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SPECIFICATION SHEET: PT_OILGAS

Description: Point oil and gas (pt_oilgas) emissions, for simulating 2016 U.S. air quality

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1. EXECUTIVE SUMMARY

The pt_oilgas sector consists of point source oil and gas emissions in United States, partly from a 2016 EPA point inventory, and partly from a projection of 2014 National Emissions Inventory (NEI) version 2 to 2016. It also includes the federally-own oil and gas sources in the Gulf of Mexico. Base year inventories were processed with the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system version 4.6. SMOKE creates emissions in a format that can be input into air quality models. National and state-level emission summaries for key pollutants are provided.

2. INTRODUCTION

This document details the approach and data sources to be used for developing 2016 emissions for the point oil and gas (pt_oilgas) sector, which consists of oil and gas exploration, production, and distribution sources, both onshore and offshore, from the 2016 NEI Point inventory.

The starting point for the 2016 beta platform pt_oilgas inventory is the 2016 point source National Emissions Inventory (NEI). The 2016 inventory includes data submitted by state / tribal / local agencies and EPA to EPA’s Emission Inventory System (EIS) for Type A (i.e., large) point sources. Point sources in the 2014 NEI not submitted for 2016 were pulled forward from the 2014 NEI unless they have been marked as shut down. The full point inventory is first split into separate components for the point emissions modeling sectors: ptegu, ptnonipm, and pt_oilgas. Sources in the pt_oilgas sector consist of sources which are not EGUs (i.e. IPM_YN is blank) and which have a North American Industry Classification System (NAICS) code corresponding to oil and gas exploration, production, or distribution. A list of all NAICS codes in the pt_oilgas sector is provided in Table 1. Further inventory preparation steps are outlined in the next section.

For the federally-owned offshore point inventory of oil and gas platforms, a 2014 inventory was developed by the U.S. Department of the Interior, Bureau of Ocean and Energy Management, Regulation, and Enforcement(BOEM) and further information on this inventory can be found at <https://www.boem.gov/2014-Gulfwide-Emission-Inventory/>. This inventory was incorporated into the 2014NEIv2 point source inventory.

Table 1: NAICS codes for pt_oilgas sector

NAICS	NAICS description
2111, 21111	Oil and Gas Extraction
211111	Crude Petroleum and Natural Gas Extraction
211112	Natural Gas Liquid Extraction
213111	Drilling Oil and Gas Wells
213112	Support Activities for Oil and Gas Operations
2212, 22121, 221210	Natural Gas Distribution
4862, 48621, 486210	Pipeline Transportation of Natural Gas
48611, 486110	Pipeline Transportation of Crude Oil

3. INVENTORY DEVELOPMENT METHODS

2016 point inventory from EIS

The 2016 pt_oilgas inventory includes both sources with updated data for 2016, and sources carried forward from the 2014NEIv2 point inventory. Each type of source can be identified based on the *calc_year* field, which is set to either 2016 or 2014. The pt_oilgas inventory was split into two components: one for 2016 sources, and one for 2014 sources. The 2016 sources were used in beta platform without further modification. The 2014 sources were projected to 2016 as described in the next section. Updates were made to selected West Virginia Type B facilities based on comments from the state.

Projection to year 2016 from 2014NEIv2

For pt_oilgas emissions that were carried forward from 2014NEIv2, the emissions were projected to represent the year 2016. Each state/SCC/NAICS combination in the inventory was classified as either an oil source, a natural gas source, a combination of oil and gas, or designated as a “no growth” source. Growth factors were based on historical state production data from Energy Information Administration (EIA) and are listed in Table 2. National 2016 pt_oilgas emissions before and after application of 2014-to-2016 projections are shown in Table 3. The historical production data for years 2014 and 2016 for oil and natural gas were taken from the following websites:

- https://www.eia.gov/dnav/pet/pet_crd_crpdn_adc_mbb1_a.htm (Crude production)
- http://www.eia.gov/dnav/ng/ng_sum_lsum_a_epg0_fgw_mmcf_a.htm (Natural gas production)

The “no growth” sources include all offshore and tribal land emissions, and all emissions with a NAICS code associated with distribution, transportation, or support activities. Idaho had no 2014 production data from EIA so assumed no growth for this state but the only sources in Idaho for this sector were pipeline transportation related. Maryland and Oregon had no oil production data on the EIA website. The factors provided in Table 2 were applied to sources with NAICS = 2111, 21111, 211111, 211112, and 213111 and with production-related SCC processes.

Table 2: 2014NEIv2-to-2016 projection factors for pt_oilgas sector for 2016beta inventory

State	Natural Gas growth	Oil growth	Combination gas/oil growth
Alabama	-9.0%	-17.5%	-13.2%
Alaska	1.9%	-1.1%	0.4%
Arizona	-55.7%	-85.7%	-70.7%

State	Natural Gas growth	Oil growth	Combination gas/oil growth
Arkansas	-26.7%	13.6%	-6.6%
California	-14.2%	-9.1%	-11.7%
Colorado	3.5%	22.0%	12.8%
Florida	8.0%	-13.2%	-2.6%
Idaho	0.0%	0.0%	0.0%
Illinois	13.2%	-9.5%	1.8%
Indiana	-6.2%	-27.5%	-16.9%
Kansas	-15.0%	-23.4%	-19.2%
Kentucky	-1.6%	-23.1%	-12.4%
Louisiana	-11.0%	-17.4%	-14.2%
Maryland	70.0%	N/A	N/A
Michigan	-12.6%	-23.4%	-18.0%
Mississippi	-10.9%	-16.3%	-13.6%
Missouri	-66.7%	-37.2%	-52.0%
Montana	-11.9%	-22.5%	-17.2%
Nebraska	27.3%	-25.0%	1.2%
Nevada	0.0%	-12.3%	-6.2%
New Mexico	1.4%	17.4%	9.4%
New York	-33.4%	-36.8%	-35.1%
North Dakota	31.4%	-4.3%	13.6%
Ohio	181.0%	44.4%	112.7%
Oklahoma	5.9%	6.9%	6.4%
Oregon	-18.0%	N/A	N/A
Pennsylvania	24.8%	-7.9%	8.5%
South Dakota	-33.9%	-21.7%	-27.8%
Tennessee	-31.9%	-22.1%	-27.0%
Texas	-6.1%	1.0%	-2.6%
Utah	-19.8%	-25.4%	-22.6%
Virginia	-10.0%	-50.0%	-30.0%
West Virginia	28.9%	0.7%	14.8%
Wyoming	-7.5%	-4.7%	-6.1%

Table 3. 2016ff pt_oilgas national emissions (excluding offshore) before and after 2014-to-2016 projections

Pollutant	Before projections	After projections	% change 2014 to 2016
CO	175,929	178,093	1.2%
NH3	4,347	4,338	-0.2%
NOX	377,517	380,026	0.7%
PM10-PRI	12,630	12,570	-0.5%
PM25-PRI	11,545	11,477	-0.6%
SO2	35,236	34,878	-1.0%
VOC	127,242	129,325	1.6%

4. ANCILLARY DATA

Spatial Allocation

Spatial allocation of pt_oilgas emissions to the national 36km and 12km domains used for air quality modeling is based on latitude and longitude data from the point source inventory.

Temporal Allocation

Reports summarizing total emissions according to the monthly, day-of-week, and hour-of-day temporal profile assignments were developed at the state and county level based on the same source data on which the inventory is based¹. The pt_oilgas sector does not use the same monthly profiles as np_oilgas, since those monthly profiles are specific to area sources derived from the Oil and Gas Tool.

Chemical Speciation

The pt_oilgas sector includes speciation of PM_{2.5} and VOC emissions, and does not use HAP integration for VOCs. Reports summarizing total PM_{2.5} and VOC emissions according to speciation profile were developed at the state and county level.

5. EMISSIONS PROJECTION METHODS

The pt_oilgas future-year projections have not been finalized as of the time this was written.

6. EMISSIONS PROCESSING REQUIREMENTS

The pt_oilgas emissions were processed for air quality modeling using the SMOKE² version 4.6 modeling system. As with all point source sectors, this is typically handled with two separate scripts, or “jobs”: one which processes time-independent, or “onetime”, programs (Smkinven, Spcmat, Grdmat, Smkreport, Elevpoint), and one which processes time-dependent programs (Temporal, Smkmerge).

The pt_oilgas sector was processed through SMOKE using a PELVCONFIG file that classifies a portion of the sector as “elevated”. The criterion for elevated sources is a plume rise of 20

¹ ERG, 2018. Technical Memorandum: Modeling Allocation Factors for the 2016 Oil and Gas Nonpoint Tool.

² <http://www.smoke-model.org/index.cfm>

meters or greater, according to the Briggs algorithm³. A value of 20 meters was chosen because this is a typical upper bound of Layer 1 in air quality modeling.

Elevated sources were output to an inline point source file for input to CMAQ, and remaining sources are output to a 2-D gridded emissions file. Therefore, one must sum both files together to capture emissions from all pt_oilgas sources. The 2-D gridded emissions from pt_oilgas must be included in the 2-D sector merge. The reason all sources were not classified as elevated sources in pt_oilgas and ptnonipm, as is done with cmv_c3 and othpt, was to limit the size of the inline point source files from these sectors.

7. EMISSIONS SUMMARIES

National and state totals by pollutant for the beta platform cases are provided here. Plots and maps are available online through the LADCO website⁴ and the Intermountain West Data Warehouse⁵. The case descriptions are as follows:

2011en, 2023en, 2028el = Final 2011, 2023, and 2028 cases from the 2011v6.3 platform

2014fd = 2014NEIv2 and 2014 NATA

2016fe = 2016 alpha platform (grown from 2014NEIv2)

2016ff = 2016 beta platform

Table 4. Comparison of national total annual CAPS pt_oilgas emissions (tons/yr)

Pollutant	2011en	2014fd	2016fe	2016ff	2023en	2028el
CO	246,377	258,374	237,926	228,145	240,910	269,315
NH3	5,947	1,340	4,373	4,353	5,917	5,950
NOX	550,571	503,674	449,476	428,717	448,424	500,064
PM10	15,611	14,646	13,688	13,237	16,345	18,235
PM2.5	14,943	14,004	12,585	12,143	15,666	17,516
SO2	68,206	49,694	43,790	35,380	66,353	90,181
VOC	165,350	185,298	182,827	177,534	178,475	199,863

Table 5. Comparison of state total annual NOx pt_oilgas emissions (tons/yr)

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Alabama	13,621	10,000	8,853	8,689	9,886	11,061
Alaska	40,715	39,296	40,554	40,586	23,829	22,928

³ https://www.cmascenter.org/smoke/documentation/4.5/html/ch06s03.html#sect_programs_elevpoint_briggs

⁴ <https://www.ladco.org/technical/modeling-results/2016-inventory-collaborative/>

⁵ <http://views.cira.colostate.edu/iwdw/eibrowser2016>

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Arizona	1,474	2,141	2,562	2,562	1,485	1,526
Arkansas	12,249	14,411	5,037	5,056	11,479	12,467
California	6,641	4,539	4,487	4,258	5,317	5,476
Colorado	30,839	23,943	23,189	24,568	35,691	41,893
Connecticut	292	347	214	214	216	242
Delaware		19	19	19		
Florida	5,331	5,312	6,432	6,432	2,291	2,319
Georgia	7,075	4,603	4,419	4,419	3,293	3,193
Idaho	1,351	884	1,091	1,091	1,102	1,134
Illinois	20,561	19,761	8,620	8,620	17,101	20,257
Indiana	10,172	8,042	5,148	5,148	10,820	12,075
Iowa	9,523	7,378	5,051	5,051	485	536
Kansas	35,886	30,326	23,493	23,398	2,539	2,815
Kentucky	8,677	4,626	4,616	4,536	6,547	7,778
Louisiana	41,820	33,468	29,786	29,676	36,181	43,261
Maine	64	32	25	25	56	59
Maryland	1,340	119	157	157	1,219	1,177
Massachusetts	246	264	263	263	212	176
Michigan	16,790	13,504	10,714	10,700	13,548	15,807
Minnesota	2,878	2,131	2,837	2,837	142	157
Mississippi	23,306	12,299	12,266	12,259	17,106	18,810
Missouri	7,211	6,856	3,979	3,979	361	399
Montana	1,481	1,407	1,348	1,347	1,283	1,321
Nebraska	3,760	4,329	3,605	3,605	790	890
Nevada	282	269	215	215	232	237
New Jersey	407	270	233	233	423	409
New Mexico	20,866	17,234	15,975	9,748	20,473	22,162
New York	1,512	1,308	1,357	1,357	1,502	1,445
North Carolina	3,056	1,199	562	562	3,308	2,724
North Dakota	5,581	5,350	5,562	5,571	5,711	5,554
Ohio	8,932	9,192	11,337	11,413	8,323	9,249
Oklahoma	61,211	61,178	58,794	46,054	54,967	65,551
Oregon	884	421	421	421	754	740
Pennsylvania	8,339	6,018	6,056	6,091	5,526	5,335
Rhode Island	27	52	59	59	26	26
South Carolina	1,543	604	667	428	857	871
South Dakota	564	433	433	433	22	25
Tennessee	6,304	3,903	4,647	4,647	4,683	5,125
Texas	76,632	65,045	53,496	53,444	91,632	102,112
Utah	3,680	2,258	2,676	2,638	2,912	2,985
Virginia	3,755	631	733	733	3,781	3,863
Washington	450	444	754	754	310	307
West Virginia	14,158	12,060	11,918	10,059	11,663	12,209
Wisconsin	603	200	534	534	531	587
Wyoming	19,566	10,092	9,307	8,850	18,988	21,949

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Offshore to EEZ		48,691	48,691	48,691		
Tribal Data	8,918	6,785	6,287	6,287	8,820	8,842

Table 6. Comparison of state total annual SO2 pt_oilgas emissions (tons/yr)

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Alabama	20,226	9,246	5,739	5,548	15,067	35,903
Alaska	1,629	1,699	1,649	1,653	1,363	1,338
Arizona	10	35	35	35	11	11
Arkansas	254	267	264	195	166	219
California	1,592	724	723	636	1,352	1,270
Colorado	512	522	506	514	544	654
Connecticut	2	2	3	3	2	2
Delaware		0	0	0		
Florida	884	1,427	1,527	1,527	850	854
Georgia	1	4	4	4	1	1
Idaho	5	3	6	6	5	5
Illinois	470	61	129	129	134	2,069
Indiana	77	263	87	87	78	410
Iowa	7	7	5	5	2	2
Kansas	65	43	37	37	33	42
Kentucky	125	113	113	112	104	260
Louisiana	582	790	877	865	446	960
Maine	3	1	1	1	3	4
Maryland	1	0	0	0	1	1
Massachusetts	5	2	2	2	4	6
Michigan	398	313	373	372	367	383
Minnesota	82	141	151	151	5	5
Mississippi	5,553	638	638	555	4,254	9,675
Missouri	3	5	3	3	0	0
Montana	114	106	69	69	85	122
Nebraska	6	4	3	3	1	1
Nevada	20	17	16	16	21	22
New Jersey	4	7	6	6	4	4
New Mexico	13,068	6,379	7,997	509	16,716	12,753
New York	7	29	10	10	8	8
North Carolina	4	3	2	2	4	4
North Dakota	6,676	5,125	3,860	3,883	11,042	7,387
Ohio	5	11	24	24	6	6
Oklahoma	809	649	652	279	649	731
Oregon	16	13	13	13	16	16
Pennsylvania	33	36	36	37	35	36
Rhode Island	1	1	2	2	1	1
South Carolina	15	7	7	2	13	15
South Dakota	22	1	1	1	1	1

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Tennessee	5	17	4	4	4	4
Texas	10,321	14,205	12,200	12,160	9,271	10,220
Utah	29	503	582	483	29	26
Virginia	10	82	1	1	10	10
Washington	11	14	20	20	10	10
West Virginia	4	4	4	6	4	4
Wisconsin	1	0	0	0	1	1
Wyoming	4,405	5,495	4,728	4,728	3,494	4,589
Offshore to EEZ		502	502	502		
Tribal Data	136	173	177	177	136	136

Table 7. Comparison of state total annual VOC pt_oilgas emissions (tons/yr)

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
Alabama	1,699	1,463	1,284	1,268	1,402	1,894
Alaska	1,253	1,375	1,689	1,689	1,122	1,108
Arizona	90	221	187	187	96	94
Arkansas	639	891	438	438	674	732
California	4,357	3,935	3,858	3,680	3,976	3,650
Colorado	47,518	23,897	23,059	23,943	62,342	66,797
Connecticut	43	30	86	86	42	46
Delaware		5	5	5		
Florida	563	558	638	638	255	265
Georgia	622	592	559	559	298	289
Idaho	39	25	30	30	40	41
Illinois	1,748	1,702	1,348	1,348	1,747	2,629
Indiana	555	400	353	353	614	693
Iowa	351	345	290	290	20	22
Kansas	4,015	3,720	2,977	2,979	1,744	1,757
Kentucky	1,321	1,141	1,123	1,104	1,098	3,844
Louisiana	11,677	11,233	11,152	11,098	10,850	14,767
Maine	51	69	53	53	51	51
Maryland	268	53	39	39	268	268
Massachusetts	66	79	78	78	76	67
Michigan	1,890	1,662	1,319	1,303	1,489	3,996
Minnesota	131	89	166	166	48	48
Mississippi	3,356	1,529	1,481	1,450	2,820	4,700
Missouri	335	350	220	220	74	63
Montana	1,069	896	924	925	1,146	1,190
Nebraska	415	343	312	312	251	263
Nevada	59	63	61	56	59	60
New Jersey	86	91	125	125	105	105
New Mexico	4,596	5,087	4,825	3,018	5,445	4,886
New York	422	463	447	447	473	444
North Carolina	546	236	144	144	622	523

State	2011en	2014fd	2016fe	2016ff	2023en	2028el
North Dakota	608	1,189	1,298	1,299	880	640
Ohio	536	1,012	1,619	1,691	1,409	1,058
Oklahoma	30,066	33,574	33,783	29,946	28,718	31,110
Oregon	83	29	29	29	75	74
Pennsylvania	1,242	1,395	1,434	1,408	1,038	1,020
Rhode Island	16	37	33	33	16	18
South Carolina	173	124	114	74	118	114
South Dakota	15	9	9	9	1	1
Tennessee	307	231	340	340	243	265
Texas	24,576	22,703	23,395	23,382	26,362	26,864
Utah	480	401	434	434	461	446
Virginia	385	167	112	112	394	406
Washington	30	36	43	43	25	24
West Virginia	3,220	2,307	2,518	2,454	2,394	3,145
Wisconsin	201	212	225	225	203	205
Wyoming	11,192	9,249	8,409	8,262	14,673	16,943
Offshore to EEZ		48,210	48,210	48,210		
Tribal Data	2,439	1,872	1,551	1,551	2,218	2,240