

WRAP Oil & Gas:

Part 1: 2002/2005 and 2018 Area Source Emissions Inventory Improvements



WRAP
SSJF Working Group
Members and Other Interested
Parties

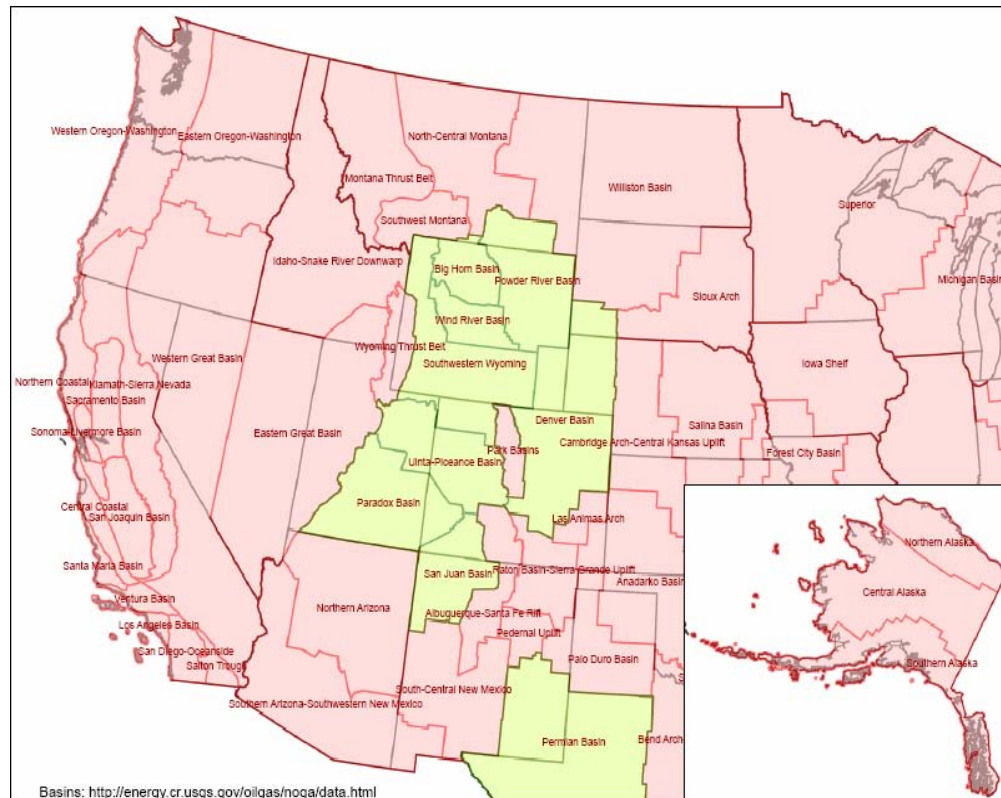
May 8, 2007



WRAP Phase II Project Overview

- Project is focused on developing an improved emissions inventory of oil and gas exploration and production area sources in the WRAP region
- Area source categories include compressor engines, drilling rigs, heaters and other wellhead equipment
- Previous emission inventory (EI) efforts:
 - WRAP Phase I analysis, 2002 and 2018 (completed 2005)
 - NMED EI for San Juan and Rio Arriba counties (completed 2006)
- Specific objectives of the Phase II project:
 - Emissions inventory improvements for 2002
 - Current base year updates for 2005
 - 2018 growth factor projections improvements
 - Control technology evaluations and control strategies scenarios
 - 2018 point source SO₂ emissions improvements

Western States Oil & Gas Regions of Interest



Major basins of O&G activity in Phase II analysis:

- Permian Basin (NM)
- San Juan Basin North (CO)
- Denver-Julesburg Basin (CO)
- Green River Basin (WY)
- Big Horn Basin (WY and MT)
- San Juan Basin South (NM)
- Uinta-Piceance Basin (CO and UT)
- Paradox Basin (UT)
- Wind River Basin (WY)
- Powder River Basin (WY and MT)

2002 Emissions Inventory Improvements

- New methodology estimated 2002 emissions on a basin-wide average basis for all basins in the WRAP region, focusing on those basins where major O&G activities are occurring and detailed producer information is available
- In basins where significant activity was not occurring, or producer information was unavailable, used Phase I estimates

Data Collection from O&G Producers

- Data were collected from all major and some medium-sized and independent oil and gas companies operating in the WRAP region
- Data collection was in the form of a questionnaire sent to each producer
- Information was provided on:
 - Overall activity (i.e. number of wells, gas production, etc.)
 - Equipment used and equipment counts
 - Emissions controls in use or planned
 - Projections of future activity, demand, and production in the region

Brief Overview of Methods

- Basin-specific emissions estimates were made using activity and equipment information provided directly by the producers
 - Previous Phase I work used available data from limited areas and generalized to WRAP region
- For Phase II EI improvements, focus is on well-head compressors and drilling rigs as area sources
- Focused basin list only – these are the areas where major oil and gas activity is occurring or expected to occur
- Updated baseline emissions year from 2002 to 2005
- Revised 2018 projections using most recent planning information available and producer data where available

2002 Emissions Inventory

Drilling Rig Emissions

- Improved estimate of actual drilling time by formation and basin from producer information on drilling times (rather than spud date and well completion date)
- Improved estimate of average drilling rig engine load by formation and basin
- Determined average horsepower requirements by formation and basin and identified most often used or representative makes/models of drilling rig engines
- Incorporated manufacturer's rated emissions factors for makes/models identified, or producers' emissions tests where available
- Incorporated SO₂ emissions factors (based on sulfur content of fuel)

2002 Emissions Inventory Drill Rig Emissions - TPY

	NOx	SOx	VOC
	2002	2002	2002
Alaska	877	66	0
Arizona	0	0	0
Colorado	2,803	118	101
Montana	1,046	225	0
Nevada	24	1	0
New Mexico	5,476	244	68
North Dakota	1,536	358	0
Oregon	0	0	0
South Dakota	29	6	0
Utah	334	17	12
Wyoming	4,997	150	228
WRAP Total	17,123	1,185	410

Note: Emissions estimates include data from previous work for the NMED in the San Juan Basin and the Southern Ute inventory in Colorado

2002 Emissions Inventory

Compressor Engine Emissions

- Determined for each basin either (a) the average percentage of wells with wellhead, lateral and central compression, or (b) percentage of total HP with wellhead, lateral or central compression
- Did not include central and lateral compressors that have been counted in a point source inventory for each state
- Determined for each basin a representative or most often used make/model of compressor, including HP and rated or tested emissions factors
- Determined for each basin an average load factor for wellhead/lateral compressors
- Basin-wide emissions estimate on the basis of total well count

2002 Emissions Inventory

Compressor Engine Emissions - TPY

	NOx	SOx	VOC
	2002	2002	2002
Alaska	0	0	0
Arizona	8	0	0
Colorado	3,271	0	1,204
Montana	1,791	0	4
Nevada	33	0	0
New Mexico	35,140	1	3,541
North Dakota	2,920	0	0
Oregon	73	0	0
South Dakota	284	0	0
Utah	843	0	53
Wyoming	1,791	0	231
WRAP Total	46,154	1	5,034

Note: Emissions estimates include data from previous work for the NMED in the San Juan Basin and the Southern Ute inventory in Colorado. Other Colorado compressor emissions are assumed to be part of Colorado's point source inventory and are not included here.

2002 Emissions Inventory Exploration & Production

- **Previous Work included:**
 - Tanks - flashing, working and breathing losses (VOC)
 - Glycol dehydration units (VOC)
 - Heaters (VOC and NO_x)
 - Pneumatic Devices (VOC)
 - Completion-venting and flaring (VOC, NO_x, CO)
- **Work Plan identified potential additional work to estimate VOC from:**
 - Venting (from unloading fluids)
 - Fugitives (using typical well diagrams)
 - Dehydrators (look at point source vs. area source distribution)
- **Resources did not allow this work to be completed**

Additional Categories

CBM Engines

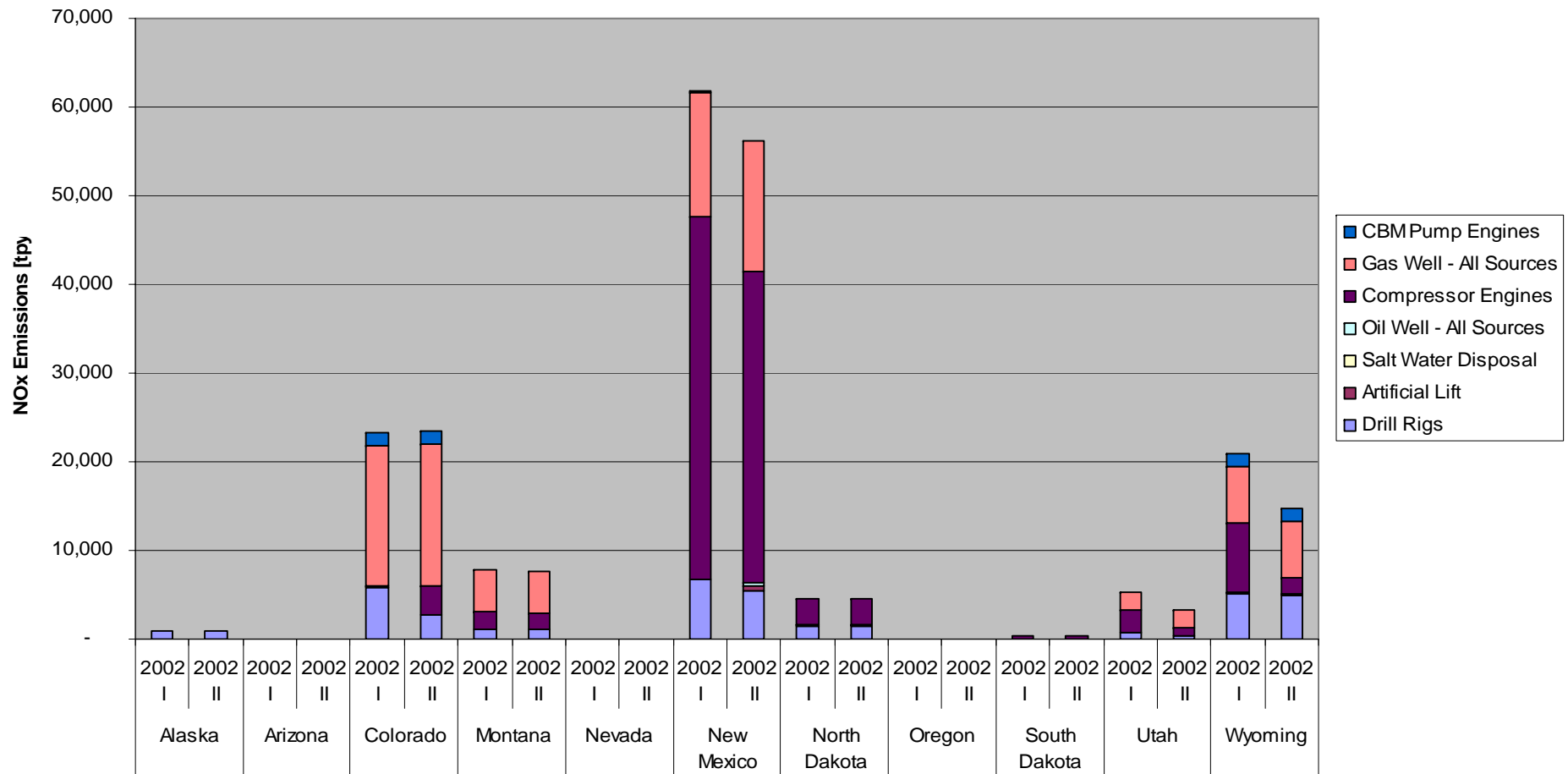
- Emissions from CBM wells were addressed through estimating drilling rig and compressor emissions
- Previous estimates for CBM pump engine emissions were not updated

Fugitive Dust Emissions

- Resources did not allow estimating fugitive dust emissions

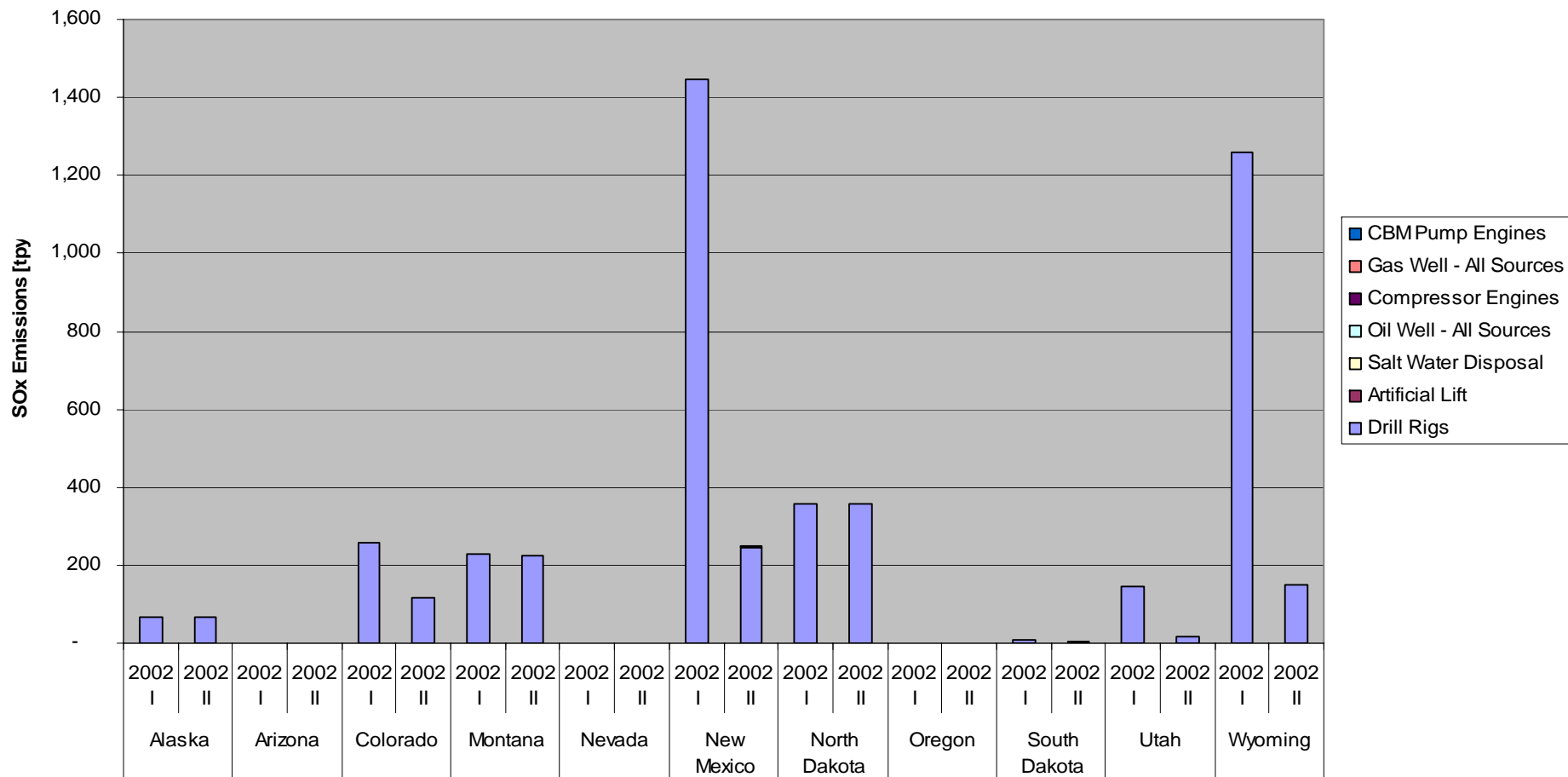
Comparison of Phase I with Phase 2 NOx Emissions for 2002

WRAP Phase I and Phase II NOx Emissions for 2002



Comparison of Phase I with Phase II SOx Emissions for 2002

WRAP Phase I and Phase II SOx Emissions for 2002



Updated 2002 → 2005 Emissions

- Objective was to update base year for projections from 2002 to 2005 using newly available state OGC data for 2005
- 2005 represents a more current base year for projections and can be used as a second “data point” to verify projections methodology
- Methodology was to first update 2002 emissions using the Phase II tasks described here, then to scale up 2002 data using 2005 OGC well count or production
- In areas with no production or wells in 2002, but with production or wells in 2005 emissions were scaled based on state average emissions per well (or per production unit)

Updated 2002 → 2005 Emissions Drill Rig Emissions - TPY

	NOx		SOx		VOC	
	2002	2005	2002	2005	2002	2005
Alaska	877	835	66	62	0	0
Arizona	0	0	0	0	0	0
Colorado	2,803	8,000	118	350	101	308
Montana	1,046	3,007	225	640	0	3
Nevada	24	37	1	1	0	0
New Mexico	5,476	8,640	244	362	68	111
North Dakota	1,536	3,055	358	688	0	0
Oregon	0	0	0	0	0	0
South Dakota	29	203	6	43	0	0
Utah	334	2,888	17	149	12	106
Wyoming	4,997	15,783	150	541	228	714
WRAP Total	17,123	42,448	1,185	2,835	410	1,242

Updated 2002 → 2005 Emissions

2005 Compressor Engine Emissions - TPY

	NOx		SOx		VOC	
	2002	2005	2002	2005	2002	2005
Alaska	0	0	0	0	0	0
Arizona	8	6	0	0	0	0
Colorado	3,271	3,302	0	0	1,204	1,225
Montana	1,791	2,267	0	0	4	10
Nevada	33	33	0	0	0	0
New Mexico	35,140	35,345	1	1	3,541	3,542
North Dakota	2,920	2,799	0	0	0	0
Oregon	73	51	0	0	0	0
South Dakota	284	305	0	0	0	0
Utah	843	996	0	0	53	64
Wyoming	1,791	3,288	0	0	231	459
WRAP Total	46,154	48,393	1	1	5,034	5,300

Note: Emissions estimates include data from previous work for the NMED in the San Juan Basin and the Southern Ute inventory in Colorado. Other Colorado compressor emissions are assumed to be part of Colorado's point source inventory and are not included here.

2018 Emissions

- Emissions estimated for county-level emissions in WRAP region for:
NO_x, SO₂, VOC, CO
- Emissions included updated growth projections from Resource Management Plans, Alaska Oil & Gas Report, and National Energy Forecast released by the Energy Information Administration (EIA)
- Projected emissions to 2018 using 2005 base case and growth factors
- State controls evaluated:
 - Wyoming BACT requirements for permitted sources
 - Colorado controls requirements for point sources (ERG)
 - Utah BACT requirements for compressors
- Federal controls evaluated:
 - Federal nonroad engine standards
 - EPA nonroad diesel fuel sulfur content standards

2018 Emissions Projections Drilling Rigs - TPY

	NOx		SOx		VOC	
	2005	2018	2005	2018	2005	2018
Alaska	835	452	62	1	0	0
Arizona	0	0	0	0	0	0
Colorado	8,000	4,413	350	11	308	155
Montana	3,007	2,821	640	6	3	10
Nevada	37	21	1	0	0	0
New Mexico	8,640	5,343	362	3	111	68
North Dakota	3,055	1,655	688	4	0	0
Oregon	0	0	0	0	0	0
South Dakota	203	118	43	0	0	0
Utah	2,888	944	149	1	106	31
Wyoming	15,783	9,883	541	3	714	407
WRAP Total	42,448	25,652	2,835	29	1,242	671

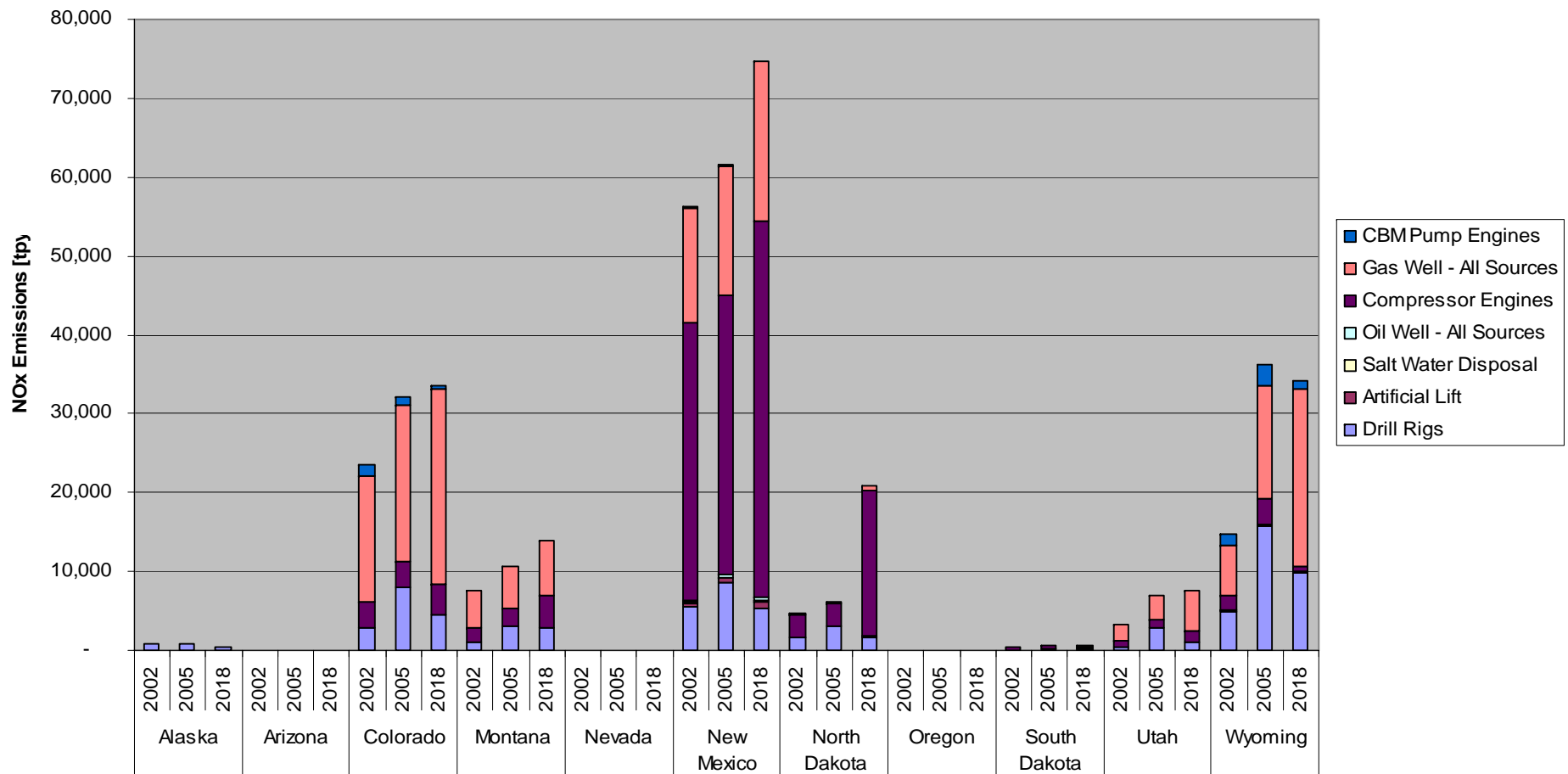
2018 Emissions Projections Compressor Engines - TPY

	NOx		SOx		VOC	
	2005	2018	2005	2018	2005	2018
Alaska	0	0	0	0	0	0
Arizona	6	8	0	0	0	0
Colorado	3,302	4,006	0	0	1,225	1,485
Montana	2,267	3,946	0	0	10	421
Nevada	33	40	0	0	0	0
New Mexico	35,345	47,599	1	1	3,542	4,879
North Dakota	2,799	18,399	0	0	0	0
Oregon	51	37	0	0	0	0
South Dakota	305	368	0	0	0	0
Utah	996	164	0	0	64	91
Wyoming	3,288	655	0	0	459	464
WRAP Total	48,393	76,399	1	1	5,300	7,340

Note: Colorado 2018 emissions projections for compressor engines are applied only to the Southern Ute inventory. All other compressor emissions are assumed to be part of Colorado's point source inventory and are not included here.

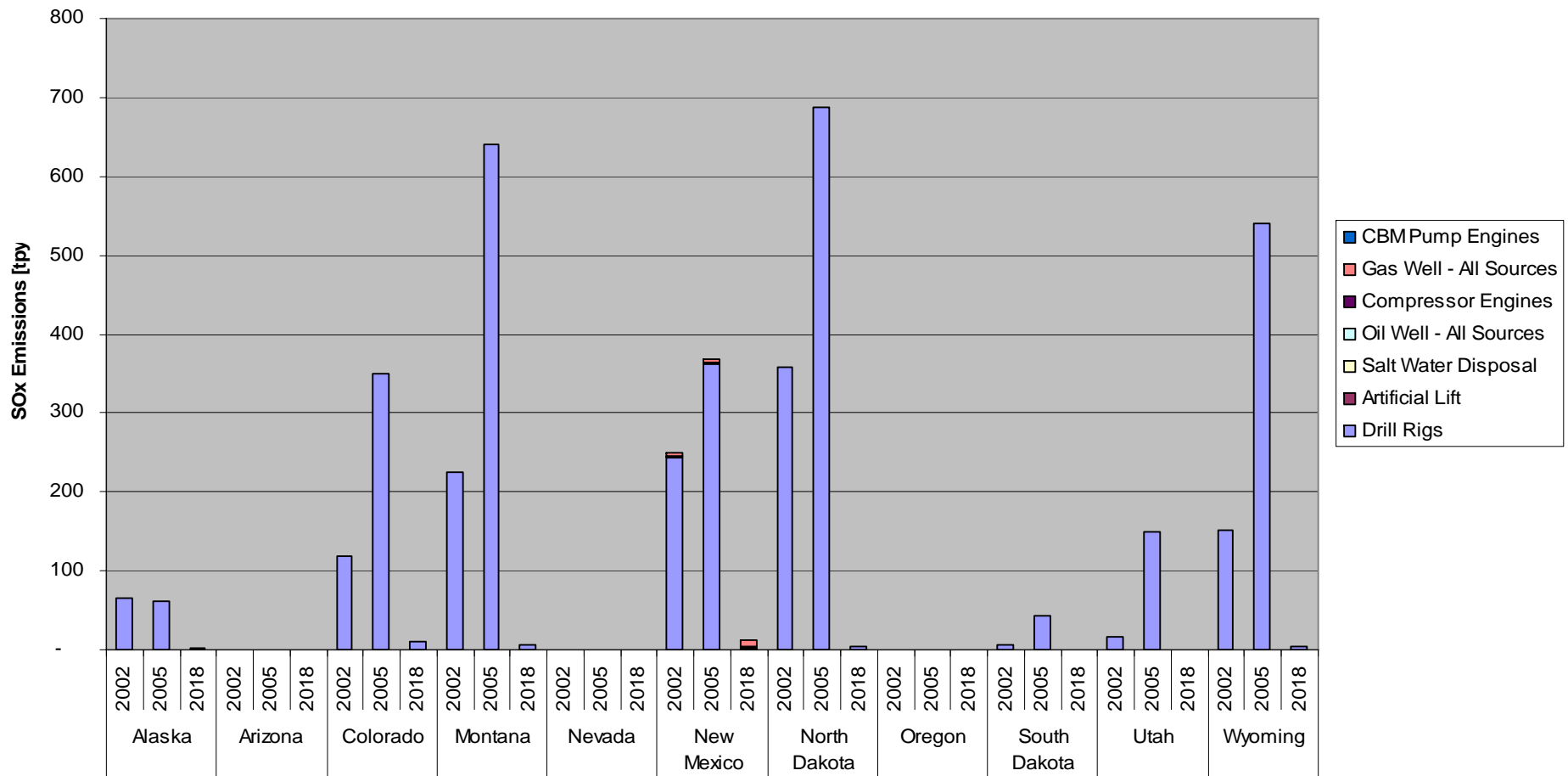
WRAP Phase II NOx Emissions for 2002, 2005 and 2018

WRAP Phase II NOx Emissions for 2002, 2005, 2018



WRAP Phase II SOx Emissions for 2002, 2005 and 2018

WRAP Phase II SOx Emissions for 2002, 2005, 2018

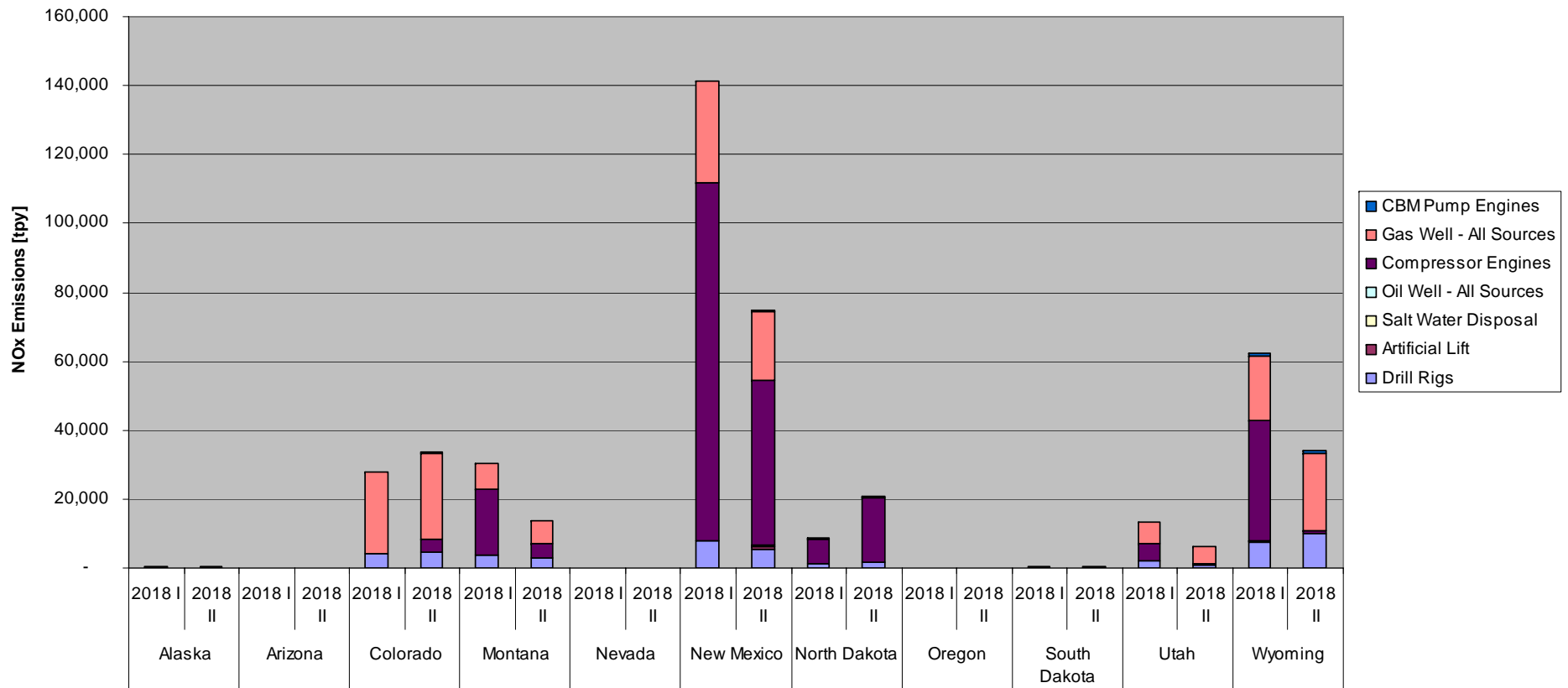


Discussion of Phase I vs Phase II NOx and SOx Emissions Inventory

- NOx emissions jump in North Dakota - due to Dakota Prairie Grasslands Resource Management Plan (RMP).
- Wyoming NOx emissions decrease from 2005 to 2018 – due to wellhead compressor emissions reduction, implementation of the BACT controls requirement by 2018
- Oil vs. gas wells – corrected the Phase I assumption of emissions based on all gas production, no gas equipment on oil wells.
- Bar chart comparing Phase I and Phase II 2018 NOx emissions is the clearest place to see the impact of the Phase II methodology reducing wellhead compression emissions (primarily in WY, MT, and in NM)
- SO₂ emissions in both 2002 and 2018 have been reduced from Phase I due to improved estimates of actual drilling times based on producer feedback
- General trend in both Phase I and Phase II analyses is for SOx emissions to decrease substantially by 2018 due to the phase-in of ultra-low sulfur diesel fuel

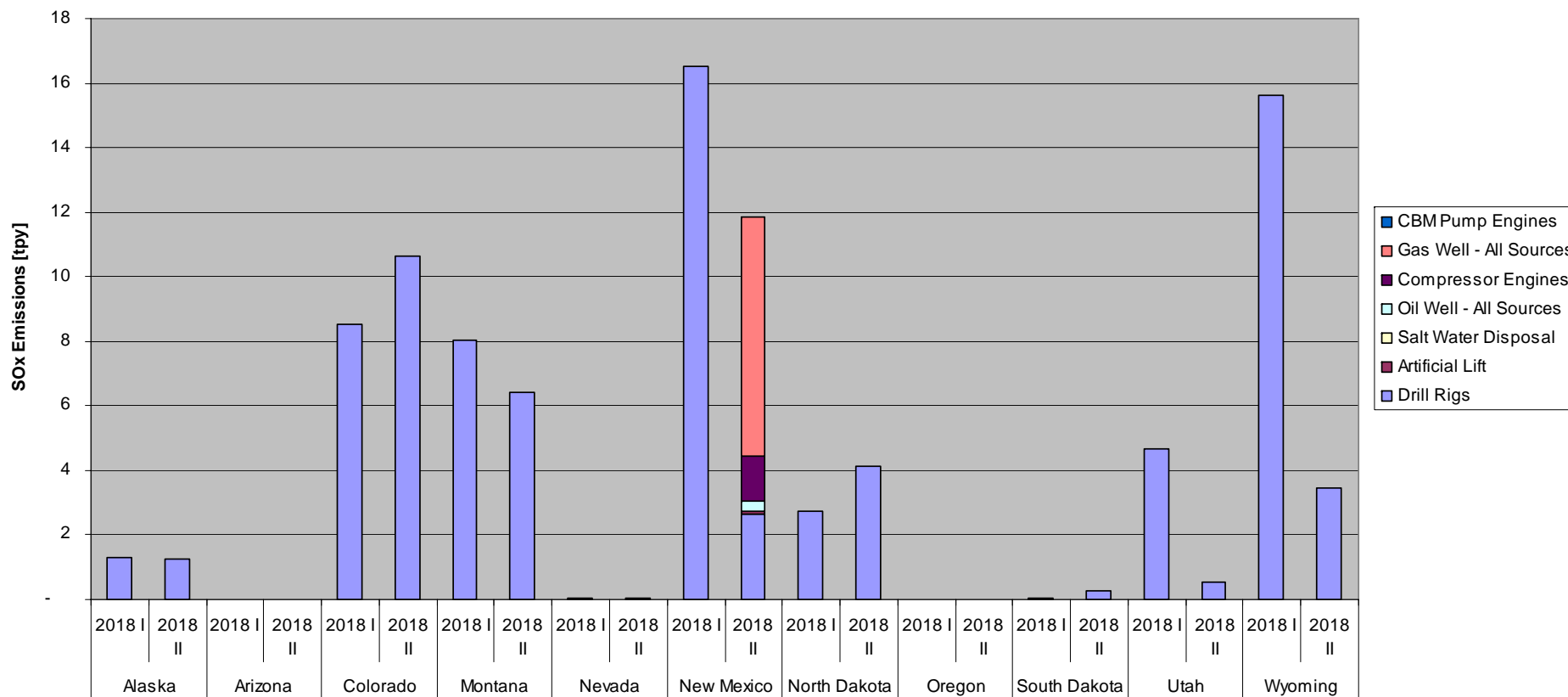
Comparison of Phase I with Phase II NOx Emissions for 2018

WRAP Phase I and Phase II NOx Emissions for 2018



Comparison of Phase I with Phase II SOx Emissions for 2018

WRAP Phase I and Phase II SOx Emissions for 2018



2018 Point Source SO₂ Emissions

- Revised Pechan report on 2018 SO₂ emissions projections to incorporate ENVIRON projection methodology and producers' information on growth forecasts and emissions controls
- Identified major SO₂ point source emissions sources in each state of interest
- Obtained producer information on control strategy effectiveness, implementation rate, timetable and growth trends from 2002 – 2005 as well as for 2018 based on production forecasts
- Conducted review of Title V Permits to determine emissions with and without control technologies
- Revised estimates of 2018 emissions

2018 Point Source SO₂ Emissions Wyoming

Plant Name	Operator	County	Previous 2018 SO ₂ Emissions [tpy] (Pechan)	Updated 2018 SO ₂ Emissions [tpy]
Whitney Canyon Gas Plant	BP	Uinta	9,172	0
Lost Cabin Gas Plant	Burlington	Fremont	3,170	2,378
Carter Creek Gas Plant	Chevron	Uinta	1,184	284
Beaver Creek Gas Plant	Devon	Fremont		42
Shute Creek Facility	Exxon	Lincoln	2,651	52
Elk Basin Gas Plant	Howell Petroleum	Park	2,136	61
Oregon Basin Gas Plant	Marathon Oil	Park	438	350
Worland Gas Plant	Highland Partners	Washakie		318
Brady Gas Plant	Anadarko	Sweetwater	210	181
Total			18,961	3,666

2018 Point Source SO₂ Emissions New Mexico

Plant Name	Operator	County	Previous 2018 SO ₂ Emissions [tpy] (Pechan)	Updated 2018 SO ₂ Emissions [tpy]
Maljamar Gas Plant	Frontier Field Services	Lea	3,373	3,574
Indian Basin Gas Plant	Marathon Oil	Eddy	2,794	1,100
Artesia Gas Plant	Duke Energy	Eddy	1,134	19
Monument Gas Plant	Targa Midstream Services	Lea	1,159	1,432
Dagger Draw Gas Plant	Agave Energy	Eddy	230	243
Denton Gas Plant	Davis Gas Processing	Lea	399	295
Eunice Gas Plant	Duke Energy	Lea	953	55
Linam Ranch Gas Plant	Duke Energy	Lea	1,261	26
Jal No. 3 Gas Plant	Sid Richardson	Lea	1,633	1,231
Eunice Gas Plant	Targa Midstream Services	Lea		25
Saunders Gas Plant	Targa Midstream Services	Lea		28
Total			12,936	8,027

Project deliverables and status

Task/deliverable	Status	Date
Project workplan	Completed and reviewed by SSJF working group	November 2006
Questionnaire to major producers	Completed and responses compiled	March 2007
2002 EI update	Completed, results in SMOKE-ready files	April 2007
2002 → 2005 baseline scale-up	Completed	April 2007
2005 → 2018 EI projections	Completed, results in SMOKE-ready files	April 2007
Control technology evaluation	Completed control technology white papers	March 2007
Control scenarios	In process	Mid-May
Final report		End of May
Presentation of controls analysis to SSJF Oil and Gas Work Group		End of May

Upcoming Conference Call Part 2: Control Technology Evaluation

- Control Technology Discussion
 - May 30, 2007
 - 2:00 p.m. (MDT)
 - Call-in number: 1-866-206-0240
 - Pass code: 323375
- Discussion to cover
 - Control technology options
 - Potential emission reductions
 - Costs and cost-effectiveness