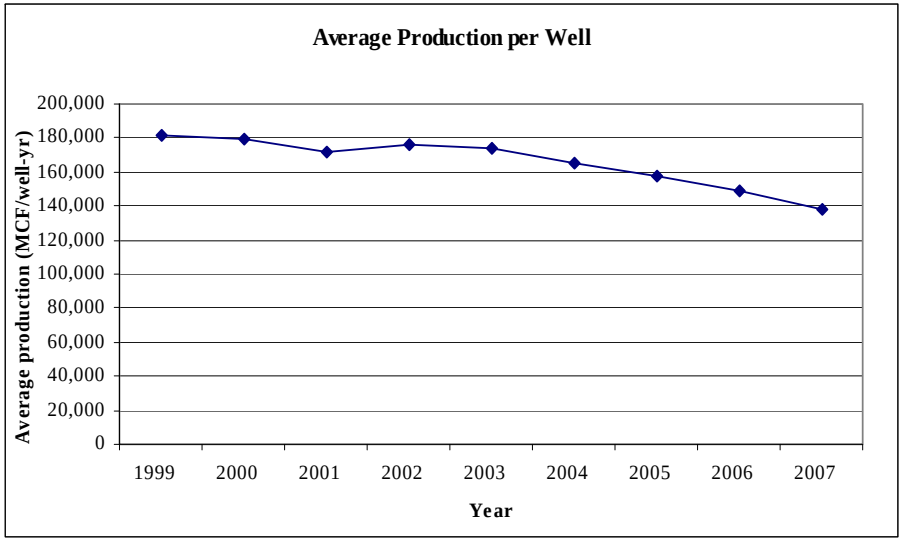
2018 Oil & Gas Emissions: Colorado 4k domain

Use Doug Blewitt (DB) spreadsheet of Northern San Juan Basin EIS emissions corresponding to new wells per the ROD; has NSPS standards incorporated.

	Area sources	Point sources
Northern San Juan Basin (NSJB) EIS area	2005 area sources + DB new 2018 emissions (all sources modeled as points)	2005 point sources + DB new 2018 emissions (all sources modeled as points)
Southern Ute Indian Tribe (SUIT)	Leave constant at 2005 emissions. No more drilling is allowed per SUIT 1999 EIS. No turnover of engines, so no NSPS applied (conservative assumption).	
Outside NSJB and SUIT areas	Leave constant at 2005 emissions. No turnover of engines, so no NSPS applied (conservative assumption).	

Northern San Juan Wells and Production: La Plata County





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2018 Oil & Gas Emissions: Utah and Arizona 4k domain

- Negligible area source O&G emissions, leave as is in WRAP 2005
- Negligible point source emissions, use WRAP PRP 2018 inventory

4K 2005 and 2018 Oil & Gas Emissions – NOx

NOx - 2005

State	(1) Compressor Engines	(2) Compressor Engines & Heaters	(3) Compressor Stations	(4) Compressor Station & Gas Processing Plant	(5) Drill Rigs	(6) Heaters	(7) Smaller NOx sources	Total
Arizona	6	-	-	-	-	6	-	13
Colorado	234	4,694	-	2,548	326	157	203	8,163
New Mexico	27,608	-	-	19,834	2,042	7,445	753	57,682
Utah	14	-	-	352	28	9	-	403
Navajo Nation	-	-	-	2,570	-	-	-	2,570
Total	**27,863**	**4,694**	**-**	**25,304**	**2,396**	**7,618**	**956**	**68,831**

NOx - 2018

State	(1) Compressor Engines	(2) Compressor Engines & Heaters	(3) Compressor Stations	(4) Compressor Station & Gas Processing Plant	(5) Drill Rigs	(6) Heaters	(7) Smaller NOx sources	Total
Arizona	6	-	-	-	-	6	-	13
Colorado	337	4,694	291	2,456	354	244	203	8,579
New Mexico	30,170	-	3,126	20,796	2,148	8,405	898	65,543
Utah	14	-	-	233	28	9	-	284
Navajo Nation	-	-	-	3,622	-	-	-	3,622
Total	**30,528**	**4,694**	**3,417**	**27,107**	**2,529**	**8,664**	**1,101**	**78,040**

(1) WRAP Area O&G + (NSJCBM + FRMP) Growth
(2) 2005 SUIT Engines
(3) (NSJCBM + FRMP) Growth
(4) WRAP PRP18 Point O&G
(5) WRAP Area O&G + 2005 SUIT + NSJCBM Growth
(6) WRAP Area O&G + (NSJCBM + FRMP) Growth
(7) WRAP Area O&G

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4K 2005 and 2018 Oil & Gas Emissions – VOC

VOC - 2005

State	(1) Completion - Flaring & Venting	(2) Flashing	(3) Fugitives	(4) Gas Plants, All Compressors, Heaters	(5) All Other Engines	(6) Venting	Total
Arizona	-	24	-	9	4	-	37
Colorado	484	224	0	3,301	64	1	4,074
New Mexico	17,718	6,528	36,988	10,947	584	44,571	117,335
Utah	-	426	-	96	10	-	532
Navajo Nation	-	-	-	293	-	-	293
Total	**18,202**	**7,201**	**36,988**	**14,646**	**661**	**44,572**	**122,270**

VOC - 2018

State	(1) Completion - Flaring & Venting	(2) Flashing	(3) Fugitives	(4) Gas Plants, All Compressors, Heaters	(5) All Other Engines	(6) Venting	Total
Arizona	-	14	-	19	4	-	37
Colorado	484	224	0	3,773	66	1	4,548
New Mexico	21,438	7,935	44,773	14,274	701	53,932	143,052
Utah	-	424	-	123	10	-	556
Navajo Nation	-	-	-	1,036	-	-	1,036
Total	**21,922**	**8,597**	**44,773**	**19,224**	**780**	**53,933**	**149,229**

(1) WRAP Area O&G
(2) WRAP Area O&G
(3) WRAP Area O&G + 2005 SUIT
(4) WRAP Area O&G + (NSJCBM + FRMP) Growth + WRAP Point O&G + 2005 SUIT
(5) WRAP Area O&G + NSJCBM Growth + 2005 SUIT
(6) WRAP Area O&G + 2005 SUIT

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4K 2005 and 2018 Power Plant Emissions

Facility Name	2005		2018	
	NOx	SO2	NOx	SO2
Four Corners Power Plant	41,743[1a]	12,653[1a]	50,981[2a]	17,935[2a]
San Juan	26,809[1a]	16,569[1a]	16,546[2b**]	9,352[2b**]
Prewitt Escalante Generating Station	3,797[1a]	1,293[1a]	3,729[2c**]	1,796[2c**]
Reeves Generating Station	151[1a]	0[1a*]	151[2d]	0[2d]
Milagro	110[1a]	3[1a]	110[2d]	3[2d]
Animas	54[1b]	0[1b]	54[2d]	0[2d]
Person Generating Project	4[1a]	0[1a*]	4[2d]	0[2d]
Desert Rock	n/a	n/a	3,325[2e]	3,319[2e]
Future Coal Units	n/a	n/a	2,680[2f]	2,904[2f]
Total Emissions (tons)	72,668	30,518	77,580	35,310

1. 2005 base case emissions data are from: (a) EPA Facility & Unit Emissions reports 2005 (CEMS) data, (b) NMED 2005 emissions inventory, & (c) EPA 9 emissions 2005 inventory info estimate for PM emissions.

* for Reeves & Person SO2 is <0.5 Tons (gas turbine plants)

2. 2018 base case emissions data are estimated using: (a) per EPA9/Steve Frey, NOx from Acid Rain Permit, SO2 conservative estimate from FIP with 88% control; (b) Presumptive BART limits; (c) WRAP PRP18a; (d) assuming constant emissions rate from 2005 to 2018, gas plants,(e) Desert Rock Energy Facility PSD Permit Application; (f) WRAP PRP based on EIA projections.

**Prorated heat input 2005-2018 is accounted for in the calculations for San Juan Generating Station

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4K 2005 and 2018 Emissions – All Sources NOx

2005 NOx

STATE	Area	Biogenics	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	97	211	2,407	4,661	13	0	0	0	7,388
Colorado	302	659	1,910	3,757	921	2,548	0	535	10,632
Navajo Nation	0	0	0	0	0	2,570	41,743	1,010	45,323
New Mexico	16,036	833	11,219	30,182	37,848	19,834	30,925	3,615	150,493
Puebla of Laguna	0	0	0	0	0	0	0	1,551	1,551
Puebla of Santa Anna	0	0	0	0	0	0	0	209	209
Southern Ute	0	0	0	0	0	4,694	0	0	4,694
Utah	42	130	181	741	51	352	0	78	1,575
Ute Mountain Reserv	0	0	0	0	0	0	0	0	0
Grand Total	**16,477**	**1,834**	**15,717**	**39,340**	**38,832**	**29,998**	**72,668**	**6,997**	**221,865**

2018 NOx

State	Area	Biogenics	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	117	211	1,217	1,934	13	0	1,340	0	4,834
Colorado	366	659	1,269	1,456	946	2,456	0	701	7,852
Farmington RMP Area	0	0	0	0	0	6,117	0	0	6,117
Navajo Nation	0	0	0	0	0	3,622	54,306	955	58,883
New Mexico	20,700	833	6,142	9,658	38,630	20,796	21,934	3,777	122,471
Northern San Juan CBM Project Area	0	0	0	0	0	483	0	0	483
Puebla of Laguna	0	0	0	0	0	0	0	2,038	2,038
Puebla of Santa Anna	0	0	0	0	0	0	0	209	209
Southern Ute	0	0	0	0	0	4,694	0	0	4,694
Utah	47	130	115	337	50	233	0	89	1,002
Ute Mountain Reserv	0	0	0	0	0	0	0	0	0
Grand Total	**21,231**	**1,834**	**8,743**	**13,385**	**39,639**	**38,401**	**77,580**	**7,770**	**208,583**

%NOx difference

State	Area	Biogenics	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	21.49%	0.00%	-49.42%	-58.50%	-0.02%				-34.58%
Colorado	21.17%	0.00%	-33.59%	-61.25%	2.69%	-3.62%		31.14%	-26.15%
Farmington RMP Area									
Navajo Nation						40.95%	30.09%	-5.43%	29.92%
New Mexico	29.08%	0.00%	-45.25%	-68.00%	2.07%	4.85%	-29.07%	4.49%	-18.62%
Northern San Juan CBM Project Area									
Puebla of Laguna								31.42%	31.42%
Puebla of Santa Anna									
Southern Ute									
Utah	11.86%	0.00%	-36.52%	-54.52%	-0.04%	-33.79%		14.31%	-36.37%
Ute Mountain Reserv									
Grand Total	**28.85%**	**0.00%**	**-44.37%**	**-65.98%**	**2.08%**	**28.01%**	**6.76%**	**11.04%**	**-5.99%**

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4K 2005 and 2018 Emissions – All Sources VOC

2005 VOC

STATE	Area	Biogenics	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	2,204	29,202	728	3,314	37	0	0	0	35,484
Colorado	3,632	84,822	4,884	2,616	891	1,257	0	348	98,450
Navajo Nation	0	0	0	0	0	293	292	121	706
New Mexico	26,675	108,515	5,690	17,079	109,480	7,857	7	1,849	277,152
Puebla of Laguna	0	0	0	0	0	0	0	11	11
Puebla of Santa Anna	0	0	0	0	0	0	0	49	49
Southern Ute	0	0	0	0	0	1,926	0	0	1,926
Utah	479	15,931	388	490	455	77	0	52	17,872
Ute Mountain Reserv	0	0	0	0	0	0	0	0	0
Grand Total	**32,989**	**238,471**	**11,690**	**23,499**	**110,862**	**11,410**	**299**	**2,429**	**431,649**

2018 VOC

State	Area	Biogenics	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	2,602	29,202	469	1,848	37	0	41	0	34,200
Colorado	4,341	84,822	3,299	1,217	892	1,246	0	413	96,230
Farmington RMP Area	0	0	0	0	0	3,220	0	0	3,220
Navajo Nation	0	0	0	0	0	1,036	184	38	1,258
New Mexico	34,313	108,515	4,179	7,753	131,900	7,930	356	2,153	297,099
Northern San Juan CBM Project Area	0	0	0	0	0	484	0	0	484
Puebla of Laguna	0	0	0	0	0	0	0	13	13
Puebla of Santa Anna	0	0	0	0	0	0	0	49	49
Southern Ute	0	0	0	0	0	1,926	0	0	1,926
Utah	651	15,931	246	277	453	103	0	72	17,732
Ute Mountain Reserv	0	0	0	0	0	0	0	0	0
Grand Total	**41,906**	**238,471**	**8,193**	**11,094**	**133,282**	**15,945**	**581**	**2,738**	**452,210**

%VOC difference

State	Area	Biogenics	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	18.09%	0.00%	-35.57%	-44.23%	0.00%				-3.62%
Colorado	19.50%	0.00%	-32.44%	-53.49%	0.16%	-0.85%		18.66%	-2.25%
Farmington RMP Area									
Navajo Nation						253.75%	-37.16%	-68.23%	78.19%
New Mexico	28.63%	0.00%	-26.57%	-54.61%	20.48%	0.93%	4987.45%	16.49%	7.20%
Northern San Juan CBM Project Area									
Puebla of Laguna								20.26%	20.26%
Puebla of Santa Anna									
Southern Ute									
Utah	35.90%	0.00%	-36.74%	-43.43%	-0.33%	34.30%		37.03%	-0.78%
Ute Mountain Reserv									
Grand Total	**27.03%**	**0.00%**	**-29.92%**	**-52.79%**	**20.22%**	**39.75%**	**94.30%**	**12.71%**	**4.76%**

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4K 2005 and 2018 Emissions – All Sources SO2

2005 SO2

STATE	Area	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	20	119	52	0	0	0	0	191
Colorado	135	53	62	19	14	0	105	388
Navajo Nation	0	0	0	0	35	12,653	179	12,867
New Mexico	5,580	625	543	116	552	17,866	3,020	28,302
Puebla of Laguna	0	0	0	0	0	0	0	0
Puebla of Santa Anna	0	0	0	0	0	0	53	53
Southern Ute	0	0	0	0	0	0	0	0
Utah	54	13	12	1	0	0	1,581	1,660
Ute Mountain Reserv	0	0	0	0	0	0	0	0
Grand Total	**5,789**	**809**	**669**	**136**	**602**	**30,518**	**4,938**	**43,462**

2018 SO2

State	Area	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	24	1	20	0	0	1,452	0	1,496
Colorado	146	5	16	19	12	0	141	339
Farmington RMP Area	0	0	0	0	0	0	0	0
Navajo Nation	0	0	0	0	155	21,253	266	21,674
New Mexico	13,204	60	140	122	548	12,607	3,180	29,861
Northern San Juan CBM Project Area	0	0	0	0	0	0	0	0
Puebla of Laguna	0	0	0	0	0	0	0	0
Puebla of Santa Anna	0	0	0	0	0	0	53	53
Southern Ute	0	0	0	0	0	0	0	0
Utah	54	0	4	1	0	0	2,122	2,182
Ute Mountain Reserv	0	0	0	0	0	0	0	0
Grand Total	**13,428**	**66**	**180**	**142**	**715**	**35,312**	**5,763**	**55,606**

%SO2 difference

State	Area	Off-road	On-road	Area Oil & Gas	Point Oil & Gas	EGU	NonEGU	Grand Total
Arizona	17.72%	-99.52%	-61.72%					683.87%
Colorado	8.63%	-91.07%	-74.04%	1.07%	-13.85%		33.97%	-12.54%
Farmington RMP Area								
Navajo Nation					337.34%	67.97%	48.94%	68.45%
New Mexico	136.61%	-90.40%	-74.22%	4.92%	-0.74%	-29.44%	5.31%	5.51%
Northern San Juan CBM Project Area								
Puebla of Laguna								
Puebla of Santa Anna								
Southern Ute								
Utah	0.94%	-97.14%	-67.24%	-0.03%	78.88%		34.23%	31.42%
Ute Mountain Reserv								
Grand Total	**131.97%**	**-91.89%**	**-73.11%**	**4.34%**	**18.94%**	**15.71%**	**16.70%**	**27.94%**

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Categories for 2018 Source Apportionment Modeling

1a. Oil & gas combustion sources (compressors, drill rigs, heaters, all other engines)

1b. Oil & gas non-combustion sources (fugitives, completions, venting)

1c. New Mexico large oil & gas points (large compressors and gas plants)

2. All other area sources
3. Biogenics
4. Mobile – on-road and nonroad

Source apportionment geographical regions are each of the four states in the 4k domain

Mitigation Scenarios

- Contract budget allows for five mitigation scenarios developed by the FCAQTF that apply across-the-board reductions to selected source categories
- Reductions need to be specified as % by SCC and geographical area (state or county)

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Oil & Gas Source Category Codes (SCCs)

SCC	Description	
2310000220	All Processes	Drill rigs
2310000330	All Processes	Artificial Lift
2310000440	All Processes	Saltwater disposal engines
2310010100	Crude Petroleum	Heaters
2310010200	Crude Petroleum	Tanks - Flashing & Standing/Working/Breathing
2310010300	Crude Petroleum	Pneumatic Devices
2310010700	Crude Petroleum	Fugitives
2310010800	Crude Petroleum	Truck Loading
2310020600	Natural Gas	Compressor Engines
2310021100	Natural Gas	Heaters
2310021300	Natural Gas	Pneumatic Devices
2310021400	Natural Gas	Dehydrators
2310021500	Natural Gas	Completion - Flaring and venting
2310023000	Natural Gas	CBM - Dewatering pump engines
2310020700	Natural Gas	Fugitives
2310020800	Natural Gas	Truck Loading
2310021600	Natural Gas	Venting
2310030210	Natural Gas Liquids	Tanks - Flashing & Standing/Working/Breathing, Uncontrolled
2310030220	Natural Gas Liquids	Tanks - Flashing & Standing/Working/Breathing, Controlled

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Initially Suggested Mitigation Scenarios

(see draft document dated September 2007)

- Scenario 1: Model all viable AQTF measures for all source categories
- Scenario 2: Enhanced control of oil and gas sources (low option)
- Scenario 3: Enhanced control of oil and gas sources (High option)
- Scenario 4: Enhanced control on power plants.
- Scenario 5: Held in reserve