APPENDIX D

Socioeconomic Analysis for Proposed Amendments to Rule 4354 (Glass Melting Furnaces)

December 16, 2021

This page intentionally blank.

POTENTIAL AMENDMENTS TO RULE 4354—GLASS MELTING FURNACES

SOCIOECONOMIC IMPACT ANALYSIS

Final

December 9, 2021

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. 21-4-22

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1. EXECUTIVE SUMMARY

This report contains ERG's analysis of the socioeconomic impacts of potential amendments to the San Joaquin Valley Air Pollution Control District (SJVAPCD or District) Rule 4354—Glass Melting Furnaces. Potential amendments to Rule 4354 are planned to take place in two stages, with reductions in sulfur oxide emissions (SOx), nitrogen oxide (NOx), and particulate matter (PM10) emissions starting in 2024, and further reductions in nitrogen oxide (NOx) emissions required by 2030.

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, both the "Flat Glass" and "Glass Container" sectors would experience significant adverse socioeconomic impacts, defined as costs that amount to 10 percent or more of profits (Berck, 1995).

Table 1. Summary of Socioeconomic Impacts due to Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Total Facilities	Facilities w/ Costs	Total Annualized Cost [a]	Average Annualized Cost per Facility	Average Profits per Facility	Cost as % Profits
Flat Glass	2	2	$1,898,273	$949,136	$2,536,800	37.41%
Glass Container	3	3	$5,059,749	$1,686,583	$8,839,780	19.08%
Fiberglass	1	0	$0	$0	$5,791,644	0.00%
Total/Average	**6**	**5**	**$6,958,021**	**$1,159,670**	**$6,230,764**	**18.61%**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.
[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.

As a secondary measure of impacts, ERG also used the IMPLAN (2021) 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 a sensitivity analysis to assess how varying degrees of recovery from the effects of the COVID-19 pandemic might affect the results of the analysis. Impacts would change slightly with a less than full recovery.

2. INTRODUCTION AND BACKGROUND

This report provides economic data and analysis in support of the San Joaquin Valley Air Pollution Control District's (SJVAPCD or District) assessment of the socioeconomic feasibility of potential amendments to existing Rule 5354 for glass melting furnaces. This work was performed by ERG under District Agreement No. 21-4-22.

Facilities with glass melting furnaces in the District produce container glass, flat glass, and fiberglass (SJVAPCD, 2020). Existing District rule 4354 (last revised in 2011) limited NOx, CO, VOC, SOx, and PM10 emissions from these furnaces (SJVAPCD, 2011; SJVAPCD, 2020). The potential amendments to Rule 4354 would satisfy the commitments included in the 2018 PM2.5 Plan to reduce SOx and NOx emissions from container and flat glass furnaces (SJVAPCD, 2020).

This analysis was prepared 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 a 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.

Overall, the region has seen annual average population growth 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, 2020a.

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 2019 (U.S. Census Bureau, 2020b). Median income growth rates varied across counties from 2010 to 2019, though the counties in the District as a whole had a CAGR of 1.32 percent overall; this is lower than the growth rate of median income for the state of California (2.23 percent). Kern County is the only county that experienced a decline in median income (-0.03 percent) while all other counties experienced some level of growth. Merced County has a notably higher growth rate of 2.66 percent. It is the only county in the District where median income increased at a rate faster than the state.

Table 3. Median Income by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	$53,461	$49,572	$47,299	$49,049	$47,607	$50,988	$52,357	$54,645	$54,217	$58,215	1.07%
Kern [a]	$53,820	$52,371	$52,165	$52,348	$52,235	$55,759	$53,633	$52,592	$53,136	$53,710	-0.03%
Kings	$52,738	$58,302	$52,194	$51,114	$46,907	$49,682	$57,213	$60,716	$63,524	$59,161	1.45%
Madera	$57,064	$53,930	$47,767	$44,396	$46,522	$51,206	$55,518	$54,099	$58,004	$65,612	1.76%
Merced	$50,184	$46,385	$49,537	$45,433	$48,332	$45,610	$51,308	$50,356	$59,488	$61,908	2.66%
San Joaquin	$59,124	$58,890	$57,633	$57,432	$56,637	$58,325	$63,967	$64,523	$66,054	$69,833	2.10%
Stanislaus	$56,799	$51,042	$52,728	$53,557	$56,007	$56,868	$58,364	$62,782	$62,142	$63,801	1.46%
Tulare	$51,305	$47,673	$45,793	$44,021	$46,717	$46,062	$49,311	$48,807	$50,290	$58,391	1.63%
SJVAPCD [a]	**$54,605**	**$52,046**	**$51,001**	**$50,891**	**$51,126**	**$53,112**	**$55,339**	**$56,292**	**$57,503**	**$60,627**	**1.32%**
California	**$68,224**	**$66,341**	**$66,275**	**$67,211**	**$67,136**	**$70,049**	**$72,803**	**$75,748**	**$77,549**	**$81,414**	**2.23%**

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

Notes:

[a] Inflated values to 2020$ 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 SJV is a weighted average by population

Poverty rates by county for the last decade are shown in Table 4. The poverty rate decreased in every county in the District in that time frame. The poverty rate within the District is higher than the state average and declining at a slower rate overall compared to the state of California's rate of -3.58 percent. Fresno and Tulare Counties have consistently had among the highest poverty rates in the District while Stanislaus and San Joaquin Counties have had the two lowest. These two counties, plus Kings and Merced Counties, have CAGRs lower than the state's. Despite its notable CAGR of median household income, Merced County had high poverty rates for most of the past decade. That trend changed in 2019, with the county poverty rate dropping from 22.0 percent in 2018 to 16.8 percent in 2019.

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

Table 4. Poverty Rate by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2019
Fresno	26.8%	25.8%	28.4%	28.8%	27.7%	25.3%	25.6%	21.1%	21.5%	20.6%	-3.24%
Kern [a]	21.2%	24.5%	23.8%	22.8%	24.8%	21.9%	22.7%	21.4%	20.6%	19.1%	-1.30%
Kings	22.2%	20.5%	21.2%	21.4%	26.6%	23.6%	16.0%	18.2%	19.2%	15.2%	-4.62%
Madera	21.0%	24.3%	23.6%	23.6%	22.2%	23.4%	20.3%	22.6%	20.9%	17.6%	-2.18%
Merced	23.0%	27.4%	24.3%	25.2%	25.2%	26.7%	20.3%	23.8%	22.0%	16.8%	-3.85%
San Joaquin	19.2%	18.1%	18.4%	19.9%	20.9%	17.4%	14.4%	15.5%	14.2%	13.7%	-4.13%
Stanislaus	19.9%	23.8%	20.3%	22.1%	18.0%	19.7%	14.2%	13.5%	15.6%	12.7%	-5.46%
Tulare	24.5%	25.7%	30.4%	30.1%	28.6%	27.6%	25.2%	24.6%	22.5%	18.8%	-3.26%
SJVAPCD [a]	**22.5%**	**23.8%**	**24.2%**	**24.6%**	**24.3%**	**22.7%**	**20.6%**	**19.7%**	**19.3%**	**17.3%**	**-3.25%**
California	**15.8%**	**16.6%**	**17.0%**	**16.8%**	**16.4%**	**15.3%**	**14.3%**	**13.3%**	**12.8%**	**11.8%**	**-3.58%**

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

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 2019. While there has been a decline in the number of people below the poverty line from 2010 to 2019, the number has fluctuated during this period. The number of people in poverty grew by over 100,000 between 2010 and 2014, but has been in decline since 2014.

The CAGR of population below the poverty line varies across counties. Fresno County has the largest population below the poverty line as of 2019, which coincides with its large population and relatively higher poverty rate. Conversely, Stanislaus, Kings, and Merced Counties have experienced a decline in poverty at a faster rate than California as a whole.

Table 5. Population Below Poverty Line by County

County	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	CAGR 2010-2018
Fresno	246,196	238,706	264,738	270,072	263,220	242,083	247,507	205,291	209,799	202,698	-2.40%
Kern [a]	171,950	201,230	196,625	189,484	208,388	186,501	193,133	184,619	178,239	166,768	-0.38%
Kings	30,425	27,101	27,819	28,473	35,623	31,453	21,565	24,935	26,299	21,063	-4.49%
Madera	29,936	34,148	33,936	34,242	32,432	34,227	29,736	33,482	31,191	26,093	-1.70%
Merced	58,360	70,243	62,448	64,552	65,405	70,118	53,314	63,485	59,283	45,396	-3.09%
San Joaquin	128,748	123,258	126,610	137,663	146,601	123,817	103,399	113,136	104,622	101,591	-2.92%
Stanislaus	101,335	122,212	104,559	114,628	94,586	104,801	76,191	73,254	85,073	69,572	-4.59%
Tulare	107,660	113,515	135,194	135,066	129,485	125,728	114,290	112,524	103,711	86,315	-2.72%
SJVAPCD [a]	**874,610**	**930,413**	**951,929**	**974,180**	**975,740**	**918,728**	**839,135**	**810,726**	**798,217**	**719,496**	**-2.41%**
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**	**4,552,837**	**-2.95%**

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

Notes:

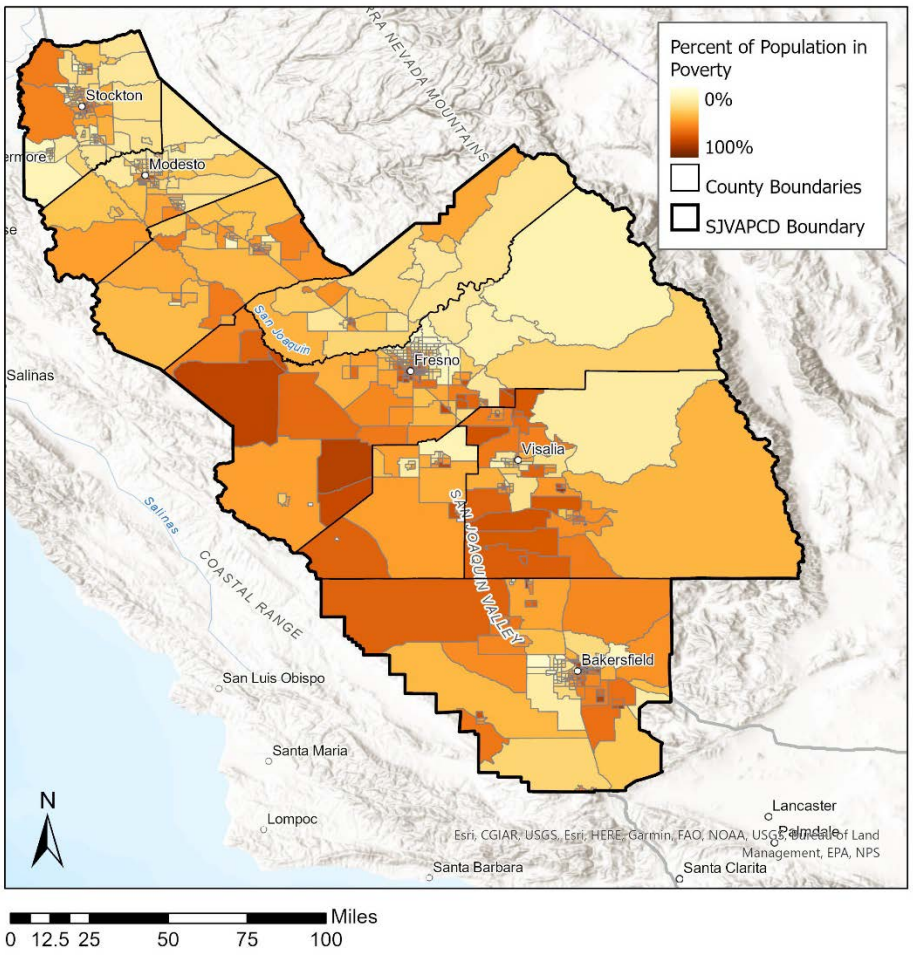
[a] While the SJVAPCD only includes a portion of Kern County, the data shown here are for the whole of the county.

Figure 1 shows where the population in poverty or at risk of poverty lives within the District[2] using CalEnviroScreen 4.0 (OEHHA, 2021a) 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 2015 to 2019. 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, 2021b).

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 4.0 threshold, nearly half (44.9 percent) of District residents are below twice the federal poverty limit (OEHHA, 2021a-b), reflected in the high poverty rates in the map in Figure 1 below.

[2] 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 (2015–2019)



Source: OEHHA, 2021a.
Map created by ERG using ArcGIS® software by Esri.

3.2. REGIONAL ECONOMIC TRENDS

This section tracks the economic trends of 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 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 (0.71 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	379,900	387,500	395,300	402,400	406,900	412,800	418,100	1.48%
Kern [a]	313,400	325,700	340,400	347,200	351,700	350,100	347,700	349,100	354,900	360,800	1.58%
Kings	49,900	49,700	50,000	50,400	50,600	51,600	51,400	52,200	53,000	53,200	0.71%
Madera	51,400	52,000	53,500	54,400	54,900	53,500	55,400	56,000	57,000	57,700	1.29%
Merced	93,200	94,500	96,200	98,000	99,700	101,100	102,200	104,500	105,600	106,900	1.54%
San Joaquin	260,000	261,000	267,100	274,600	279,200	286,400	292,400	300,700	304,600	307,900	1.90%
Stanislaus	202,200	202,400	205,900	209,800	213,700	218,000	221,800	224,100	227,500	228,800	1.38%
Tulare	168,100	168,700	168,800	172,200	172,100	178,500	180,500	183,200	183,300	184,400	1.03%
SJVAPCD [a]	1,504,400	1,524,200	1,555,400	1,586,500	1,609,400	1,634,500	1,653,800	1,676,700	1,698,700	1,717,800	1.48%
California	16,091,900	16,258,100	16,602,700	16,958,400	17,310,900	17,660,700	17,980,100	18,257,100	18,460,700	18,627,400	1.64%

Source: CAEDD, 2021.

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 industry 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.

3.3. REGIONAL TRENDS IN GLASS MELTING FURNACES

The number of glass manufacturers has decreased both statewide and regionally since 2009 (US Census, 2019). Financial burdens experienced by manufacturers as a result of air quality regulation compliance contribute to the decline of glass manufacturing regionally (Campbell, 2014).

3.4. IMPACTS OF THE COVID-19 PANDEMIC

The COVID-19 pandemic has affected virtually every industry to some degree, including the glass product manufacturers that would have costs under the potential amendments to Rule 4354.

Demand for glass packaging has remained steady during the pandemic. One of the most significant reasons for this is the increased level of beer consumption globally (ReportLinker, 2021). While beer sales in the US dropped from $120 billion in 2019 to about $100 billion in 2020, the sales of beer and other alcoholic drinks in glass bottles took only a small hit relative to other alcoholic drink sources; glass bottles represented 29 percent and 28 percent of all alcoholic beverage sales in 2019 and 2020, respectively (NBWA, 2021). This can be attributed to a sales source shift away from bars and restaurants toward liquor stores.

Restaurant closures also put a greater emphasis on packaging for food products. With people eating much more often from home, packaged food sales increased. This development increased glass demand and put a greater emphasis on recycling programs, which struggled to supply glass manufacturers with recycled materials at the outset of the pandemic (O-I Glass, 2020). Since the share of recycled glass shifted away from businesses and more toward homes, recycling companies have experienced a greater degree of contamination due to 'wishcycling' and reduced amounts of recyclable scrap (Bothwell, 2021). Recycled glass supplies decreased dramatically across the country, with some states seeing as high as a 62 percent decrease in supplies. Bottle bill states like California resumed their recycling programs after the initial stages of the pandemic though, and with redemption centers opening again, the system has seen about 80 percent of pre-pandemic recycled glass quantities (Bothwell, 2021).

While 90 percent of glass containers are used for food and beverage packaging, glass vials are a priority item during the pandemic (Research and Markets, 2020). Pharmaceutical glass is collected separately from standard glass and is kept in a closed-loop production process to ensure that these materials are not mixed in with others not suitable for use in vials (Bothwell, 2021). Medical-grade vial production needs to increase by 5 to 10 percent within the next two years in order to handle global vaccine delivery systems (Rowland, 2020). Hundreds of millions of dollars is being poured into this effort. To conserve glass supply, the most common size of vials produced can hold 8 to 15 doses of a given vaccine (Rowland, 2020).

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 (2021) 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 for each affected sector, including employment, revenue, profits, and average pay per employee. The process of estimating each of these endpoints 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 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 (2021) 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 converted the SIC codes to the North American Industry Classification System (NAICS) codes that are used with other sources of economic data used in the analysis using U.S. Census Bureau (2020d) concordances.[3] (See Table A-2 for a list of the NAICS code(s) that mapped to each SIC code.)

ERG estimated facility revenues and profits using the same method the District has used for prior analyses. Dividing industry "sales, value of shipments, or revenues" by "number of employees taken from the 2017 Economic Census for the relevant NAICS codes results in estimated output per employee. This was inflated to represent 2020 dollars using the U.S. Bureau of Economic Analysis (BEA) gross domestic product implicit price deflator (BEA, 2021). The data used for these calculations are presented in Appendix B. Multiplying output per employee by the number of employees in each facility results in estimated facility revenues.

ERG estimated profits for private industries by multiplying revenue figures by the average profit rate for each NAICS for 2015 through 2020 (see Appendix B). The profit rate was calculated using data from the Risk Management Association's (RMA) 2020 Annual Statement Studies, which 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.

[3] SIC codes were last updated in 1987, and NAICS codes were first issued in 1997. The U.S. Census Bureau's (2020d) 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 6-digit NAICS codes.

4.1.2. COVID-19 and Baseline Industry Profile Estimates

To reflect the impact of the COVID-19 pandemic, ERG examined the need to create a **"COVID-adjusted" baseline**, which would alter employment, revenue, and payroll figures for each facility using IMPLAN (2021) data. IMPLAN's "Evolving Economy" data use economic data points from the third 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, 2021). IMPLAN uses only the third quarter 2020 data, adjusts it for seasonality, and annualizes the single quarter of data to an entire year.

Using outputs of the IMPLAN model, ERG estimates the percentage change in employment, revenue, and payroll by NAICS between 2019 (the most recent full year for which data are available) and 2020 Q3 (the "Evolving Economy" dataset, the most recent estimate). District-wide, this approach suggests that revenue contracted by 4.5 percent, and employment contracted by 8.9 percent (see Table 9).

Table 9. District-Wide COVID-19 Impacts

	2019	2020 Q3 [a]	% Change
Revenue	$345.0 billion	$329.5 billion	-4.5%
Employment	2.0 million	1.8 million	-8.9%

Source: IMPLAN, 2021

Note:

[a] Data are modeled for an entire year as if it were like the third quarter of 2020.

To estimate the impacts of the COVID-19 pandemic on individual industries, ERG multiplied the percentage change from 2019 to the third 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 (2021)).

In most industries, this results in a decrease in revenue and employment, but an *increase* in 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 2019 and the third quarter of 2020 include restaurants (a 30.6 percent decrease in revenue and 33.6 percent decrease in employment) and dry cleaning and laundry services (a 44.6 percent decrease in revenue and a 77.1 percent decrease in employment).

Notably, some sectors saw revenue and employment *growth* when comparing 2019 and the third quarter of 2020. These sectors include oil and gas extraction (a 74.5 percent increase in revenue and 69.5 percent increase in employment), dog and cat food manufacturing (an 84.9 percent increase in revenue and 22.5 percent increase in employment), and tree nuts (an 11.1 percent increase in revenue and 71.6 percent increase in employment).

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, using third quarter of 2020 data and applying it to the entire year does not capture any lagging impacts of the COVID-19 pandemic that may take time to be seen in the data (for

example, companies that were able to stay open for much of the pandemic but ultimately closed). Given the shortcomings of the dataset, IMPLAN suggests using both the pre-pandemic (2019) and 2020 data to compare the results (Clouse, 2020).

However, while the pattern that complete recovery from the COVID-19 pandemic will take is unknown, many sectors will have recovered significantly by the time this analysis is performed and even more so by the time compliance is required with the potential rule amendments. Therefore, ERG started with a baseline assuming 100 percent recovery from COVID-19 (i.e., return to the 2019 baseline), but also performed a sensitivity analysis assuming 70 percent recovery (with the results presented in Section 4.4.3).

See Appendix C 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 (2021). Total costs were calculated by summing the one-time capital costs and one-time permit costs (annualized over a 10-year period using a 4 percent discount rate) with ongoing annual costs. Costs to meet the NOx emissions limits starting in 2029 were discounted using a 4 percent rate to account for the fact that those costs would not start being incurred until 7 years following the start of the revised limits. 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.

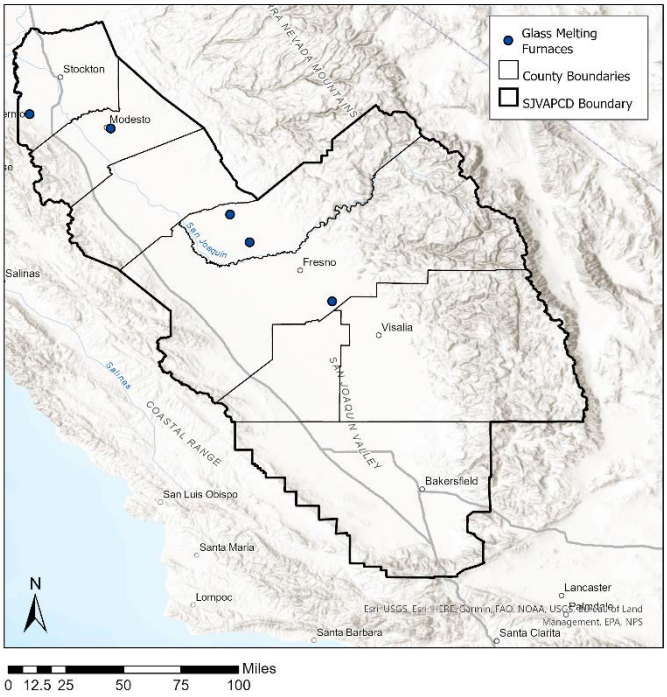
To estimate both direct employment impacts of the potential rule amendments and indirect and induced effects, ERG used IMPLAN's (2021) input-output model. IMPLAN "is a regional economic analysis software application that is designed to estimate the impact or ripple effect (specifically backward linkages) of a given economic activity within a specific geographic area through the implementation of its Input-Output model" (IMPLAN, 2020).

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).

4.2. PROFILE OF AFFECTED ENTITIES

Figure 2 presents the facilities operating glass melting furnaces (whether affected by potential rule changes or not). Facilities were mapped using the geocoding function in ArcGIS Pro 2.6.0. Five out of six facilities are displayed. The majority of facilities are located outside of major metropolitan areas. No county has more than one facility. There are no affected facilities in Kern, Kings, Merced and Tulare Counties.

Figure 2. Map of Facilities Operating Glass Melting Furnaces



Source data: SJVAPCD, 2021.
Map created by ERG using ArcGIS® software by Esri.

Table 10 includes a profile of facilities affected by the potential amendments to Rule 4354 (i.e., those that will incur compliance costs). A total of five facilities will incur retrofit and permit fee costs.

Table 10. Profile of Facilities Affected by Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Total Facilities	Facilities w/ Costs	% w/ Costs	Total, All Facilities		
				Employees	Revenue	Profits
Flat Glass	2	2	100%	322	$129,693,262	$5,073,600
Glass Container	3	3	100%	1,328	$677,897,241	$26,519,340
Fiberglass	1	0	0%	371	$146,698,188	$5,791,644
Total	**6**	**5**	**83%**	**2,021**	**$954,288,692**	**$37,384,585**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.
[a] Calculated from the 2017 Economic Census as estimated revenues per employee for NAICS 327211, 327213, and 327993 (U.S. Census Bureau, 2020e), inflated to 2020 dollars (BEA 2021); see Appendix B for details. Revenue per employee multiplied by the number of facility employees (NAICS.com, 2021).
[b] Calculated as facility revenue multiplied by average profit rates from 2015 to 2020 (RMA, 2021); see Appendix B for details.

Table 11 shows the characteristics of the average facility affected by the potential amendments to Rule 4354. (The exact characteristics of individual facilities could be either higher or lower than these average estimates.)

Table 11. Characteristics of Facilities with Costs due to the Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Average per Facility			Average Annual Pay per Employee
	Employees	Revenue	Profits	
Flat Glass	161	$64,846,631	$2,536,800	$55,863
Glass Container	443	$225,965,747	$8,839,780	$55,863
Fiberglass	371	$146,698,188	$5,791,644	$55,863
Average	**337**	**$159,048,115**	**$6,230,764**	**$55,863**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

4.3. COMPLIANCE COST ESTIMATES

Compliance costs were estimated by SJVAPCD (2021), and include:

- One-time costs for units retrofit by December 31, 2023.
- One-time costs for units retrofit by December 31, 2029.
- One-time permit costs.
- Annual operating and maintenance (O&M) costs for the units retrofit in 2023, beginning in 2023 and continuing indefinitely.
- Annual O&M costs for the units retrofit in 2029, beginning in 2029 and continuing indefinitely.

Total costs are calculated by annualizing the one-time retrofit costs that will be incurred in either 2023 or 2029 over a 10-year period using a 4 percent interest rate, and then summing annualized one-time costs and annualized costs to yield the total. Costs to meet the NOx emissions limits starting in 2029 were discounted using a 4 percent rate because they would not start being incurred until 7 years following the start of the revised SOx limits.

Table 12 shows the one-time, annual, and total annualized costs incurred by sector. Costs would total **$7.0 million**, with the majority of these incurred by the "Glass Container" sector.

Table 12. Costs of Compliance with Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Permit Modification [a]	Capital Costs [b]	O&M Costs [c]	Total Annualized Costs [d]
	One-Time	One-Time	Annual	Annualized One-Time + Annual
	2023 & 2029	2023 & 2029	2023 & 2029	2023 & 2029
Flat Glass	$16,000	$7,369,974	$1,526,133	$1,898,273
Glass Container	$30,000	$19,103,074	$3,825,062	$5,059,749
Total	**$46,000**	**$26,473,047**	**$5,351,195**	**$6,958,021**

Source: SJVAPCD, 2021.

[a] Includes costs to modify the permit to reflect actual emissions.

[b] Includes one-time capital costs in 2029.

[c] Includes the costs to operate and maintain the new equipment.

[d] The total annualized cost is calculated by summing annualized one-time costs (annualized over a 10-year period using a 4 percent discount rate) and annual costs.

4.4. IMPACTS ON AFFECTED ENTITIES

This section first discusses our primary impacts test, which compares compliance costs to profits for affected facilities. ERG then discusses indirect and induced impacts to related industries, and the results of sensitivity analyses that examine results under varying degrees of economic recovery from the COVID-19 pandemic.

4.4.1. Direct Impacts

One possible measure of 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 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 **18.6 percent of profits.** Both the "Flat Glass" and "Glass Container" sectors face impacts greater than 10 percent of profits, with "Flat Glass" facing the highest impacts, at **37.4 percent** of profits.

Table 13. Economic Impacts for Entities Affected by Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Average Annualized Cost per Facility	Average Profits per Facility	Cost as % Profits
Flat Glass	$949,136	$2,536,800	37.41%
Glass Container	$1,686,583	$8,839,780	19.08%
Fiberglass	$0	$5,791,644	0.00%
Average	**$1,159,670**	**$6,230,764**	**18.61%**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

4.4.2. Employment, Indirect, and Induced Impacts

In addition to the primary test of direct impacts of costs on revenue, 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**, 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 **$7.0 million and 21 jobs.**

Table 14. Direct, Indirect, and Induced Impacts of Potential Amendments to Rule 4354—Glass Melting Furnaces

Sector	Direct		Indirect		Induced		Total	
	Revenue (Costs)	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment	Revenue	Employ-ment
Flat Glass	$1,898,273	6	$8,255	0	$14	0	$1,906,542	6
Glass Container	$5,059,749	15	$25	0	$125	0	$5,059,899	15
Fiberglass	$0	0	$131	0	$57	0	$188	0
Total	**$6,958,021**	**21**	**$8,411**	**0**	**$196**	**0**	**$6,966,629**	**21**

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

Table 15 compares these impacts to the total size of the District's 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 4354—Glass Melting Furnaces

	Total Rule Impacts	District-Wide [a]	% of District-Wide
Revenue	$6,966,629	$329,543,696,694	0.002%
Employment	21	1,844,909	0.001%

Source: ERG estimates based on IMPLAN, 2021.

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 4.1.2, the primary estimates used in this analysis reflect a 100 percent recovery from COVID-19. ERG also conducted a sensitivity analysis that reflects COVID-19-adjusted

economic factors, reflecting a 70 percent recovery from COVID-19 using the percentage change between IMPLAN's (2021) 2019 and third quarter of 2020 "Evolving Economy" model.

Table 16 shows how the results of the analysis would vary under these economic recovery scenarios. Both indirect and induced cost impacts increase with a lower level of economic recovery, as would be expected. Costs comprise a greater portion of profits with a lower level of recovery from the pandemic, another expected outcome.

Table 16. Results of COVID-19 Sensitivity Analyses for the Impacts of Rule 4354—Glass Melting Furnaces

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	100%	$6,958,021	18.61%	21	$8,411	0	$196	0	$6,966,629	21
Sensitivity Analysis 1	70%	$6,958,021	18.90%	21	$8,848	0	$204	0	$6,967,073	21

Sources: ERG estimates based on SJVAPCD, 2021; U.S. Census Bureau, 2020; U.S. Census Bureau, 2020d; U.S. Census Bureau, 2020e; RMA, 2021.

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. Although the average facility values presented in **Table 11** suggest some facilities appear to be small, all five affected facilities are owned by larger corporations, some of which are multinational.

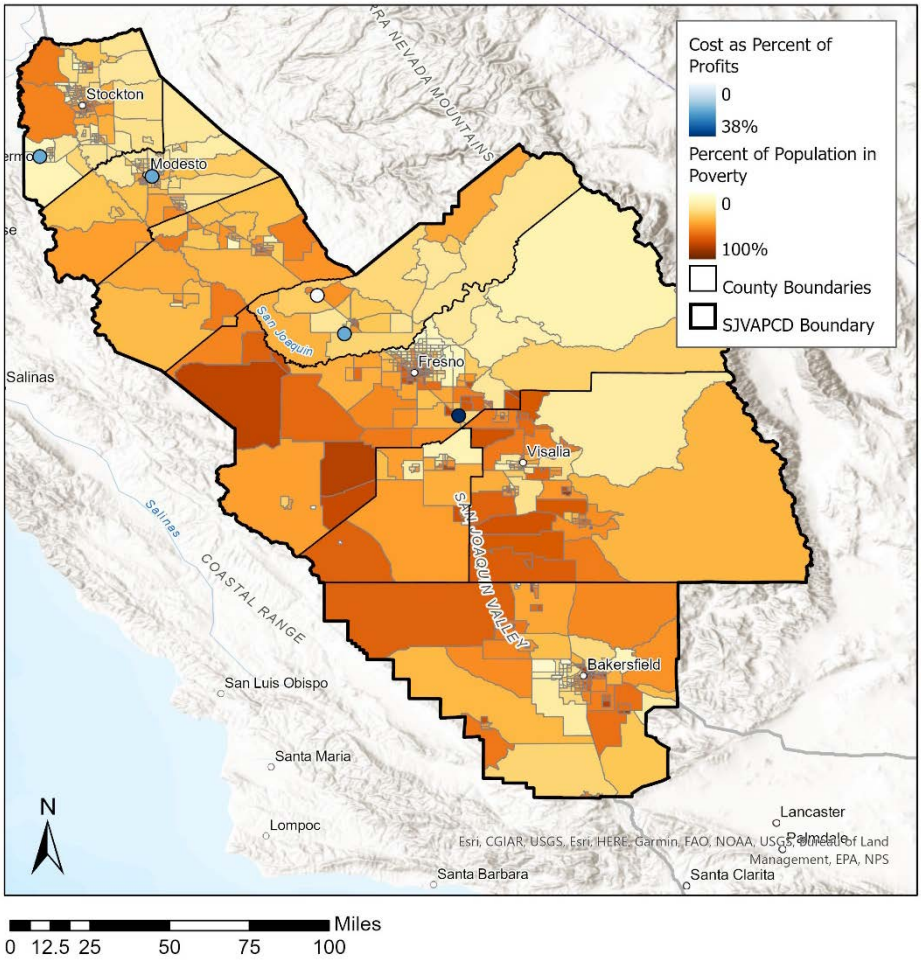
4.6. IMPACTS ON AT-RISK POPULATIONS

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 4.0 (OEHHA, 2021a). (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 3 presents a map of the potentially affected facilities overlying the percent of population living two times the federal poverty level. The facilities are colored in blue based on the estimated cost of compliance as a percent of profit. There is no correlation between the location of facilities and percent of the population living in poverty. However, the overall percentage of population living in poverty in the District is higher than the percentage for the state of California overall, and potentially impacted facilities are located in areas with fairly high poverty rates. Impacts are highest for the two "Flat Glass" facilities, which are both located in Fresno County (one of these facilities is not mapped). This could impact vulnerable populations in Fresno County.

Figure 3. Map of Facilities in Relation to Population Living in Poverty



Source data: SJVAPCD, 2021; ERG estimates; OEHHA, 2021a
Map created by ERG using ArcGIS® software by Esri

REFERENCES

Ardagh Group. (2020). Annual Report For the Year Ended December 31, 205-December 31, 2020. Available at https://www.ardaghgroup.com/userfiles/files/investors/Ardagh-Group-SA-Annual-Report-2020-full.pdf (Accessed May 14, 2021)

Berck, P. (1995). Development of a Methodology to Assess the Economic Impact Required by SB 513/AB 969. Final Report. Contract No. 93-314. Available at https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/past/93-314.pdf (Accessed September 23, 2020)

Bothwell, L. (2021). COVID-19's Impact on Glass Recycling. Available at https://www.waste360.com/recycling/covid-19s-impact-glass-recycling (Accessed May 10, 2021)

Bureau of Labor Statistics (BLS). (2020). Quarterly Census of Employment and Wages (QCEW). Available at https://www.bls.gov/cew/downloadable-data-files.htm (Accessed September 17, 2020)

California Central Valley Economic Development Corporation (CCVEDC). (2020). Incentives. Available at https://centralcalifornia.org/our-services/incentives/ (Accessed September 24, 2020)

California Employment Development Department (CAEDD). (2021). Local Area Unemployment Statistics (LAUS), Annual Average. Available at https://data.edd.ca.gov/Labor-Force-and-Unemployment-Rates/Local-Area-Unemployment-Statistics-LAUS-Annual-Ave/7jbb-3rb8 (Accessed April 27, 2021)

California Office of Environmental Health Hazard Assessment (OEHHA). (2021a). CalEnviroScreen 4.0 (Released Oct 13, 2021). Available at https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40 (Accessed November 19, 2021)

California Office of Environmental Health Hazard Assessment (OEHHA). (2021b). CalEnviroScreen 4.0 Report. Available at https://oehha.ca.gov/media/downloads/calenviroscreen/report/calenviroscreen40reportf2021.pdf (Accessed November 19, 2021)

Campbell, J. (2014). NSG-Pilkington selling glass plant, 185 acres. Available at https://www.mantecabulletin.com/news/nsg-pilkington-selling-glass-plant-185-acres/ (Accessed November 23, 2021)

CertainTeed. (2021). Inside CertainTeed. Available at https://www.certainteed.com/about-certainteed/ (Accessed May 17, 2021)

Clouse, C. (2020). Using the Evolving Economy - COVID 2020 Q2 Data. IMPLAN Support Site, IMPLAN Group, LLC.

Demski, J. (2021). What You Need to Know About Evolving Economy - COVID Q3-2020 Data. Available at https://blog.implan.com/covid-q3-data-faqs (Accessed April 27, 2021)

Dun and Bradstreet. (2021). Gallo Glass Company. Available at https://www.dnb.com/business-directory/company-profiles.gallo_glass_company.f75090368189901a40876600dae35ca6.html (Accessed May 14, 2021)

IMPLAN Group LLC. (2020). IMPLAN Citation Guidelines. Available at https://implan.com/citation-guidelines/ (Accessed October 1, 2020)

IMPLAN Group LLC. (2021). Evolving Economy - COVID Q3-2020. Huntersville, NC. Available at https://www.implan.com/ (Accessed April 27, 2021)

Internal Revenue Service (IRS). (2016). SOI Tax Stats - Corporation Source Book- Data File. . Available at https://www.irs.gov/statistics/soi-tax-stats-corporation-source-book-data-file (Accessed April 25, 2016)

Lillis, R. (2019). On the rise? The Central Valley is beating the Bay Area and L.A. in key measures Available at https://www.sacbee.com/news/california/big-valley/article223896300.html (Accessed September 24, 2020)

Manta. (2021a). Vitro Flat Glass LLC. Available at https://www.manta.com/c/mhbrffl/vitro-flat-glass-llc#:~:text=Current (Accessed May 14, 2021)

Manta. (2021b). Guardian Industries Corporation. Available at https://www.manta.com/c/mm5vq4c/guardian-industries-corporation (Accessed May 14, 2021)

NAICS.com. (2021). Data Append Provided to Eastern Research Group, Inc..

National Beer Wholesalers Association (NBWA). (2021). Industry Fast Facts. Available at https://www.nbwa.org/resources/industry-fast-facts#:~:text=Based%20on%20beer%20shipment%20data,are%20considered%20legal%20drinking%20age. (Accessed May 5, 2021)

O-I Glass, Inc. (2020). COVID-19 Exposes Recycling Weaknesses that Leave U.S. Manufacturing Vulnerable. Available at https://www.o-i.com/news/covid-19-exposes-recycling-weaknesses-that-leave-u-s-manufacturing-vulnerable/ (Accessed May 5, 2021)

O-I Glass, Inc. (2021a). Annual Report for the Fiscal Year Ended December 31, 2015-December 31, 2020. Available at https://investors.o-i.com/annual-reports (Accessed May 17, 2021)

O-I Glass, Inc. (2021b). About us. Available at https://www.linkedin.com/company/o-i#:~:text=Globally%20headquartered%20in%20Perrysburg%2C%20Ohio,and%20jars%20around%20the%20globe. (Accessed May 17, 2021)

Owler. (2021). CertainTeed. Available at https://www.owler.com/company/certainteed (Accessed May 17, 2021)

ReportLinker. (2021). Glass Bottles and Containers Market - Growth, Trends, COVID-19 Impact, and Forecasts (2021-2026). Available at https://www.globenewswire.com/fr/news-release/2021/03/02/2184955/0/en/Glass-Bottles-and-Containers-Market-Growth-Trends-COVID-19-Impact-and-Forecasts-2021-2026.html (Accessed May 5, 2021)

Research and Markets. (2020). COVID-19's Impact on the Glass Packaging Market - Greater Demand for Medicine Bottles, Food Jars and Beverage Bottles. Available at https://www.globenewswire.com/news-release/2020/05/12/2031678/0/en/COVID-19-s-Impact-on-the-Glass-Packaging-Market-Greater-Demand-for-Medicine-Bottles-Food-Jars-and-Beverage-Bottles.html (Accessed May 5, 2021)

Rowland, C. (2020). A race is on to make enough small glass vials to deliver coronavirus vaccine around the world. Available at https://www.washingtonpost.com/business/2020/07/13/coronavirus-vaccine-corning-glass/ (Accessed May 5, 2021)

San Joaquin Valley Air Pollution Control District (SJVAPCD). (2011). Rule 4354 Glass Melting Furnaces (Adopted September 14, 1994; Amended April 16, 1998; Amended February 21, 2002, Amended August 17, 2006, Amended October 16, 2008, Amended September 16, 2010; Amended May 19, 2011) . Available at https://www.valleyair.org/rules/currntrules/R4354%20051911.pdf (Accessed February 16, 2021)

San Joaquin Valley Air Pollution Control District (SJVAPCD). (2021). Facility and Cost Data Prepared for Eastern Research Group, Inc. (ERG). May 2021.

San Joaquin Valley Air Pollution Control District (SJVAPCD). (2020). Public Scoping Meeting for Potential Amendments to District Rule 4354 (Glass Melting Furnaces). December 3, 2020. Available at https://www.valleyair.org/Workshops/postings/2020/12-03-20_r4354/presentation.pdf (Accessed February 16, 2021)

The Risk Management Association (RMA). (2021). eStatement Studies. Available at https://rmau.org/eMentor/industry?keyword=&searchType=None&industryCode=&sortIndustry=Code&naicsLevelFilter=IndustryGroup&sectorCode=&sortSector=Code (Accessed June 22, 2021)

U.S. Census Bureau. (2019). County Business Patterns Data. Available at https://www.census.gov/programs-surveys/cbp/data/datasets.html (Accessed November 23, 2021)

U.S. Census Bureau. (2020a). County Population Totals: 2010-2019: Annual Estimates of the Resident Population for Counties: April 1, 2010 to July 1, 2019. Available at https://www.census.gov/data/datasets/time-series/demo/popest/2010s-counties-total.html#par_textimage_739801612 (Accessed September 8, 2020)

U.S. Census Bureau. (2020b). Median Income in the Past 12 Months (un 2018 Inflation-Adjusted Dollars). Available at https://data.census.gov/cedsci/table?q=S1903&text=S1903&tid=ACSST1Y2018.S1903&hidePreview=false (Accessed April 27, 2021)

U.S. Census Bureau. (2020c). Poverty Status in the Past 12 Months. Available at https://data.census.gov/cedsci/all?q=POVERTY%20STATUS%20IN%20THE%20PAST%2012%20MONTHS (Accessed April 27, 2021)

U.S. Census Bureau. (2020d). North American Industry Classification System - Concordances. Available at https://www.census.gov/eos/www/naics/concordances/concordances.html (Accessed September 2, 2020)

U.S. Census Bureau. (2020e). Manufacturing: Summary Statistics for the U.S., States, and Selected Geographies 2017 (ECNBASIC2017). Revised June 2, 2020. Available at https://data.census.gov/cedsci/table?q=EC1771BASIC%20Summary%20Statistics%20for%20the%20U.S.,%20States,%20and%20Selected%20Geographies%3A%202017&n=N0000.00&tid=ECNBASIC2017.EC1700BASIC&hidePreview=true (Accessed October 1, 2021)

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

Table A-1 shows the concordance between SIC codes and sectors developed by SJV APCD (SJVAPCD, 2020). (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 Rule 4354—Glass Melting Furnaces

SIC Code	SIC Industry	Sector
3211	Flat Glass	Flat Glass
3221	Glass Containers	Flat Glass
3296	Mineral Wool	Flat Glass

Source: SJVAPCD, 2020.

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 (2020d) 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 4354—Glass Melting Furnaces

SIC Code	SIC Industry	Corresponding NAICS
3211	Flat Glass	3272 Glass and Glass Product Manufacturing
3221	Glass Containers	3272 Glass and Glass Product Manufacturing
3296	Mineral Wool	3279 Other Nonmetallic Mineral Product Manufacturing

Source: ERG estimates based on SJVAPCD, 2021; Manta, 2021a.

APPENDIX B. PROFIT RATES BY NAICS INDUSTRY

Table B-1 presents the 2017 U.S. Economic Census data for flat glass manufacturing (NAICS 327211), glass container manufacturing (327213), and mineral wool manufacturing (327993) in California, along with the calculation of revenue per employee used to estimate revenue per establishment for these facilities in the District.

Table B-1. Number of U.S. Firms, Establishments, Revenue, Payroll and Employees for Glass Manufacturing Related NAICS, 2017

NAICS	Industry	Geographic Region	Number of Firms	Number of Estab.	Sales, value of shipments, or revenue ($1,000)	Annual Payroll ($1,000)	Number of Employees	Number of Production Employees	Revenue per Employee[a]
327211	Flat glass manufacturing	California	11	13	$387,715	$68,877	1,280	1,017	$381,328
327213	Glass container manufacturing	California	3	4	$698,338	$114,752	1,696	1,433	$484,033
327993	Mineral wool manufacturing	California	23	26	$637,641	$122,183	1,979	1,701	$374,973

Source: U.S. Census Bureau, 2020e

[a] ERG Calculation

Table B-2 tabulates the GDP implicit price deflator used to convert the Economic Census 2017-dollar values to the 2020-dollar values used in this analysis.

Table B-2. GDP Implicit Price Deflator, 2017 - 2020

Year	GDP Implicit Price Deflator Index (2012 = 100)	Multiplier to Convert to 2020 Value
2017	107.747	1.055
2018	110.321	1.030
2019	112.294	1.012
2020	113.648	1.000

Source: BEA, 2021

Table B-3 shows the profit rates used for private industry, which were estimated using the average rate for 2015 through 2020 data from RMA (2021).

Table B-3. Calculation of Average Profit Rate, NAICS 3272 and 3279, 2015 - 2020

NAICS	Industry	Average	2015	2016	2017	2018	2019	2020
3272	Glass and Glass Product Manufacturing	3.91%	4.10%	4.61%	4.39%	3.67%	3.10%	3.60%
3279	Other Nonmetallic Mineral Product Manufacturing	3.95%	3.17%	3.38%	4.39%	4.32%	3.96%	4.46%

Source: RMA, 2021

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 (2021) datasets for 2019 and the "Evolving Economy" dataset developed using data for the third quarter of 2021.

Table C-3. COVID-19 Adjustments by NAICS Industry for Facilities Affected by Rule 4354—Glass Melting Furnaces

NAICS	Industry	COVID-19-Adjusted Change in Sensitivity Analysis		
		Revenue	Employment	Average Pay
3272	Glass and Glass Product Manufacturing	-0.70%	-3.91%	0.44%
3279	Other Nonmetallic Mineral Product Manufacturing	-5.91%	-6.83%	-2.22%

Source: ERG estimates based on IMPLAN, 2021.