

September 13, 2017

MEMORANDUM

To: Tom Moore, WESTAR-WRAP
From: John Grant, Rajashi Parikh, Amnon Bar-Ilan
Subject: Greater San Juan and Permian Basin Future Year Emission Inventory Forecasts

As part of the Greater San Juan and Permian Basin¹ emission inventory project², Ramboll Environ will develop future year emission inventories for each basin. This memorandum outlines the methodology by which Ramboll Environ will develop the future year emission inventories.

Overview

Ramboll Environ will develop future year emissions by applying scalars to the base year inventory. Consistent with previous WESTAR-WRAP oil and gas (O&G) studies (e.g. Williston and Great Plains³) two sets of scalars will be applied to the base year emissions inventory: (1) scalars to account for changes in O&G activity from the base to future year and (2) scalars to account for changes in emissions control from the base to future year.

Future Year

The future year inventory will be developed for calendar year 2028. Ramboll Environ will develop O&G activity forecasts to 2023 and extend 2023 trends to 2028. Control factors will be developed for application to the 2028 future year inventory.

O&G Activity Change Scalars

Ramboll Environ will apply O&G activity scalars at the well type and SCC-level by basin or sub-basin level, consistent with past WESTAR-WRAP inventory studies.

For the Greater San Juan Basin, O&G activity change scalars will be developed based on O&G activity forecasts from the US Bureau of Land Management (BLM) study, Colorado Air Resource Management Modeling Study 2.0 (CARMMS)⁴. CARMMS includes O&G activity forecasts for low and high development scenarios for the following areas that are included in the Greater San Juan Basin:

- Mancos Shale
- Southern Ute Indian Tribe (SUIT) Shale Supplemental Environmental Impact Study (SEIS)
- Tres Rios Field Office (TRFO)

¹ Permian Basin emission inventory development in this study is limited to the portion of the Permian Basin in New Mexico.

² <https://www.wrapair2.org/SanJuanPermian.aspx>

³ <https://www.wrapair2.org/ND-SD-MT.aspx>

⁴ Not yet published

- Farmington Field Office (FFO)

In consultation with the WESTAR-WRAP project manager Ramboll Environ will determine whether to base the future year forecasts on the low or high scenario. Figure 1 shows the TRFO, FFO, and SUIT areas in southwest Colorado and northwest New Mexico; the Mancos Shale (not shown) intersects the TRFO and FFO areas.

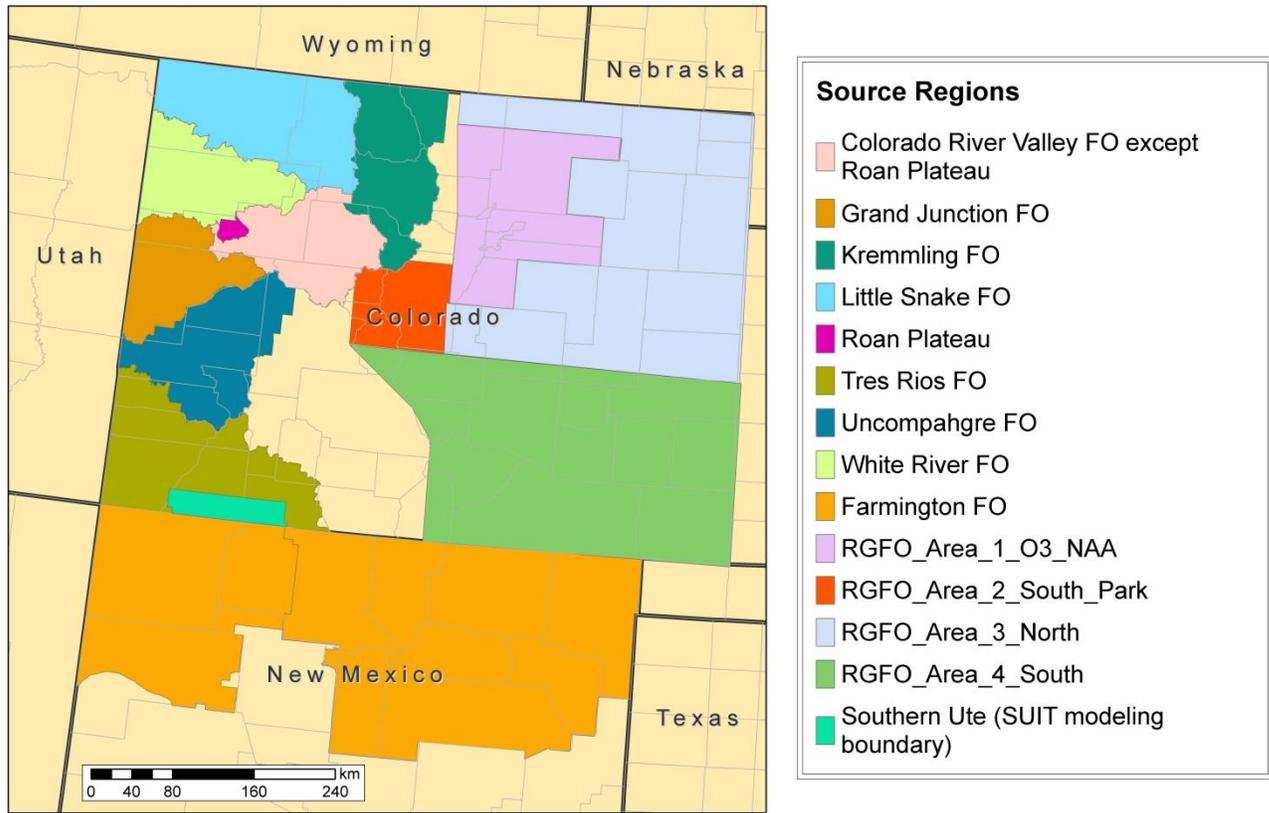


Figure 1. Colorado Field Office Planning Areas⁵.

Table 1 shows CARMMS O&G activity forecasts for the Mancos Shale, SUIT, and TRFO; CARMMS assumed no increase in O&G activity in the FFO outside of the Mancos Shale. Table 1 forecasts are aggregate over all well types, but the CARMMS study includes forecasts at the well type (i.e. oil, gas, and coalbed methane) level. Forecasts can also be distinguished by mineral designation (i.e. federal and non-federal). Mancos Shale and SUIT SEIS O&G developments are estimated to come online after the base year; these developments each have their own inventory based on the type of equipment expected to be used at these unconventional wells. Ramboll Environ recommends adding

⁵ Source: CARMMS report, not yet published

emissions from these inventories directly into the future year inventory rather than incorporating O&G activity from these developments into O&G activity scalars.

Table 1. CARMMS O&G activity forecasts for 2015, 2023, and 2025⁶.

Area	Year	Spud Count	Active Well Count	Gas Production (BCF/yr)	Oil Production (Mbbl/yr)
Low Scenario					
Mancos Shale	2015	0	0	0	0
	2023	173	1166	245	21114
	2025	173	1513	283	23950
SUIT (SEIS)	2015	0	0	0	0
	2023	20	104	49	94
	2025	48	200	102	211
TRFO	2015	68	3498	339	135
	2023	33	3831	260	66
	2025	33	3897	247	59
High Scenario					
Mancos Shale	2015	0	0	0	0
	2023	347	2333	489	42228
	2025	347	3026	566	47901
SUIT (SEIS)	2015	0	0	0	0
	2023	40	208	99	187
	2025	96	400	204	423
TRFO	2015	68	3498	339	135
	2023	82	4224	323	79
	2025	82	4389	322	72

For the Permian Basin, O&G activity change scalars will be developed based on US Energy Information Association (EIA) Annual Energy Outlook (AEO) forecasts. EIA publishes activity forecasts by oil and gas supply model region (Figure 2). Ramboll Environ has obtained shale play-level forecasts from EIA which include the Avalon/Bone Springs and Wolfcamp shale plays which are in the portion of the Permian Basin in New Mexico⁷ (Figure 3).

⁶ O&G Activity estimates for CARMMS developed by BLM staff

⁷ Email from John Staub (EIA), June 28, 2017

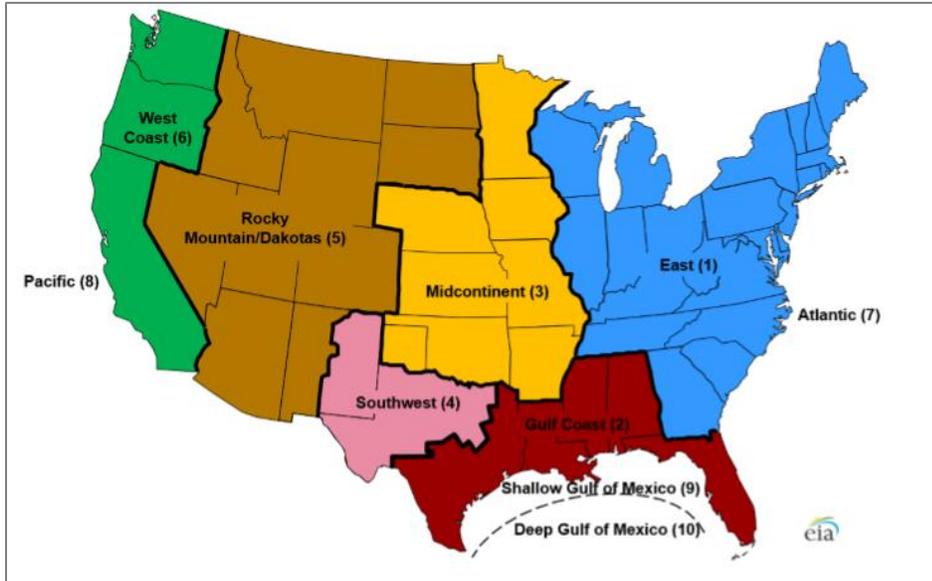


Figure 2. EIA Oil and Gas Supply Module Regions⁸.

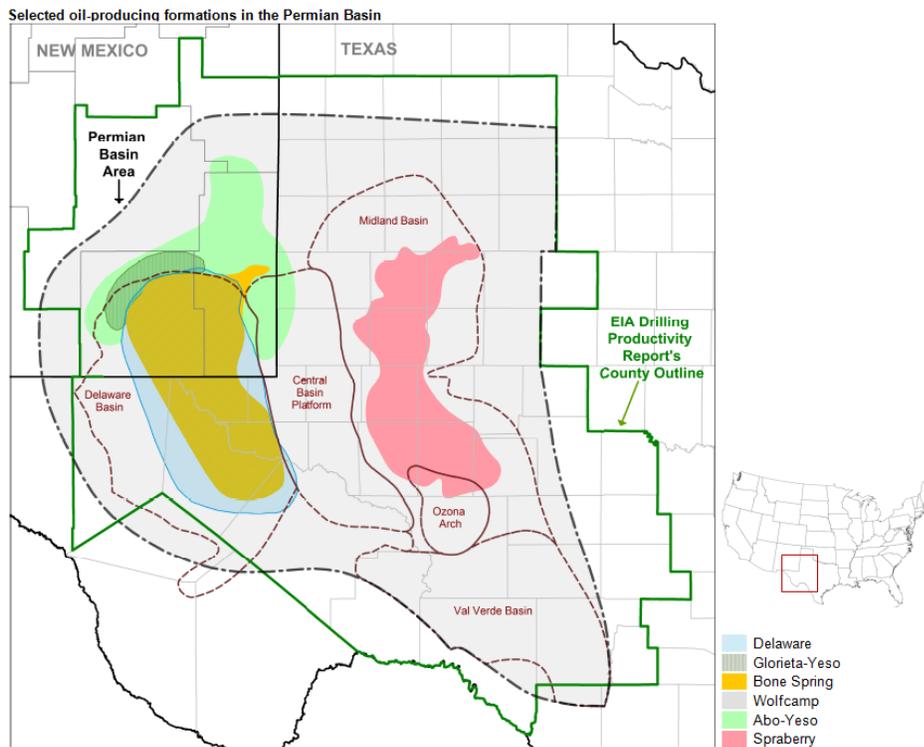


Figure 3. Permian Basin oil plays⁹ (note: Permian Basin forecasts will be developed for New Mexico only, Texas is not part of this study).

⁸ Source: EIA (2017), "Assumptions to the Annual Energy Outlook 2017", (Figure 9.1), available online at <https://www.eia.gov/outlooks/aeo/assumptions/>

⁹ <https://www.eia.gov/todayinenergy/detail.php?id=17031>

Table 2 shows EIA forecasts applicable to the Permian Basin. Ramboll Environ has learned from EIA staff that information released by EIA as part of the AEO is limited to shale play data provided by email to Ramboll Environ⁷ and the Oil and Gas Supply Module region-level data available online. EIA does not release more detailed information because of uncertainty in forecasts for smaller formations. Ramboll Environ will develop NM-specific forecasts for the Permian Basin to the extent feasible based on the limited information available from the EIA.

Table 2. 2017 AEO O&G production estimates for 2014 and forecasts to 2023 and 2028⁷.

Region / Tight Oil Play (states)	Oil Production (million barrels per day)			Gas Production (trillion cubic feet per year)		
	2014	2023	2028	2014	2023	2028
Southwest Region-wide						
Southwest (NM & TX)	1.74	2.68	2.69	3.56	2.89	3.15
Tight Oil Plays in the Permian Basin (New Mexico)						
Avalon/Bone Springs (NM & TX)	0.19	0.44	0.34	not available		
Wolfcamp (NM & TX)	0.20	0.68	0.73			
Spraberry (TX)	0.47	0.91	0.98			
Other (several states ^A)	0.65	0.46	0.54			

^A Includes tight oil plays in the Permian and other US O&G Basins which are not available by play (e.g. Delaware and “Glorieta and Yeso” tight oil plays). EIA does not release more detailed information because of uncertainty in forecasts for smaller formations.

Emissions Control Scalars

Ramboll Environ will develop O&G control scalars at the SCC-level, consistent with past WESTAR-WRAP inventory studies. Control scalars will be estimated in accordance with regulatory jurisdiction; for example, Colorado Department of Public Health and Environment [CDPHE] rules will only be applied to O&G emission sources in Colorado which are not on tribal lands.

Emission control factors will be developed to explicitly account from emission changes resulting from state, federal, and/or tribal regulations. Table 3 lists federal and state regulations applicable to O&G emissions and identifies regulations for which control scalars will and will not be developed; only regulations that are expected to have substantial impact on O&G criteria pollutant emission will be estimated. Since the status of NSPS Subpart OOOOa is uncertain at this time, two sets of control factors will be developed, one with and one without Subpart OOOOa.

Unless the New Mexico Environment Department (NMED) or SUIT Environmental Programs Division staff provide information on additional state or tribe specific regulations that should be accounted for in their respective jurisdictions, no additional state or tribe specific regulations will be considered for O&G activity in New Mexico or on SUIT land.

Table 3. Control scalar development status by regulation.

Regulations for which Control Scalars <u>WILL</u> be developed	Regulations for which Control Scalars <u>WILL NOT</u> be developed
Federal Regulations	
NSPS OOOO – O&G Phase I	NESHAP Subpart HH (dehydrators)
NSPS OOOOa – O&G Phase II	Tribal MNSR
NSPS JJJJ – Spark-ignited engines	Subpart KKKK (turbines)
Farmington RMP Conditions of Approval Standards for Gas Compressors	Point Source Process Heater/Boiler MACT, NSPS
Federal Tier Standards for off-road diesel engines	
BLM Methane Rule	
State Regulations	
Colorado Regulation 7	None