COMPARISONS OF 2016V1 MODELING PLATFORM VS 2014 WRAP BASELINE OIL AND GAS INVENTORIES

Point and non-point oil and gas sources in seven WRAP States

J. Vukovich USEPA OAQPS

COLLABORATIVE VS. WRAP OIL AND GAS INVENTORIES

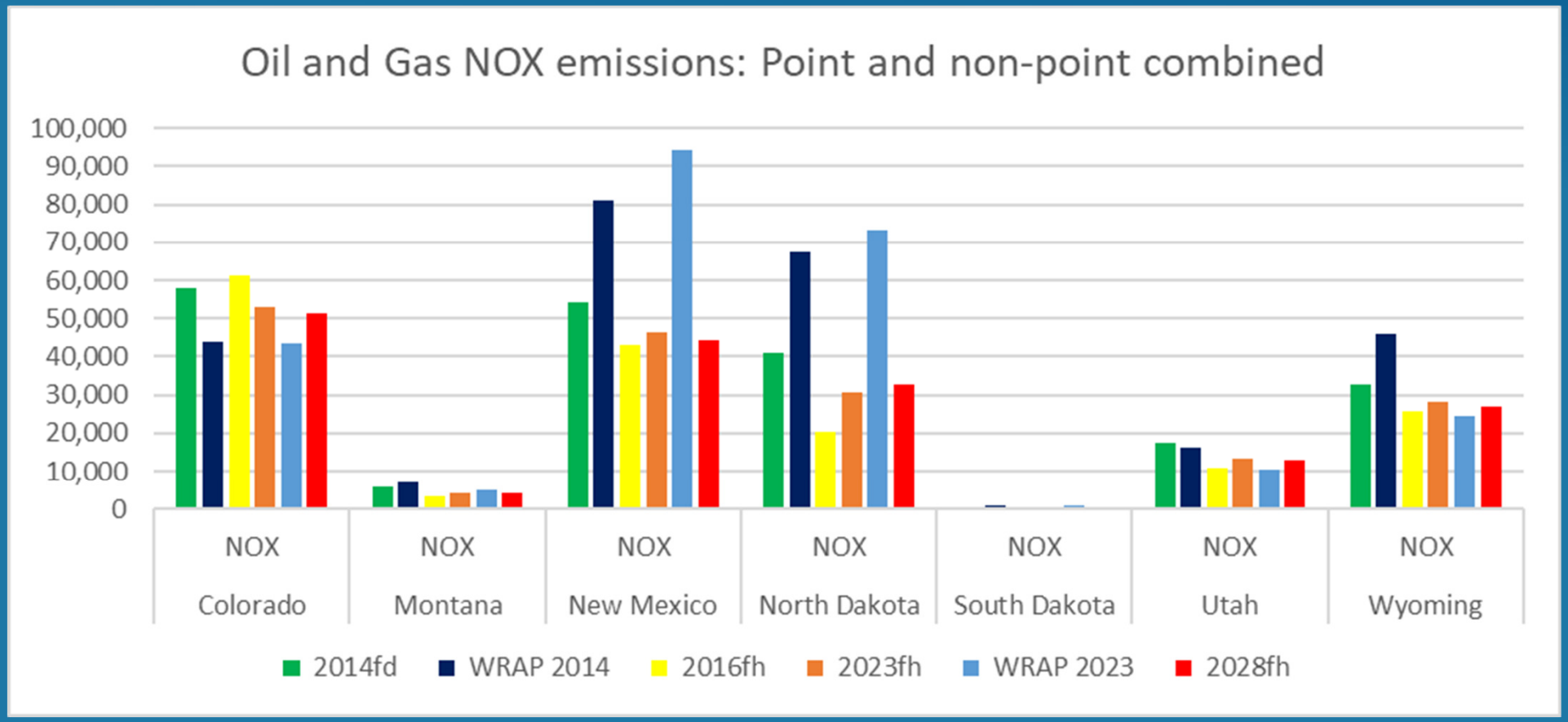
2016 version 1 Collaborative Workgroup effort

- Non-point developed with Oil and Gas Tool using 2016 activity data
  - Colorado based on 2014NEIv2
  - WRAP states didn't submit data
- Point sources
  - Type A major sources: 2016 year specific
  - Other: Growth sources assumption from 2014 to 2016
- Lower 48 states plus Alaska
- Future years: 2023 and 2028

WRAP 2014 Baseline *

- Point and non-point using 2014 activity data
- Developed using basin specific studies post-2014NEI
- Did not use the O&G Tool
- Used data from recent survey
- 7 WRAP States: CO, MT, NM, ND, SD, UT and WY
- Future year: same case used for 2023 and 2028
- Provided own gridding surrogates and some speciation information

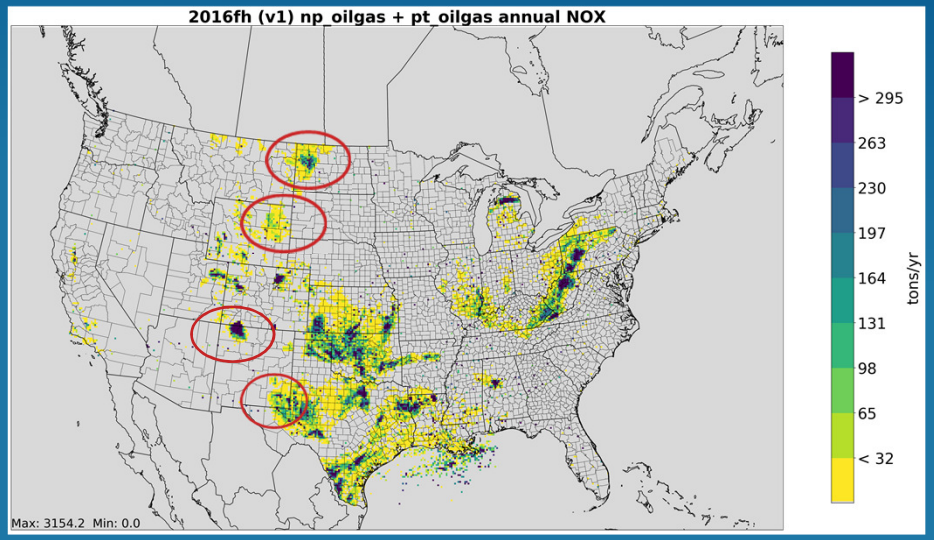
STATE NOX EMISSIONS FOR BASE AND FUTURE CASES



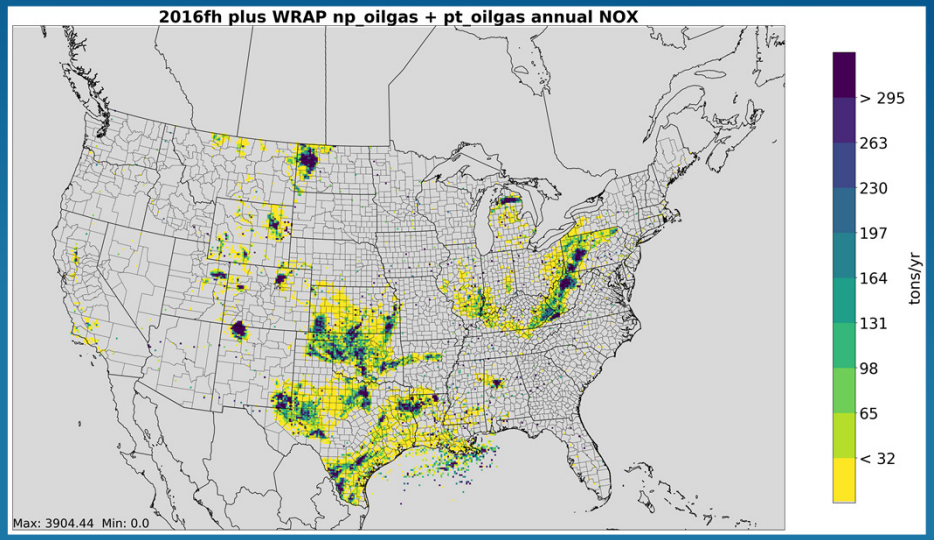
2014fd = 2014NEIv2 2016fh = 2016v1 2023fh and 2028fh are based off of 2016v1

NOX Point + Nonpoint

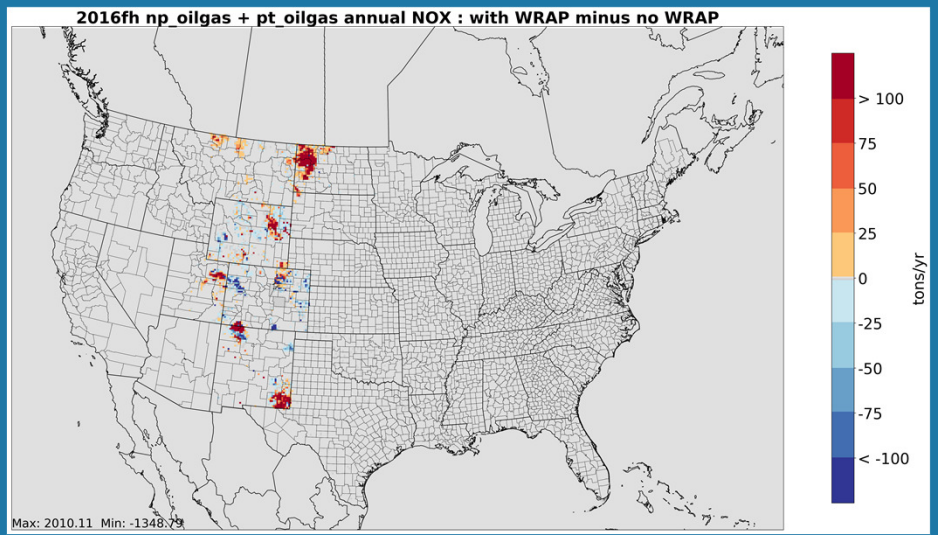
2016V1



2016V1 with WRAP2014



2016V1 with WRAP2014 – 2016v1

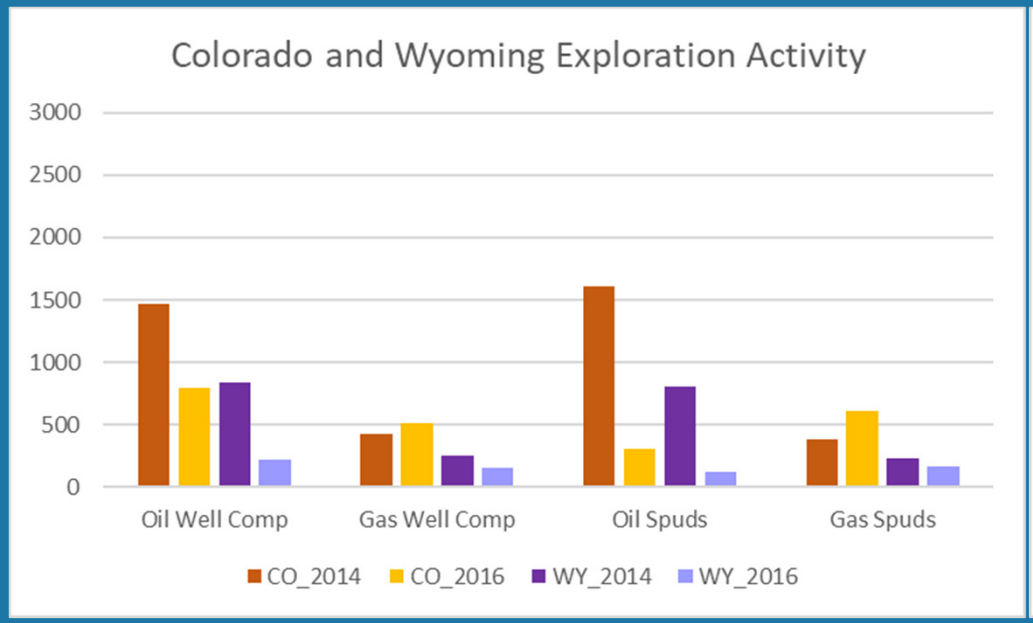


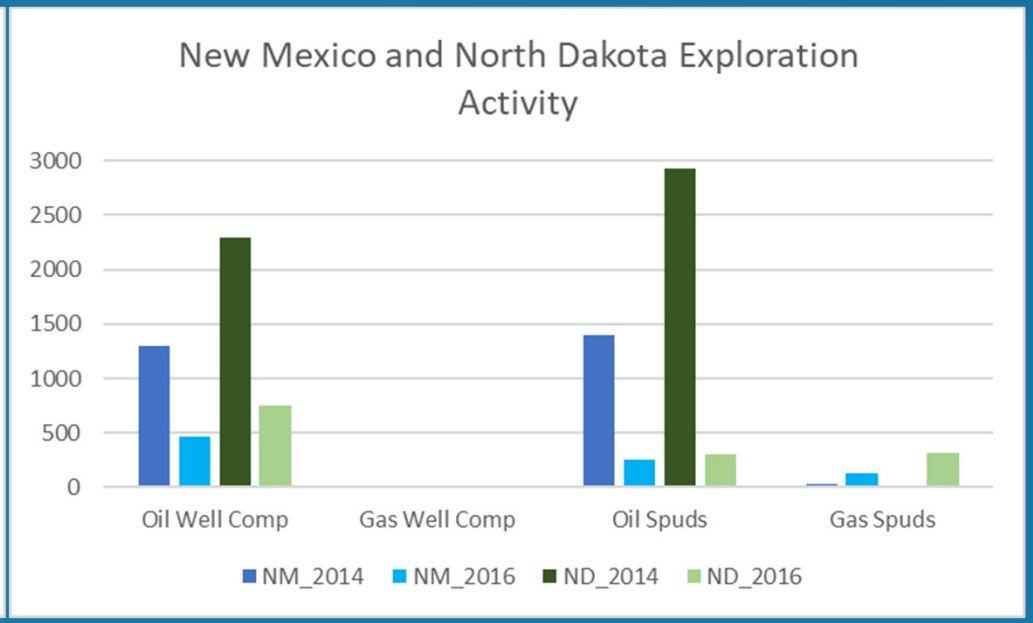
NOX DIFFERENCE HIGHLIGHTS

- WRAP 7-state total 263K tons vs 2016v1 165K tons
  - Year 2023: WRAP = 251K, 2023fh=175K, 2028fh=173K
- New Mexico (40K+ tons in WRAP vs 2016v1)
  - Mainly 4 Counties (2 in San Juan Basin and 2 in Permian Basin)
  - Main differences in ICEs, some Artificial Lift; Pipeline Transportation
- North Dakota (47K+ tons in WRAP vs 2016v1)
  - 6-7 Counties in Williston Basin
  - Fracturing Engines, Artificial Lift, and Drill Rigs differences
- Wyoming (20K+ tons in WRAP vs 2016v1)
  - Mainly Campbell county
  - Fracturing Engines, Drill Rigs
- EXPLORATION all 7 states: WRAP2014=136K tons, 2016v1=48K tons

HISTORICAL EXPLORATION DATA AND TRENDS

Overall Oil Exploration down somewhat significantly in 2016 when compare to 2014. Natural Gas Exploration trends variable in these states.



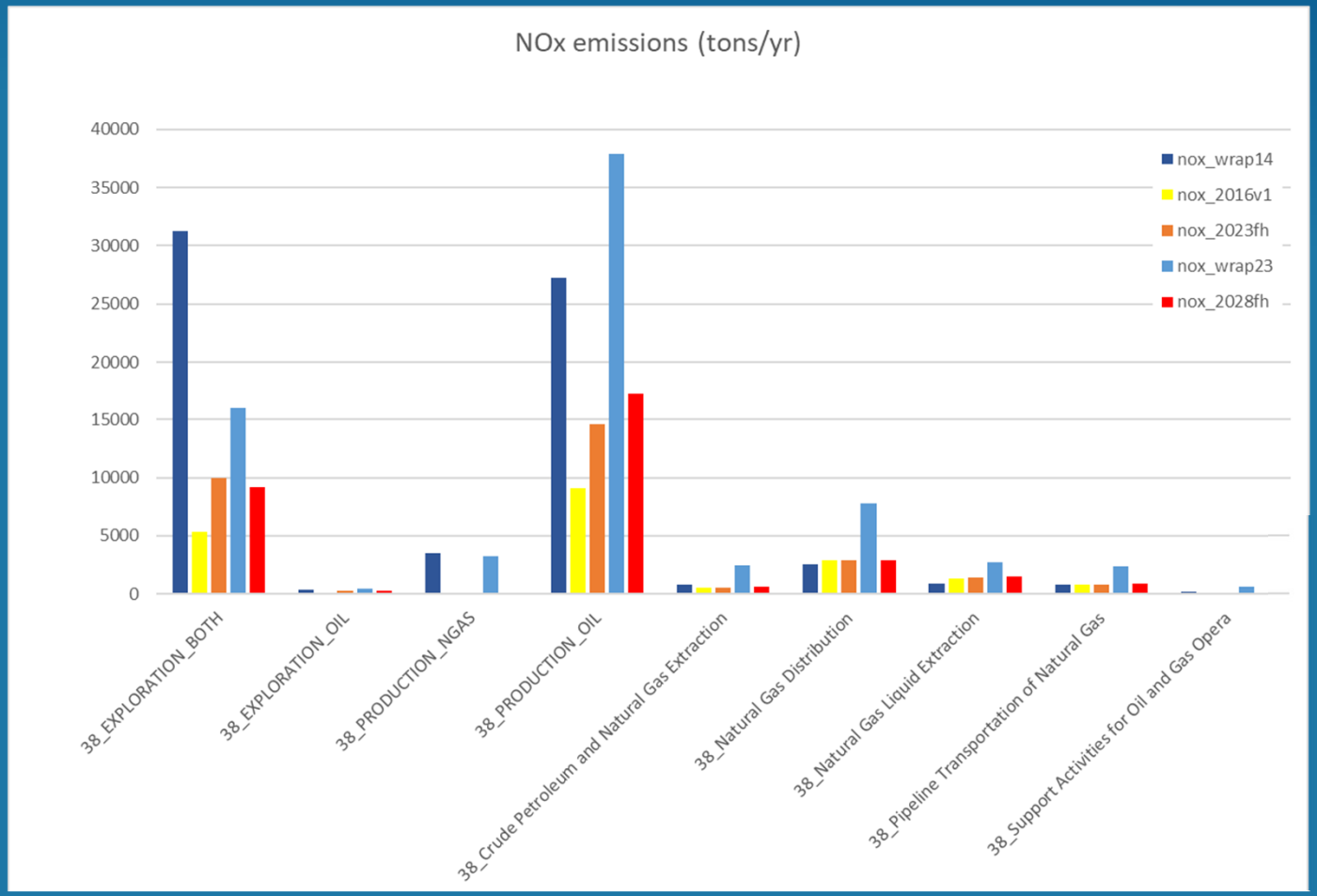


Sources are: DrillingInfo's HPDI and RigDATA databases

SUB-SECTOR ANALYSIS BY STATE

- Nonpoint sector broken down by SCC groupings
  - EXPLORATION or PRODUCTION
  - OIL, GAS, Coal Bed Methane (CBM) or BOTH(oil and/or gas)
  - Displayed in CAPS (e.g. PRODUCTION_OIL)
- Point sector broken down by NAICS
  - Oil, Gas, Gas Liquids, Oil and Gas extractions (production)
  - Pipeline Transportation
  - Support Activities
  - Natural Gas Distribution
  - Displayed in non-CAPS (e.g. Natural Gas Extraction)
- Goal
  - Highlight activity differences in 2014 and 2016
  - Highlight other differences in base and future years

NORTH DAKOTA: SUBSECTOR NOX BREAKDOWN



EIA oil production:
2014: 1,081 barrels/day
2016: 1,032 barrels/day
-4.5%

Table 2-13. NOx and VOC Emission Changes by Basin Resulting from Integration of Operator Survey Data.

Basin	Emissions (tons/year)	
	NOx	VOC
Williston , ND	19,108	-280,542
Permian , NM	4,900	-25,719
Sweetgrass , MT	1,789	600
Williston , MT	-1,036	-16,169
Powder River , MT	-1	5
Central Montana Uplift , M	226	116
Big Horn , MT	9	0
Total Change	**24,995**	**-321,708**
Percent Change	**8%**	**-24%**

Table 2-15. Williston Basin Casinghead Gas Emissions Comparison.

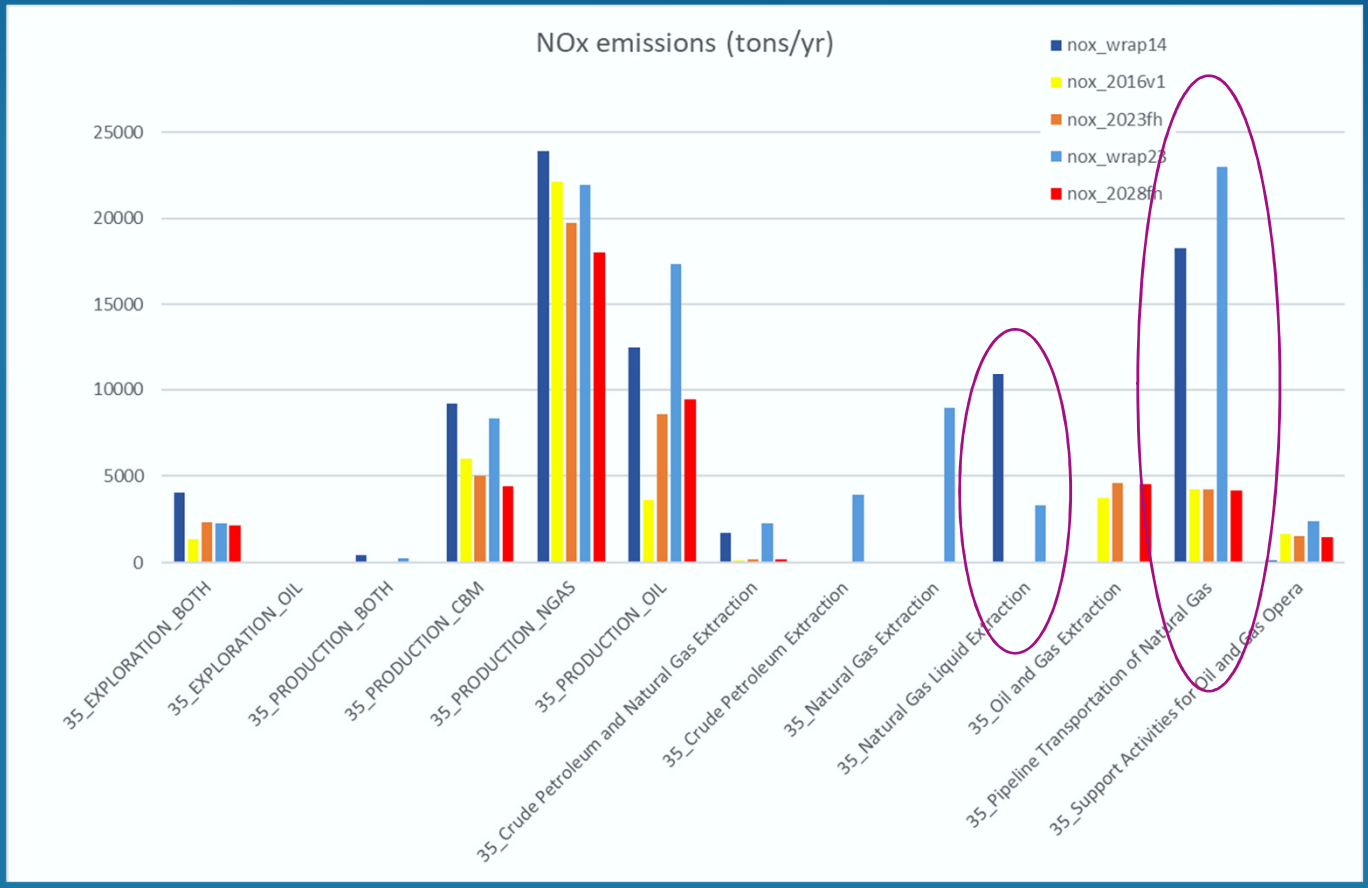
Pollutant	Williston Basin Casinghead Emissions (tons/yr)			
	MT	ND	SD	Total
Original 2014 Base Year Emissions (WRAP OGWG)				
NOx	20	292	1	313
VOC	6,718	98,388	443	105,549
CO	105	1,541	7	1,653
SO_x	-	-	-	-
Revised 2014 Base Year Emissions				
NOx	330	6,869	229	7,428
VOC	8,081	203,984	6,802	218,867
CO	1,797	37,375	1,246	40,418
SO_x	3	1,498	50	1,552
Ratio of Revised to Previous 2014 Base Year Emissions				
NOx	16.6	23.6	174.6	23.7
VOC	1.2	2.1	15.4	2.1
CO	17.1	24.3	179.7	24.4
SO_x				

Tables taken from WRAP report indicate that new survey data increased NOx in ND (engines)
Exploration higher in 2014 vs 2016

NEW MEXICO : SUBSECTOR NOX BREAKDOWN

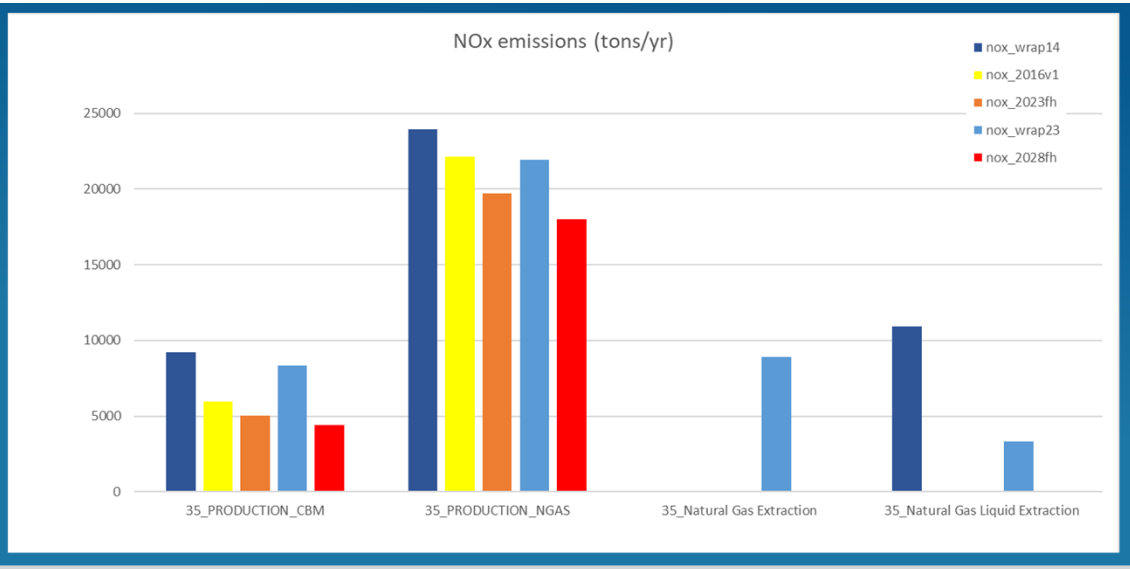
EIA NG production:
2014: 1,266,379 MMcf
2016: 1,282,666 MMcf
+2%

EIA oil production:
2014: 343 barrels/day
2016: 400 barrels/day
+16%



Pipeline Transportation of Natural Gas emissions much higher in WRAP2014
Majority of the NG Liquid Extraction plants are in the 2016v1 non-EGU inventory
What role do the basin-specific studies have in explaining differences?

NEW MEXICO NOX : PRODUCTION SUBSECTORS



stid	sect	stid_ndesc	nox_wrap14	nox_2016v1	nox_2023fh	nox_wrap23	nox_2028fh
35	nonpt	35_PRODUCTION_CBM	9216	5980	5042	8359	4414
35	nonpt	35_PRODUCTION_NGAS	23932	22149	19718	21937	18000
35	pt	35_Natural Gas Extraction			0	8923	0
35	pt	35_Natural Gas Liquid Extraction	10928	0	0	3305	0
To		Total	44077	28129	24759	42524	22414

stid	sect	stid_ndesc	nox_wrap14	nox_2016v1	nox_2023fh	nox_wrap23	nox_2028fh
35	nonpt	35_PRODUCTION_OIL	12504	3640	8600	17362	9456
35	pt	35_Crude Petroleum Extraction			0	3912	0
To		Total	12504	3640	8600	21274	9456

Some of these differences can be attributed to the new survey data (engines)
WRAP basin-specific studies will need to be examined for more information?
Future year projections for WRAP include adding new POINT sources

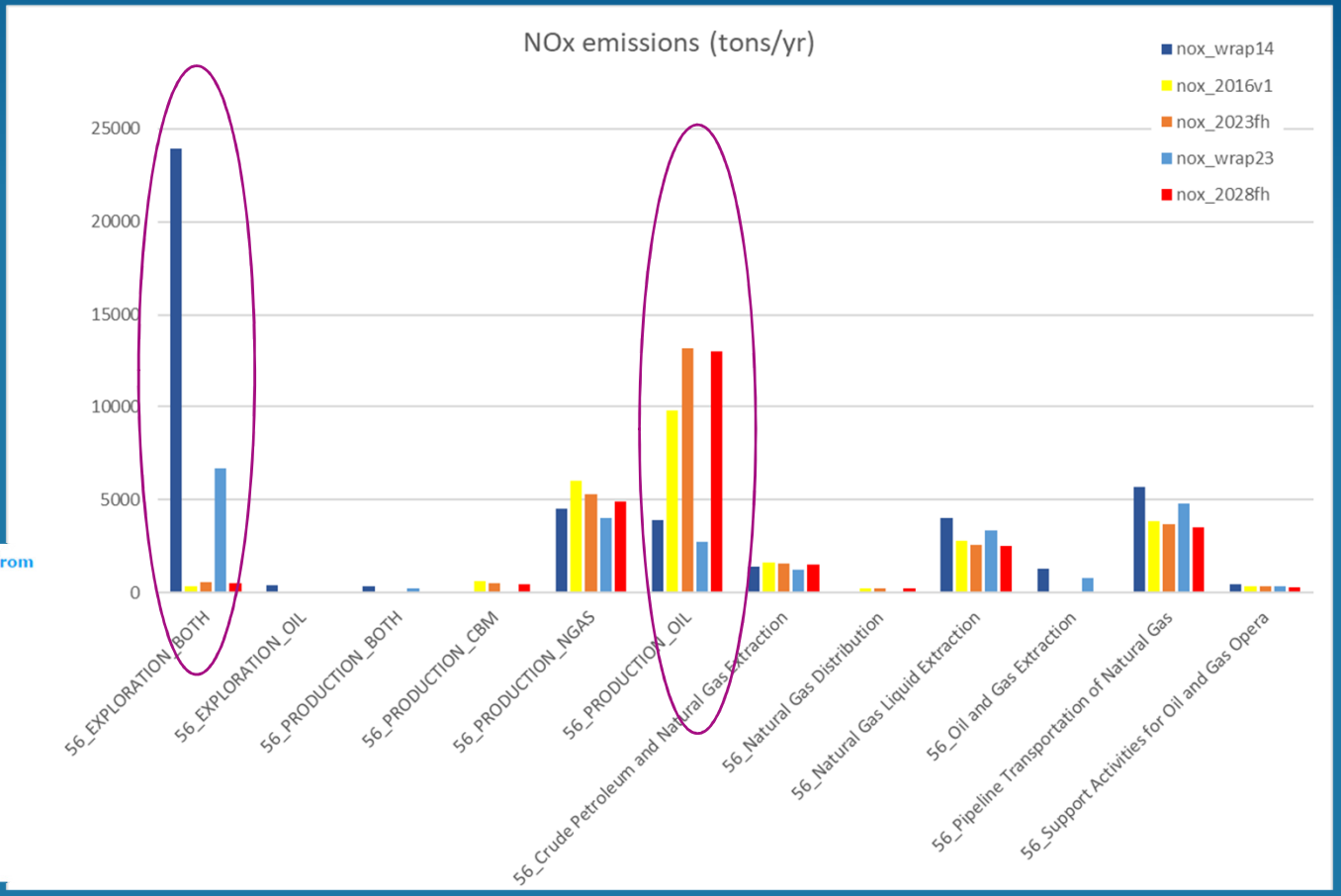
WYOMING: SUBSECTOR NOX BREAKDOWN

EIA NG production:
2014: 1998505 MMcf
2016: 1848623 MMcf
-7.5%

EIA oil production :
2014: 209 barrels/day
2016: 198 barrels/day
-5.2%

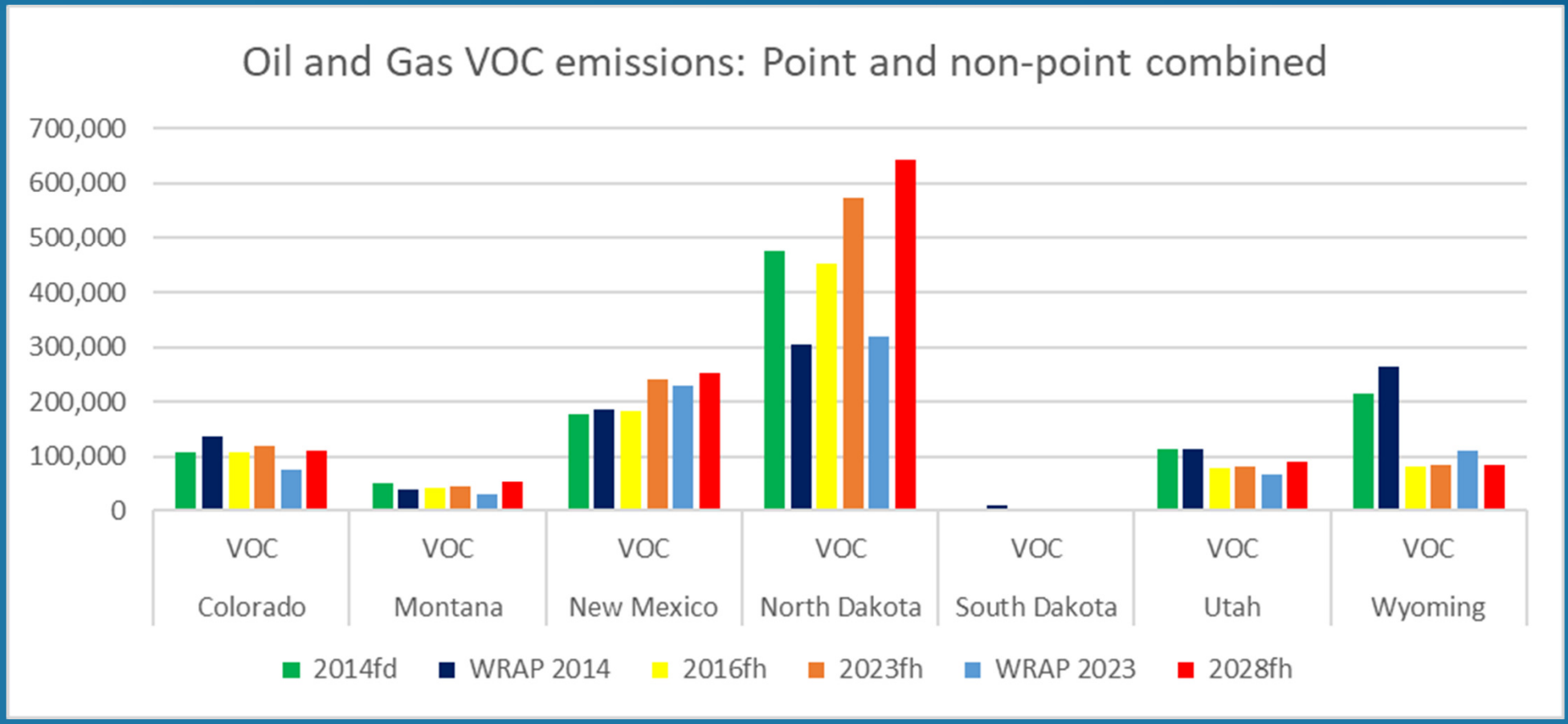
Table 2-12. NOx and VOC Emission Changes by Source Category Resulting from Integration of Operator Survey Data.

Basin	Emissions (tons/year)	
	NOx	VOC
Hydraulic Fracturing Engin	23,096	1,933
Artificial Lift Engines	13,977	3,186
Generator Engines	2,833	334
Nonpoint Compressor Eng	2,025	31
Drill Rigs	-17,812	-789
Oil Tanks	858	-326,939
Condensate Tanks	18	537
Total Change	**24,995**	**-321,708**
Percent Change	**8%**	**-24%**



Exploration activity higher in 2014
Oil Production diffs: WRAP basin-specific studies explain these differences?
Other reasons for differences?

STATE VOC EMISSIONS FOR BASE AND FUTURE CASES



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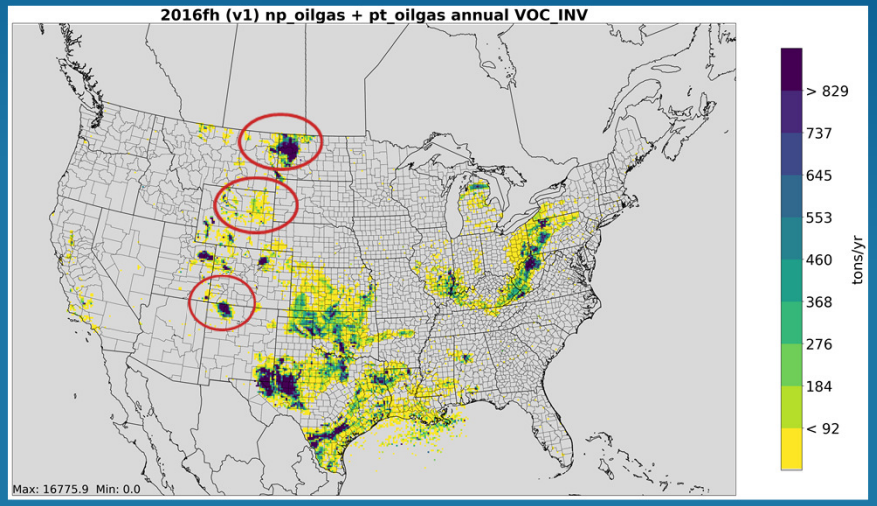
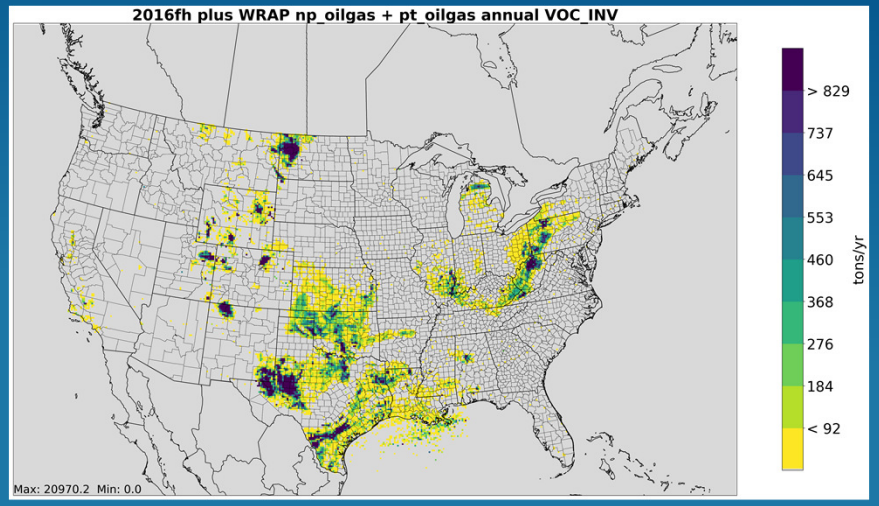
VOC
Point +
Nonpoint

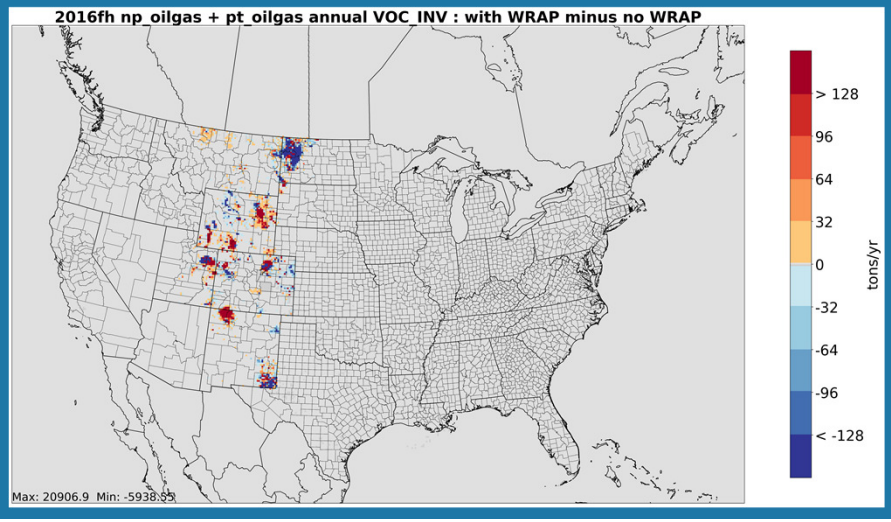
2016V1



2016V1 with WRAP2014



2016V1 with WRAP14 – 2016v1



FURTHER EXAMINATION OF VOC DIFFERENCES

- WRAP 7-state total 1.05M tons vs 0.95M tons in 2016v1
  - Year 2023: WRAP = 0.84M, 2023fh = 1.15M tons, 2028fh= 1.23M
- North Dakota (150k tons less in WRAP vs 2016v1)
  - 6-7 Counties in Williston Basin
  - 2016v1 Oil Tanks flashing etc = 281K tons, WRAP = 10K
  - WRAP2014 Oil Production all processes SCC = 203K tons, 2016v1 = 94K tons
- Wyoming (180k tons more in WRAP vs 2016v1)
  - About 4 counties with most differences
  - Huge amount of VOC emissions in WY: oil well completion venting
- EXPLORATION all 7 states: WRAP2014= 387K tons; 2016v1=26K tons

NORTH DAKOTA: SUBSECTOR VOC BREAKDOWN

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2014: 1,081 barrels/day
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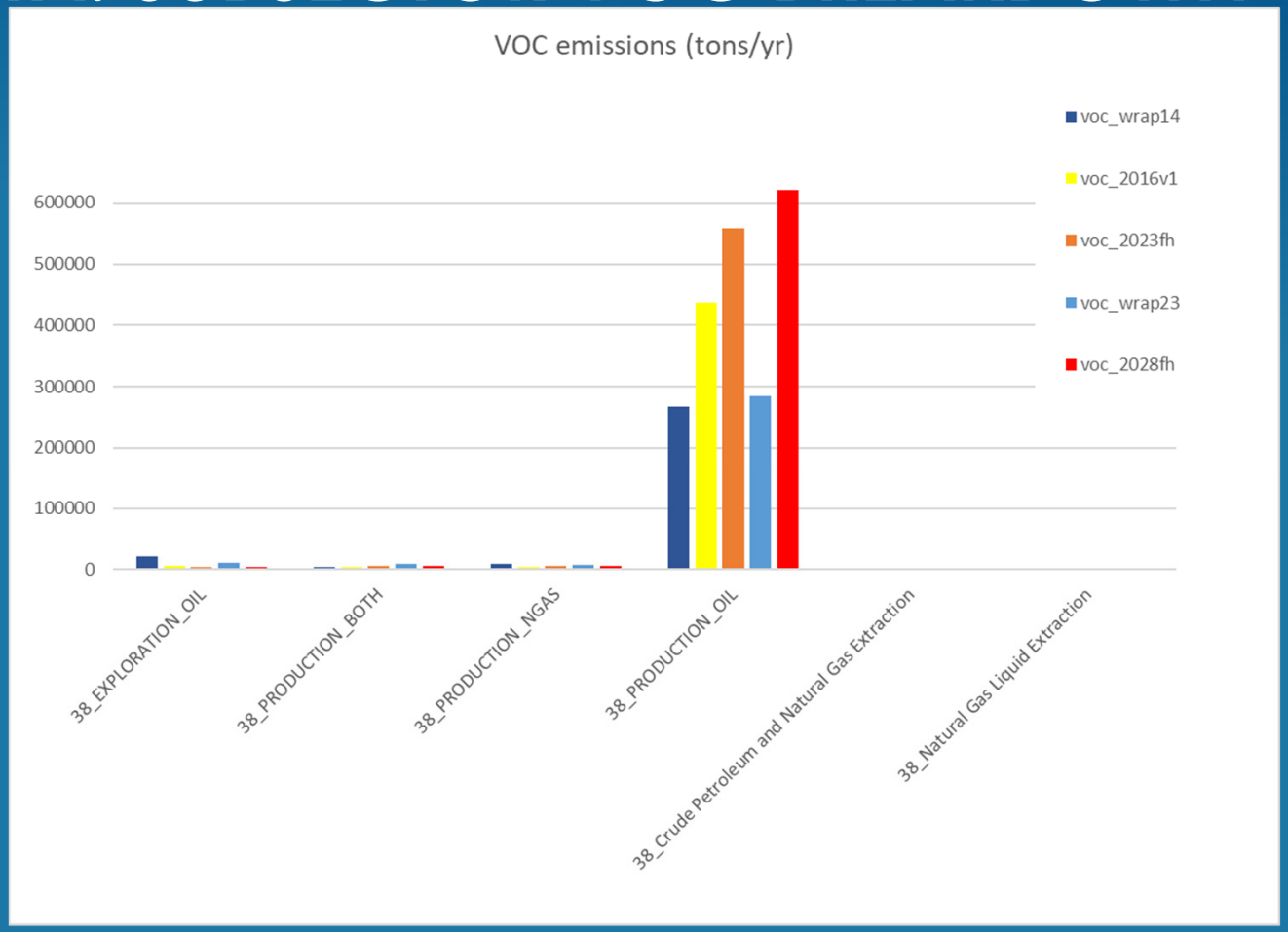

WRAP's survey changes for Williston Basin reducing VOC emissions
Majority attributed to Oil Tanks source category ("higher emission control prevalence")

WYOMING: SUBSECTOR VOC BREAKDOWN

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2016: 1,848,623 MMcf
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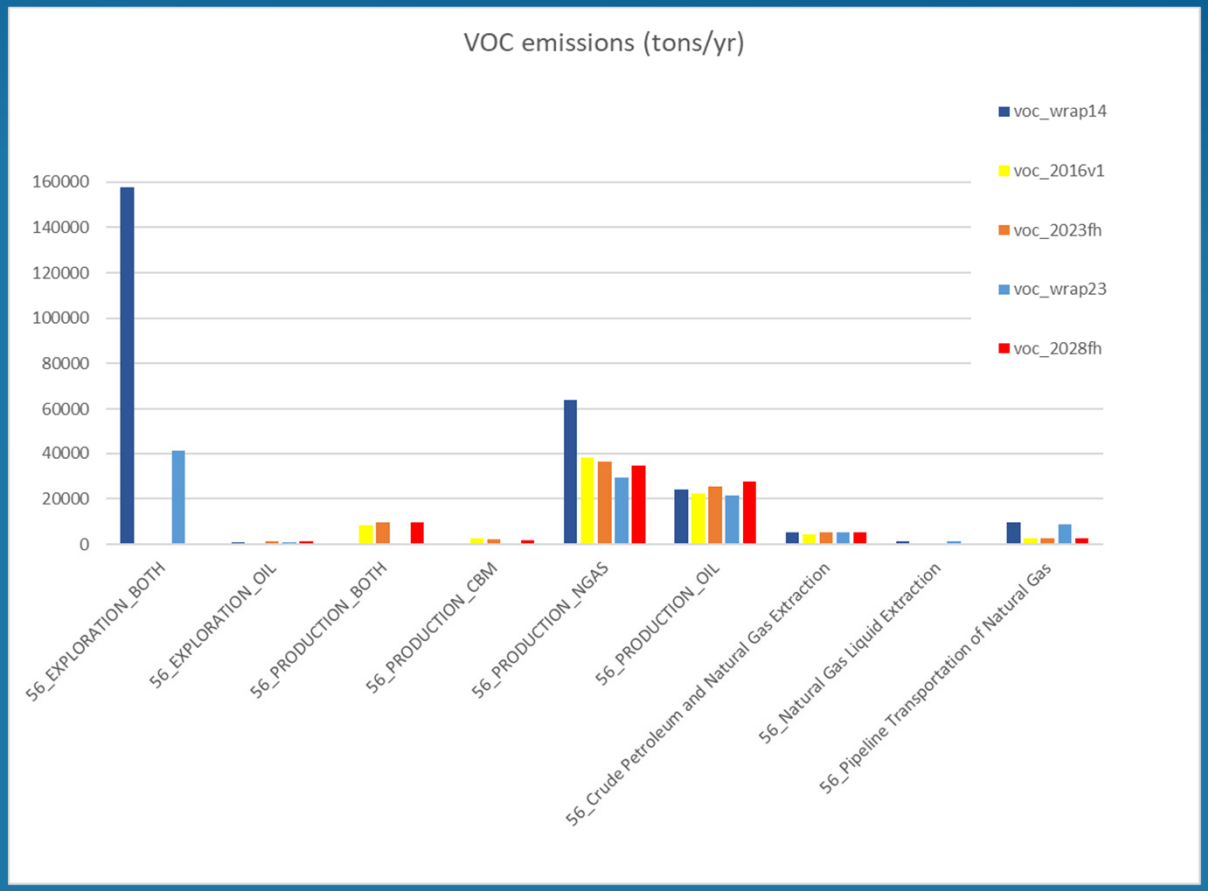
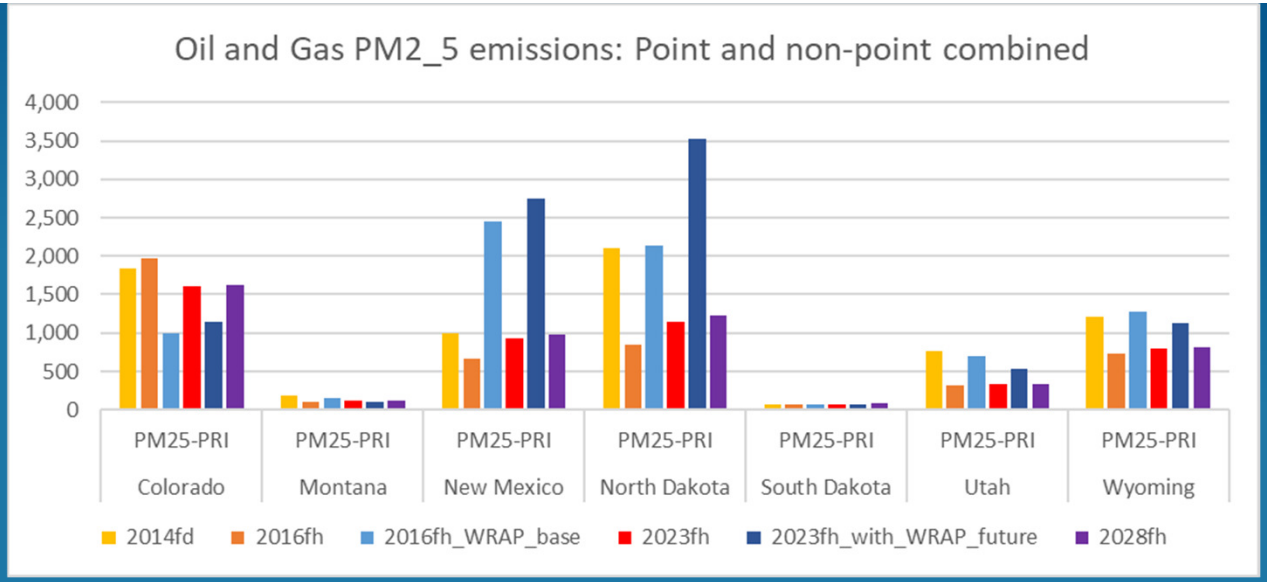


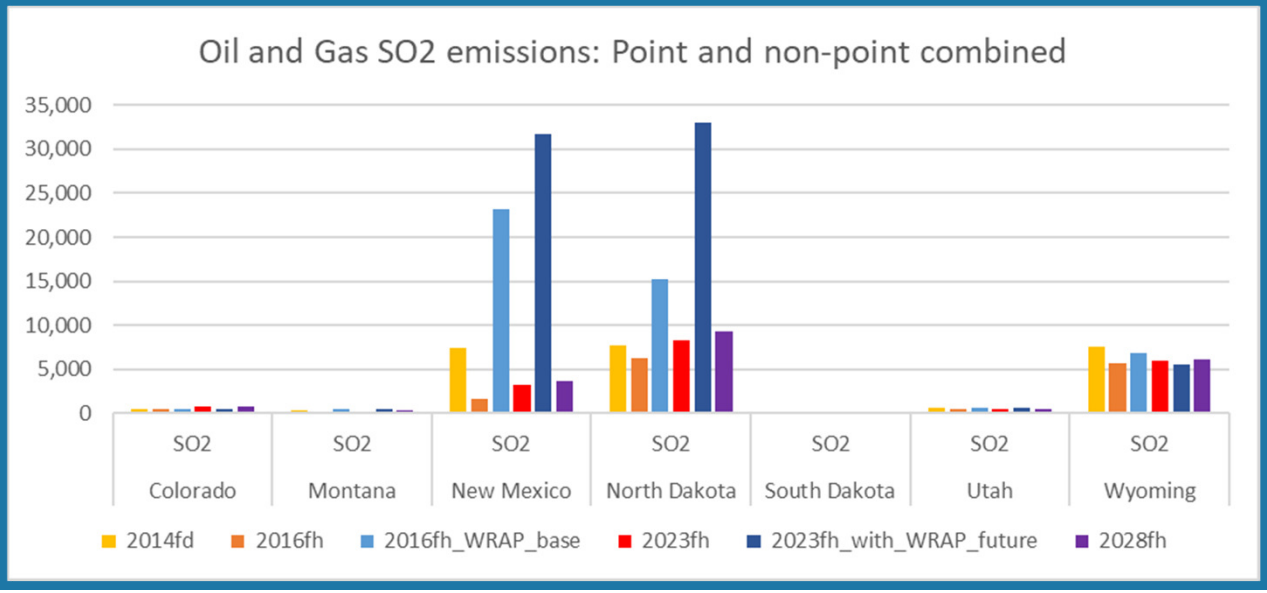
Oil well completion venting the main source of Exploration differences in 2014
Some decrease in NG production from 2014 to 2016
Why completion venting so high in WY in base AND future year?

SUMMARY

- Differences between WRAP2014 and 2016v1 can mainly be attributed to
  - 2014 vs 2016 activity
  - New survey information
  - Post-NEI2014 basin-specific studies
- WRAP2014: +100K tons in NOX and VOC vs. 2016v1
- WRAP2023: +75K tons in NOX and -300K tons of VOC vs 2023fh
- New Mexico Point sources
  - Pipeline transportation differences needs more explanation
  - Majority of the NG Liquid Extraction WRAP emissions are in 2016v1 ptnonipm (non-EGU)
- WRAP inventories have been processed through SMOKE for base and future year
  - Data packages prepared to provide the WRAP data as an option for 2016v1 platform

EXTRA SLIDES


Oil and Gas PM2_5 emissions: Point and non-point combined
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
PM25-PRI Colorado
PM25-PRI Montana
PM25-PRI New Mexico
PM25-PRI North Dakota
PM25-PRI South Dakota
PM25-PRI Utah
PM25-PRI Wyoming
2014fd
2016fh
2016fh_WRAP_base
2023fh
2023fh_with_WRAP_future
2028fh


Oil and Gas SO2 emissions: Point and non-point combined
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
SO2 Colorado
SO2 Montana
SO2 New Mexico
SO2 North Dakota
SO2 South Dakota
SO2 Utah
SO2 Wyoming
2014fd
2016fh
2016fh_WRAP_base
2023fh
2023fh_with_WRAP_future
2028fh

NEW MEXICO: SUBSECTOR BREAKDOWN

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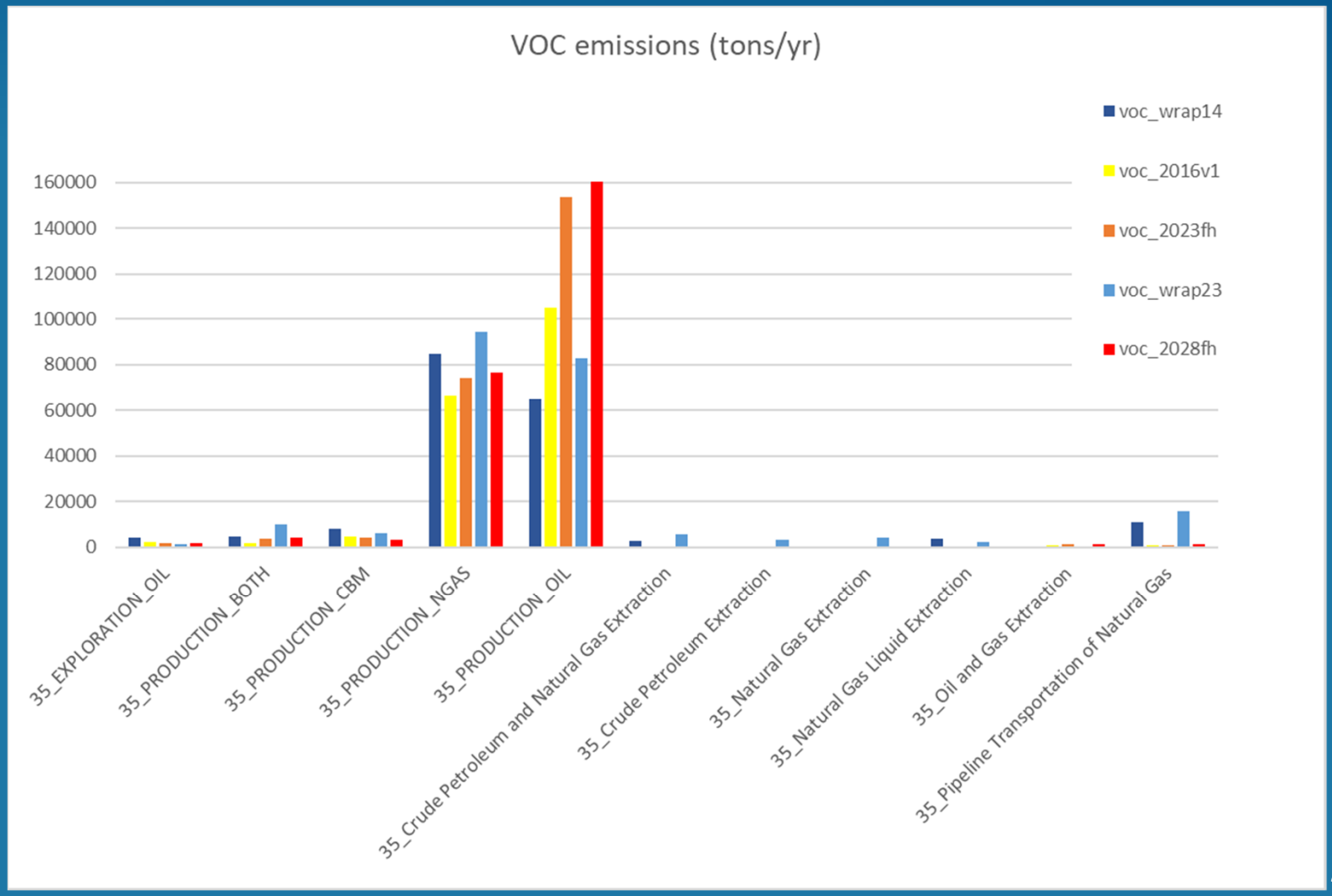
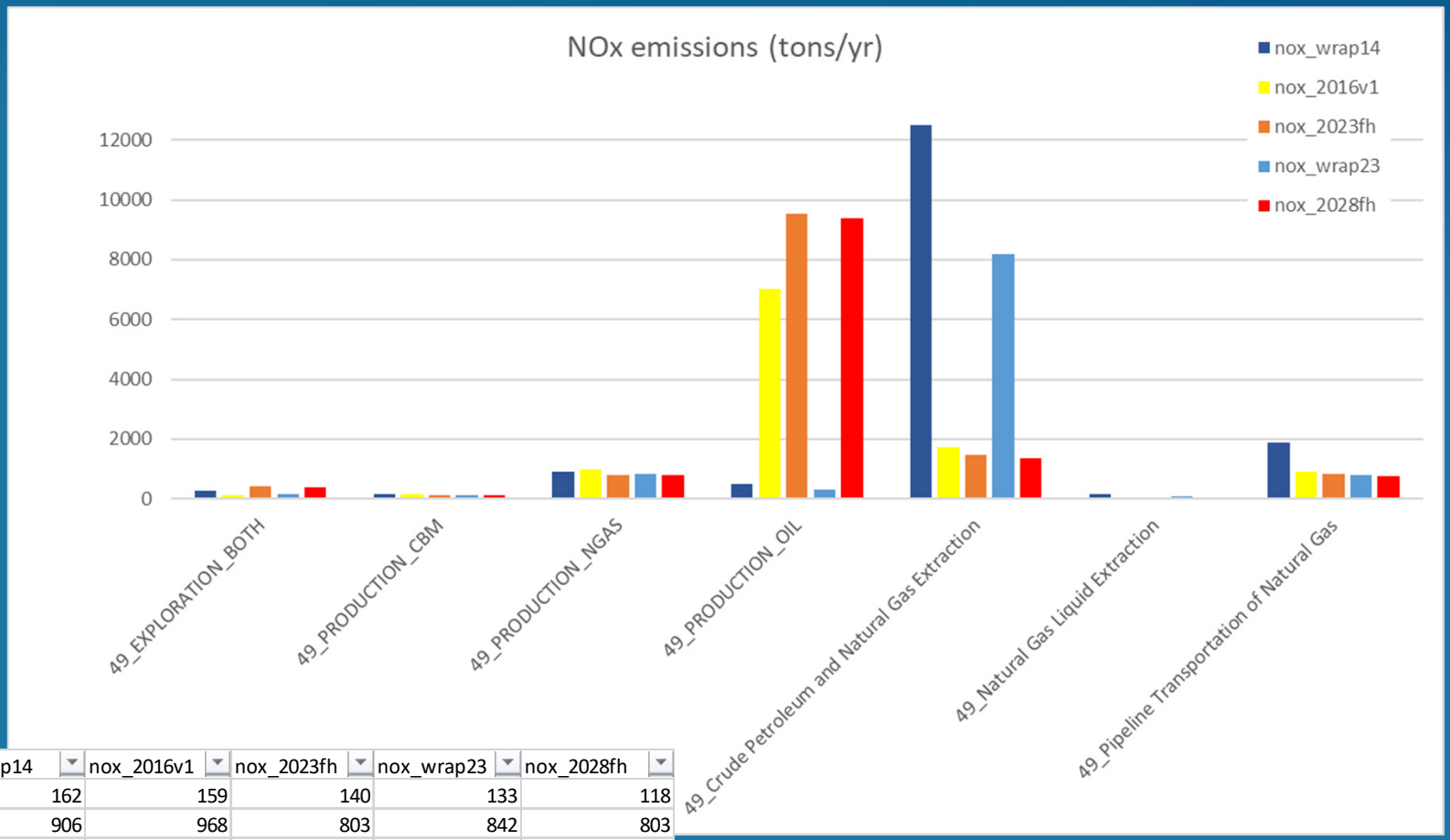


UTAH: SUBSECTOR BREAKDOWN

EIA NG production
2014: 454545 MMcf
2016: 365268 MMcf
-20%

EIA oil production:
2014: 112 barrels/day
2016: 83 barrels/day
-25%

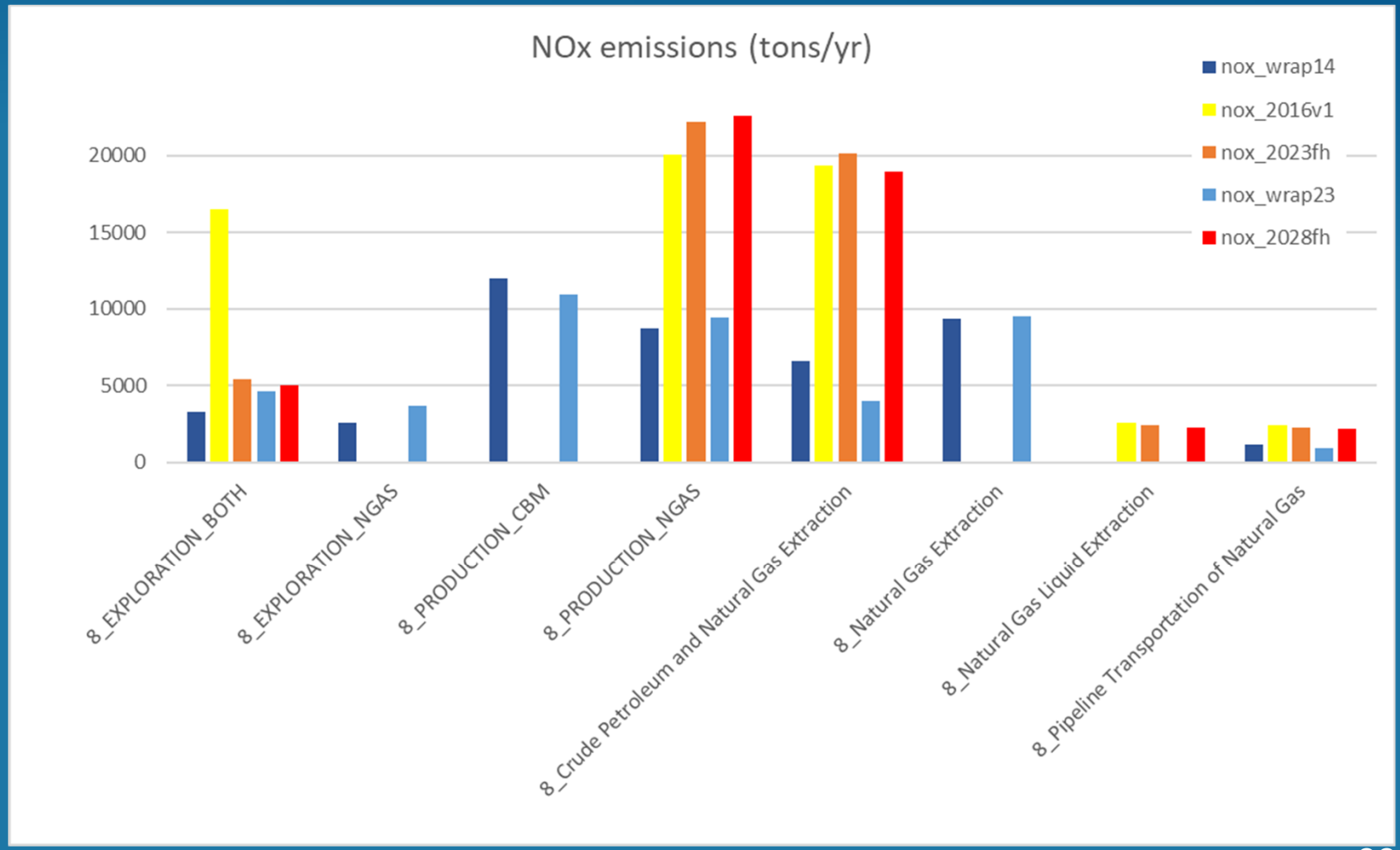


stid_ndesc	nox_wrap14	nox_2016v1	nox_2023fh	nox_wrap23	nox_2028fh
49_PRODUCTION_CBM	162	159	140	133	118
49_PRODUCTION_NGAS	906	968	803	842	803
49_PRODUCTION_OIL	484	7033	9527	320	9402
49_Crude Petroleum and Natural Gas Extrac	12491	1725	1463	8202	1360
Total	14043	9885	11932	9497	11682

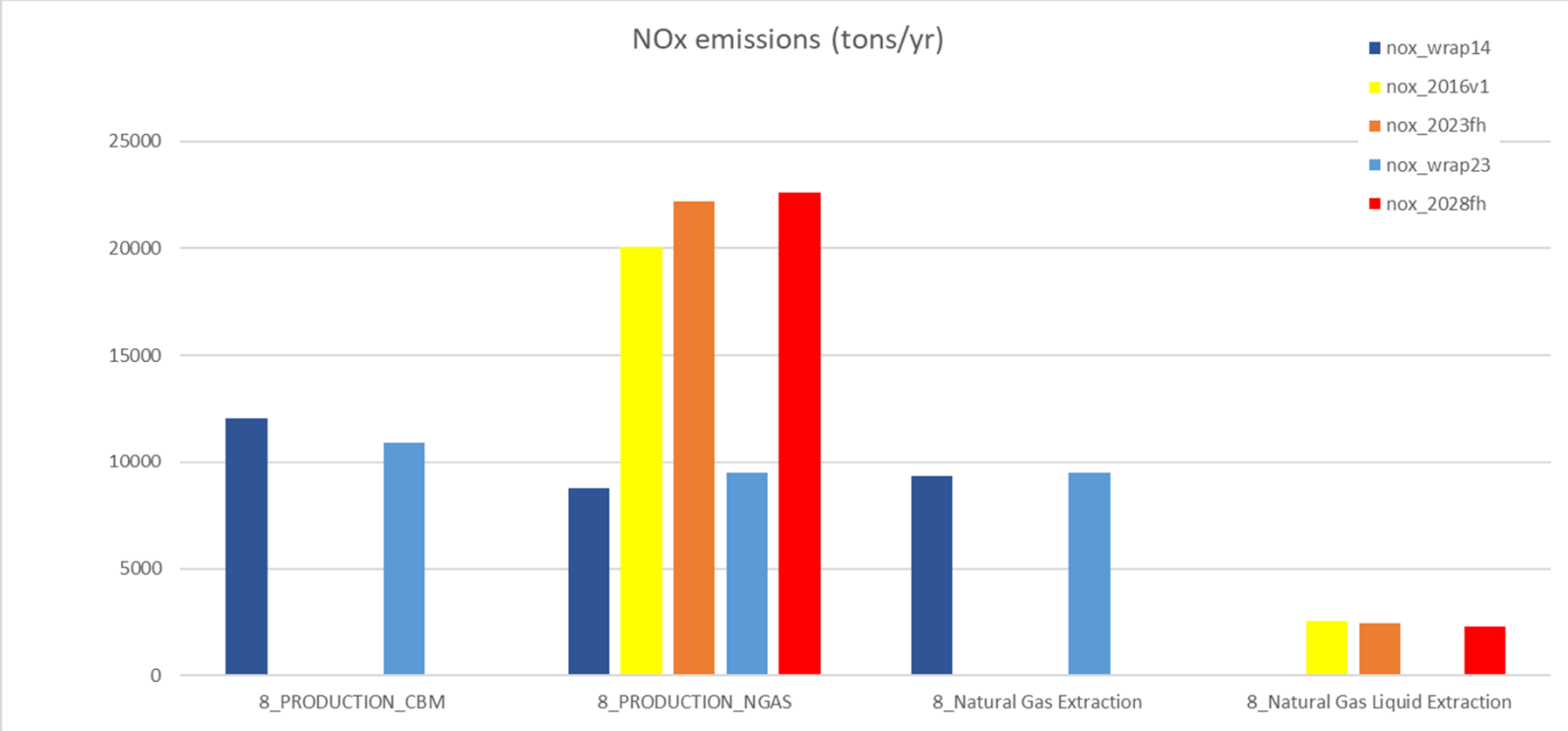
COLORADO: SUBSECTOR BREAKDOWN

EIA NG production:
2014: 1643487 MMcf
2016: 1688375 MMcf
+3%

EIA oil production:
2014: 262 barrels/day
2016: 318 barrels/day
+21%



COLORADO: SUBSECTOR GAS BREAKDOWN

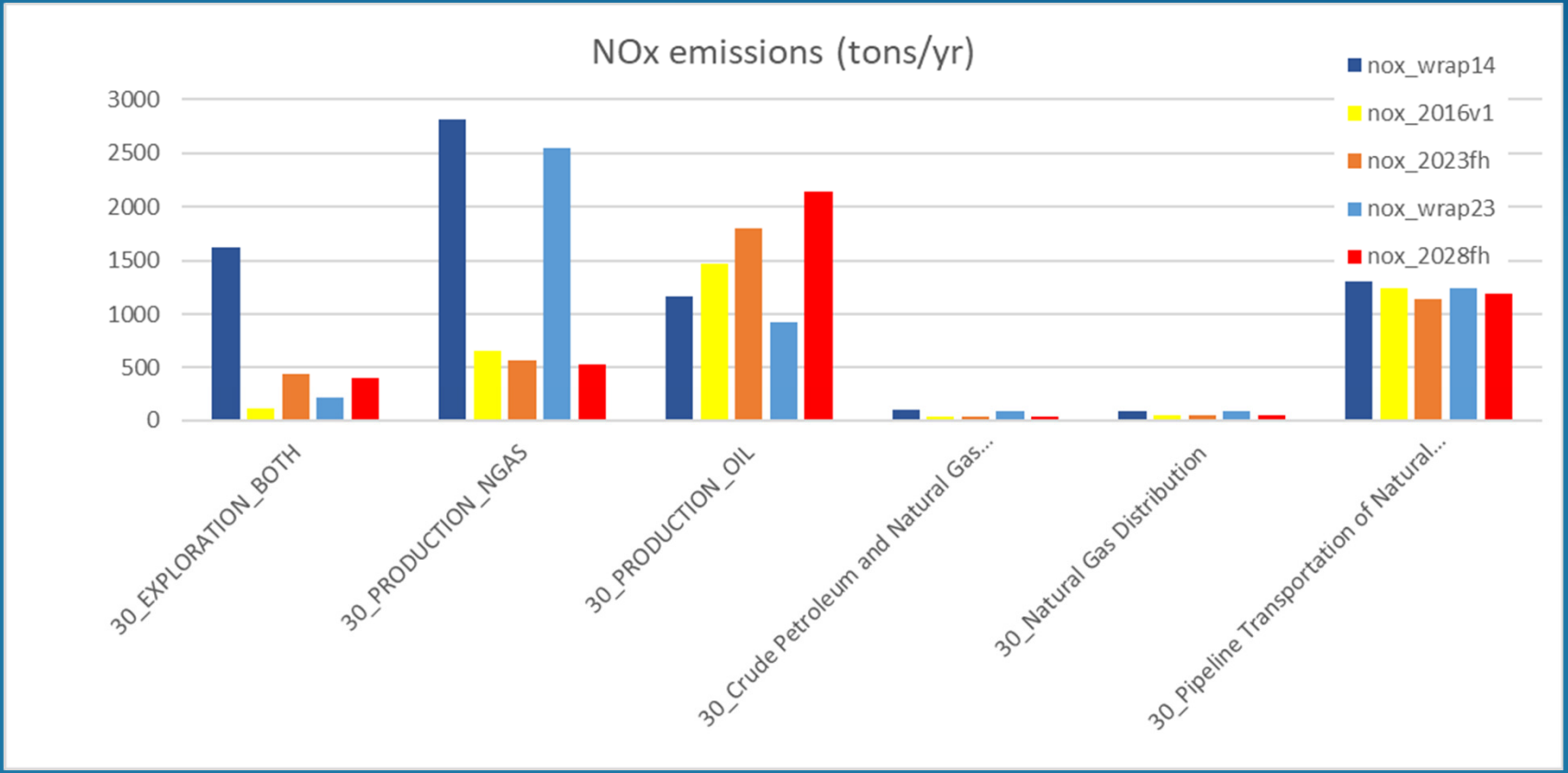


stid_ndesc	nox_wrap14	nox_2016v1	nox_2023fh	nox_wrap23	nox_2028fh
8_PRODUCTION_CBM	12042	0	0	10921	0
8_PRODUCTION_NGAS	8732	20075	22163	9468	22603
8_Natural Gas Extraction	9325	0	0	9488	0
8_Natural Gas Liquid Extraction	0	2557	2434	61	2312
Total	30099	22632	24597	29937	24915

MONTANA: SUBSECTOR BREAKDOWN

EIA NG production:
2014: 59160 MMcf
2016: 52146 MMcf
-14%

EIA oil production:
2014: 82 barrels/day
2016: 63 barrels/day
-23%



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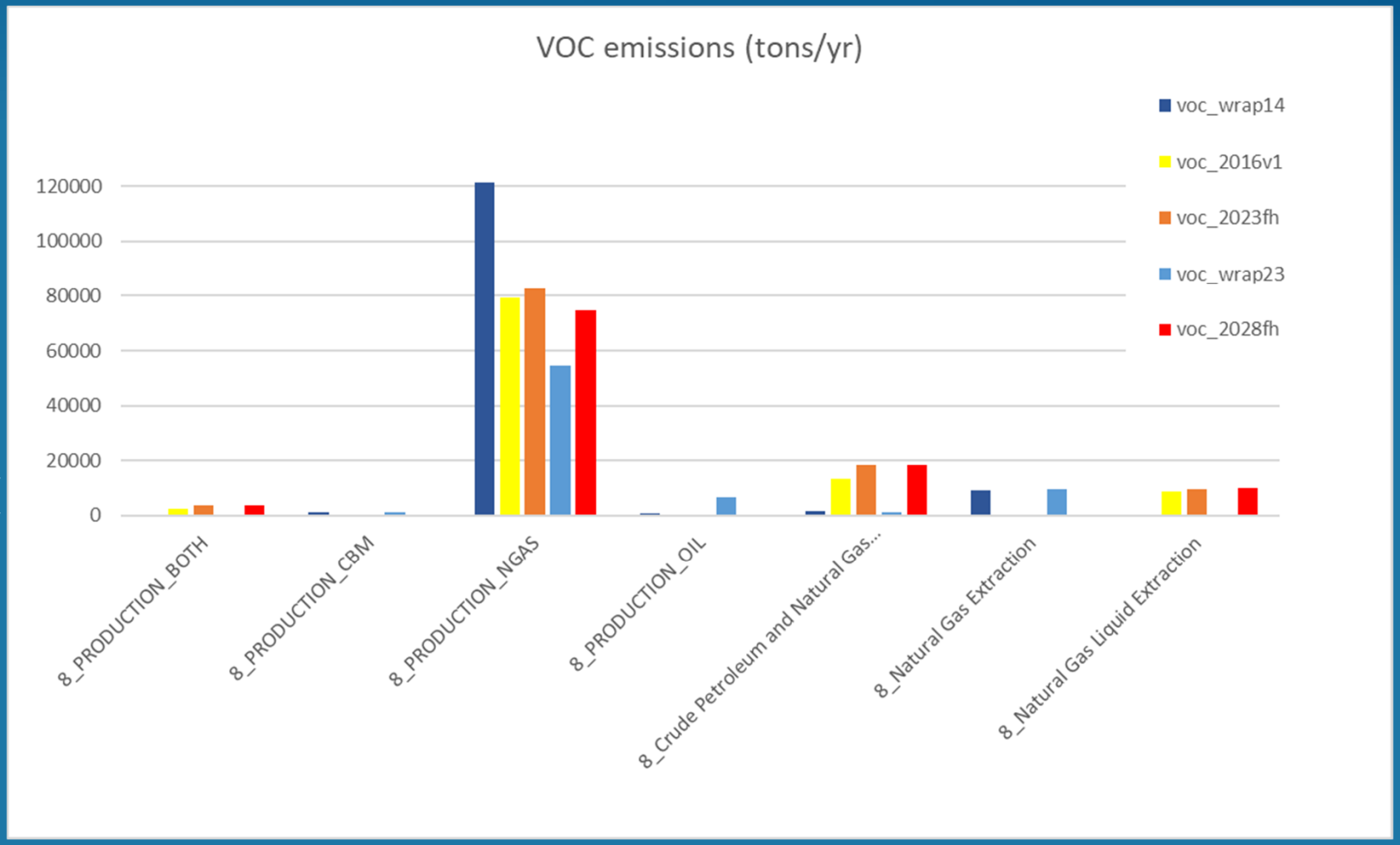

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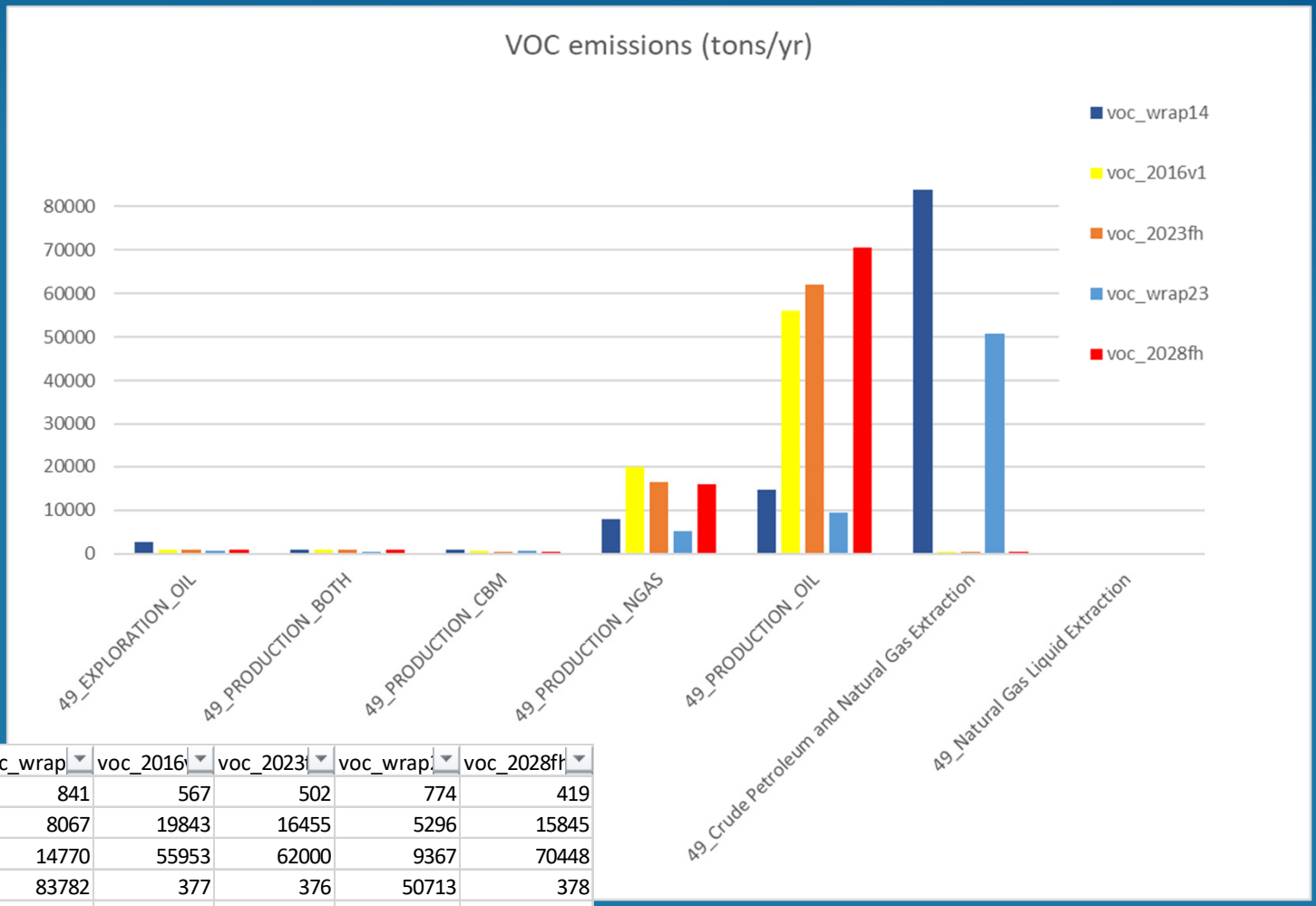
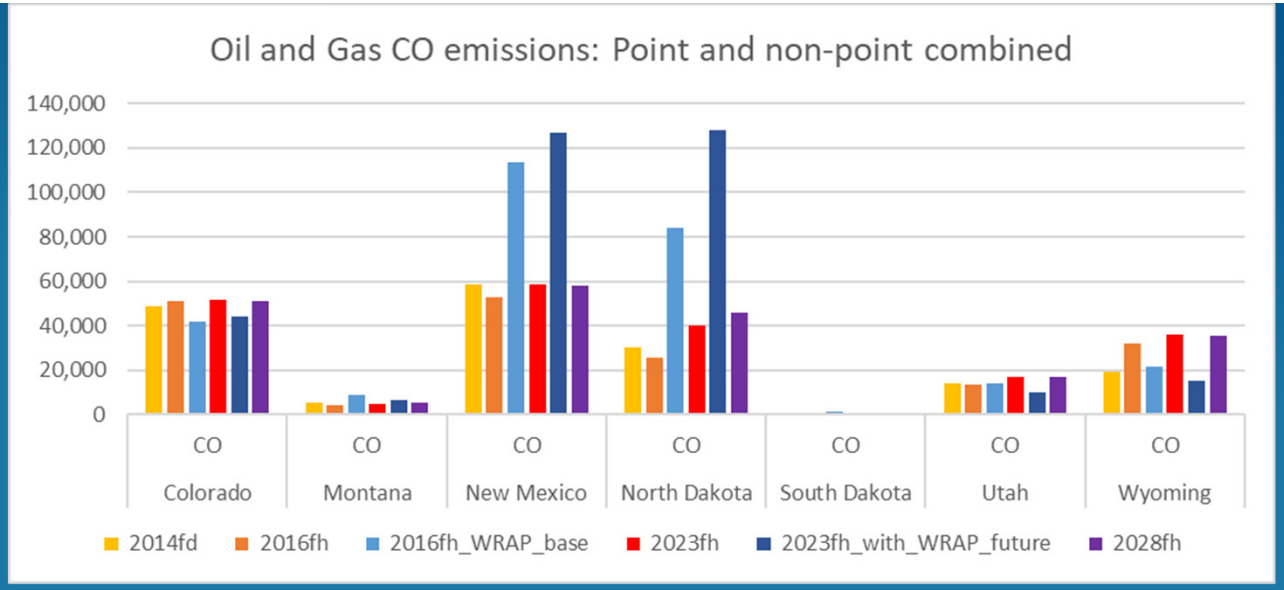
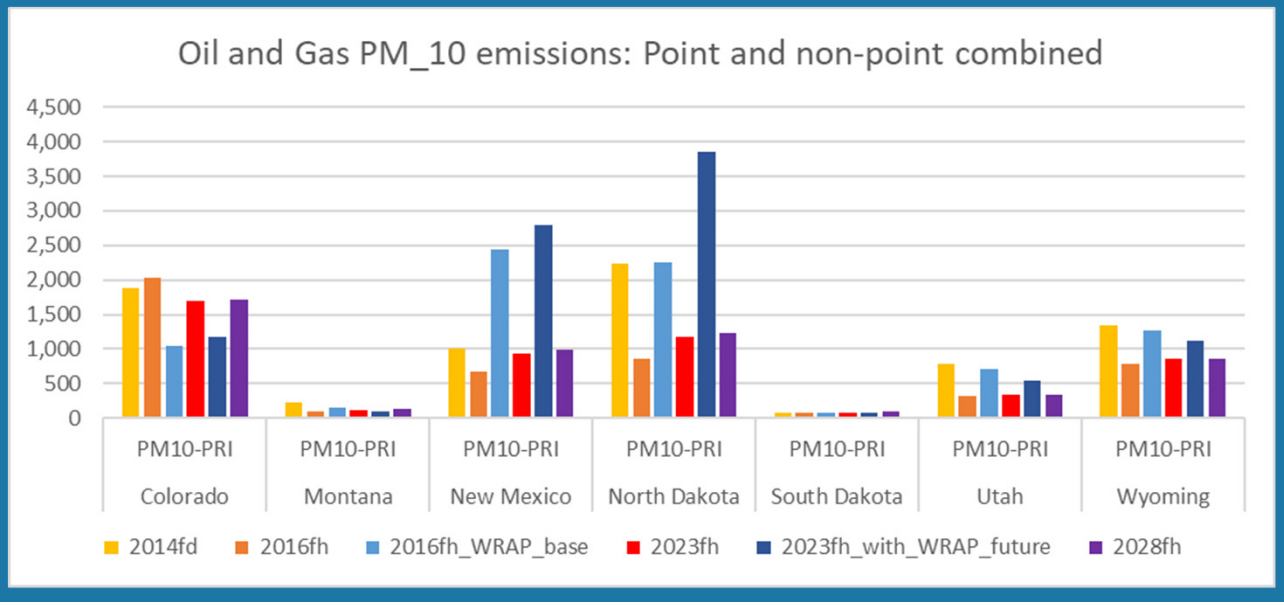


stid_ndesc	voc_wrap	voc_2016	voc_2023	voc_wrap	voc_2028fh
49_PRODUCTION_CBM	841	567	502	774	419
49_PRODUCTION_NGAS	8067	19843	16455	5296	15845
49_PRODUCTION_OIL	14770	55953	62000	9367	70448
49_Crude Petroleum and Natural Gas Extrac	83782	377	376	50713	378
Total	107460	76740	79333	66151	87091


Oil and Gas CO emissions: Point and non-point combined
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
CO
Colorado
CO
Montana
CO
New Mexico
CO
North Dakota
CO
South Dakota
CO
Utah
CO
Wyoming
2014fd
2016fh
2016fh_WRAP_base
2023fh
2023fh_with_WRAP_future
2028fh


Oil and Gas PM_10 emissions: Point and non-point combined
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
PM10-PRI
Colorado
PM10-PRI
Montana
PM10-PRI
New Mexico
PM10-PRI
North Dakota
PM10-PRI
South Dakota
PM10-PRI
Utah
PM10-PRI
Wyoming
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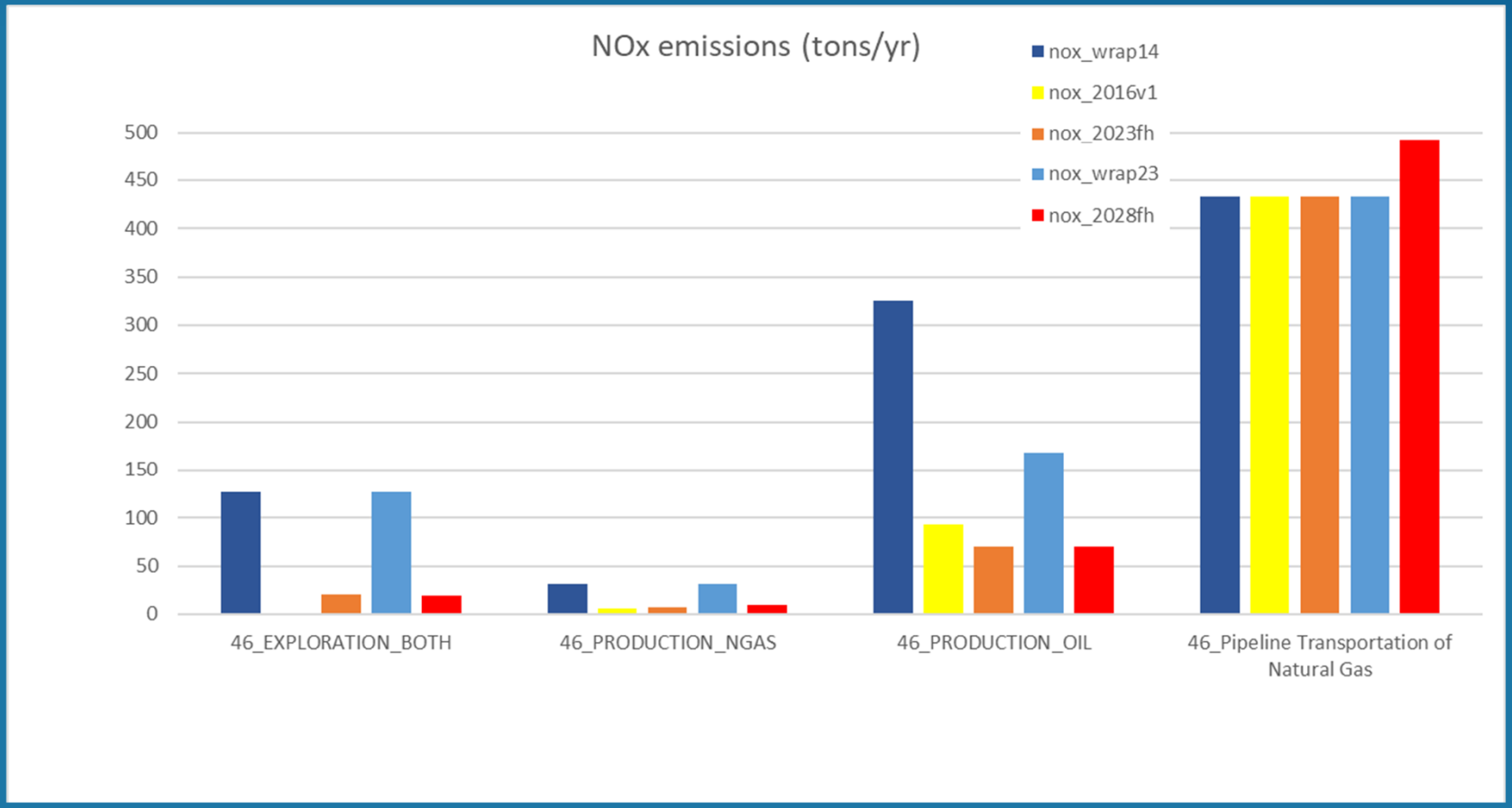
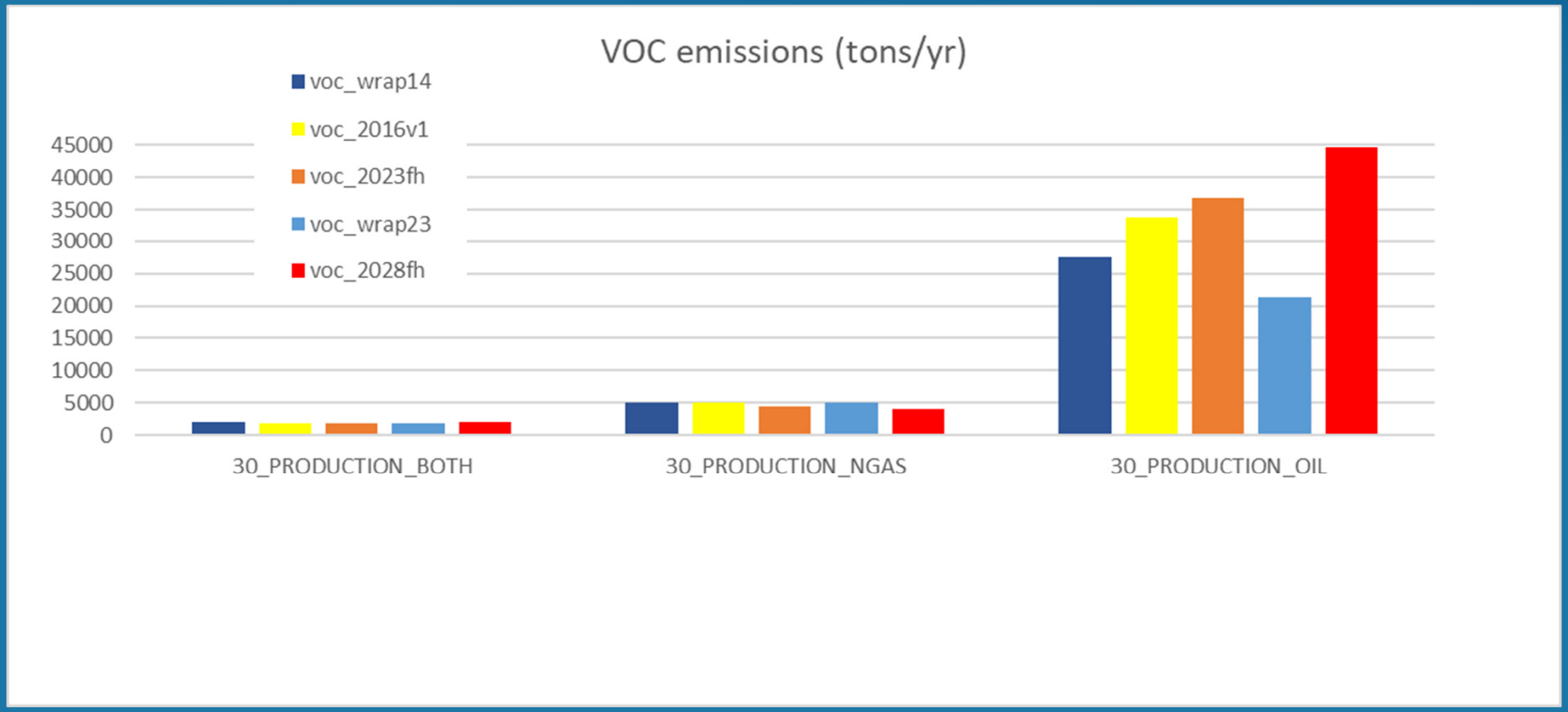
2016fh_WRAP_base
2023fh
2023fh_with_WRAP_future
2028fh

SOUTH DAKOTA: SUBSECTOR BREAKDOWN



MONTANA: SUBSECTOR BREAKDOWN



SOUTH DAKOTA: SUBSECTOR BREAKDOWN