APPENDIX D

Socioeconomic Impact Analysis For Proposed Amendments to Rule 4311

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POTENTIAL AMENDMENTS TO RULE 4311—FLARES

SOCIOECONOMIC IMPACT ANALYSIS

Draft

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Submitted to:

San Joaquin Valley Air Pollution Control District
1900 East Gettysburg Avenue
Fresno, CA 93726-0244

Submitted by:

Eastern Research Group, Inc. (ERG)
8950 Cal Center Drive, Suite 230
Sacramento, CA 95826

District Agreement No. CONT-00656

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1. EXECUTIVE SUMMARY

This report estimates the socioeconomic impacts of potential amendments to the San Joaquin Valley Air Pollution Control District (SJVAPCD or District) Rule 4311 (Flares). This rule amendment would satisfy the commitments included in the *2016 Ozone Plan* and *2018 PM2.5 Plan* to enact additional low NOx flare emission limits, include additional flare minimization requirements, remove the exemption for non-major sources, and evaluate requiring ultra-low NOx flare technology (SJVAPCD, 2020a). Some facilities would incur costs under the potential amendments to install ultra-low NOx flare technology.

After providing an overview of demographic and economic trends in the District as a whole and describing how the COVID-19 pandemic has impacted the District economically, ERG estimates the impacts of the potential amendments on entities that would incur costs under the potential amendments by comparing compliance costs to profits.

As shown in Table 1, no affected sector would experience a significant adverse impact, defined as costs that amount to 10 percent or more of profits (Berck, 1995). The "Oil and Gas Production" sector would incur both the highest average cost per facility and highest impacts. Note that the wastewater treatment facilities impacted by this rule are operated by local government agencies. Because local governments do not seek to maximize profits in the same way that private entities do, profit values are not shown in the following and subsequent tables. Local governments commonly raise fees to cover the compliance costs of regulations, and will likely plan for incurring these additional costs through their annual budgeting processes.

Table 1. Summary of Socioeconomic Impacts due to Potential Amendments to Rule 4311—Flares

Sector	Affected Facilities	Total Annualized Cost [a]	Average Annualized Cost per Facility	Average Profits per Facility	Cost as % Profits
Oil and Gas Production	14	$5,106,410	$364,744	$5,361,445	6.80%
Wastewater Treatment – Major [b]	2	$337,523	$168,762	—	—
Landfill	10	$1,968,911	$196,891	$7,128,137	2.76%
Total/Average	**26**	**$7,412,844**	**$285,109**	**$5,628,523**	**5.07%**

Sources: ERG estimates based on SJVAPCD, 2020b; U.S. Census Bureau, 2015; U.S. Census Bureau, 2020b; U.S. Census Bureau 2020c; NASS, 2019; CA EDD, 2020a; U.S. Census Bureau, 2020a; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2017a; U.S. Census Bureau, 2017b; BLS, 2020; IMPLAN, 2020a; OPM, 2017; IRS, 2016; RMA, 2020.

Notes:

[a] The total annualized cost is calculated by summing annualized one-time costs (annualized over a 10-year period using a 10 percent discount rate) and annual costs.

[b] As government agencies, wastewater treatment facilities do not have profits, so profit values are not shown here.

As a secondary measure of impacts, ERG also used the IMPLAN (2020a) input-output model to assess how facilities with costs under the potential amendments might react by reducing employment, as well as a "ripple effect" felt if affected facilities reduce purchases from their suppliers, and their suppliers in turn reduce their own purchases. These impacts make up less than **0.01 percent** of District-wide revenue and employment.

ERG also conducted sensitivity analyses to assess how varying degrees of recovery from the effects of the COVID-19 pandemic might affect the results of the analysis. Impacts would increase

slightly with a full recovery. This is because IMPLAN (2020a) data suggest that some of the affected sectors actually have higher revenues under the main analysis with no recovery from the pandemic.

2. INTRODUCTION AND BACKGROUND

This report contains ERG's analysis of economic data and analysis in support of the San Joaquin Valley Air Pollution Control District (SJVAPCD or District) assessment of the socioeconomic feasibility of potential amendments to its existing rules for flares. This work was performed by ERG under District Agreement No. CONT-00656.

Flaring is a high temperature oxidation process used to burn combustible components, primarily hydrocarbons, of waste gases from industrial operations, primarily for the purpose of controlling emissions and as a safety device. Flares operating in the District are employed by a diverse group of sectors for a wide variety of applications, including oil and gas production, wastewater treatment, and landfills.

The potential amendments would revise existing District Rule 4311 (last revised in 2009), which was designed "to limit the emissions of volatile organic compounds (VOC), oxides of nitrogen (NOx), and sulfur oxides (SOx) from the operation of flares" (SJVAPCD, 2009).

The potential amendments to Rule 4311 will satisfy the commitments included in the *2016 Ozone Plan* and *2018 PM2.5 Plan* to evaluate requiring ultra-low NOx flare technology to lower emission limitations for existing and new flaring activities, and to include additional flare minimization requirements (SJVAPCD, 2020a).

This analysis was prepared by ERG to meet the requirements of California Health and Safety Code §40728.5, which requires an assessment of the socioeconomic impacts of the adoption, amendment, or repeal of air district rules. It begins by providing an overview of demographic and economic trends in the District, and then estimates the economic impacts on specific entities subject to the potential rule amendments (including small entities), and how those economic impacts might affect the surrounding communities, including at-risk populations.

3. REGIONAL DEMOGRAPHIC AND ECONOMIC TRENDS

In this section ERG considers larger demographic and economic trends in the District, which includes eight counties that are home to over 4 million people.[1] These counties have become more populous over the last decade, and the median income (adjusted for inflation) has also increased. Utilities, wholesale and retail trade, and transportation, along with agriculture and oil and gas extraction, are the predominant industries within the District both in terms of establishments and employment.

3.1. REGIONAL DEMOGRAPHIC TRENDS

This section presents the demographic shifts within the District's jurisdiction over the past decade. The District has experienced greater population growth rate than the state as a whole, but the median income has lagged the state. The poverty rate throughout the District, while decreasing over time, is doing so at a slower pace than California as a whole.

The San Joaquin Valley contains almost 11 percent of the state of California's population. Table 2 shows how this population has changed over the last 10 years. Table 2 also shows the compound annual growth rate (CAGR) between 2010 and 2019. The CAGR is the constant rate the population would have changed annually to go from the 2010 level to the 2019 level.

The region has seen small amounts of population growth, an annual average growth rate marginally higher than the state of California. Kings and Madera Counties, the two counties with the smallest population of the counties in the District, saw little growth in their populations from 2010 to 2019, and were the only counties to have population declines in any one year over the last ten years. San Joaquin County saw the most growth, increasing at 1.16 percent annually.

[1] While only part of Kern County falls into the District's boundaries, all of Kern County is included in the data presented in this section, as the data were only available at the county level.

Table 2. Population Trends by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	932,039	939,406	945,045	951,514	960,567	969,488	976,830	985,238	991,950	999,101	0.78%
Kern [a]	840,996	847,970	853,606	862,000	869,176	876,031	880,856	887,356	893,758	900,202	0.76%
Kings	152,370	151,868	150,991	150,337	149,495	150,085	149,382	149,665	151,382	152,940	0.04%
Madera	150,986	151,675	151,527	151,370	153,456	153,576	153,956	155,423	156,882	157,327	0.46%
Merced	256,721	259,297	260,867	262,026	264,419	266,353	267,628	271,096	274,151	277,680	0.88%
San Joaquin	687,127	694,354	699,593	702,046	711,579	722,271	732,809	743,296	752,491	762,148	1.16%
Stanislaus	515,145	517,560	520,424	523,451	528,015	533,211	539,255	544,717	548,126	550,660	0.74%
Tulare	442,969	446,784	449,779	452,460	455,138	457,161	459,235	462,308	464,589	466,195	0.57%
SJVAPCD [a]	**3,978,353**	**4,008,914**	**4,031,832**	**4,055,204**	**4,091,845**	**4,128,176**	**4,159,951**	**4,199,099**	**4,233,329**	**4,266,253**	**0.78%**
California	**37,319,502**	**37,638,369**	**37,948,800**	**38,260,787**	**38,596,972**	**38,918,045**	**39,167,117**	**39,358,497**	**39,461,588**	**39,512,223**	**0.64%**

Source: U.S. Census Bureau, 2020e.

Notes:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Table 3 shows the median income by county for 2010 through 2018 U.S. Census Bureau (2019a).[2] Median income growth rates varied across counties from 2010 to 2018, though the counties in the District as a whole had a CAGR of 0.63 percent overall; this is significantly lower than the growth rate of median income for the state of California (1.60 percent). Kern and Tulare Counties experienced declines in median income (-0.17 percent and -0.26 percent respectively) while all other counties experienced some level of growth. Kings and Merced Counties have notably higher growth rates of 2.34 percent and 2.13 percent, respectively. These are the only two counties in the District where median income increased at a rate faster than the state.

[2] 2018 is the most recent data year currently available in the U.S. Census Bureau (2019a) median income data from the American Community Survey.

Table 3. Median Income by County [a]

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	CAGR 2010-2018
Fresno	$52,859	$49,014	$46,766	$48,496	$47,071	$50,369	$51,728	$53,987	$53,547	0.16%
Kern [b]	$53,213	$51,781	$51,578	$51,758	$51,647	$55,082	$52,990	$51,959	$52,478	-0.17%
Kings	$52,144	$57,645	$51,606	$50,538	$46,378	$49,078	$56,527	$59,985	$62,738	2.34%
Madera	$56,421	$53,323	$47,229	$43,896	$45,998	$50,585	$54,852	$53,448	$57,287	0.19%
Merced	$49,619	$45,863	$48,979	$44,921	$47,788	$45,056	$50,692	$49,750	$58,752	2.13%
San Joaquin	$58,458	$58,227	$56,984	$56,785	$55,999	$57,617	$63,199	$63,746	$65,237	1.38%
Stanislaus	$56,159	$50,467	$52,134	$52,954	$55,376	$56,177	$57,664	$62,027	$61,373	1.12%
Tulare	$50,727	$47,136	$45,277	$43,525	$46,191	$45,503	$48,719	$48,219	$49,668	-0.26%
SJVAPCD [b][c]	**$53,990**	**$51,459**	**$50,426**	**$50,318**	**$50,550**	**$52,467**	**$54,674**	**$55,614**	**$56,791**	**0.63%**
California	**$67,455**	**$65,594**	**$65,529**	**$66,454**	**$67,136**	**$69,198**	**$71,929**	**$74,837**	**$76,589**	**1.60%**

Source: U.S. Census Bureau, 2019a.

Notes:

[a] Inflated values to 2019$ using the BEA (2020) GDP deflator.

[b] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

[c] Median income for SJVAPCD is a weighted average by population.

Poverty rates by county for the same nine-year period are shown in Table 4. The poverty rate decreased in every county in the District in that time frame. Poverty rates within the District are higher than state average, and declining at a slower rate overall compared to the state of California's rate of -2.60 percent. Fresno and Tulare Counties consistently had the highest poverty rates while Stanislaus and San Joaquin Counties had the two lowest. San Joaquin and Stanislaus Counties were also the only two counties in the District with a lower CAGR lower than the state. Despite Merced County's notable CAGR of median household income, its poverty rate has declined at one of the slowest rates (-0.55 percent) in the District.

Many the District's leading industries, including agriculture, transportation, and manufacturing, typically employ a higher percentage of low income and less educated employees than other industries, and have unstable or seasonal employment needs (Abood, 2014), likely leading to the relatively high rates of poverty.

Table 4. Poverty Rate by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	CAGR 2010-2018
Fresno	26.8%	25.8%	28.4%	28.8%	27.7%	25.3%	25.6%	21.1%	21.5%	-2.72%
Kern [a]	21.2%	24.5%	23.8%	22.8%	24.8%	21.9%	22.7%	21.4%	20.6%	-0.36%
Kings	22.2%	20.5%	21.2%	21.4%	26.6%	23.6%	16.0%	18.2%	19.2%	-1.80%
Madera	21.0%	24.3%	23.6%	23.6%	22.2%	23.4%	20.3%	22.6%	20.9%	-0.06%
Merced	23.0%	27.4%	24.3%	25.2%	25.2%	26.7%	20.3%	23.8%	22.0%	-0.55%
San Joaquin	19.2%	18.1%	18.4%	19.9%	20.9%	17.4%	14.4%	15.5%	14.2%	-3.70%
Stanislaus	19.9%	23.8%	20.3%	22.1%	18.0%	19.7%	14.2%	13.5%	15.6%	-3.00%
Tulare	24.5%	25.7%	30.4%	30.1%	28.6%	27.6%	25.2%	24.6%	22.5%	-1.06%
SJVAPCD [a]	**22.5%**	**23.8%**	**24.2%**	**24.6%**	**24.3%**	**22.7%**	**20.6%**	**19.7%**	**19.3%**	**-1.91%**
California	**15.8%**	**16.6%**	**17.0%**	**16.8%**	**16.4%**	**15.3%**	**14.3%**	**13.3%**	**12.8%**	**-2.60%**

Source: U.S. Census Bureau, 2019b.

Notes:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Table 5 shows the population below the poverty line from 2010 to 2018. While there was a decline in the number of people below the poverty line from 2010 to 2018, the number fluctuated during this period. The number of people in poverty grew by over 100,000 between 2010 and 2014, but has declined since 2014.

The CAGR of population below the poverty line varies across counties. Fresno County had the largest population below the poverty line as of 2018, which coincides with its large population and relatively higher poverty rate. Conversely, San Joaquin County has a notable decline in CAGR at -2.56 percent, one of three counties to see declines in poverty at a rate faster than the state (along with Fresno and Stanislaus Counties). Kern, Madera, and Merced Counties have positive CAGR and have seen an increase in population below the poverty over the nine-year period.

Table 5. Population Below Poverty Line by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	CAGR 2010-2018
Fresno	246,196	238,706	264,738	270,072	263,220	242,083	247,507	205,291	209,799	-1.98%
Kern [a]	171,950	201,230	196,625	189,484	208,388	186,501	193,133	184,619	178,239	0.45%
Kings	30,425	27,101	27,819	28,473	35,623	31,453	21,565	24,935	26,299	-1.81%
Madera	29,936	34,148	33,936	34,242	32,432	34,227	29,736	33,482	31,191	0.51%
Merced	58,360	70,243	62,448	64,552	65,405	70,118	53,314	63,485	59,283	0.20%
San Joaquin	128,748	123,258	126,610	137,663	146,601	123,817	103,399	113,136	104,622	-2.56%
Stanislaus	101,335	122,212	104,559	114,628	94,586	104,801	76,191	73,254	85,073	-2.16%
Tulare	107,660	113,515	135,194	135,066	129,485	125,728	114,290	112,524	103,711	-0.47%
SJVAPCD [a]	**874,610**	**930,413**	**951,929**	**974,180**	**975,740**	**918,728**	**839,135**	**810,726**	**798,217**	**-1.14%**
California	**5,783,043**	**6,118,803**	**6,325,319**	**6,328,824**	**6,259,098**	**5,891,678**	**5,525,524**	**5,160,208**	**4,969,326**	**-1.88%**

Source: U.S. Census Bureau, 2019b.

Notes:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

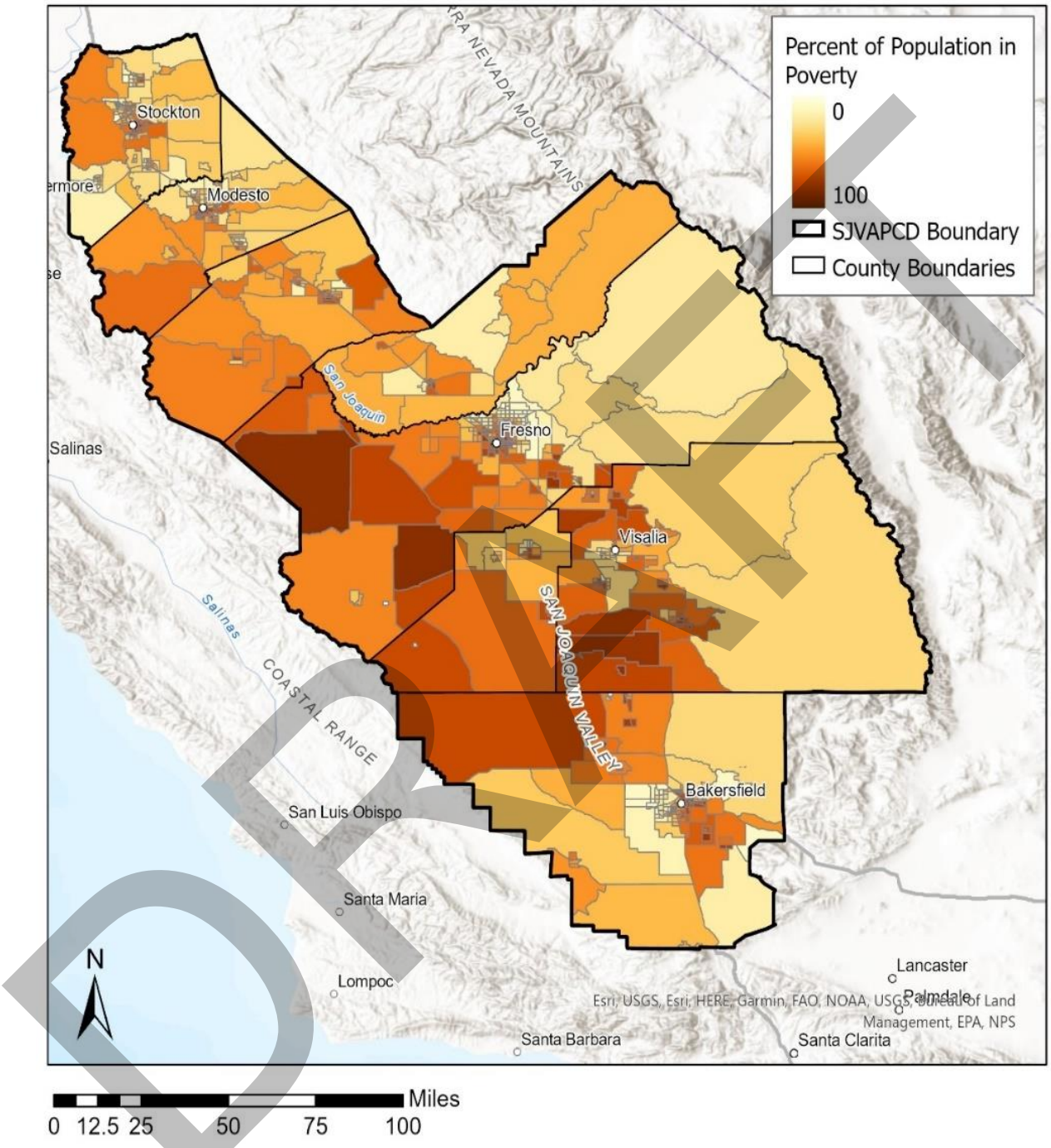
Figure 1 shows where the population in poverty or at risk of poverty lives within the District[3] using CalEnviroScreen 3.0 (OEHHA, 2018) data on the percent of population living below two times the federal poverty limit. CalEnviroScreen poverty data is derived from the US Census Bureau's American Community Survey 5-year estimates for 2011 to 2015. CalEnviroScreen uses a poverty threshold of two times the poverty level to account for the higher cost of living in California compared to other parts of the country (OEHHA, 2017).

As shown in Table 4 above, roughly 20 percent of the District population is below the federal poverty limit, depending on the year. Using the higher CalEnviroScreen 3.0 threshold, nearly half (48.7 percent) of District residents are below twice the federal poverty limit (OEHHA, 2018), reflected in the high poverty rates in the map in Figure 1 below.

As seen in Figure 1, several large census tracts in the western part of the District have particularly high rates of poverty. Census tracts, on average, have a population of 4,000 people. The larger census tracts include more rural areas and several have higher rates of poverty compared to urban areas. Many rural areas depend on the agricultural industry for employment, which likely explains the high rates of poverty in the rural regions, particularly in the southwest District, where the percentage of agricultural jobs is highest (Abood, 2014). Areas of lower poverty are clustered near major cities and in the less densely populated areas in the Sierra Nevada foothills and mountains.

[3] Note that only the part of Kern County included in the SJVAPCD is shown. There are four census tracts on the eastern border of Kern County that are in the Eastern Kern Air Pollution Control District. The portions of these census tracts that fall outside of the SJVAPCD border are not shown.

Figure 1. Percentage of the Population Living below Two Times the Federal Poverty Level by Census Tract (2018)



Source: OEHHA, 2018.

3.2. REGIONAL ECONOMIC TRENDS

This section tracks the economic trends in the District over the past decade. Total employment growth in the District is slightly below that of California. Overall, employment, the number of establishments, and average pay have all increased across the District during that period.

Table 6 presents employment trends over the same 10-year span. During that period, overall employment throughout the District has also increased. The District as a whole saw a CAGR of 1.48 percent in employment over the last decade, slightly below that of the entire state of California (1.64 percent). No individual county experienced a decline in employment, although Kings County has a notably lower growth rate (0.72 percent) than the other counties in the region.

San Joaquin County was the only county in the District to experience an employment growth rate greater than that of California as a whole. This may be in part due to the California Central Valley Economic Development Corporation's (CCVEDC) efforts to encourage companies to locate within the District through tax credits and incentives and grants (CCVEDC, 2020). A few large employers (Amazon, Tesla, etc.) have moved to San Joaquin County in recent years, creating numerous job opportunities within the county. Some people have also moved from the more expensive Bay Area and Los Angeles-San Diego area to the Central Valley, with San Joaquin County being one of the more popular areas to relocate (Lillis, 2019).

Table 6. Employment Trends by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	366,200	370,200	373,500	379,800	387,500	395,700	402,700	407,400	412,783	418,092	1.48%
Kern [a]	313,400	325,700	340,400	347,200	351,700	350,500	348,000	349,500	354,892	360,783	1.58%
Kings	49,900	49,700	50,000	50,400	50,600	51,700	51,500	52,300	53,025	53,233	0.72%
Madera	51,400	52,000	53,500	54,400	54,900	53,500	55,400	56,100	56,958	57,642	1.28%
Merced	93,200	94,500	96,200	98,000	99,700	101,200	102,300	104,600	105,650	106,875	1.53%
San Joaquin	260,000	261,000	267,100	274,600	279,200	286,600	292,600	301,100	304,617	307,842	1.89%
Stanislaus	202,200	202,400	205,900	209,800	213,700	218,200	222,000	224,400	227,533	228,750	1.38%
Tulare	168,100	168,700	168,800	172,200	172,100	178,700	180,700	183,500	183,300	184,350	1.03%
SJVAPCD [a]	**1,504,400**	**1,524,200**	**1,555,400**	**1,586,400**	**1,609,400**	**1,636,100**	**1,655,200**	**1,678,900**	**1,698,758**	**1,717,567**	**1.48%**
California	**16,091,900**	**16,258,100**	**16,602,700**	**16,958,400**	**17,310,900**	**17,681,800**	**18,002,800**	**18,285,500**	**18,460,433**	**18,623,900**	**1.64%**

Source: CA EDD, 2020b.

Notes:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Table 7 shows the economic trends by sector in the District by presenting three snapshots from 2009 to 2019 using data from the Bureau of Labor Statistics' (BLS, 2020) Quarterly Census of Employment and Wages (QCEW). The recent influx of new employers explains the continued growth in the utilities, trade and transportation industries. These industries have been the largest employers in the District for the last 11 years, followed closely by agriculture and oil and gas extraction. The education, health and social services industry has seen the greatest increase of establishments in the District over the past decade, although it is the one industry that has experienced a decrease in average pay over that same time frame. The information sector is the smallest industry in the district and has gotten smaller over the last 11 years.

Table 7. Economic Trends in the San Joaquin Valley, 2009-2019 [a]

NAICS	Sector	2009			2014			2019		
		Establish-ments	Employ-ment	Average Annual Pay [c]	Establish-ments	Employ-ment	Average Annual Pay [c]	Establish-ments	Employ-ment	Average Annual Pay
11, 21	Agriculture, Oil and Gas Extraction	7,789	189,766	$29,692	7,438	217,769	$33,068	7,430	217,649	$36,568
23	Construction	6,099	50,178	$55,144	5,377	56,011	$54,022	6,637	70,498	$59,475
31-33	Manufacturing	2,640	105,142	$52,640	2,531	107,702	$53,749	2,715	110,892	$55,863
22, 42, 44-45, 48-49	Utilities, Trade and Transportation	14,041	219,813	$40,871	14,500	246,596	$41,428	16,026	282,861	$43,587
51	Information	602	13,482	$59,608	510	11,035	$68,525	498	6,127	$60,315
52-53	Finance Activities	5,747	44,703	$52,430	5,652	41,123	$55,695	6,443	42,638	$59,747
54-56	Profession and Business Services	7,944	97,494	$45,994	8,391	106,412	$45,985	9,054	116,895	$50,424
61-62	Educational, Health and Social Services	7,503	140,416	$54,050	39,280	184,959	$47,321	53,489	223,552	$48,667
71-72	Leisure and Hospitality	5,960	97,885	$17,407	6,224	111,610	$16,859	7,424	130,279	$19,906
81	Other Services	38,938	53,413	$24,934	5,124	32,856	$33,084	5,603	24,860	$35,245
99	Unclassified	1,730	2,112	$34,651	1,917	3,006	$31,870	4	4	$25,752
SJVAPCD Total/Average [b]		**98,993**	**1,014,404**	**$40,664**	**96,944**	**1,119,079**	**$41,095**	**115,323**	**1,226,255**	**$43,903**

Source: BLS, 2020.

Notes:

[a] Includes all of Kern County.

[b] Annual average pay is a weighted average of the eight counties in the SJV APCD weighted by employment in sector.

[c] Annual average pay is adjusted to 2019 dollars using the BEA (2020) GDP deflator.

Table 8 presents the CAGR of the economic data from Table 7. The number of establishments, employment, and average annual pay have all increased over the last 11 years across the District. Health, education, and social services has seen the greatest growth in establishments and employment over that time frame, but it is the one industry that experienced a decrease in average pay (outside of the unclassified businesses). There are fewer establishments in the agriculture, oil, and gas extraction industry today than there were a decade ago, but employment and pay have both increased. The information industry has experienced the greatest decrease in employment across the District.

Table 8. Compound Annual Growth Rate of Establishments, Employment, and Annual Pay [a]

NAICS	Sector	Establishments			Employment			Average Annual Pay		
		2009-2014	2014-2019	2009-2019	2009-2014	2014-2019	2009-2019	2009-2014	2014-2019	2009-2019
11, 21	Agriculture, Oil and Gas Extraction	-0.92%	-0.02%	-0.47%	2.79%	-0.01%	1.38%	2.18%	2.03%	2.10%
23	Construction	-2.49%	4.30%	0.85%	2.22%	4.71%	3.46%	-0.41%	1.94%	0.76%
31-33	Manufacturing	-0.84%	1.41%	0.28%	0.48%	0.59%	0.53%	0.42%	0.77%	0.60%
22, 42, 44-45, 48-49	Utilities, Trade and Transportation	0.65%	2.02%	1.33%	2.33%	2.78%	2.55%	0.27%	1.02%	0.65%
51	Information	-3.26%	-0.48%	-1.88%	-3.93%	-11.10%	-7.58%	2.83%	-2.52%	0.12%
52-53	Finance Activities	-0.33%	2.65%	1.15%	-1.66%	0.73%	-0.47%	1.22%	1.41%	1.32%
54-56	Profession and Business Services	1.10%	1.53%	1.32%	1.77%	1.90%	1.83%	0.00%	1.86%	0.92%
61-62	Educational, Health and Social Services	39.25%	6.37%	21.70%	5.67%	3.86%	4.76%	-2.62%	0.56%	-1.04%
71-72	Leisure and Hospitality	0.87%	3.59%	2.22%	2.66%	3.14%	2.90%	-0.64%	3.38%	1.35%
81	Other Services	-33.34%	1.80%	-17.62%	-9.26%	-5.42%	-7.36%	5.82%	1.27%	3.52%
99	Unclassified	2.07%	-70.90%	-45.50%	7.31%	-73.40%	-46.58%	-1.66%	-4.17%	-2.92%
SJVAPCD Total/Average		**-0.42%**	**3.53%**	**1.54%**	**1.98%**	**1.85%**	**1.91%**	**0.21%**	**1.33%**	**0.77%**

Source: BLS, 2020.

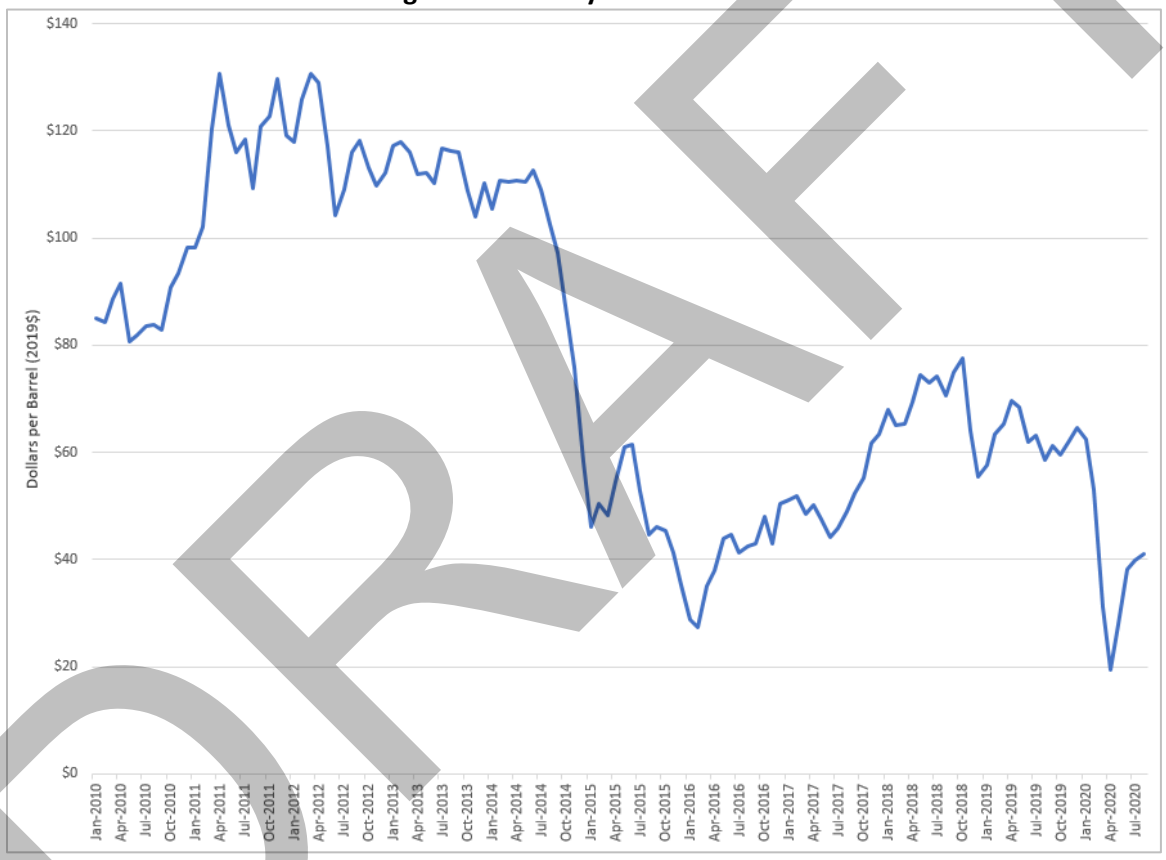
Notes:

[a] Includes all of Kern County.

This proposed rule amendment for flares would primarily impact oil and gas producers in the District. Industry-specific trends, including the price of crude oil, number of producing wells, and overall oil production, are provided below.

Based on U.S. Energy Information Administration (EIA) data, crude oil prices across California have generally increased over the last few years since a significant drop-off in prices at the end of 2014 and into 2015 (EIA, 2020a). In December 2019, the price for a barrel of crude oil was $64.51. This price is below the average monthly price from 2010 to 2019 of $80.74 but is significantly higher than that of January 2016 ($28.83), an increase of 124 percent. Monthly prices from 2010 through July 2020 are shown in Figure 2. Prices dipped considerably in the spring of 2020 (with the onset of the COVID-19 pandemic) but have since started to recover.

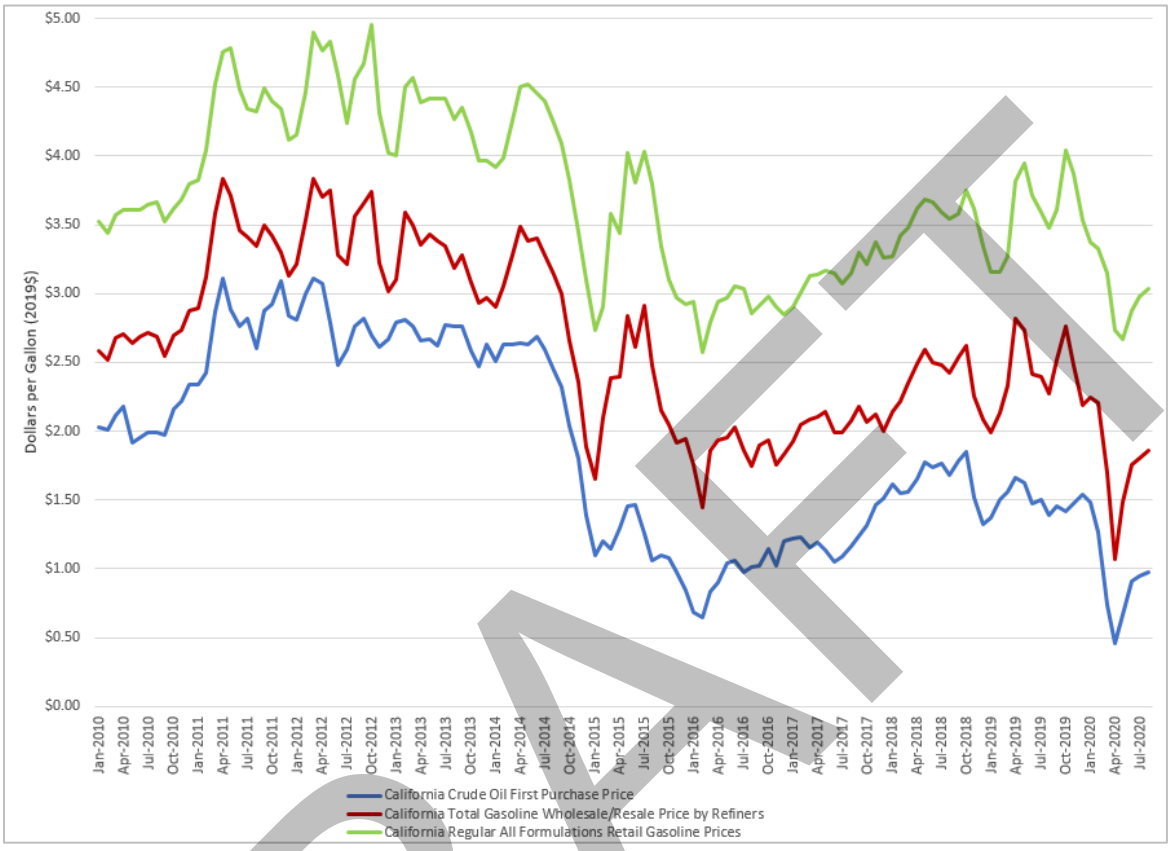
Figure 2. Monthly Crude Oil Price



Source: EIA, 2020a.

Figure 3 shows the same crude oil prices from above converted into dollars per gallon and also compares that price to the wholesale price of refined gasoline and the reformulated gas price from gas stations (in the state of California, all gasoline must be reformulated, so the "All Formulations" price presented in Figure 3 is the same as the reformulated price). The gross margins between the retail price and the wholesale price tend to be greater than those between the wholesale and crude prices. On average over this 10-year time frame, gas stations recognized a gross margin of $1.08 compared to the refineries' gross margin of $0.77 per gallon (EIA, 2020a-c).

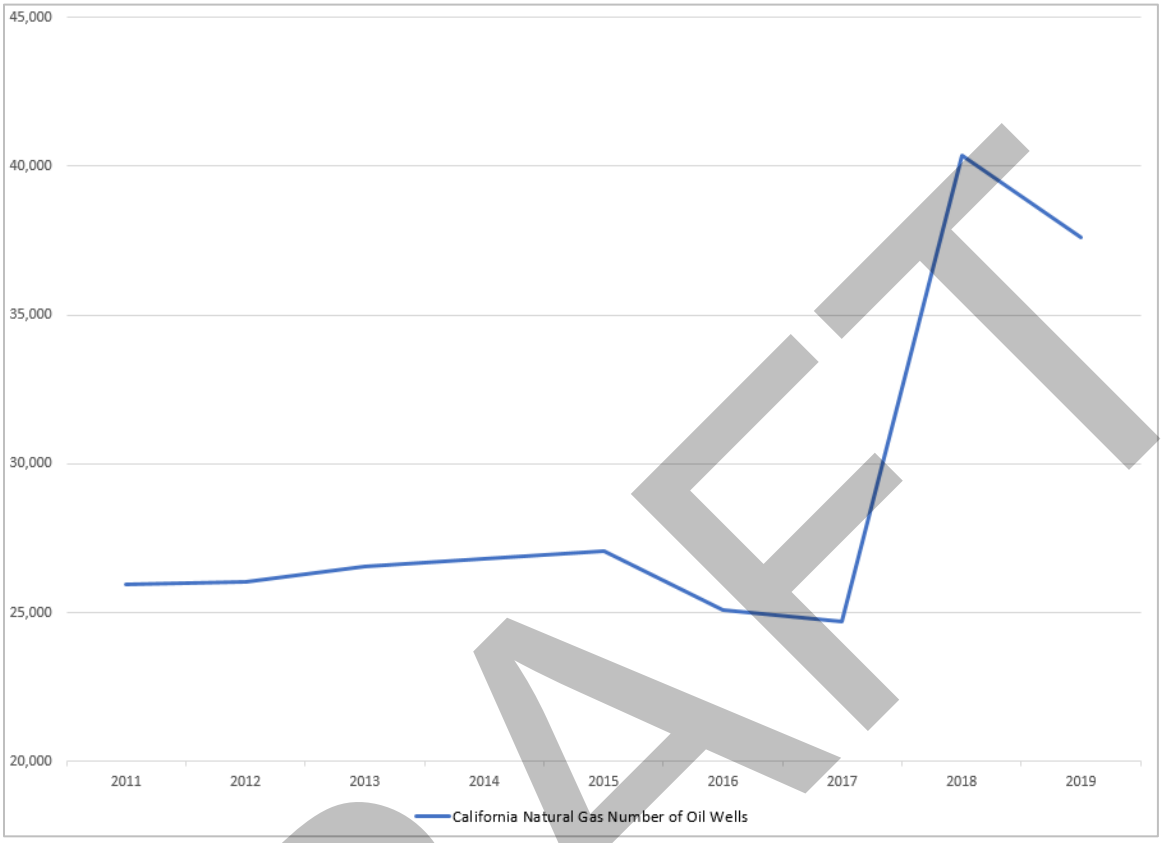
Figure 3. Comparison of California Monthly Price per Gallon of Oil



Source: EIA, 2020a-c.

As presented in Figure 4, the state of California saw a 63 percent increase in the number of oil wells in 2018 from the decade-low mark in 2017 (EIA, 2020d). The number of producing wells decreased in 2019 by 6 percent but is still much higher than at any other point in the last decade.

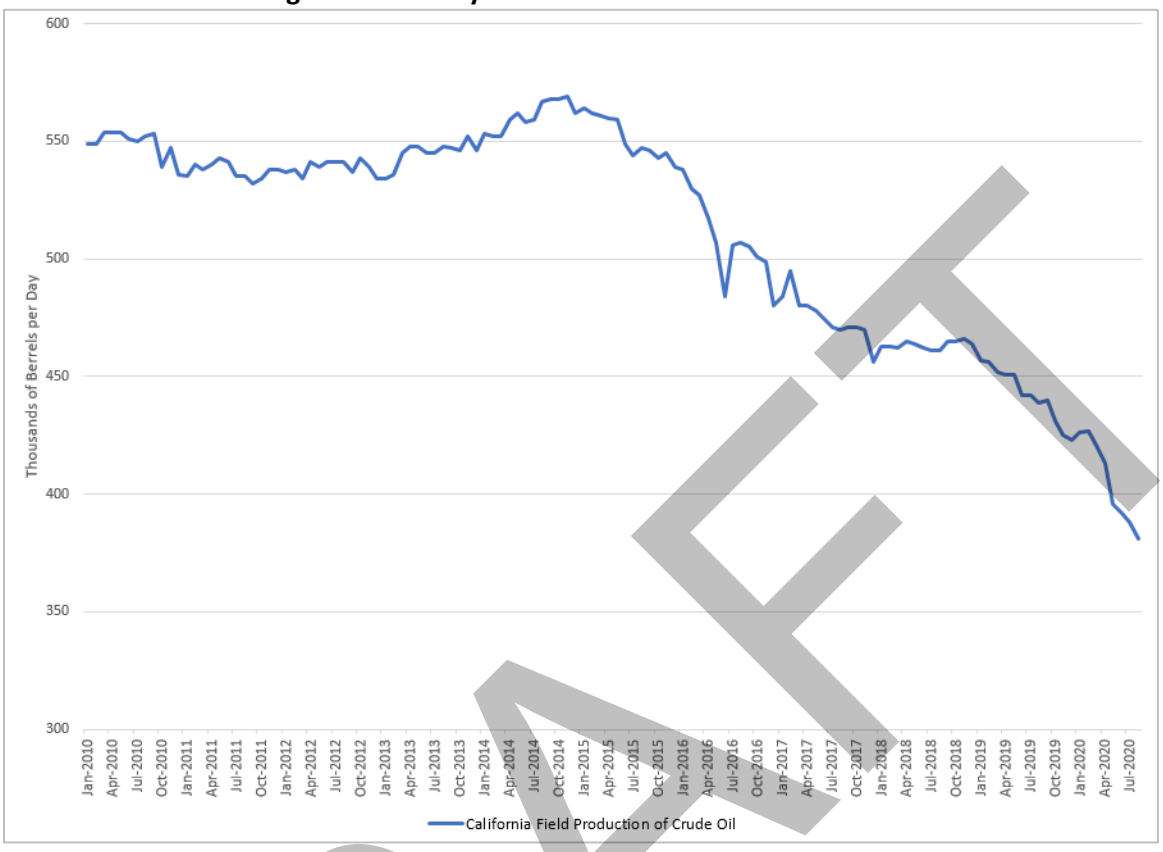
Figure 4. Number of Producing Wells in California



Source: EIA, 2020d.

Oil production has not necessarily coincided with the number of producing wells across California. Monthly crude oil production, as shown in Figure 5, has dropped significantly since a decade-high of 569,000 barrels per day in November 2014 (EIA, 2020e).

Figure 5. Monthly Crude Oil Production in California

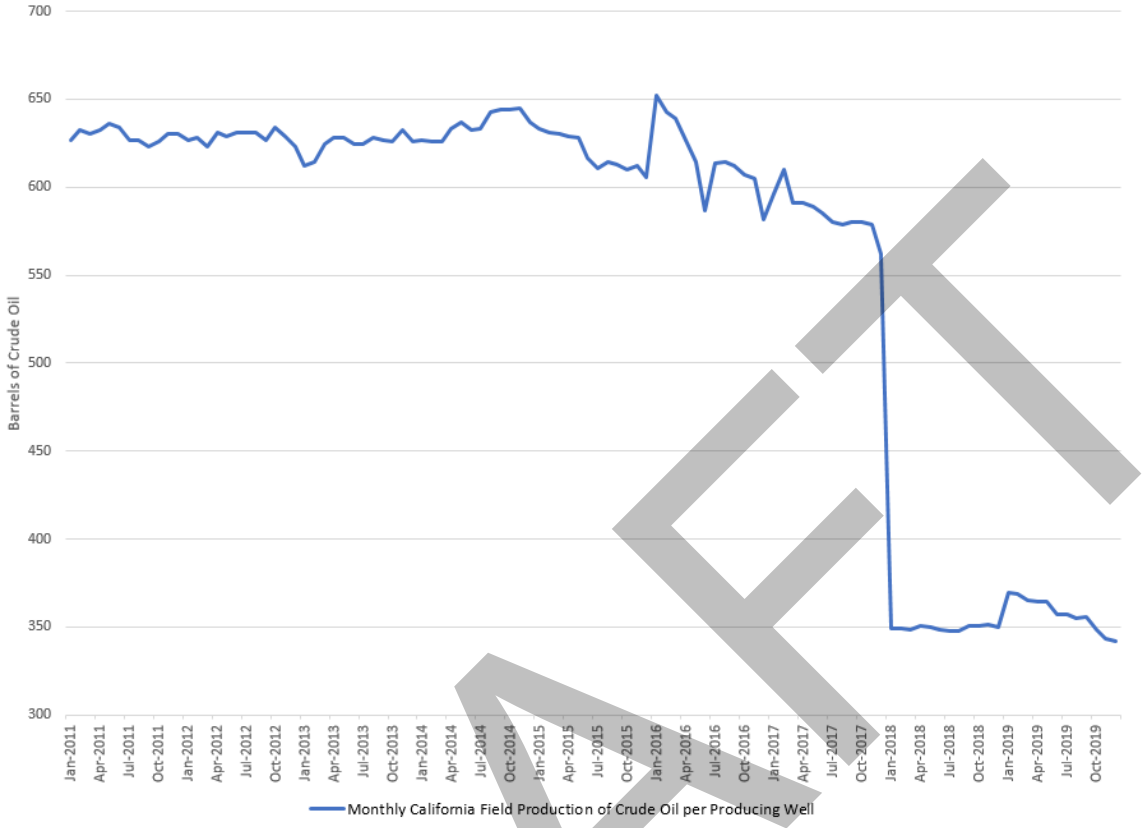


Source: EIA, 2020e.

From 2011 to 2019, oil production per well has generally decreased (EIA, 2020d-e). As shown in Figure 6, 2018 represented a dramatic downturn in per-well production, namely due to the sudden increase in the number of wells producing oil in California that year.

The downward trend since 2016 in both oil production and the number of producing wells seen in Figure 3 through Figure 5 represent the changing dynamics of the oil extraction industry. Fracking has become an increasingly deployed method of oil extraction, especially in top producing states like Texas, North Dakota, and New Mexico. The California state government places more restrictions on this practice than these other states, while some municipalities and counties have outright banned fracking (Nikolewski, 2018). In recent years, state policymakers have also pushed measures that promote renewable energy. California is also a more expensive state for oil companies to operate in. Extraction is more difficult since the oil in California is generally heavier. As a result, many companies have moved to other states such as Texas.

Figure 6. Monthly Crude Oil Production per Producing Well in California

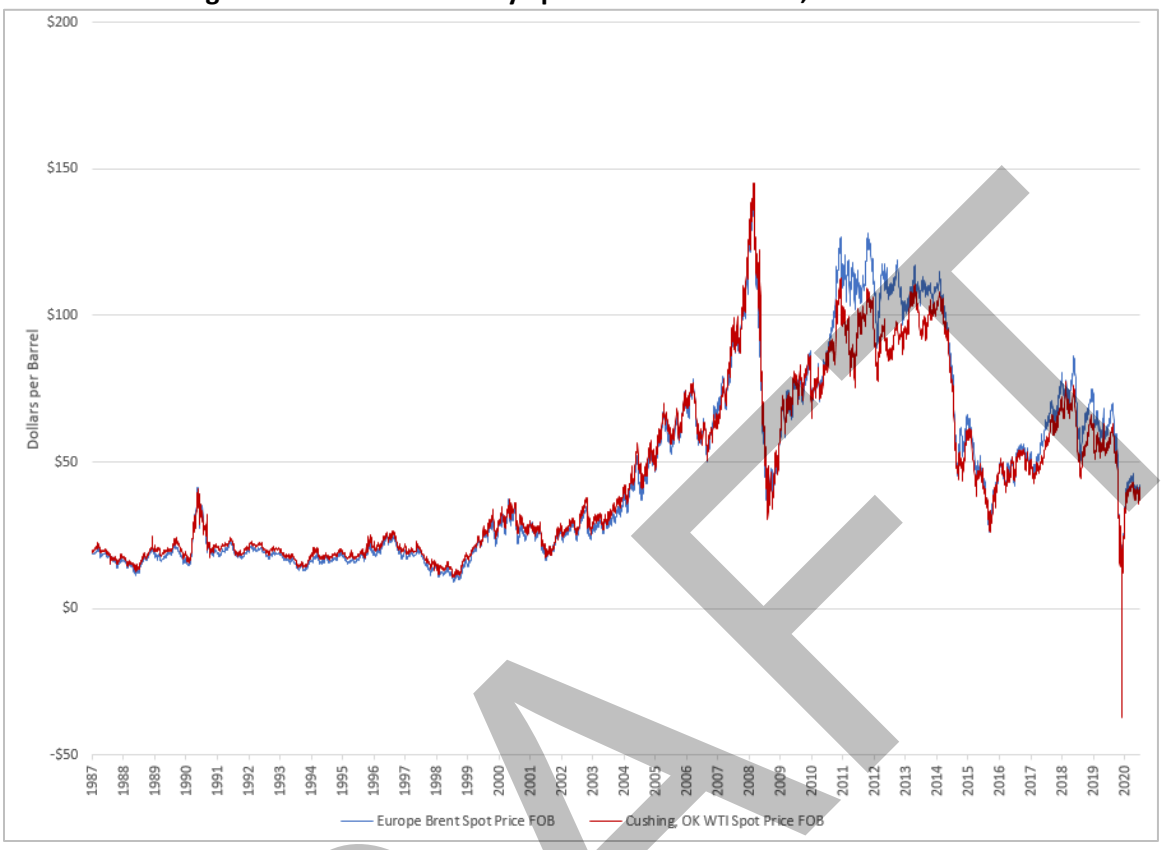


Source: EIA, 2020d-e.

Figure 7 shows daily spot prices for crude oil going back to 1987 (EIA, 2020f-g). There are two main spot price indicators used for crude oil trade: the West Texas Intermediate (WTI) spot price and the Brent Crude spot price. The WTI price is the benchmark in the United States since it refers to oil that is extracted from U.S. wells and sent via pipeline to Cushing, Oklahoma. At the same time, the EIA has determined that the price of Brent crude oil is a better indicator of prices throughout the U.S. than WTI (EIA, 2014). Brent crude oil is extracted from four oil fields in the North Sea and is the price used in nearly two-thirds of contracts globally, making it the global benchmark for crude oil prices (Bradfield, 2018). Of note, both the WTI and Brent spot indicators represent free on board (FOB) prices, which means that the buyer is liable for any damage to the goods while being shipped to them.

As can be seen in Figure 7, the WTI crude oil price dropped below zero for one day in April 2020, the first time this had ever happened. This was determined to be the result of weak demand (likely due to a decrease in travel across the country due to the COVID-19 pandemic), storage capacity reaching its limits, and unconstrained oil production (Wallace, 2020). It has since begun to recover, although not to 2019 levels.

Figure 7. WTI vs Brent Daily Spot Price of Crude Oil, 1987-Present



Source: EIA, 2020f-g.

3.3. IMPACTS OF THE COVID-19 PANDEMIC

The COVID-19 pandemic has resulted in the third oil price collapse that the oil and gas extraction industry has seen in just the last 12 years. This price shock, unlike the previous two, was swift, resulting in wide-ranging changes across the industry in a short period of time. Stay-at-home orders in California and around the world resulted in depressed demand for gas. Even as some of these restrictions have now eased, a combination of job losses and remote work means that far fewer people are commuting. Travel for recreational activities is reduced as well, whether because facilities are closed or have restrictions in place or because people are reluctant to expose themselves to illness. Those who have lost their jobs as a result of the coronavirus are conscious of their expenses, including on travel.

The COVID-19-driven lack of demand coincided with a massive oversupply of oil that left the industry with very little storage space (Kasler, 2020). This combination of supply and demand mismatches resulted in an 87 percent drop in the Brent per-barrel price of oil from January to April of 2020 (McCarthy, 2020). Gas prices have also dropped nationwide. For instance, over a one month period from late February to late March 2020, the price of gas dropped significantly across California, falling from $3.49 to $3.20 statewide, while the prices in the metro areas of Fresno and Madera-Chowchilla both fell from about $3.33 to just under $3.00 over that same timeframe (Sheehan, 2020). The average price of regular unleaded gasoline in California in late September 2020 ($3.22) was about 70 cents

cheaper than a year prior ($3.95) (AAA, 2020).[4] Fresno and Merced Counties have seen similar changes to their average gas prices, albeit with slightly lower prices than the statewide average.

Oil and gas companies started to decrease rate of production in response to demand changes. The number of oil rigs operating across the country has dropped by more than 70 percent since the end of August 2019 (Flores, 2020). California has seen a similar drop in oil rigs within the state, declining from 18 rigs in operation in late August of 2019 to just four at the end of August 2020 (Baker Hughes, 2020). By and large, California's oil and gas production is centered in the San Joaquin Valley, with a majority of oil production in Kern County specifically. Before the pandemic began, nearly 10,000 people were employed within the oil and gas extraction industry in Kern County (Kasler, 2020). Rigs account for about 100 jobs each (Flores, 2020), which means that California's oil and gas industry closures over the past year resulted in the loss of approximately 1,400 jobs.

The pandemic has also halted maintenance projects at refineries and pumps across the globe. With companies either shutdown or at limited working capacity, the supply of spare parts for repairs has dwindled. Maintenance workers are unable to conduct equipment inspections. There will likely be a backlog of maintenance projects after all lockdowns are lifted, and companies will want to get as much maintenance work done as soon as possible given the lost production time (Yagova, George, and Sharafedin, 2020). Typically, companies perform maintenance inspections during lulls in production. Instead, they will need to conduct these inspections when production should be picking up. This will further delay crude production, slowing the industry's ability to recover.

Unlike previous economic hits to the industry, oil and gas extraction will likely not recover quickly from this downturn. Where some industries are hoping for a "V-shaped" recovery, oil and gas extraction is more likely to recover in a "U-shaped," with a protracted downturn before recovery begins (Flores, 2020). The industry will likely be looking at flat or even decreased demand post-pandemic, with technology leading supply response instead of workers (Barbosa et al, 2020).

Because the COVID-19 pandemic has dramatically altered metrics used to estimate socioeconomic impacts, such as revenue and employment, ERG uses a "COVID-adjusted baseline" for these metrics, as discussed further in Section 4.1.2 below.

[4] Not all of the gasoline purchased in California is produced from California crude oil sources: "California produces about one-third of the crude oil it uses. Most of the rest comes from South America, the Middle East and Alaska" (Kasler, 2020). Nonetheless, low gas prices in California and elsewhere affect California oil producers and refineries.

4. SOCIOECONOMIC IMPACT ANALYSIS

ERG calculated the direct impacts of the proposed rule amendments by comparing the costs of compliance to profits of affected facilities. ERG estimated potential employment impacts using IMPLAN's (2020a) input-output model. Additionally, ERG used the IMPLAN model to capture indirect and induced impacts (i.e., impacts that might arise if directly impacted entities reduce purchases from their suppliers and households adjust their spending as a result of changes in earnings).

4.1. DATA SOURCES AND METHODOLOGY

To estimate socioeconomic impacts, ERG compares the costs of compliance with the potential amendments with profits per facility. ERG sought to create a profile, including employment, revenue, profits, and average pay per employee, for each affected sector. The process of estimating each of these profile elements also requires other data to be used (e.g., facility name, address).

This section describes the data sources used to create the baseline industry profile, how this profile was adjusted to capture the impacts of the COVID-19 pandemic, and how socioeconomic impacts were estimated.

The sections that follow detail the resulting profile of affected entities and the socioeconomic impacts of compliance with the potential rule amendments.

4.1.1. Baseline Industry Profile Estimates

SJVAPCD (2020b) provided ERG with an initial list of affected facilities, including fields for facility ID, facility description, Standard Industrial Classification (SIC) code, number of emissions sources, and unit location.

ERG next identified additional data points for use in the analysis. For instance, SJVAPCD's (2020b) facility data includes a SIC code which ERG converted to the North American Industry Classification System (NAICS) codes. NAICS codes are used with other sources of economic data in the analysis based on a combination of U.S. Census Bureau (2020b) concordances.[5] Where a SIC code could map to multiple NAICS codes, ERG used information on companies' websites or other search tools about what type of industry they are engaged in to assign a NAICS code. (See Table A-2 for a list of the NAICS code(s) that mapped to each SIC code.)

Employment and revenue data for most private industries were drawn from the U.S. Census Bureau's (2020b) Economic Census, using 2017 data for California. Where data for certain industries

[5] SIC codes were last updated in 1987, and NAICS codes were first issued in 1997. The U.S. Census Bureau's (2020b) concordances map 1987 SIC codes to 1997 NAICS codes, and from there to the NAICS codes that are revised every five years (thus far in 2002, 2007, 2012, and 2017). SIC and NAICS codes are available at different levels of granularity. The SIC codes used in SJVAPCD's (2020a) data are 4-digit SIC codes, and ERG mapped these to 4-digit NAICS codes.

were not available,[6] ERG instead used estimates from the U.S. Census Bureau's (2015) Statistics of U.S. Businesses for 2012 for California or, if that was not available, the U.S. Census Bureau's (2020c) estimates for 2017 for the U.S.[7]

For the agricultural sector, revenue data are available in the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS, 2019) Census of Agriculture for California for 2017, using the "market value of agricultural products sold." Employment data are drawn from the California Employment Development Department (CA EDD, 2020b) and are for California for 2017.

To estimate average payroll per employee, data for private entities by sector come from BLS' (2020) QCEW. For state and local government entities, data are from the U.S. Census Bureau's (2017a) State and Local Government Employment and Payroll and U.S. Census Bureau's (2017b) Government Units Survey. For federal entities, data are an Office of Personnel Management (OPM, 2017) estimate of the average base salary for full-time permanent employees.

ERG estimated profits for private industries by multiplying revenue figures by the average profit rate for each NAICS for 2010 through 2013 using data from the Internal Revenue Service (IRS, 2016) "SOI Tax Stats - Corporation Source Book." The profit rate was calculated as "Net Income (less deficit)" divided by "Total Receipts."[8] (See Appendix B for profit rates by NAICS code.) For agricultural industries (which are not included in the IRS data at a granular level) ERG used data from the Risk Management Association's (RMA, 2020 Annual Statement Studies). The RMA studies are prepared standardized income statements from data submitted by individual enterprises to assess risk and evaluate financial performance relative to other enterprises in the same industry.

4.1.2. COVID-19-Adjusted Baseline Industry Profile Estimates

To reflect the impact of the COVID-19 pandemic, ERG estimates **"COVID-adjusted" baseline**, which alters employment, revenue, and payroll figures for each facility using IMPLAN (2020a) data. IMPLAN's "Evolving Economy" data use economic data points from the second quarter of 2020 to reflect the impacts on the pandemic, taking into account industry losses, shifts in household spending and behavior, stimulus checks and unemployment benefits, and Paycheck Protection Program (PPP) loans (Demski, 2020). IMPLAN uses only the second quarter 2020 data, adjusts it for seasonality, and annualizes the single quarter of data to represent an entire year. This annualization approach means that IMPLAN models 2020 as if the entire year had an economy like in the early stages of the pandemic, without the relatively normal first quarter of 2020 and without any level of recovery later in the year (Clouse, 2020).

[6] U.S. Census (2020b) Economic Census data were not available for California for NAICS 1151 Support Activities for Crop Production, 2212 Natural Gas Distribution, 2213 Water, Sewage and Other Systems, and 5324 Commercial and Industrial Machinery and Equipment Rental and Leasing.

[7] U.S. Census Bureau (2020c) Statistics of U.S. Businesses estimates for 2017 that include state-level revenue data will not be released until January 2021.

[8] 2013 is the most recent year for which profit rate data are available.

While the IMPLAN data for 2020 reflect the impacts of the COVID-19 pandemic and government response, it is important to note that it does not *only* capture the impacts of the pandemic, as other trends may also be captured in the changes between 2018 and 2020 (Clouse, 2020).

Using outputs of the IMPLAN model, ERG estimates the percentage change in employment, revenue, and payroll by NAICS between 2018 (the second-most recent year for which data are available) and 2020 (the "Evolving Economy" dataset, the most recent estimate). District-wide, this approach suggests that revenue contracted by 8 percent, and employment contracted by 9.9 percent (see Table 9). This likely underestimates the impacts of COVID because of continued economic growth through 2019 into the start of 2020. The impact of COVID is more appropriately against a baseline that incorporates this additional growth. Such a baseline would be higher than it was in 2018, and the economic decline in the second quarter of 2020 due to COVID shown in Table 9 would likely be even larger when compared against the later baseline (were such data available).

Table 9. District-Wide COVID-19 Impacts

	2018	2020 Q2 [a]	% Change
Revenue	$333.1 billion	$306.5 billion	-8.0%
Employment	2.0 million	1.8 million	-9.8%

Source: IMPLAN, 2020a.

Note:

[a] Data are modeled for an entire year as if it were like the second quarter of 2020 (i.e., the early stage of the pandemic.)

To estimate the impacts of the COVID-19 pandemic on individual industries, ERG multiplied the percentage change from 2018 to the second quarter of 2020 in the IMPLAN model by the baseline data to produce "COVID-adjusted" estimates for each NAICS code (which was then mapped onto SIC codes for use in conjunction with the cost data provided by SJVAPCD (2020c)). In most industries, this results in decreased revenue and employment, but *increased* average payroll per employee, reflecting the fact that more workers in lower-paid occupations have been laid off than workers in higher-paid administrative and executive occupations (Clouse, 2020).

The industries with the largest decrease in revenue and employment between 2018 and the second quarter of 2020 include restaurants (a 46.7 percent decrease in revenue and 49.6 percent decrease in employment), support activities for crop production (a 32.2 percent decrease in revenue and 13.9 percent decrease in employment), and dry cleaning and laundry services (a 30.0 percent decrease in revenue and a 34.8 percent decrease in employment).

Notably, some sectors saw substantial revenue growth in 2019 through the first quarter of 2020, and thus appear to show less substantial impacts using the COVID-19-adjusted baseline. These sectors include oil and gas extraction (a 33.6 percent increase in revenue, state and local governments (a 15.0 and 9.6 percent increase in revenue, respectively), hospitals (a 7.4 increase in revenue), and the administrative and support and waste management and remediation service sector (between a 5 and 10 percent increase in revenue, depending on the specific industry).

This increase in revenue in the oil and gas industry and state and local governments is primarily the result of the forces driving economic growth prior to COVID-19. To account for this, IMPLAN's estimated the effect of growth in employment and increased labor productivity in these sectors between 2018 and 2020 prior to COVID-19, which, combined, suggest an increase in output (IMPLAN, 2020c). While IMPLAN's "Evolving Economy" dataset represents their best available estimate of the

economy in 2020 based on the economic data that are currently released, the modeling approach has limitations. For instance, it is not possible to separate trends in an industry sector between 2018 and the second quarter of 2020 from the specific impacts of COVID-19 on the economy between the first and the second quarter of 2020. Using second quarter of 2020 data and applying it to the entire year also does not capture any lagging impacts of the COVID-19 pandemic that may take time to be seen in the data. Given the shortcomings of the dataset, IMPLAN suggests using both the 2018 and 2020 models to compare the results (Clouse, 2020). ERG has done this in the sensitivity analysis in Section 4.4.3 below.

While the pattern recovery from the COVID-19 pandemic is unknown, many sectors may have fully or partially recovered by the time compliance with the potential rule amendments is required. To capture this, while the primary analysis includes the worst-case scenario of no recovery, ERG also performed three sensitivity analyses assuming 30 percent, 70 percent, or 100 percent recovery (i.e., return to the 2018 baseline) (see the results presented in Section 4.4.3).

Note that the industries with lower revenue in 2018 than the second quarter of 2020 in the IMPLAN (2020a) data actually fare worse in terms of economic impacts under the COVID-19 recovery sensitivity analyses, because they are modeled as gradually returning to their (lower) 2018 revenue levels. This includes oil and gas extraction, one of the main industries affected by the potential amendments.

See Appendix B for detail on the revenue, employment, and payroll adjustments for the sectors affected by the potential amendments.

4.1.3. Estimating Impacts on Affected Entities

Cost estimates (i.e., the direct cost of the potential rule amendments by SIC code) were provided by SJVAPCD (2020b). Total costs were calculated by summing the one-time capital costs (annualized over a 10-year period using a 10 percent discount rate) and ongoing annual costs. (Note that this approach does not account for the fact that costs will not be incurred for several years, thus resulting in greater cost and impacts estimates than an approach that takes into account the time value of money.)

To estimate impacts, the direct costs of the rule (i.e., the cost of compliance with the rule) are compared to profits for each SIC code. Because each SIC code can include multiple NAICS codes, and because it is unknown which facilities are those with costs, ERG compared the costs of compliance with the proposed amendments to profits.

To estimate both direct employment impacts of the potential rule amendments and indirect and induced effects, ERG used IMPLAN's (2020a) input-output model. IMPLAN "is a regional economic analysis software application that is designed to estimate the impact or ripple effect (specifically backward linkages) of a given economic activity within a specific geographic area through the implementation of its Input-Output model" (IMPLAN Group LLC, 2020b).

Based on the costs to affected facilities, the IMPLAN model estimates how many jobs might be lost in reaction to the costs to affected firms. It also estimates indirect costs (i.e., the impact to affected firms' suppliers when the direct cost of rule compliance causes affected firms to reduce their purchases from those companies) and induced impacts (i.e., how households that have lost income in turn adjust their purchases).

4.1.4. Aggregating to the Sector Level

While the inputs to the analysis are estimated on a NAICS code or SIC code basis, the results are presented with those more granular industries aggregated into a smaller number of sectors:

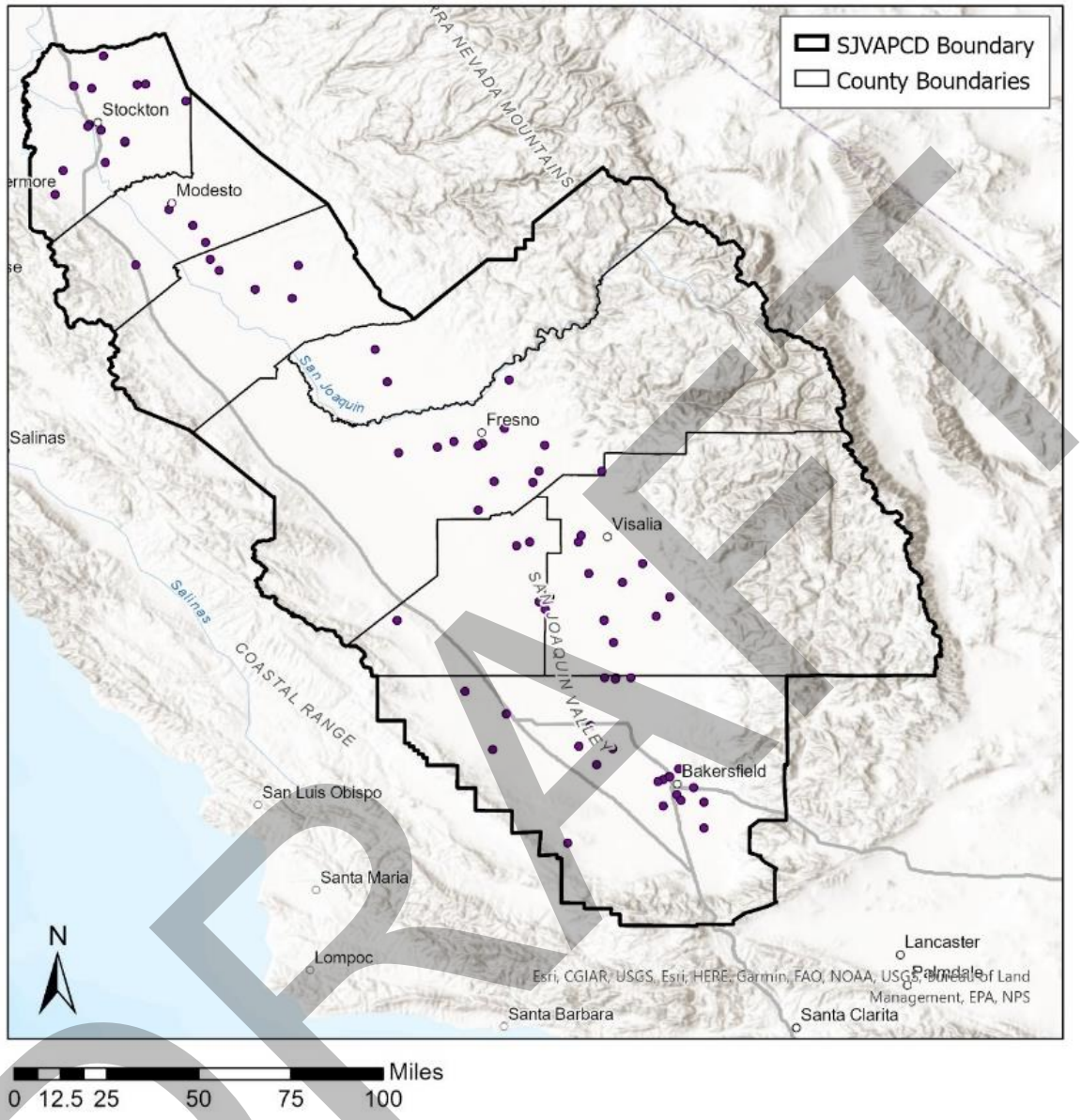
- Oil and Gas Production
- Wastewater Treatment – Major
- Landfill
- Other Industries (those not directly affected by the rule, but that may see indirect or induced impacts).

These SIC code to sector mappings were developed by SJVAPCD (2020c). See Appendix A for a concordance between SIC codes and sectors.

4.2. PROFILE OF AFFECTED ENTITIES

Figure 8 shows the location of facilities operating flares (whether affected by the rulemaking or not). The map was created by using ArcGIS Pro 2.6.0 to geocode the affected facilities. Out of the 167 affected facilities, 92 were mapped while the remaining facilities did not have sufficient location information. Facilities are spread throughout the San Joaquin Valley. There are higher concentrations of facilities near highly populated metro areas, although there are not many facilities located in the center of cities. Many of the unmapped facilities are oil and gas producers, located in fields far from population centers. Kern County contains 99 of these affected facilities, likely owing to the large number of oil and gas facilities located within the county.

Figure 8. Map of Facilities Operating Flares



Source data: SJVAPCD, 2020b; CARB, 2020; ERG estimates.
Map created by ERG using ArcGIS® software by Esri

Table 10 includes a profile of facilities affected by the potential amendments to Rule 4311 (i.e., those that will incur compliance costs). A total of 26 facilities will incur costs for installing ultra-low NOx flare technology.

Table 10. Profile of Facilities Affected by Potential Amendments to Rule 4311—Flares

Sector	Total Facilities	Affected Facilities	% Affected	Total		
				Employees	Revenue	Profits
Oil and Gas Production	74	14	18.9%	604	$1,024,168,123	$75,060,224
Wastewater Treatment – Major [a]	13	2	15.4%	107	$474,087,512	—
Landfill	28	10	35.7%	476	$1,883,250,638	$71,281,368
Other Industries	52	0	0.0%	N/A	N/A	N/A
Total	**167**	**26**	**15.6%**	**1,187**	**$3,381,506,273**	**$146,341,592**

Sources: ERG estimates based on SJVAPCD, 2020b; U.S. Census Bureau, 2015; U.S. Census Bureau, 2020b; U.S. Census Bureau 2020c; NASS, 2019; CA EDD, 2020a; U.S. Census Bureau, 2020a; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2017a; U.S. Census Bureau, 2017b; BLS, 2020; IMPLAN, 2020a; OPM, 2017; IRS, 2016; RMA, 2020.
Note:
[a] As government agencies, wastewater treatment facilities do not have profits, so profit values are not shown here.

Table 11 shows the characteristics of the average facility affected by the potential amendments to Rule 4311. (The exact characteristics of individual facilities could be either higher or lower than these average estimates.)

Table 11. Characteristics of Average Facilities Affected by Potential Amendments to Rule 4311—Flares

Sector	Average per Facility			Average Annual Pay per Employee
	Employees	Revenue	Profits	
Oil and Gas Production	43	$73,154,866	$5,361,445	$38,934
Wastewater Treatment – Major [a]	54	$237,043,756	—	$23,376
Landfill	48	$188,325,064	$7,128,137	$29,973
Average	**46**	**$130,057,934**	**$5,628,523**	**$33,935**

Sources: ERG estimates based on SJVAPCD, 2020b; U.S. Census Bureau, 2015; U.S. Census Bureau, 2020b; U.S. Census Bureau 2020c; NASS, 2019; CA EDD, 2020a; U.S. Census Bureau, 2020a; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2017a; U.S. Census Bureau, 2017b; BLS, 2020; IMPLAN, 2020a; OPM, 2017; IRS, 2016; RMA, 2020.
Note:
[a] As government agencies, wastewater treatment facilities do not have profits, so profit values are not shown here.

4.3. COMPLIANCE COST ESTIMATES

Compliance costs were estimated by SJVAPCD (2020c), and include:

- One-time costs for replacement with ultra-low NOx flare technology by January 1, 2024.
- Annual operating and maintenance (O&M) costs for the new flares, beginning by January 1, 2024, and continuing indefinitely.

Total costs are calculated by annualizing the one-time retrofit costs that will be incurred by 2024 over a 10-year period using a 10 percent interest rate, and then summing annualized one-time costs and annualized costs to yield the total.[9]

[9] Note that this is a conservative cost estimate in the sense that costs that will not be incurred until the beginning of 2024 are not discounted to account for the time value of money between 2024 and now.

Table 12 shows the one-time, annual, and total annualized costs incurred by sector. Costs would total **$7.4 million**, with the majority of these incurred by the "Oil and Gas Production" sector.

Table 12. Costs of Compliance with Potential Amendments to Rule 4311—Flares

Sector	Retrofit Capital Costs [a]	Retrofit O&M Costs [b]	Total Annualized Costs [d]
	One-Time	Annual	Annualized One-Time + Annual
	2024	2024+	—
Oil and Gas Production	$28,223,558	$513,156	$5,106,410
Wastewater Treatment – Major	$1,398,425	$109,936	$337,523
Landfill	$8,157,588	$641,301	$1,968,911
Total	**$37,779,571**	**$1,264,393**	**$7,412,844**

Source: SJVAPCD, 2020c.

[a] Includes one-time capital costs for retrofit with ultra-low NOx flare technology.

[b] Includes operating and maintenance costs for the new units.

[c] The total annualized cost is calculated by summing annualized one-time costs (annualized over a 10-year period using a 10 percent discount rate) and annual costs.

4.4. IMPACTS ON AFFECTED ENTITIES

4.4.1. Direct Impacts

One possible metric for determining economic feasibility is a comparison of total annualized costs to profits for affected facilities, with a threshold of 10 percent of profits indicating a finding of a finding of significant adverse impact (Berck, 1995). Therefore, ERG uses this comparison to aid in the District's determination of economic feasibility of the rule amendments.

As shown in Table 13, overall rule impacts are approximately **5.1 percent of profits.** The "Oil and Gas Production" sector would face the highest impacts, at **6.8 percent** of profits.

Table 13. Economic Impacts for Entities Affected by Potential Amendments to Rule 4311—Flares

Sector	Average Annualized Cost per Facility	Average Profits per Facility	Cost as % Profits
Oil and Gas Production	$364,744	$5,361,445	6.80%
Wastewater Treatment – Major [a]	$168,762	—	—
Landfill	$196,891	$7,128,137	2.76%
Average	**$285,109**	**$5,628,523**	**5.07%**

Sources: ERG estimates based on SJVAPCD, 2020b; SJVAPCD, 2020c; U.S. Census Bureau, 2015; U.S. Census Bureau, 2020b; U.S. Census Bureau 2020c; NASS, 2019; CA EDD, 2020a; U.S. Census Bureau, 2020a; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2017a; U.S. Census Bureau, 2017b; BLS, 2020; IMPLAN, 2020a; OPM, 2017; IRS, 2016; RMA, 2020.

Note:

[a] As government agencies, wastewater treatment facilities do not have profits, so profit values are not shown here.

4.4.2. Employment, Indirect and Induced Impacts

In addition to the primary metric for estimating direct impacts on revenue (i.e., costs), ERG also assessed potential direct impacts on employment, indirect impacts, and induced impacts using IMPLAN's (2020a) input-output model. The IMPLAN model uses the direct costs of the rule to estimate "ripple effect (specifically backward linkages) of a given economic activity within a specific geographic area through the implementation of its Input-Output model" (IMPLAN, 2020b).

Outputs from the IMPLAN model include:

- **Direct employment impacts** caused if facilities with compliance costs under the potential amendments were to attempt to offset these costs by reducing the number of employees.
- **Indirect revenue and employment impacts** that capture how directly affected firms might react to the direct cost of rule compliance by reducing purchases from their suppliers, and how those suppliers might in turn reduce employees.
- **Induced revenue and employment impacts** that capture how households will adjust their spending as a result of any changes in earnings.

Table 14 summarizes these impacts, which, taken together, could have a total impact on the District economy of **$8.0 million and 18 jobs.**

Table 14. Direct, Indirect, and Induced Impacts of Potential Amendments to Rule 4311—Flares

Sector	Direct		Indirect		Induced		Total	
	Revenue (Costs)	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment
Oil and Gas Production	$5,106,410	6	$15,360	0	$957	0	$5,122,727	6
Wastewater Treatment – Major	$337,523	1	$3,879	0	$986	0	$342,389	1
Landfill	$1,968,911	9	$66,347	0	$2,033	0	$2,037,291	9
Other Industries	$0	0	$290,871	1	$218,116	1	$508,987	2
Total	**$7,412,844**	**15**	**$376,457**	**1**	**$222,092**	**1**	**$8,011,393**	**18**

Sources: ERG estimates based on SJVAPCD, 2020b; SJVAPCD, 2020c; U.S. Census Bureau, 2015; U.S. Census Bureau, 2020b; U.S. Census Bureau 2020c; NASS, 2019; CA EDD, 2020a; U.S. Census Bureau, 2020a; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2017a; U.S. Census Bureau, 2017b; BLS, 2020; IMPLAN, 2020a; OPM, 2017; IRS, 2016; RMA, 2020.

Table 15 compares these impacts to the total size of the District economy (as estimated in the IMPLAN model). These impacts represent **less than 0.01 percent** of revenue and employment District-wide.

Table 15. Comparison of Total Impacts against the District-Wide Economy for Potential Amendments to Rule 4311—Flares

	Total Rule Impacts	Size of District Economy [a]	% of District Economy
Revenue	$8,011,393	$306,518,988,618	0.003%
Employment	18	1,806,161	0.001%

Source: ERG estimates based on IMPLAN, 2020a.

Note:

[a] While the SJVAPCD only includes a portion of Kern County, the data shown here include the whole of the county.

4.4.3. COVID-19 Sensitivity Analysis

As discussed in Section 4.4.3, the primary estimates used in this analysis reflect a "COVID-19-adjusted baseline" where the baseline economic indicators are adjusted using the percentage change between IMPLAN's (2020a) 2018 and second quarter of 2020 "Evolving Economy" model. ERG also conducted three sensitivity analyses that capture varying degrees of economic recovery from the pandemic (i.e., 30 percent, 70 percent, 100 percent).

Table 16 shows how the results of the analysis would vary under these three recovery sensitivity analyses. Counter-intuitively, costs as a percentage of profits would actually *increase* under the recovery scenarios. This is because the sector most heavily impacted by the rule, "Oil and Gas Production," has higher revenue in IMPLAN's (2020a) model under the 2018-based 100 percent recovery scenario than under the second quarter of 2020 model used for the primary estimate.

Induced impacts also increase slightly with greater COVID-19 recovery, likely because IMPLAN's (2020a) 2020 model takes into account changes in household income and spending patterns (e.g., stimulus checks, unemployment checks, increased saving) that are removed in the recovery scenarios.

Table 16. Results of COVID-19 Sensitivity Analyses for the Impacts of Rule 4311—Flares

Analysis	Recovery from COVID-19 Baseline	Direct			Indirect		Induced		Total	
		Revenue (Costs)	Costs % Profits	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment
Primary Estimate	0%	$7,412,844	5.07%	16	$441,314	2	$189,155	1	$8,043,314	19
Sensitivity Analysis 1	30%	$7,412,844	5.34%	16	$421,857	1	$199,037	1	$8,033,738	18
Sensitivity Analysis 2	70%	$7,412,844	5.76%	16	$395,914	1	$212,211	1	$8,020,970	18
Sensitivity Analysis 3	100%	$7,412,844	6.11%	15	$376,457	1	$222,092	1	$8,011,393	18

Sources: ERG estimates based on SJVAPCD, 2020b; SJVAPCD, 2020c; U.S. Census Bureau, 2015; U.S. Census Bureau, 2020b; U.S. Census Bureau 2020c; NASS, 2019; CA EDD, 2020; U.S. Census Bureau, 2020a; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2017a; U.S. Census Bureau, 2017b; BLS, 2020; IMPLAN, 2020a; OPM, 2017; IRS, 2016; RMA, 2020.

4.5. IMPACTS ON SMALL ENTITIES

The entities affected by the potential amendments may include small entities (i.e., small businesses and/or small government entities).

For private entities, small businesses are defined in the California Small Business Procurement and Contract Act (Cal. Gov't Code § 14837) as an independently owned and operated, non-dominant business with principal office located in California with fewer than 100 employees and earning less than $15 million in revenues.

For government entities, the Regulatory Flexibility Act definition is that "a small governmental jurisdiction is a government of a city, county, town, township, village, school district, or special district with a population of less than 50,000."

Because ERG did not estimate costs on a facility-specific basis, it is not possible to identify whether any small entities are among the facilities that will incur costs under the potential rule. To the extent that small entities face similar costs to large entities but have lower profits, compliance costs will make up a greater proportion of their profits. However, since the majority of the flares that are anticipated to incur costs to comply with the rule are located at local government facilities (landfills, wastewater treatment plant) or at oil and gas facilities, many of which are large employers, the impact of this rule on small businesses as defined above may not be significant.

4.6. IMPACTS ON AT-RISK POPULATIONS

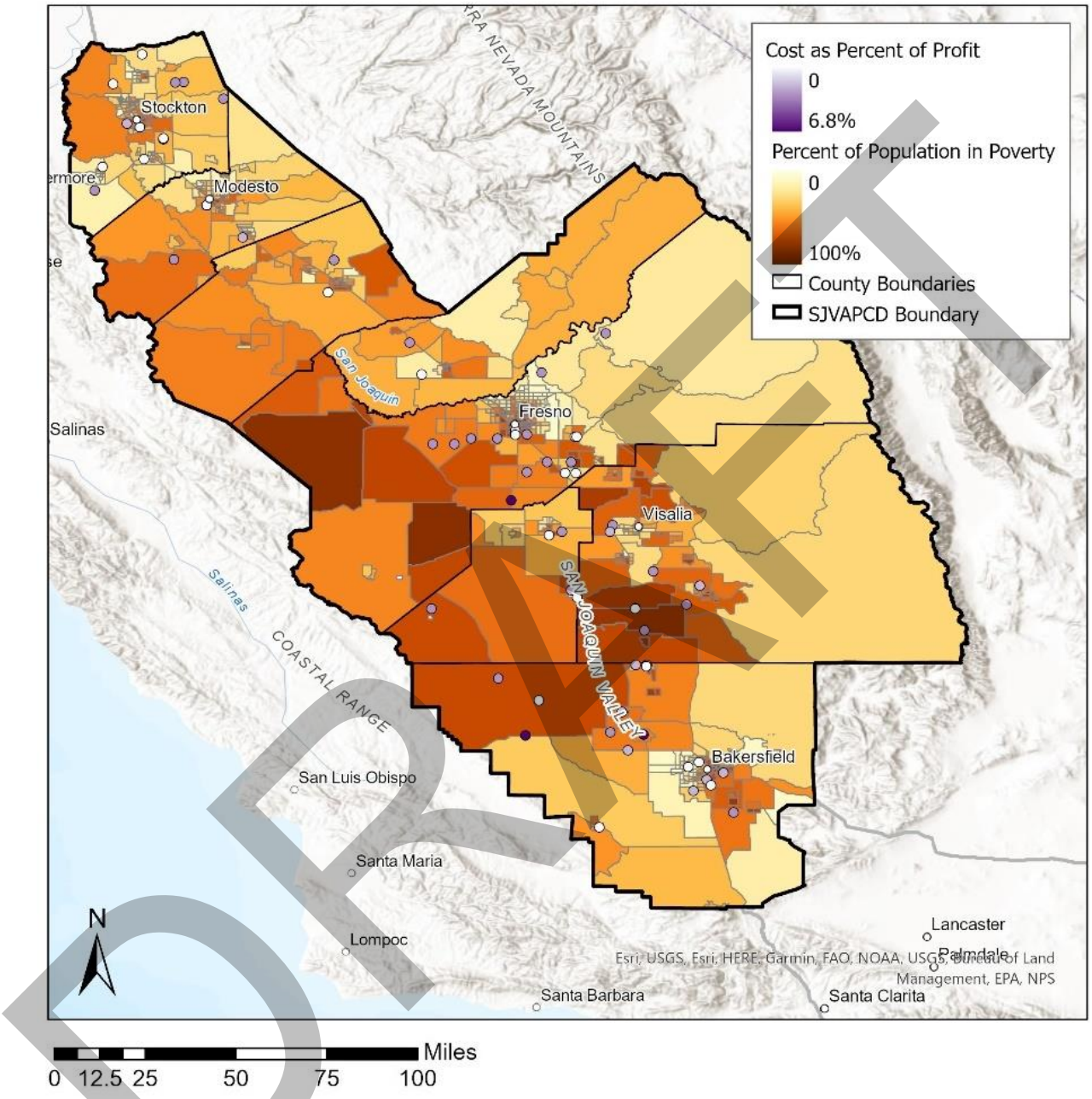
Cal. Gov't Code § 65040.12 defines environmental justice as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies."

The entities affected by the potential amendments may operate facilities in areas with a high number of at-risk populations. To help further the District's environmental justice goals, ERG overlaid data on the impacts of the rule with data on poverty using data from CalEnviroScreen 3.0 (OEHHA, 2018). (Note that not every facility in a given industry will necessarily be impacted by the rule, but this analysis does not include an assessment of impacts on individual facilities.)

Figure 9 presents the percent of the population living below two times the poverty rate overlaid with potentially affected facilities. While there is no statistical correlation between affected facilities and poverty, many of the potentially impacted facilities are located in census tracts with high percentages of the population living in poverty[10]. The majority of facilities face impacts of over six percent. These facilities are primarily in the "Oil and Gas Production" sector, most of which are located in Kern County. Many of these facilities are not represented on the map due to insufficient address information. This could impact vulnerable populations in Kern County, which is one of two counties that has experienced a decline in median income from 2010 to 2018 and experienced a smaller decline in poverty rate compared to the other counties in the District.

[10] Correlation was assessed using the Generalized Linear Regression tool in ArcGIS Pro 2.6.0 and found $R^2 = 0$.

Figure 9. Map of Facilities in Relation to Population Living in Poverty



Source data: SJVAPCD, 2020b; CARB, 2020; ERG estimates; OEHHA, 2018.

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APPENDIX A. SECTOR, SIC CODE, AND NAICS CODE CONCORDANCES

Table A-1 shows the concordance between SIC codes and sectors developed by SJVAPCD (SJVAPCD, 2020c). SIC codes that were not in the original concordance but that might have indirect and induced impacts were assigned the sector "Other Industries."

Table A-1. SIC Code to Sector Concordance used to Analyze the Impacts of 4311—Flares

SIC Code	SIC Industry	Sector
1311	Crude Petroleum and Natural Gas	Oil and Gas Production
4952	Sewerage Systems	Wastewater Treatment – Major
4953	Refuse Systems - Materials Recovery Facilities	Landfill

Source: SJVAPCD, 2020c.

Table A-2 shows the NAICS codes that map to the SIC codes used in the analysis (limited to the NAICS codes assigned to the facilities in the District that may be affected by the potential amendments). This concordance was primarily developed using the U.S. Census Bureau's (2020a) SIC to NAICS concordances. Where multiple NAICS codes map to one SIC code, ERG used information on companies' websites or other search tools about what type of industry they are engaged in to assign a NAICS code.

Table A-2. SIC to NAICS Concordance for Facilities that may be Affected by Potential Amendments to Rule 4311—Flares

SIC Code	SIC Industry	Corresponding NAICS
1311	Crude Petroleum and Natural Gas	2111 (Oil and Gas Extraction)
4952	Sewerage Systems	9993 (Local Government)
4953	Refuse Systems - Materials Recovery Facilities	5622 (Waste Treatment and Disposal), 9993 (Local Government)

Source: ERG estimates based on SJVAPCD, 2020b; U.S. Census Bureau, 2020a.

APPENDIX B. PROFIT RATES BY NAICS INDUSTRY

Table B-1 shows the profit rates used for private industry, which were estimated using the average rate for 2000 through 2013 data from the Internal Revenue Service (IRS, 2016) "SOI Tax Stats - Corporation Source Book."

Table B-1. Profit Rate by NAICS Industry for Facilities Affected by Rule 4311—Flares

NAICS	Industry	Average	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2111	Oil and Gas Extraction	7.33%	6.53%	5.55%	0.85%	5.50%	8.04%	14.89%	16.06%	11.11%	10.31%	2.50%	8.29%	5.99%	3.50%	3.50%
5622	Waste Treatment and Disposal	3.47%	1.83%	2.78%	1.49%	-0.78%	3.05%	5.19%	-1.57%	6.69%	4.14%	6.25%	6.27%	4.23%	4.92%	4.13%
9993	Local Government	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Source: ERG estimates based on IMPLAN, 2020a.

Note: Profit rate calculated as "Net Income (less deficit)" divided by "Total Receipts."

APPENDIX C. COVID-19 BASELINE ADJUSTMENTS BY NAICS INDUSTRY

Table C-1 shows the percentage change in revenue, employment, and average pay per employee by NAICS code, derived by comparing IMPLAN's (2020) datasets for 2018 and the "Evolving Economy" dataset developed using data for the second quarter of 2020.

Table C-1. COVID-19 Adjustments by NAICS Industry for Facilities Affected by Rule 4311—Flares

NAICS	Industry	COVID-19-Adjusted Change in Baseline		
		Revenue	Employment	Average Pay
2111	Oil and Gas Extraction	33.55%	29.86%	6.47%
5622	Waste Treatment and Disposal	9.90%	3.37%	7.41%
9993	Local Government	9.59%	4.86%	5.84%

Source: ERG estimates based on IMPLAN, 2020a.