

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Draft Socioeconomic Impact Assessment for Proposed Rule 2305 – Warehouse Indirect Source Rule – Warehouse Actions and Investments to Reduce Emissions (WAIRE) Program and Proposed Rule 316 – Fees for Rule 2305

March 2021

Deputy Executive Officer

Planning, Rule Development, and Area Sources
Sarah L. Rees, Ph.D.

Planning and Rules Manager

Planning, Rule Development, and Area Sources
Ian MacMillan

Authors:

Paul Stroik, Ph.D., Air Quality Specialist
Ryan Finseth, Ph.D., Air Quality Specialist

Technical Assistance:

Caitlin Dawson, Air Quality Specialist
Victor Juan, Program Supervisor
Farimah Shirmohammadi, Air Quality Specialist

Reviewed By:

Shah Dabirian, Ph.D., Program Supervisor
Barbara Baird, Chief Deputy Counsel
Veera Tyagi, Principal Deputy District Counsel

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
GOVERNING BOARD**

Chairman: DR. WILLIAM A. BURKE
Speaker of the Assembly Appointee

Vice Chairman: BEN BENOIT
Mayor Pro Tem, Wildomar
Cities of Riverside County

MEMBERS:

LISA BARTLETT
Supervisor, Fifth District
County of Orange

JOE BUSCAINO
Council Member, 15th District
City of Los Angeles Representative

MICHAEL A. CACCIOTTI
Mayor Pro Tem, South Pasadena
Cities of Los Angeles County/Eastern Region

VANESSA DELGADO
Senate Rules Committee Appointee

GIDEON KRACOV
Governor's Appointee

SHEILA KUEHL
Supervisor, Third District
County of Los Angeles

LARRY MCCALLON
Mayor Pro Tem, Highland
Cities of San Bernardino County

V. MANUEL PEREZ
Supervisor, Fourth District
County of Riverside

REX RICHARDSON
Vice Mayor, City of Long Beach
Cities of Los Angeles County/Western Region

CARLOS RODRIGUEZ
Mayor Pro Tem, Yorba Linda
Cities of Orange County

JANICE RUTHERFORD
Supervisor, Second District
County of San Bernardino

EXECUTIVE OFFICER:

WAYNE NASTRI

EXECUTIVE SUMMARY

A socioeconomic analysis was conducted to assess the potential impacts of Proposed Rule (PR) 2305 – Warehouse Indirect Source Rule – Warehouse Actions and Investments to Reduce Emissions (WAIRE) Program and Proposed Rule 316 – Fees for Rule 2305 on the four-county region of Los Angeles, Orange, Riverside, and San Bernardino. A summary of the analysis and findings is presented below.

<p>Elements of Proposed Amendments</p>	<p>Proposed Rule (PR) 2305 – Warehouse Indirect Source Rule – Warehouse Actions and Investments to Reduce Emissions (WAIRE) Program and PR 316 – Fees for Rule 2305 would apply to operators and owners of existing and new warehouses.</p> <p>PR 2305 would be applicable to any existing or new warehouse located in South Coast AQMD’s jurisdiction with an indoor warehouse floor space equal to or greater than 100,000 square feet within a single building that may be used for warehousing activities by one or more warehouse operators.</p> <p>PR 2305 would require warehouses subject to the rule to annually take actions which either reduce emissions regionally and/or locally or that facilitate emission reductions.</p> <p>Warehouse owners or operators would be subject to an annual WAIRE Points Compliance Obligation (WPCO). WAIRE Points can be earned by selecting from the following implementation measures in the WAIRE Menu: 1) acquiring and/or using near-zero-emission (NZE) and zero-emission (ZE) trucks; 2) acquiring and/or using ZE yard trucks; 3) installing and/or using ZE charging/fueling infrastructure (e.g., electric charger or hydrogen fuel station) for cars, trucks, and/or transport refrigeration units (TRUs); 4) installing and/or using onsite solar panels; and 5) installing MERV 16 or greater filters or filter systems in residences, schools, daycares, hospitals, or community centers.</p> <p>WAIRE Points may be earned only for “surplus” actions which go beyond existing federal and state regulations already applicable to warehouse owners or operators earning WAIRE Points. In lieu of satisfying the WPCO via implementation measures, warehouse owners or operators may choose the option to pay a mitigation fee to the South Coast AQMD which would be used in a mitigation program to achieve emissions reduction in the same region as the warehouse.</p> <p>PR 316 – Fees for Rule 2305 establishes fees to recover South Coast AQMD administrative costs associated with ensuring compliance, such as submittal and review of various notifications and reports, implementing an incentive program using up to 6.25% of the mitigation fees from warehouse operators that pay a mitigation fee, as well as compliance activities such as conducting desktop audits, onsite inspections, and reviewing records.</p>
---	--

<p>Community Profile</p>	<p>CalEnviroScreen 3.0 (CES 3.0) GIS data was used to quantify the environmental burdens, prevalence of existing health conditions, and the population demographics in adjacent communities. Based on population-weighted averages, these communities face substantially higher burden than the district as a whole.</p> <p>The population within 0.5 miles of a large warehouse has a population-weighted average CES 3.0 Score of 46.6 (85th percentile statewide), while the South Coast AQMD jurisdiction has a population-weighted average CES 3.0 Score of 33.9 (67th percentile statewide). Risks posed from PM2.5 and diesel PM are also higher for populations located within 0.5 miles of warehousing facilities.</p> <p>Communities within 0.5 miles have an average asthma rate of 56 per 10,000 individuals (64th percentile) and experience heart attacks at a rate of 9.2 per 10,000 individuals (65th percentile). Comparably, the district-wide percentiles for asthma and cardiovascular incidence rates are 53rd and 57th, respectively.</p> <p>Warehouse-adjacent communities are 62.1% Hispanic and 7.6% African American, while the district-wide population is 45.4% Hispanic and 6.5% African American. In addition, the warehouse-adjacent communities experience poverty at a higher rate (46.7%) than non-warehouse-adjacent communities (38.2%).</p>
<p>Potentially Affected Facilities and Industries</p>	<p>PR 2305 is expected to potentially affect 3,995 warehouse operators at 2,902 warehouses classified under a variety of industry codes, mainly in the goods-movement industries of construction (NAICS 23), manufacturing (NAICS 31-33), wholesale trade (NAICS 42), retail trade (NAICS 44-45), and transportation and warehousing (NAICS 48-49). Of the 3,995 warehouse operators potentially affected by PR 2305, 1,964 are estimated to be in Los Angeles (LA) County, 468 estimated to be in Orange (OR) County, 470 estimated to be in Riverside (RV) County, and 1,093 estimated to be in San Bernardino (SB) County.</p>
<p>Cost Assumptions</p>	<p>All dollar figures presented in 2018 dollars.</p> <p>Purchases of ZE and NZE emission equipment is modeled as a one-time capital cost. Costs/savings resulting from the subsequent use of ZE and NZE equipment is modeled as recurring operating and maintenance (O&M) costs.</p> <p>The potential menu options available to facilities to meet compliance obligations are:</p> <ul style="list-style-type: none"> ▪ ZE and NZE Truck Acquisitions (Capital Cost) and Usage (O&M Cost) ▪ ZE and NZE Truck Visits from a Non-Owned Fleet (O&M) ▪ Electric Vehicle Charger Acquisition (Capital) and Usage (O&M) ▪ Hydrogen Filling Station Acquisition (Capital) and Usage (O&M) ▪ ZE Yard Truck Acquisition (Capital) and Usage (O&M) ▪ Solar Panel Acquisition (Capital) and Usage (O&M) ▪ High-Efficiency Filter Systems Acquisition (Capital) and Replacement Filters (O&M) ▪ TRU Plug Acquisition (Capital) and Usage (O&M) ▪ Pay Mitigation Fee (O&M)

Facilities are also expected to incur recurring O&M costs related to notification and reporting of compliance attainment.

Zero and Near-Zero Emission Truck Acquisition and Usage

Capital costs of Diesel, NZE, and ZE trucks are presented in the tables below. Diesel and NZE capital costs are assumed to remain constant across the entire compliance period. The incremental acquisition cost is set equal to the difference between the capital cost of each ZE or NZE truck and its diesel equivalent. An 8% sales tax is also applied to each ZE truck acquisition.

Capital Costs for Diesel and NZE Truck Acquisitions

Vehicle Class	Diesel	NZE
Class 2b-3	\$50,000	N/A
Class 6	\$85,000	\$115,000
Class 8	\$130,000	\$195,000

Capital Cost by ZE Truck Class and Year (Pre-Tax)

Year	ZE Class 8	ZE Class 6	ZE Class 2b-3
2022	\$265,556	\$134,877	\$71,920
2023	\$231,236	\$125,177	\$68,318
2024	\$201,351	\$116,174	\$64,896
2025	\$194,134	\$112,591	\$63,635
2026	\$188,312	\$109,702	\$62,599
2027	\$183,371	\$107,253	\$61,684
2028	\$178,870	\$105,025	\$60,829
2029	\$174,809	\$103,016	\$60,035
2030	\$170,748	\$101,008	\$59,241
2031	\$170,748	\$101,008	\$59,241

Recurring costs associated with the use/visits of facility-owned NZE and ZE trucks is done on a per-mile basis. Per-mile usage costs resulting from fuel consumption and other costs (including maintenance, fees, insurance, and mid-life costs) were calculated for all truck classes and fuel types.

ZE and NZE Emission Truck Visits from a Non-Owned Fleet

The cost of hiring visits from clean Class 8 trucks is expected to be greater than hiring visits from Class 8 diesel trucks. See below for a list of per visit incremental costs. The calculation of incremental costs assumes a three-year payback period and accounts for the difference in acquisition and usage costs of ZE/NZE and diesel trucks.

Incremental Costs per Visit from a Non-Owned Fleet for All Truck Classes and Fuel Types

Truck	Cost per Visit
NZE Class 8	\$10.48
NZE Class 6	\$38.16
ZE Class 8	\$149.04
ZE Class 6	\$1.92
ZE Class 2b-3	\$15.76

Electric Vehicle Charger Acquisition and Usage

Electric vehicle charger costs are calculated on a per unit basis, where construction and permitting costs are incurred on a project basis. The cost is assumed to be \$30,000 per charger. Construction mobilization cost is assumed to be \$10,000 per project with permitting and charger energization costs are assumed to be \$70,000 per project.

Hydrogen Filling Station Acquisition and Usage

Total installed cost is \$2,000,000 per 700 kg/day project. Each Class 8 Truck is assumed to use 2,440 kg/year of hydrogen. Hydrogen usage costs are assumed to decline over time from roughly \$9.75/kg in 2020 to \$6.20/kg in 2031.

ZE Yard Truck Acquisition and Usage

The one-time incremental cost is assumed to be \$210,000 per truck. ZE yard truck capital costs are expected to decline over time due to projected future decreases in battery costs. Each ZE yard truck is assumed to operate for 1,000 hours per year for a total annual usage cost of \$6,250 per yard.

Solar Panel Acquisition and Usage

The price for a rooftop solar panel system (including installation) is set \$2.80 per kW, resulting in a total installed cost of \$280,000 for a 100 kW solar panel system. Solar panel usage is assumed to result in a net savings of \$0.17 per kWh generated. Each 100 kW system has an estimated electrical generation of 165,000 kWh annually.

High-Efficiency Filter Systems Acquisition and Replacement Filters

The estimated costs analyzed for the installation of 25 air filter systems with MERV 16 air filters is \$65,000. The cost for the replacement/installation of 200 MERV 16 air filters is \$60,000.

TRU Plug Acquisition and Usage

The per unit cost of a TRU plug is assumed to be \$1,600. Associated construction and permitting costs are assumed to be \$4,700 and \$7,000 per installation project, respectively. Each installed TRU is assumed to consume 10,658 kWh of electricity annually. Assuming a rate of \$0.18/kWh, annual TRU usage cost is set to \$1,918.

	<p>Pay Mitigation Fee In lieu of earning WAIRE Points from equipment acquisitions and usage, all facilities may choose to pay a fee of \$1,000 for each WAIRE Point in their WPCO attributed to their facility in every year of compliance.</p> <p>Administrative Costs All operators are also expected to incur expenses related to fees outlined in Rule 316 for Warehouse Operations Notifications (\$29.51/submission), Initial Site Information Reports (\$140.68/submission), and Annual WAIRE Reports (\$392.50/submission).</p> <p>All warehouse operators are also expected to incur costs associated with the reporting related to compiling all relevant compliance data and submitting the information as required by PR 2305. This type of reporting is estimated to be no more than 25 hours of work totaling \$1,250 per year.</p> <p>To estimate truck traffic for determining compliance obligations, it is assumed that all facilities will install two cameras at a one-time cost of \$2,000 per facility. Staff time will also be required for reviewing recordings. It is estimated that 144 hours per year (at \$50/hr) for a total annual cost of \$7,200 per facility.</p> <p>It is also expected that facilities that elect to meet compliance obligations through ZE or NZE truck visits will incur additional costs related to truck tracking. For this analysis, it is assumed that tracking will be done through truck driver surveys and is expected to take one hour of work per week (at \$50/hr) for a total annual cost of \$2,600 per facility.</p>
<p>Scenario Compliance Costs</p>	<p>To estimate the potential impacts of PR 2305 and PR 316, cost estimates were developed for 19 different scenarios were developed to show the range of potential compliance outcomes. A description of the 19 scenarios analyzed is included in Table 15 of this report.</p> <p>Each scenario is structured to follow a series of choices a warehouse operator may make based on compliance choices from a previous year. As a bounding analysis approach, all warehouses were assumed to only comply with a single scenario approach from 2022 through 2031.</p> <p>For these scenario analyses, all 2,902 potentially affected facilities were modeled for every year from 2022-2031 using their square footage and the applicable average trip generation rates to determine their compliance obligation. The amount of warehousing space was assumed to grow 1.8% per year, consistent with analysis from SCAG.</p> <p>A cost summary for all 19 scenarios is included in the table below:</p>

	Equipment	NPV (1%)	Average Annual Cost	Average Annual Cost (\$/sq. ft)
Sc1	NZE Class 8	\$1,278,413,601	\$131,752,320	\$0.16
Sc2	NZE Class 8	\$1,447,600,821	\$148,892,406	\$0.18
Sc3	NZE Class 8	\$730,933,265	\$76,133,655	\$0.09
Sc4	NZE Class 8	\$958,102,980	\$101,852,369	\$0.13
Sc5	ZE Class 8	\$6,031,698,873	\$640,960,611	\$0.79
Sc6	ZE Class 6 & 8	\$1,589,868,694	\$165,388,142	\$0.20
Sc7	Mitigation Fee	\$6,232,397,351	\$663,563,162	\$0.82
Sc7a	Mitigation Fee	\$1,218,492,901	\$126,933,102	\$0.16
Sc8	NZE Class 6	\$1,909,866,571	\$195,656,567	\$0.24
Sc9	NZE Class 6	\$7,274,704,923	\$774,530,820	\$0.96
Sc10	ZE Class 6	\$753,078,754	\$79,992,980	\$0.10
Sc11	Solar	\$10,801,413,546	\$1,087,484,221	\$1.35
Sc12	ZE Class 8	\$8,153,250,950	\$840,728,166	\$1.04
Sc13	ZE Class 2b-3	\$837,857,597	\$84,942,252	\$0.11
Sc14	ZE Class 2b-3	\$4,086,553,410	\$434,791,866	\$0.54
Sc15	Filter System	\$7,335,720,221	\$781,049,602	\$0.97
Sc16	Filter	\$7,278,153,596	\$774,928,172	\$0.96
Sc17	TRU	\$337,221,825	\$36,267,245	\$4.10
Sc18	Yard Trucks	\$1,273,766,669	\$132,688,209	\$0.16

Average annual costs range from \$76.1M/yr. (or \$0.09/sq. ft./yr.) for the lowest cost scenario (Scenario 3: Carl Moyer Funded NZE Class 8 Acquisitions and Associated Usage) up to \$1.1B/yr. (or \$1.35/sq. ft./yr.) for the highest cost scenario (Scenario 11: Solar Panel Installations).

The costs presented here are default calculations broadly applicable to the industry, however individual warehouse operators may identify different specific costs for their operations. Warehouse operators are assumed to gravitate towards the lowest cost options for their specific situations. The maximum cost that warehouse operators would be expected to incur is \$0.82/sq. ft./yr. resulting from the mitigation fee scenario.

PR 2305 Expected Annual Foregone Jobs (2022-2031)

Jobs and Other Socioeconomic Impacts	Cost scenario	Annual foregone jobs (% of total jobs in LA, OR, RV, and SB counties)
	Low-cost scenario (4% interest rate)	1,700 (0.01%)
	High-cost scenario (4% interest rate)	11,400 (0.10%)
	<p>Based on the above assumptions, the compliance cost of PR 2305, and the application of the Regional Economic Models, Inc. (REMI) model, it is projected 1,700 – 11,400 jobs will be forgone on average annually from 2022 - 2031 in total across all South Coast AQMD industries. The projected job forgone impacts represent about 0.01% - 0.10% of total employment in the four-county region for both the low-cost (Scenario 3) and high-cost (Scenario 7) scenarios. Scenario 3 assumes all potentially affected warehouse operators comply with PR 2305 by purchasing and using Class 8 near-zero emission vehicles, while Scenario 7 assumes all potentially affected warehouse operators comply with PR 2305 by paying a mitigation fee and not receiving any funds from the mitigation fee for future compliance with PR 2305.</p> <p>Retail trade (NAICS 44-45) and construction (NAICS 23) are expected to bear most of the estimated total compliance cost of PR 2305, with around an estimated total 450 jobs forgone on average annually between 2022 to 2031 for the low-cost scenario (Scenario 3), and an estimated total 3,100 jobs forgone on average annually between 2022 to 2031 for the high-cost scenario (Scenario 7).</p>	
Competitiveness	<p>As a result of PR 2305 being implemented, South Coast AQMD staff expects no warehouse relocation and minimal goods movement diversion. These conclusions are made from warehouse relocation estimation work performed by Industrial Economics, Inc. for South Coast AQMD, along with the Port of Los Angeles (POLA) and Port of Long Beach (POLB) clean truck fund rate study.</p> <p>Minimal effects on warehousing demand is expected as evidenced from historical trends in industrial rent prices and warehouse availability. Industrial rental prices in the South Coast AQMD jurisdiction have risen around 63% from 2012 to 2019, from \$5.88 per square foot to \$9.60 per square foot. Over the same time overall warehouse capacity within the South Coast AQMD jurisdiction has risen from 500 million square feet to around 700 million, with vacancy rates falling from around 6% to around 4%. These trends in warehousing operation costs with a concurrent increase in warehouse capacity and decrease in warehouse vacancy lead South Coast AQMD staff to believe PR 2305 would have little effect on regional competitiveness.</p>	
Impacts of CEQA Alternatives	<p>There are five CEQA alternatives associated with PR 2305. Alternative A, the no project alternative, would mean PR 2305 would not be adopted. Alternative B (less stringent with less emission reduction) increases minimum square feet required to be affected by PR 2305, delays the initial compliance date by one year, and relaxes the rule stringency down to 0.0001. Alternative C (more stringent with more emission reductions) increases rule stringency to 0.005. Alternative D (no zero emission) allows for all compliance actions except for zero-emission ones. Alternative E (no natural gas) allows for all compliance actions except for natural gas ones.</p>	

	Average Annual, 2022-2031			
	Alternatives	Cost	Job Impacts	DCF Cost-Effectiveness, 4%; \$ per ton NOx
	Proposed Amendments	\$76,133,655 - \$663,563,162	1,700 – 11,400	\$43,835 - \$94,998
	Alternative A - No Project	-	-	
	Alternative B - Decreased Emission Reductions	\$19,315,935 - \$34,567,127	380 – 630	\$164,944 - \$357,011
	Alternative C - Increased Emission Reductions	\$71,754,630 - \$1,006,909,962	1,600 – 16,700	\$27,706 - \$94,839
	Alternative D - All Natural Gas Options Only	\$76,133,655 - \$663,563,162	1,700 – 11,400	\$43,835 - \$94,998
	Alternative E - All Electric Options Only	\$79,992,980 - \$663,563,162	2,700 - 11,400	\$49,491 - \$94,998
Public Health Benefits	<p>Public health benefits resulting from compliance with PR 2305 are calculated using an incidence per ton (IPT) methodology, developed by the U.S. Environmental Protection Agency. The IPT methodology is an approximation based on the general assumption that the relationship between emissions and adverse health outcomes is linear.</p> <p>For a sample scenario (Scenario 1: NZE Class 8 Acquisitions and Usage), it is estimated PR 2305 will result in 300 fewer deaths, 4,500 fewer asthma attacks, and 18,000 fewer work loss days from 2022-2031. Estimated monetized public health benefits total \$3.66 billion over the compliance period.</p> <p>The linearity assumption underpinning the IPT and BPT methodologies employed here is a rough approximation which ignores complex chemistry, precursor pollutant interactions, and finer-scale geographical effects. To get a refined estimate of the expected reduction in adverse health outcomes resulting from PR 2305, one would need to undertake a detailed analysis similar to the CMAQ and BenMAP modeling performed for the 2016 AQMP.</p>			

INTRODUCTION

Proposed Rule (PR) 2305 – Warehouse Indirect Source Rule – Warehouse Actions and Investments to Reduce Emissions (WAIRE) Program and PR 316 – Fees for Rule 2305 would apply to operators and owners of existing and new warehouses. These warehouses are used to receive, store, and serve as a distribution point for goods. The majority of emissions associated with warehouses are from on-road vehicles such as trucks that deliver goods, and off-road vehicles such as cargo handling equipment. PR 2305 would require warehouses subject to the rule to annually take actions that either reduce emissions regionally and locally or that facilitate emission reductions.

If adopted, PR 2305 would be applicable to any existing or new warehouse located in South Coast AQMD’s jurisdiction with an indoor warehouse floor space equal to or greater than 100,000 square feet within a single building that may be used for warehousing activities by one or more warehouse operators. At the time of this analysis, approximately 3,320 facilities located throughout South Coast AQMD’s jurisdiction would be subject to PR 2305. An estimated 418 of these facilities are expected to only be subject to reporting requirements, and the remaining 2,902 warehouses would be required to comply with additional air quality improvement measures.

Warehouse owners or operators of these 2,902 warehouses would be subject to an annual WAIRE Points Compliance Obligation (WPCO). WAIRE Points can be earned by selecting from the following implementation measures in the WAIRE Menu: 1) acquiring and/or using near-zero emissions (NZE) and zero emission (ZE) trucks; 2) acquiring and/or using ZE yard trucks; 3) installing and/or using ZE charging/fueling infrastructure (e.g., electric charger, hydrogen fuel station) for cars, trucks, and/or transport refrigeration units (TRUs); 4) installing and/or using onsite solar panels; and 5) installing MERV 16 or greater filters or filter systems in residences, schools, daycares, hospitals, or community centers. In addition, warehouse operators may apply to earn WAIRE Points through a Custom WAIRE Plan specific to their operations that satisfies prescribed performance metrics. Custom WAIRE Plans could include measures like installing offsite fueling/charging infrastructure or implementing new onsite practices to reduce air quality impacts from electricity consumption (such as installing and operating battery storage, or energy management systems to shift when electricity is used).¹

WAIRE Points may be earned only for “surplus” actions that go beyond existing federal and state regulations that warehouse owners or operators earning WAIRE Points must comply with. In lieu of satisfying the WPCO via implementation measures, warehouse owners or operators may choose the option to pay a mitigation fee to the South Coast AQMD that would be used in a mitigation program to achieve the emissions reductions. Similar to the measures used to earn WAIRE Points, the mitigation program would implement measures such as subsidizing the purchase of NZE ZE trucks and/or the installation of charging and fueling infrastructure for ZE trucks. The environmental

¹ Given the uncertainty regarding Custom WAIRE Plans, they are not included as a part of the cost analysis performed in this Socioeconomic Impact Assessment.

impacts associated with the mitigation program are similar to implementation of measures to earn WAIRE Points from the WAIRE Menu. The mitigation program would prioritize use of the mitigation fees in areas near the warehouses using this compliance option.

In addition, South Coast AQMD staff has developed PR 316 – Fees for Rule 2305 to establish fees to recover South Coast AQMD administrative costs associated with ensuring compliance, such as submittal and review of various notifications and reports, Custom WAIRE Plan application evaluation, implementing an incentive program using fees from warehouse operators that choose to pay a mitigation fee,² as well as compliance activities such as conducting desktop audits, onsite inspections, and reviewing records.

Implementation of the proposed project is expected to result in NO_x and PM, including DPM, emission reductions and reduced associated public health impacts from warehouse activities which will vary depending upon the implementation measures employed.

LEGISLATIVE MANDATES

The legal mandates directly related to the assessment of the proposed rule include South Coast AQMD Governing Board resolutions and various sections of the California Health & Safety Code.

South Coast AQMD Governing Board Resolutions

On March 17, 1989 the South Coast AQMD Governing Board adopted a resolution that calls for an economic analysis of regulatory impacts that includes the following elements:

- Affected industries
- Range of probable costs
- Cost-effectiveness of control alternatives
- Public health benefits

Health & Safety Code Requirements

The state legislature adopted legislation which reinforces and expands the Governing Board resolutions for socioeconomic impact assessments. California Health and Safety Code section 40440.8, which became effective on January 1, 1991, requires a socioeconomic impact assessment be performed for any proposed rule, rule amendment, or rule repeal which "will significantly affect air quality or emissions limitations."

Specifically, the scope of the socioeconomic impact assessment should include the following:

- Type of affected industries;
- Impact on employment and the regional economy;

² Up to 6.25% of mitigation fee revenue collected will be allowed usable to cover administrative costs of implementing the incentive program from collected mitigation fees.

- Range of probable costs, including those to industry;
- Availability and cost-effectiveness of alternatives to the rule;
- Emission reduction potential; and
- Necessity of adopting, amending, or repealing the rule in order to attain state and federal ambient air quality standards.

Health and Safety Code section 40728.5, which became effective on January 1, 1992, requires the South Coast AQMD Governing Board to actively consider the socioeconomic impacts of regulations and make a good faith effort to minimize adverse socioeconomic impacts. It also expands socioeconomic impact assessments to include small business impacts, specifically it includes the following:

- Type of industries or business affected, including small businesses; and
- Range of probable costs, including costs to industry or business, including small business.

Finally, Health and Safety Code section 40920.6, which became effective on January 1, 1996, requires incremental cost-effectiveness be performed for a proposed rule or amendment which imposes Best Available Retrofit Control Technology or “all feasible measures” requirements relating to ozone, carbon monoxide (CO), oxides of sulfur (SO_x), oxides of nitrogen (NO_x), and their precursors.

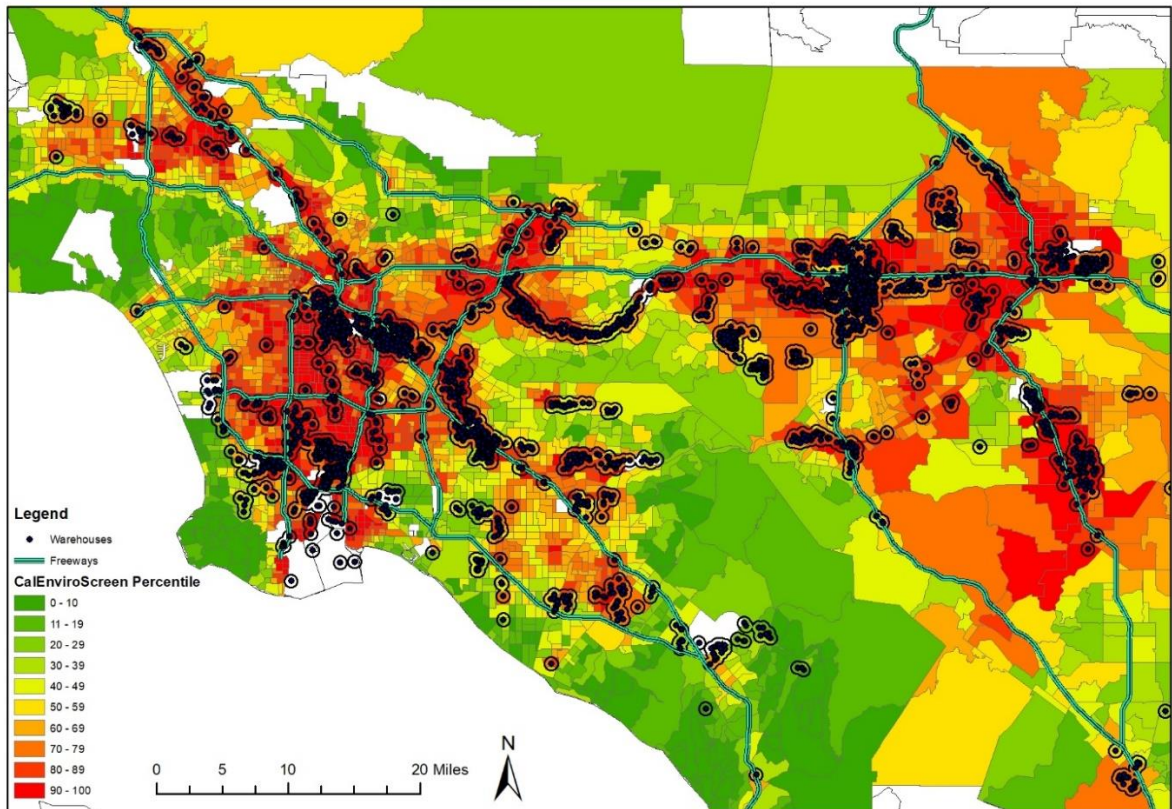
COMMUNITY PROFILE

To analyze the environmental burdens facing communities adjacent to large warehouse facilities, we rely on CalEnviroScreen 3.0 (CES 3.0) data published by the California Office of Environmental Health Hazard Assessment (OEHHA). CES 3.0 combines local environmental, health, and socioeconomic data to generate an aggregate score for individual census tracts within the state. In general, census tracts with more sensitive populations (high prevalence of asthma, cardiovascular disease, low-birth weight infants) and elevated exposure to environmental pollution (air, groundwater, toxics) tend to have the highest CES 3.0 aggregate scores and are generally considered to be at the highest risk.³

The census tract map in Figure 1 displays the location of the 2,902 large warehouse facilities potentially required to take actions to reduce emissions by PR 2305. The census tracts are color-coded with their CES 3.0 percentile, where dark green represents lower aggregate scores and less environmental burden, while dark red represents higher scores and higher burden. A buffer area of 0.5 miles around all warehouse locations is also shown.

³ Additional information on CalEnviroScreen 3.0 can be found here:
<https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf>.

Figure 1: Map of Warehousing Facilities in the South Coast AQMD Jurisdiction



Using buffers of 0.5, 1, and 2 miles around potentially affected warehouse facilities, spatial statistics were calculated using ArcGIS to quantify the environmental burdens, prevalence of existing health conditions, and the population demographics in adjacent communities. Table 1 above summarizes some of the environmental burdens facing communities located near large warehousing facilities in the South Coast AQMD jurisdiction. Based on population-weighted averages, these communities face substantially higher burden than the district as a whole (including both warehouse-adjacent and non-warehouse-adjacent communities).⁴ The population within 0.5 miles of a large warehouse has a population weighted average CES 3.0 Score of 46.6 (85th percentile statewide), while the South Coast AQMD as a whole has a population weighted average CES 3.0 Score of 33.9 (67th percentile statewide).⁵ Risks posed from PM_{2.5} and diesel PM are also higher for populations located within 0.5 miles of warehousing facilities. The higher South Coast AQMD average for ozone compared to warehouse adjacent communities reflects the regional nature of ozone formation. Trucks are the largest source of NO_x emissions in the air basin and truck activity is focused at warehouses. However, because NO_x emissions are spread out along

⁴ Population-weighted average calculations assume that population is uniformly distributed within each census tract.

⁵ Preliminary results presented at the October 9, 2020 PR 2305 Working Group Meeting and the February 16, 2021 Public Workshop reported that the population within 0.5 miles of a large warehouse was in the 80th percentile of CES 3.0 scores, while the population of the South Coast AQMD as a whole was in the 61st percentile. These results were based on taking a population-weighted average of CES 3.0 score percentiles directly. The updated percentiles reported in this document are based on a calculated population-weighted average CES 3.0 Score that is then compared to all statewide CES 3.0 Scores to determine the percentile.

an entire truck’s journey to/from a warehouse and ozone is formed from secondary reactions in the atmosphere, ozone does not have as pronounced localized effects as pollutants like diesel PM.

Table 1: Population-Weighted Average CES 3.0 Scores, Ambient Concentrations of Ozone and PM2.5, and Diesel PM Emissions⁶

	Population	CES 3.0 Score (percentile)	Ozone, ppm (percentile)	PM2.5, µg/m3 (percentile)	Diesel PM, kg/day (percentile)
SCAQMD - ALL	16,114,899	33.9 (67)	0.052 (72)	11.3 (66)	21.1 (65)
Within 0.5 miles of at least one PR 2305 warehouse	2,401,554	46.6 (85)	0.051 (69)	11.9 (69)	25.5 (77)
Within 1 mile of at least one PR 2305 warehouse	6,200,544	43.2 (80)	0.050 (65)	11.8 (69)	25.0 (76)
Within 2 miles of at least one PR 2305 warehouse	11,589,892	38.4 (74)	0.051 (69)	11.7 (69)	23.8 (73)

Additionally, the prevalence of preexisting health conditions is higher on average in communities near PR 2305 warehouses. See Table 2 below. Those communities within 0.5 miles have an average asthma rate of 56 per 10,000 individuals (64th percentile) and experience heart attacks at a rate of 9.2 per 10,000 individuals (65th percentile). Comparably, the district-wide percentiles for asthma and cardiovascular incidence rates are 53rd and 57th, respectively.

Tables 3 and 4 below summarize socioeconomic and ethnic characteristics of adjacent and non-adjacent communities. Warehouse-adjacent communities are 62.1% Hispanic and 7.6% African American, while the district-wide population is 45.4% Hispanic and 6.5% African American. In addition, the warehouse-adjacent communities experience poverty at a higher rate (46.7%) than non-warehouse-adjacent communities (38.2%).

⁶ Population data is from 2010 US Census. Ozone scores reported as mean of summer months (May-October) of the daily maximum 8-hour ozone concentration (ppm), averaged over three years (2012 to 2014). PM2.5 scores reported annual mean concentration of PM2.5 (average of quarterly means, µg/m3), over three years (2012 to 2014). Diesel PM scores reported as gridded diesel PM emissions from on-road and non-road sources for a 2012 summer day in July (kg/day).

Table 2: Population-Weighted Average Incidence Rates of Asthma, Cardiovascular Issues and Low Birth Weight (per 10,000 individuals) in Warehouse-Adjacent Communities

	Asthma (percentile)	Cardiovascular (percentile)	Low Birth Weight (percentile)
SCAQMD - ALL	47.6 (53)	8.5 (57)	5.1 (55)
Within 0.5 miles of at least one PR 2305 warehouse	55.5 (64)	9.2 (65)	5.4 (63)
Within 1 mile of at least one PR 2305 warehouse	55.0 (63)	9.1 (64)	5.4 (62)
Within 2 miles of at least one PR 2305 warehouse	52.3 (59)	8.8 (61)	5.3 (60)

Table 3: Poverty and Unemployment Rates in Warehouse Adjacent Communities

	Poverty Rate (percentile)	Unemployment (percentile)
SCAQMD - ALL	38.2 (57)	10.2 (58)
Within 0.5 miles of at least one PR 2305 warehouse	46.7 (69)	11.1 (64)
Within 1 mile of at least one PR 2305 warehouse	45.2 (67)	10.9 (63)
Within 2 miles of at least one PR 2305 warehouse	42.1 (63)	10.6 (61)

Table 4: Ethnicity Rates in Warehouse Adjacent Communities

	Hispanic %	White %	African American %	Native American %	Asian American %
SCAQMD - ALL	45.4	32.3	6.5	0.2	13.1
Within 0.5 miles of at least one PR 2305 warehouse	62.1	17.5	7.6	0.2	10.9
Within 1 mile of at least one PR 2305 warehouse	59.1	19.9	7.4	0.2	11.6
Within 2 miles of at least one PR 2305 warehouse	52.4	25.1	7.4	0.2	12.8

AFFECTED INDUSTRIES/FACILITIES

Affected Industries and Industry Profile

PR 2305 covers warehousing operations with greater than 100,000 square feet due to their associated emissions of nitrogen oxide and particulate matter from fossil-fuel combustion of off-site and on-site trucks. Examples of these operations are visitations of diesel trucks of sizes varying from light and medium Class 2b-3 trucks to larger heavy Class 8 trucks, as well as on-site usage of hostler/yard trucks.

Using CoStar data of warehousing operations within the South Coast AQMD jurisdiction, South Coast AQMD staff expects PR 2305 to affect 2,902 warehousing locations, consisting of 3,995 warehouse operators.⁷ More operators are expected affected than warehousing locations, i.e. physical addresses of warehouses, because many warehouses host multiple tenants/businesses.

Currently industry categories are recorded and reported as numerical codes coming from the North American Industry Classification System, or NAICS. NAICS codes are hierarchical, and are as long as six digits, with the first digit indicating broad industry categories, and each additional digit indicates a more refined industry within the prior digit's relative broader industry.

In most South Coast AQMD rules, very specific industry categories are affected, allowing for easy identification and enumeration of potentially affected facilities by six-digit industry category. However, warehousing operations occur at facilities in myriad industries. Moreover, PR 2305 is expected to affect thousands of operators, most of which South Coast AQMD staff had no formal activity with prior to development of PR 2305,

⁷ CoStar data provides both warehouse locations and historical operator data, which South Coast AQMD staff believes includes historical operators no longer in operation. Consequently, South Coast AQMD staff estimates the number of PR 2305 potentially affected operators as the number of single-tenant warehouses plus an assumed two operators for each multi-tenant warehouse.

making identification of NAICS codes for all PR 2305 potentially affected warehouse operators difficult.

Using facility-specific information collected from Dun and Bradstreet, South Coast AQMD staff believes it has reliable information for 1,154 of the assumed 3,995 warehouse operators potentially affected by PR 2305.⁸ Table 5 presents the industries covering these 1,154 identified warehouse operators potentially affected by PR 2305. Approximately 89% of these warehouse operators are associated with NAICS codes belonging to the “goods movement” sector.⁹

Table 5: PR 2305 Identified Potentially Affected Warehouse Operators

NAICS	Industry description	Identified potentially affected operators
11	Agriculture, Forestry, Fishing and Hunting	3
22	Utilities	1
23	Construction	22
31-33	Manufacturing	326
42	Wholesale Trade	296
44-45	Retail Trade	139
48-49	Transportation and Warehousing	240
51	Information	9
52	Finance and Insurance	6
53	Real Estate and Rental and Leasing	15
54	Professional, Scientific, and Technical Services	25
55	Management of Companies and Enterprises	1
56	Administrative and Support and Waste Management and Remediation Services	47
61	Educational Services	2
62	Health Care and Social Assistance	4
81	Other Services (except Public Administration)	17
92	Public Administration	1
	Total	1,154

Note: This table presents the subset of warehouse operators for which South Coast AQMD staff believes reliable industry information exists from Dun and Bradstreet.

⁸ South Coast AQMD staff merged CoStar warehouse owner and operator data, specifically warehouse size, with Dun and Bradstreet facility data. The number of “reliable” potentially affected warehouse operators combined with Dun and Bradstreet data was determined by using Microsoft Excel’s “Fuzzy Lookup” add-in (<https://www.microsoft.com/en-us/download/details.aspx?id=15011>), matching CoStar warehouse operator and Dun and Bradstreet warehouse operator data. “Reliable” matches are those matches occurring for single-tenant warehouses with matches found to be greater than 85% similar when matching on operator name and warehouse address.

⁹ Construction (NAICS 23), manufacturing (NAICS 31-33), wholesale trade (NAICS 42), retail trade (NAICS 44-45), and transportation and warehousing (NAICS 48-49) are identified by the Southern California Association of Governments (SCAG) as the industries which make up the “goods movement” sector (https://scag.ca.gov/sites/main/files/file-attachments/0903fconnectsocial_goods-movement.pdf).

Table 6 lists the industries within the “goods movement” sector, each industry’s estimated total number of facilities potentially subject to PR 2305, and total number of facilities in each industry.^{10,11} Approximately 2.3% of all facilities in the potentially affected “goods movement” sector are expected to be affected by PR 2305.

Table 6: PR 2305 Estimated Potentially Affected Warehouse Operators and Regional Industry Comparison for "Goods Movement" Sector

NAICS	Industry	Estimated potentially affected operators	Total facilities in 2020	Percent of facilities potentially affected by PR 2305
23	Construction	76	34,266	0.22%
31-33	Manufacturing	1,129	21,646	5.21%
42	Wholesale Trade	1,025	33,596	3.05%
44-45	Retail Trade	481	48,904	0.98%
48-49	Transportation and Warehousing	831	14,272	5.82%
	TOTAL	3,541	152,683	2.32%

Note: Total potentially affected facilities is estimated for each industry by multiplying its identified potentially affected operators by the number of total assumed potentially affected operators divided by the number of total identified potentially affected operators ($4,000/1,154 = 3.466$). Data on total facilities estimated and provided by Economic Modeling Specialists International. Individual operator values may not sum to total due to rounding of estimates.

Of the 3,995 PR 2305 potentially affected warehouse operators, 1,964 are estimated to be in Los Angeles (LA) County, 468 estimated to be in Orange (OR) County, 470 estimated to be in Riverside (RV) County, and 1,093 estimated to be in San Bernardino (SB) County.

Although detailed economic information about specific PR 2305 potentially affected warehousing operators is unavailable, economic information about the broader industries which include these facilities is available. Table 7 presents a 2018 economic profile of the “goods movement” industries potentially affected by PR 2305 located in LA, OR, RV, and SB counties. These industries consist of about 147,000 facilities; facilities which earn an average annual revenue of about \$4.9 million. These industries employ about 3,160,000 employees with an average annual salary of about \$63,000.

¹⁰ Total facilities is estimated and provided by Economic Modeling Specialists International (EMSI), accessed February 25th, 2021, <https://www.economicmodeling.com/>. This data relies on payroll information provided by facilities for the U.S. Bureau of Labor Statistics’ Quarterly Census of Employment and Wages.

¹¹ Total potentially affected facilities is estimated for each industry by multiplying its identified potentially affected operators by the number of total assumed potentially affected operators divided by the number of total identified potentially affected operators ($4,000/1,154 = 3.466$).

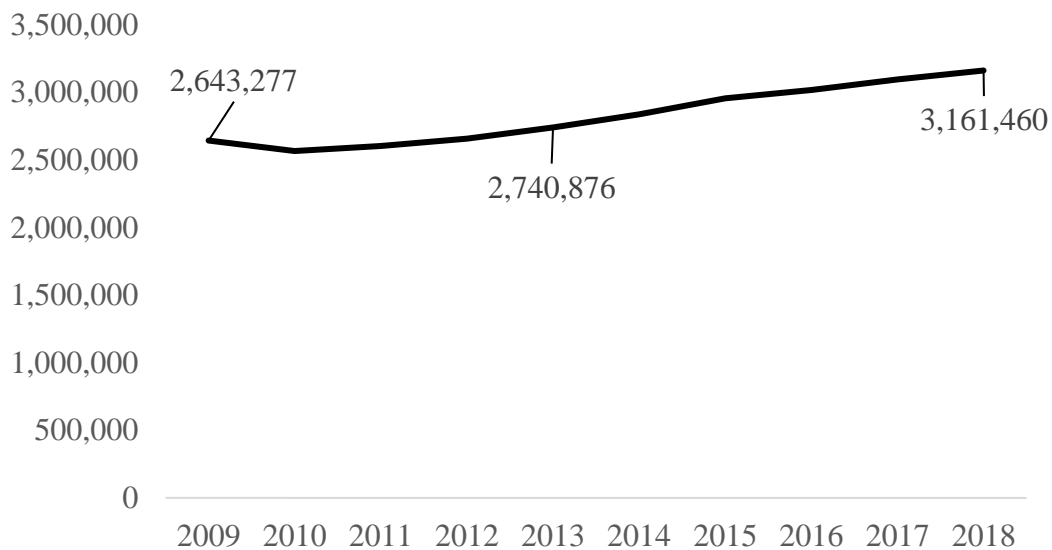
Table 7: PR 2305 Potentially Affected Industries - Industry Profile in LA, OR, RV, and SB counties (2018)

Approximate Number of Facilities	147,473
Approximate Number of Employees	3,161,460
Approximate Average Number of Employees per Facility	21
Approximate Annual Average Salary per Employee	\$63,010
Approximate Annual Average Revenue per Facility	\$4,868,717

Note: Data estimated and provided by Economic Modeling Specialists International for all "goods movement" industries with facilities expected to be affected by PR 2305, specifically NAICS 23, 31-33, 42, 44-45, and 48-49.

As illustrated by Figure 1, total employment in LA, OR, RV, and SB counties in the “goods movement” industries potentially affected by PR 2305 was around 2.64 million in 2009, and around 3.16 million in 2018. This indicates about a 20 percent growth in employment in the “goods movement” industries potentially affected by PR 2305 from 2009-2018, which is in line with the broader trends within California.

Figure 1: PR 2305 Potentially Affected Industries Employment 2009-2018



Small Businesses

South Coast AQMD defines a "small business" in Rule 102 as one which employs 10 or fewer persons and which earns less than \$500,000 in gross annual receipts. South Coast AQMD also defines “small business” for the purpose of qualifying for access to services from the South Coast AQMD’s Small Business Assistance Office as a business with an annual receipt of \$5 million or less, or with 100 or fewer employees.

U.S. Small Business Administration (SBA) definitions of small businesses vary by six-digit North American Industrial Classification System (NAICS) code. For PR 2305

potentially affected industries, a firm is considered a “small business” by SBA if it has under a certain number of employees, which can be found on the SBA website.¹²

In addition to South Coast AQMD and SBA's definitions of a small business, the federal Clean Air Act Amendments (CAAA) of 1990 also provides a definition of a small business. The CAAA classifies a business as a "small business stationary source" if it: (1) employs 100 or fewer employees, (2) emits less than 10 tons per year of any single pollutant and less than 20 tons per year of all pollutants, and (3) is a small business as defined under the federal Small Business Act ([15 U.S.C. Sec. 631, et seq.](#)).

Revenue and employee data from the Dun and Bradstreet Enterprise Database was available for all 1,154 PR 2305 identified potentially affected facilities. The number of facilities potentially affected by PR 2305 that are classified as small businesses and classification definition are listed in Table 8 below:

Table 8: PR 2305 Potentially Affected Facilities Small Business Tabulation

Small Business Definition	# Small Businesses
South Coast AQMD (Rule 102)	290 out of 1,154
South Coast AQMD (Small Business Assistance Office)	768 out of 1,154
U.S. Small Business Administration (SBA)	1,031 out of 1,154
1990 Clean Air Act Amendments (CAAA)	727 out of 1,154

COMPLIANCE COSTS

Methods and Sources of Data

Analysis Timeframe

This analysis considers an analysis timeframe from 2021-2031.

Cost Estimate Year

All costs presented in this report are estimated 2018 dollars. The per-unit dollar figures used for any cost/benefit resulting from PR 2305 passing are either 2018 reported costs/benefits, or costs/benefits from earlier years inflated to 2018 values using the all-industry producer price index reported by the CoreLogic® Marshall & Swift® Equipment Cost Index (M&S index).

One-Time and Recurring Costs

Potentially affected facilities can meet their compliance obligation through the purchase of near-zero emission (NZE) and zero emission (ZE) equipment or equipment that facilitates its use, and through the usage of NZE and ZE equipment. Facilities can opt to pay a mitigation fee in lieu of the purchase and/or usage of equipment. Purchases of ZE and NZE emission equipment is modeled as a one-time capital cost. Costs/savings resulting from the subsequent use of ZE and NZE equipment is modeled as recurring operating and maintenance (O&M) costs.

¹² The latest SBA definition of small businesses by industry can be found at the following website: <http://www.sba.gov/content/table-small-business-size-standards>.

Currently, the potential menu options available to facilities to meet compliance obligations are:

- ZE and NZE Truck Acquisitions (Capital Cost) and Usage (O&M Cost)
- ZE and NZE Truck Visits from a Non-Owned Fleet (O&M)
- Electric Vehicle Charger Acquisition (Capital) and Usage (O&M)
- Hydrogen Filling Station Acquisition (Capital) and Usage (O&M)
- ZE Yard Truck Acquisition (Capital) and Usage (O&M)
- Solar Panel Acquisition (Capital) and Usage (O&M)
- High-Efficiency Filter Systems Acquisition (Capital) and Replacement Filters (O&M)
- TRU Plug Acquisition (Capital) and Usage (O&M)
- Pay Mitigation Fee (O&M)

Additionally, facilities are expected to incur recurring O&M costs related to notification and reporting of compliance attainment.

Below is summary of the cost assumptions underlying this socioeconomic impact assessment. More detailed information on the analysis underlying these assumptions can be found in the WAIRE Menu Technical Report provided in Appendix B of the PR 2305 & PR 316 Draft Staff Report.

Zero and Near-Zero Emission Truck Acquisition and Usage

Table 9 below presents capital costs of Diesel and NZE trucks. These costs are assumed to remain constant across the entire compliance period.^{13,14} Per unit incremental costs of NZE Class 8 and Class 6 trucks are assumed to be \$65,000 and \$30,000, respectively. These costs are inclusive of taxes and based on analysis research documented in the WAIRE Menu Technical Report.

Capital costs of ZE trucks are expected to decrease over time as a result of decreased battery costs. Projected capital costs over time for each ZE vehicle class can be found in Table 10 below.^{15,16} The incremental acquisition cost is set equal to the difference between the capital cost of each ZE truck and its diesel equivalent. An 8% sales tax is also applied to each ZE truck acquisition.

When the number of NZE or ZE truck purchases for a given class in any compliance year falls below the expected number of truck purchases in CARB's EMFAC 2017 projections, the incremental acquisition cost for each truck class and fuel type is used. However, if the

¹³ Capital costs for diesel trucks can be found in Table C-6 of the CARB ACT Appendix C-1 – SRIA submitted to DoF: <https://ww3.arb.ca.gov/regact/2019/act2019/appc.pdf>

¹⁴ Capital costs for NZE Class 8 trucks can be found in Table 31 of the 2018 Feasibility Assessment for Drayage Trucks: <https://cleanairactionplan.org/documents/final-drayage-truck-feasibility-assessment.pdf/>. Class 6 capital costs were calculated by taking the ratio of capital costs for NZE Class 6 and 8 trucks found in the WAIRE Menu Technical Report.

¹⁵ Capital costs for each ZE truck class (2b-3, 6, 8) for model years 2024-2030 are taken from CARB's ACT Appendix C-1 – SRIA as submitted to DoF (Table C-7): <https://ww3.arb.ca.gov/regact/2019/act2019/appc.pdf>.

¹⁶ To fill in missing years (2022, 2023), ZE capital costs were linearized between 2018 and 2024. 2031 costs assumed to be equal to 2030.

number of truck purchases in a given year exceeds EMFAC 2017 projections, the full capital cost associated with each truck type is used for those trucks above projections.

Table 9: Pre-Tax Capital Costs for Diesel and NZE Truck Acquisitions

Vehicle Class	Diesel	NZE
Class 2b-3	\$50,000	N/A
Class 6	\$85,000	\$115,000
Class 8	\$130,000	\$195,000

Table 10: Pre-Tax Capital Cost by ZE Truck Class and Year

Year	ZE Class 8	ZE Class 6	ZE Class 2b-3
2022	\$265,556	\$134,877	\$71,920
2023	\$231,236	\$125,177	\$68,318
2024	\$201,351	\$116,174	\$64,896
2025	\$194,134	\$112,591	\$63,635
2026	\$188,312	\$109,702	\$62,599
2027	\$183,371	\$107,253	\$61,684
2028	\$178,870	\$105,025	\$60,829
2029	\$174,809	\$103,016	\$60,035
2030	\$170,748	\$101,008	\$59,241
2031	\$170,748	\$101,008	\$59,241

Recurring costs associated with the use/visits of facility-owned NZE and ZE trucks is done on a per-mile basis. Per-mile usage costs resulting from fuel consumption and other costs (including maintenance, fees, insurance, and mid-life costs) were calculated for all truck classes and fuel types.^{17,18,19} A detailed breakdown of total usage costs for Class 8, 6, and 2b-3 trucks for all relevant fuel types can be found in Tables 11, 12, and 13 below. Per-mile usage costs (not considering capital costs) of Class 6 and 8 NZE trucks is slightly lower than diesel, and results in a modest net savings to facilities. Per-mile usage costs of Class 2b-3, 6, and 8 ZE trucks is significantly lower than diesel and results in a net savings to facilities.

¹⁷ Data on maintenance costs, mid-life costs, fuel cost and fuel economy for diesel, ZE and NZE trucks is taken from the WAIRE Menu Technical Report.

¹⁸ Vehicle fees for all ZE and diesel truck classes are taken from CARB's ACT Total Cost of Ownership document: <https://ww3.arb.ca.gov/regact/2019/act2019/apph.pdf>. Fees for NZE trucks are assumed to be the same as diesel trucks.

¹⁹ Annual insurance costs assumed to be equal to 3% of vehicle value. Vehicle value assumed to decrease by 10% in years 2-8 and an additional 5% in years 9-11. The average annual cost is included in the per mile cost analysis.

Table 11: Usage Costs for Class 8 Trucks by Fuel Type

	Diesel	ZE	NZE
Annual Miles	54,000	54,000	54,000
Fuel Cost	\$3.74	\$0.15	\$2.92
Fuel Efficiency (miles per)	5.9	0.48	5.1
\$/mile	\$0.63	\$0.31	\$0.57
Total Fuel Cost	\$34,231	\$16,875	\$30,918
Maintenance Cost (per mile)	\$0.19	\$0.14	\$0.21
Total Maintenance Cost	\$10,260	\$7,695	\$11,340
Annualized Mid-life Cost	-	\$3,579	-
Fees	\$3,112	\$2,847	\$3,112
Insurance Costs	\$1,934	\$3,950	\$2,389
Total Other Cost	\$15,306	\$18,071	\$16,841
Total Fuel + Other Cost	\$49,536	\$34,946	\$47,759
\$/mile	\$0.92	\$0.65	\$0.88

Table 12: Usage Costs for Class 6 Trucks by Fuel Type

	Diesel	ZE	NZE
Annual Miles	24,000	24,000	24,000
Fuel Cost	\$3.74	\$0.17	\$2.42
Fuel Efficiency (miles per)	7.4	1.04	6.3
\$/mile	\$0.51	\$0.16	\$0.38
Total Fuel Cost	\$12,130	\$3,923	\$9,219
Maintenance Cost (per mile)	\$0.22	\$0.17	\$0.24
Total Maintenance Cost	\$5,280	\$3,960	\$5,760
Annualized Mid-life Cost	-	-	-
Fees	\$1,300	\$1,272	\$1,300
Insurance Costs	\$1,264	\$2,006	\$1,466
Total Other Cost	\$7,844	\$7,238	\$8,525
Total Fuel + Other Cost	\$19,974	\$11,161	\$17,744
\$/mile	\$0.83	\$0.47	\$0.74

ZE and NZE Emission Truck Visits from a Non-Owned Fleet

Facilities can earn points toward their compliance obligation by arranging visits from ZE or NZE trucks owned by a third-party. It is assumed that the cost of hiring visits from clean trucks will be greater than hiring visits from diesel trucks. The incremental cost resulting from third-party owned ZE and NZE trucks are taken from the WAIRE Menu Technical Report. See Table 14 below for a list of per visit incremental costs. The calculation of incremental costs assumes a three-year payback period and accounts for the difference in acquisition and usage costs of ZE/NZE and diesel trucks.

Table 13: Usage Costs for Class 2b-3 Trucks by Fuel Type

	Diesel	ZE
Annual Miles	15,000	15,000
Fuel Cost	\$3.74	\$0.18
Fuel Efficiency (miles per)	23.2	1.79
\$/mile	\$0.16	\$0.10
Total Fuel Cost	\$2,418	\$1,508
Maintenance Cost (per mile)	\$0.17	\$0.13
Total Maintenance Cost	\$2,550	\$1,913
Annualized Mid-life Cost	-	-
Fees	\$927	\$861
Insurance Costs	\$744	\$1,070
Total Other Cost	\$4,221	\$3,843
Total Fuel + Other Cost	\$6,639	\$5,351
\$/mile	\$0.44	\$0.36

Table 14: Incremental Costs per Visit from a Non-Owned Fleet for All Truck Classes and Fuel Types

Truck	Cost per Visit
NZE Class 8	\$10.48
NZE Class 6	\$38.16
ZE Class 8	\$149.04
ZE Class 6	\$1.92
ZE Class 2b-3	\$15.76

Electric Vehicle Charger Acquisition and Usage

One-time capital costs resulting from Level 3 electric vehicle charger acquisition include the cost of the charger, as well as the construction, permitting, and charger energization costs related to charger installation. Chargers costs are calculated on a per unit basis, where construction and permitting costs are incurred on a project basis. The cost is assumed to be \$30,000 per charger. Construction mobilization cost is assumed to be \$10,000 per project with permitting and charger energization costs are assumed to be \$70,000 per project. Costs are taken from the WAIRE Menu Technical Report Appendix B. Each charger is expected to dispense 165,000 kWh per year. Electricity costs are accounted for in the per-mile usage costs of Class 6 and Class 8 ZE Trucks. To avoid double-counting, it is assumed that no costs are incurred for charger usage in this analysis.

Hydrogen Filling Station Acquisition and Usage

The one-time cost of hydrogen station acquisition and installation and the recurring costs of subsequent usage are taken from the WAIRE Menu Technical Report. Total installed cost is \$2,000,000 per 700 kg/day project. Each Class 8 Truck is assumed to use 2,440

kg/year of hydrogen. It is assumed that hydrogen usage costs decline over time from roughly \$9.75/kg in 2020 to \$6.20/kg in 2031.²⁰

ZE Yard Truck Acquisition and Usage

ZE yard trucks currently cost about \$310,000 while their diesel equivalent costs about \$100,000.²¹ The one-time incremental cost is assumed to be \$210,000 per truck. ZE yard truck capital costs are expected to decline over time due to projected future decreases in battery costs. However, ZE yard truck capital cost projections are not available for future years. Staff applied a yearly cost multiplier based on ZE Class 2b-3 capital costs to the incremental cost of ZE yard trucks.²² Annual usage cost for ZE yard trucks is expected to be lower than their diesel equivalent. Each ZE yard truck is assumed to operate for 1,000 hours per year for a total annual usage cost of \$6,250 per yard truck based on analysis included in the WAIRE Menu Technical Report.

Solar Panel Acquisition and Usage

Based on the analysis provided in the WAIRE Menu Technical Report, the price for a rooftop solar panel system (including installation) is set \$2.80 per kW, resulting in a total installed cost of \$280,000 for a 100 kW solar panel system. Electricity generated from rooftop solar panel systems is assumed to save operators on grid power costs. Solar panel usage is assumed to result in a net savings of \$0.17 per kWh generated. Each 100 kW system has an estimated electrical generation of 165,000 kWh annually.

High-Efficiency Filter Systems Acquisition and Replacement Filters

The estimated costs analyzed for the installation of 25 air filter systems with MERV 16 air filters is \$65,000 based on the analysis provided in the WAIRE Menu Technical Report. The cost for the replacement/installation of 200 MERV 16 air filters is \$60,000.

TRU Plug Acquisition and Usage

The per unit cost of a TRU plug is assumed to be \$1,600. Associated construction and permitting costs are assumed to be \$4,700 and \$7,000 per installation project, respectively. Each installed TRU is assumed to consume 10,658 kWh of electricity annually. Assuming a rate of \$0.18/kWh, annual TRU usage cost is set to \$1,918.

Pay Mitigation Fee

The cost calculation for the mitigation fee scenario is straightforward. In lieu of earning WAIRE Points from equipment acquisitions and usage, all facilities choose to pay a fee of \$1,000 for each WAIRE Point in their WPCO attributed to their facility in every year of compliance.

Administrative Costs

In addition to costs expected from compliance actions outlined above, all operators are also expected to incur expenses related to fees outlined in Rule 316 for Warehouse Operations

²⁰ Hydrogen cost projections can be found in CARB ACT Appendix C-1 – SRIA submitted to DoF (Figure C-5): <https://ww3.arb.ca.gov/regact/2019/act2019/appc.pdf>

²¹ <https://cleanairactionplan.org/documents/final-cargo-handling-equipment-che-feasibility-assessment.pdf/>

²² A cost multiplier is generated by taking ratio of difference in capital cost in each year (2022 -2031) to the difference in capital costs in year 1 (2022).

Notifications (\$29.51/submission), Initial Site Information Reports (\$140.68/submission), and Annual WAIRE Reports (\$392.50/submission).

All warehouse operators are also expected to incur costs associated with the reporting related to compiling all relevant compliance data and submitting the information as required by PR 2305. This type of reporting is expected to be similar to the kind of reporting required in CARB's ACT regulation, specifically for large entity reporting, and is estimated to be no more than 25 hours of work totaling \$1,250 per year.²³

To estimate truck traffic for determining compliance obligations, it is assumed that all facilities will install two cameras at a one-time cost of \$2,000 per facility. Staff time will also be required for reviewing recordings. It is estimated that 1,152 hours of video will need to be reviewed per year (48 hours per month x 2 driveways per operator x 12 months). Speeding the video up to 8x results in a total staff time of 144 hours per year (at \$50/hr) for a total annual cost of \$7,200 per facility.

It is also expected that facilities that elect to meet compliance obligations through ZE or NZE truck visits will incur additional costs related to truck tracking. For this analysis, it is assumed that tracking will be done through truck driver surveys and drivers visiting a warehouse will be required to provide basic information such as license plate and/or VIN, trucking company, and contact info.²⁴ The compilation of truck surveys is expected to take one hour of work per week (at \$50/hr) for a total annual cost of \$2,600 per facility.

Scenario Analysis

With an estimated 4,000 warehouse operators and 32 potential compliance actions, it is not possible to determine the precise cost of PR 2305 and PR 316. In addition, due to annual compliance obligations, the potential compliance approach may vary from year to year. To estimate the potential impacts of PR 2305 and PR 316, 19 different scenarios were developed in an attempt to show the range of potential compliance outcomes. A description of the 19 scenarios analyzed is included in Table 15 below. The scenarios were developed to show potential cost and emissions impacts from all 32 WAIRE Menu actions, as well as using mitigation fees.

Each scenario is structured to follow a series of choices a warehouse operator may make based on compliance choices from a previous year. For example, if a warehouse operator purchased an NZE Class 8 truck in their first year complying with PR, they were assumed to use that same truck in subsequent years to meet future compliance obligations. As a bounding analysis approach, all warehouses were assumed to only comply with a single scenario approach from 2022 through 2031. No single scenario in this bounding analysis is expected to occur. Rather, they present possible extreme compliance outcomes.

For these scenario analyses, all 2,902 potentially affected facilities were modeled for every year from 2022-2031 using their square footage and the applicable average trip generation rates to determine their compliance obligation. All results presented in this section assume

²³ <https://ww3.arb.ca.gov/regact/2019/act2019/isor.pdf>

²⁴ Under PR 2305, a typical 250,000 sq. ft warehouse would be expected to receive anywhere from five visits per day (for larger Class 8 trucks) up to 24 visits per day (from smaller trucks).

a rule stringency of .0025 and three year phase-in period. The amount of warehousing space was assumed to grow 1.8% per year, consistent with analysis from SCAG.^{25,26} In addition, the scenario analysis attempts to isolate and attribute capital and O&M costs for only the equipment incremental to current CARB regulations such as CARB's ACT and Low NOx Omnibus regulations.

Tables 16 – 21 below present the total number of each compliance action for each scenario over the 2022-2031 compliance period. Table 16 presents the number of ZE and NZE truck acquisitions by scenario by year, and Table 17 presents the associated usage in vehicle miles traveled (VMT). Projected ZE and NZE truck visits from a non-owned fleet are shown in Table 18. Truck visits in Scenario 7a earn points toward compliance obligation but do not result in additional costs to facilities.

The number of equipment acquisitions in each compliance year for Scenario 6 (level 3 chargers), Scenario 12 (hydrogen stations), Scenario 17 (TRU plugs), and Scenario 18 (ZE yard trucks) are presented in Table 19. The number of equipment acquisitions for Scenario 11 (rooftop solar), Scenario 15 (filter systems), and Scenario 16 (filters) are shown in Table 20.

Table 21 presents the total annual mitigation fees paid for Scenarios 3, 5, 7, 11, and 17. Table 22 lists projected administrative costs associated with PR 316 fees, reporting, camera installations, video review, and truck surveys for every scenario except Scenario 17. Scenario 17 applies only to cold-storage facilities and total administrative costs are proportionate to the number of facilities in each compliance year.

Table 23 presents total annual costs by scenario. Total costs include one-time costs resulting from equipment acquisition, recurring costs associated with equipment usage, mitigation fees paid, and administrative costs and fees. Table 24 below shows a cost summary for each compliance scenario including net present value (assuming 1% and 4% discount rates), average annual cost, and a weighted average annual cost per square foot of warehouse space after taking into account equipment acquisition from CARB's ACT, Low NOx Omnibus. The total costs presented here are inclusive of all administrative costs and fees related to compliance. Average annual costs range from \$76.1M/yr. (or \$0.09/sq. ft./yr.) for the lowest cost scenario (Scenario 3: Carl Moyer Funded NZE Class 8 Acquisitions and Associated Usage) up to \$1.1B/yr. (or \$1.35/sq. ft./yr.) for the highest cost scenario (Scenario 11: Solar Panel Installations).

²⁵ For information on average trip generation rates, see PR 2305 (d)(1)(C)

²⁶ https://scag.ca.gov/sites/main/files/file-attachments/final_report_03_30_18.pdf

Table 15: Scenario Descriptions

#	Scenario Description	Notes
1	NZE Class 8 truck acquisitions and subsequent visits from those trucks	
2	NZE Class 8 truck acquisitions and subsequent visits from those trucks (early purchase)	One additional truck is acquired earlier than required, thus increasing WAIRE Points earned from truck visits in subsequent years.
3	NZE Class 8 truck acquisitions (funded by Carl Moyer program) and subsequent visits from those trucks	No WAIRE Points earned for truck acquisitions. Mitigation fees paid to earn WAIRE Points in first year of compliance.
4	NZE Class 8 truck visits from non-owned fleets	No WAIRE Points earned for truck acquisitions.
5	ZE Class 8 truck visits from non-owned fleets	No WAIRE Points earned for truck acquisitions. ZE Class 8 trucks are assumed to not be commercially available until late 2022. Mitigation fees paid to earn WAIRE Points until then.
6	Level 3 charger installations followed by ZE Class 6 & Class 8 truck acquisitions and subsequent visits from those trucks, using installed chargers	Chargers provide ~30,000 kWh/year per Class 6 truck, and ~90,000 kWh/yr per Class 8 truck. Class 8 trucks only acquired if 25 Class 6 trucks had been previously purchased for one warehouse.
7	Pay Mitigation Fee	
7a	Pay Mitigation Fee	Facilities also earn Points by tracking truck visits resulting from ZE and NZE trucks purchased with Mitigation Fee funds.
8	NZE Class 6 truck acquisitions and subsequent visits from those trucks	
9	NZE Class 6 truck visits from non-owned fleets	No WAIRE Points earned for truck acquisitions.
10	ZE Class 6 truck visits from non-owned fleets	No WAIRE Points earned for truck acquisitions.
11	Rooftop solar panel installations and usage	Solar panel coverage limited to 50% of building square footage. Mitigation fees used to make up any shortfall in WAIRE Points.
12	Hydrogen station installations followed by ZE Class 8 truck acquisitions and subsequent visits from those trucks, using the hydrogen station	System installation in first year is followed by a truck acquisition. In subsequent years trucks are only acquired if needed to earn WAIRE Points.
13	ZE Class 2b-3 truck acquisitions and subsequent visits from those trucks	
14	ZE Class 2b-3 truck visits from non-owned fleets	
15	Filter System Installations	
16	Filter Purchases	
17	TRU plug installations and usage in cold storage facilities	Scenario is only applied to cold storage warehouses. Plugs limited to 1:10,000 sq. ft. of building space.
18	ZE Hostler Acquisitions and Usage	

Table 16: ZE and NZE Truck Acquisitions by Scenario by Year.

	Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sc1	NZE Class 8	2,944	3,558	3,600	1,224	0	0	0	0	0	0
Sc2	NZE Class 8	3,867	3,086	4,747	42	58	0	0	0	0	0
Sc3	NZE Class 8	2,944	6,669	1,950	1,026	0	0	0	0	0	0
Sc6	ZE Class 8	0	0	59	103	0	0	0	0	0	0
Sc6	ZE Class 6	0	4,413	6,304	3,904	3,103	1,176	695	27	0	0
Sc8	NZE Class 6	5,665	9,774	12,181	4,066	0	0	0	0	0	0
Sc12	ZE Class 8	0	936	981	1,095	3,012	955	804	0	131	0
Sc13	ZE Class 2b-3	10,168	14,823	17,580	7,535	2,753	22	0	0	0	0

Table 17: ZE and NZE Truck VMT (millions) by Scenario by Year.

	Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sc1	NZE Class 8	0.0	122.2	269.8	428.4	499.8	534.4	553.4	588.8	620.3	634.2
Sc2	NZE Class 8	0.0	160.5	288.5	494.7	517.1	556.4	582.9	597.7	611.7	625.8
Sc3	NZE Class 8	0.0	122.2	398.9	489.0	552.2	567.4	581.3	595.1	609.0	622.9
Sc6	ZE Class 8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sc6	ZE Class 6	0.0	0.0	64.0	92.4	55.9	40.8	8.5	0.0	0.0	0.0
Sc8	NZE Class 6	0.0	83.7	228.0	416.2	520.6	575.5	608.1	638.1	671.5	690.7
Sc12	ZE Class 8	0.0	0.0	37.7	75.6	117.7	237.7	269.9	294.3	281.4	274.3
Sc13	ZE Class 2b-3	0.0	161.8	395.1	678.8	807.2	862.7	881.5	905.5	922.2	927.0

Table 18: ZE and NZE Truck Visits (Non-Owned Fleet) by Scenario by Year
(millions)

	Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sc4	NZE Class 8	1.18	2.83	4.86	5.77	6.27	6.43	6.59	6.75	6.91	7.06
Sc5	ZE Class 8	0.00	2.29	3.90	4.57	4.89	4.90	4.86	4.75	4.59	4.36
Sc7a	NZE Class 8	0.00	1.30	2.77	4.30	5.65	5.94	6.12	6.29	6.49	6.65
Sc7a	NZE Class 6	0.00	0.00	0.34	0.97	0.97	0.97	0.97	0.97	0.97	0.96
Sc9	NZE Class 6	4.14	9.91	17.02	20.20	21.96	22.51	23.06	23.61	24.16	24.72
Sc10	ZE Class 6	4.14	9.90	16.96	20.04	21.66	22.01	22.28	22.46	22.54	22.54
Sc14	ZE Class 2b-3	5.52	13.21	22.61	26.73	28.91	29.41	29.84	30.21	30.53	30.64

Table 19: Equipment Acquisitions by Year - Scenarios 6, 12, 17, and 18

	Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sc6	Chargers	1,863	1,045	1,254	169	195	195	195	195	195	195
Sc12	H2 Stations	955	1,003	1,160	54	54	54	54	54	54	54
Sc17	TRU Plugs	242	710	1,187	1,140	522	494	494	494	494	494
Sc18	ZE Yard Trucks	1,183	1,082	1,423	153	268	324	112	107	106	106

Table 20: Equipment Acquisitions by Year - Scenarios 11, 15, and 16 (in thousands)

	Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sc11	Solar (kW)	907.7	1,779.3	1,766.2	1,185.9	640.4	108.4	108.4	108.4	108.4	108.4
Sc15	Filter Systems	62.3	148.9	255.7	303.3	329.5	337.7	346.0	354.2	362.5	370.7
Sc16	Filters	534.2	1,277.9	2,195.8	2,606.2	2,832.2	2,903.3	2,974.4	3045.6	3,116.7	3,187.8

Table 21: Mitigation Fee Paid by Scenario by Year (millions)

	Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sc3	NZE Class 8	\$136.1	\$149.0	\$49.6	\$19.4	\$20.1	\$18.2	\$18.2	\$18.2	\$18.2	\$18.2
Sc5	ZE Class 8	\$136.1	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0
Sc7	Mitigation Fee	\$136.1	\$325.6	\$559.6	\$664.2	\$721.8	\$740.0	\$758.1	\$776.3	\$794.4	\$812.5
Sc7a	Mitigation Fee	\$136.1	\$195.1	\$241.8	\$142.7	\$27.4	\$15.2	\$16.2	\$19.0	\$14.9	\$15.3
Sc11	Solar	\$0.0	\$44.7	\$12.1	\$396.0	\$506.0	\$649.8	\$666.8	\$683.9	\$700.9	\$718.0
Sc17	TRU	\$0.0	\$0.2	\$6.8	\$17.2	\$34.4	\$39.6	\$44.4	\$49.3	\$54.1	\$59.0

Table 22: Administrative Costs by Year (millions) (excluding Scenario 17)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
316 Fees	\$1.03	\$1.53	\$2.05	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87
Reporting	\$1.67	\$3.37	\$5.09	\$5.15	\$5.21	\$5.27	\$5.33	\$5.39	\$5.44	\$5.50
Cameras	\$2.68	\$2.71	\$2.76	\$0.09	\$0.09	\$0.09	\$0.09	\$0.09	\$0.09	\$0.09
Reviewing Video	\$9.64	\$19.40	\$29.33	\$29.66	\$30.00	\$30.34	\$30.68	\$31.02	\$31.36	\$31.69
Truck Surveys	\$3.48	\$7.01	\$10.59	\$10.71	\$10.83	\$10.96	\$11.08	\$11.20	\$11.32	\$11.45

The costs presented here are default calculations broadly applicable to the industry, however individual warehouse operators may identify different specific costs for their operations. Warehouse operators are assumed to gravitate towards the lowest cost options for their specific situations. As such, the maximum cost that warehouse operators would be expected to incur is \$0.82/sq. ft./yr. resulting from the mitigation fee scenario. However, based on the cost analysis, it is likely that in most situations warehouse operators will identify substantially cheaper options that work within their operations.

Table 23: Total Annual Costs by Scenario (millions)

	Equipment	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sc1	NZE Class 8	\$263	\$338	\$421	\$113	\$32	\$31	\$31	\$30	\$30	\$30
Sc2	NZE Class 8	\$408	\$263	\$600	\$34	\$35	\$30	\$30	\$30	\$30	\$30
Sc3	NZE Class 8	\$155	\$179	\$86	\$51	\$50	\$48	\$48	\$48	\$48	\$48
Sc4	NZE Class 8	\$31	\$64	\$101	\$108	\$114	\$116	\$118	\$120	\$122	\$125
Sc5	ZE Class 8	\$155	\$375	\$631	\$729	\$777	\$779	\$773	\$758	\$734	\$700
Sc6	ZE Class 6 & 8	\$151	\$339	\$495	\$156	\$132	\$83	\$82	\$72	\$72	\$72
Sc7	Mitigation Fee	\$151	\$353	\$599	\$701	\$759	\$778	\$796	\$815	\$833	\$852
Sc7a	Mitigation Fee	\$155	\$229	\$292	\$190	\$75	\$64	\$65	\$69	\$65	\$66
Sc8	NZE Class 6	\$239	\$629	\$888	\$249	\$0	-\$5	-\$7	-\$10	-\$12	-\$14
Sc9	NZE Class 6	\$177	\$412	\$699	\$818	\$886	\$907	\$929	\$951	\$972	\$994
Sc10	ZE Class 6	\$26	\$53	\$82	\$86	\$90	\$91	\$92	\$93	\$93	\$94
Sc11	Solar	\$2,557	\$4,799	\$4,243	\$2,504	\$754	-\$771	-\$784	-\$797	-\$809	-\$822
Sc12	ZE Class 8	\$1,929	\$2,142	\$2,455	\$249	\$467	\$259	\$251	\$213	\$220	\$223
Sc13	ZE Class 2b-3	\$259	\$313	\$299	\$100	\$16	-\$25	-\$27	-\$28	-\$29	-\$29
Sc14	ZE Class 2b-3	\$106	\$242	\$406	\$469	\$504	\$512	\$519	\$526	\$531	\$533
Sc15	Filter System	\$177	\$414	\$704	\$825	\$894	\$916	\$937	\$959	\$981	\$1,003
Sc16	Filter	\$175	\$410	\$698	\$819	\$887	\$909	\$930	\$952	\$974	\$996
Sc17	TRU	\$1	\$3	\$12	\$23	\$41	\$46	\$51	\$57	\$62	\$68
Sc18	Yard Trucks	\$263	\$224	\$256	\$80	\$94	\$100	\$77	\$77	\$77	\$78

Table 24: Total Cost Summary for All Scenarios

	Equipment	NPV (1%)	NPV (4%)	Average Annual Cost	Average Annual Cost (\$/sq. ft)
Sc1	NZE Class 8	\$1,278,413,601	\$1,172,701,781	\$131,752,320	\$0.16
Sc2	NZE Class 8	\$1,447,600,821	\$1,335,513,397	\$148,892,406	\$0.18
Sc3	NZE Class 8	\$730,933,265	\$651,467,159	\$76,133,655	\$0.09
Sc4	NZE Class 8	\$958,102,980	\$803,499,274	\$101,852,369	\$0.13
Sc5	ZE Class 8	\$6,031,698,873	\$5,062,842,825	\$640,960,611	\$0.79
Sc6	ZE Class 6 & 8	\$1,589,868,694	\$1,420,266,453	\$165,388,142	\$0.20
Sc7	Mitigation Fee	\$6,232,397,351	\$5,202,153,481	\$663,563,162	\$0.82
Sc7a	Mitigation Fee	\$1,218,492,901	\$1,084,493,675	\$126,933,102	\$0.16

Proposed Rule 2305**Draft Socioeconomic Impact Assessment**

Sc8	NZE Class 6	\$1,909,866,571	\$1,778,780,705	\$195,656,567	\$0.24
Sc9	NZE Class 6	\$7,274,704,923	\$6,072,323,215	\$774,530,820	\$0.96
Sc10	ZE Class 6	\$753,078,754	\$633,069,714	\$79,992,980	\$0.10
Sc11	Solar	\$10,801,413,546	\$10,517,301,835	\$1,087,484,221	\$1.35
Sc12	ZE Class 8	\$8,153,250,950	\$7,470,020,012	\$840,728,166	\$1.04
Sc13	ZE Class 2b-3	\$837,857,597	\$802,583,687	\$84,942,252	\$0.11
Sc14	ZE Class 2b-3	\$4,086,553,410	\$3,418,077,028	\$434,791,866	\$0.54
Sc15	Filter System	\$7,335,720,221	\$6,122,711,300	\$781,049,602	\$0.97
Sc16	Filter	\$7,278,153,596	\$6,074,477,947	\$774,928,172	\$0.96
Sc17	TRU	\$337,221,825	\$272,937,187	\$36,267,245	\$4.10
Sc18	Yard Trucks	\$1,273,766,669	\$1,134,582,316	\$132,688,209	\$0.16

JOBS AND OTHER SOCIOECONOMIC IMPACTS

The REMI model (PI+ v2.4.1) was used to assess the total socioeconomic impacts of the regulatory change from PR 2305.²⁷ The model links the economic activities in the counties of Los Angeles, Orange, Riverside, and San Bernardino, and for each county, it is comprised of five interrelated blocks: (1) output and demand, (2) labor and capital, (3) population and labor force, (4) wages, prices and costs, and (5) market shares.²⁸

Given the uncertain nature of compliance action taken by each potentially affected warehouse operator potentially subject to PR 2305, a bounding analysis was performed in estimating jobs affects estimated due to implementation of PR 2305. This bounding analysis analyzes scenarios wherein all warehouse operators are assumed to comply using the same compliance action. South Coast AQMD staff modeled and presents the results of those scenarios which they believe to be high- and low-cost scenarios, along with a few additional scenarios to provide a more complete picture of the range of jobs impacts due to implementation of PR 2305.

The scenarios modeled to estimate the range of jobs impacts due to implementation of PR 2305 are scenarios 3, 6, 7, 7a, and 13. Scenarios 3 and 13 are low-cost natural gas and zero-emission scenarios respectively. Scenarios 7 and 7a are high-cost scenarios from all warehouse operators complying with PR 2305 through paying a mitigation fee. Scenario 6 was included to consider a scenario involving electric vehicle charger installations.

Each assessment herein is performed relative to a baseline (“business as usual”) where PR 2305 would not be adopted. Adoption of PR 2305 would create a regulatory scenario under which the potentially affected facilities would incur average annual compliance costs

²⁷ Regional Economic Modeling Inc. (REMI). Policy Insight® for the South Coast Area (160-sector model). Version 2.4.1, 2020.

²⁸ Within each county, producers are made up of 156 private non-farm industries and sectors, three government sectors, and a farm sector. Trade flows are captured between sectors as well as across the four counties and the rest of U.S. Market shares of industries are dependent upon their product prices, access to production inputs, and local infrastructure. The demographic/migration component has 160 ages/gender/race/ethnicity cohorts and captures population changes in births, deaths, and migration. (For details, please refer to REMI online documentation at <http://www.remi.com/products/pi>.)

estimated to range from about \$76 - \$660 million for low- and high-cost scenarios respectively.

Direct effects of proposed rules/amendments must be estimated and used as inputs into the REMI PI+ model in order for the model to assess secondary and induced impacts for all actors in the four-county economy on an annual basis and across a user-defined horizon (2022 - 2031). Direct effects of PR 2305 include additional costs to the potentially affected facilities and additional sales by local vendors of equipment, devices, or services supplying the necessary goods/services to help the potentially affected facilities meet the proposed requirements of PR 2305.

While compliance expenditures may increase the cost of doing business for affected facilities, the purchase and installation of additional equipment combined with spending on operation and maintenance may increase sales in other sectors. Tables 25-28 list the industry sectors modeled in REMI PI+ that would either incur a cost or benefit from the compliance expenditures.²⁹

All compliance costs expected due to PR 2305 are included in the REMI PI+ model as spending in the industry categories listed in Table 25. This could substantially mute negative regional effects on employment if the REMI PI+ model assumed all spending from any industry in the South Coast AQMD jurisdiction was spent within the South Coast AQMD jurisdiction. However, each industry is provided a set of “regional purchase coefficients” within the REMI PI+ model, which accounts for industries within the South Coast AQMD jurisdiction spending often going to other facilities outside the South Coast AQMD jurisdiction.

²⁹ Improved public health due to reduced criteria and toxic air pollution may improve worker productivity and other economic factors. Including these factors in a jobs/REMI analysis would only increase the desire of individuals to relocate or stay in the South Coast AQMD jurisdiction. Thus the jobs estimates provided are conservative estimates, and would likely be less after accounting for this improved “amenity” value.

**Table 25: Industries Incurring Costs or Benefitting from PR 2305 Compliance –
Scenario 7 & 7a**

Compliance Cost Source	Industries Incurring Compliance Costs (NAICS in REMI)	Industries with Adjusted Demand (NAICS in REMI)
NZE and/or ZE truck purchases ^{3,6,7,7a,13}	Total annual compliance cost split amongst all industries potentially affected by PR 2305 proportional to total warehouse square footage. ³⁰	<i>One-time Capital:</i> Motor Vehicle Manufacturing (NAICS 3361)
Reduced purchase of diesel fuel ^{3,6,7,7a,13}		<i>Recurring:</i> Petroleum and Coal Products Manufacturing (NAICS 324)
Purchase of natural gas fuel ^{3,7,7a}		<i>Recurring:</i> Oil and Gas Extraction (NAICS 211)
Purchase of electricity as fuel ^{6,7,13}		<i>Recurring:</i> Electric Power Generation, Transmission, and Distribution (NAICS 2211)
Net change in maintenance cost ^{3,6,7,7a,13}		<i>Recurring:</i> Automotive Repair and Maintenance (NAICS 8111)
Net change in insurance cost ^{3,6,7,7a,13}		<i>Recurring:</i> Insurance Carriers (NAICS 5241)
Net change in DMV fees ^{6,7,13}		<i>Recurring:</i> State Government (NAICS 92)
Level 3 charger purchase ^{6,7}		<i>One-time Capital:</i> Other Electrical Equipment and Component Manufacturing (NAICS 3359)
Level 3 charger construction ^{6,7}		<i>One-time Capital:</i> Construction (NAICS 23)
Level 3 charger permitting ^{6,7}		<i>Recurring:</i> Local Government (NAICS 92)
Level 3 charger energization ^{6,7}		<i>One-time Capital:</i> Electric Power Generation, Transmission, and Distribution (NAICS 2211)

³ Indicates this compliance cost source and respective demand are included in Scenario 3.

⁶ Indicates this compliance cost source and respective demand are included in Scenario 6.

⁷ Indicates this compliance cost source and respective demand are included in Scenario 7.

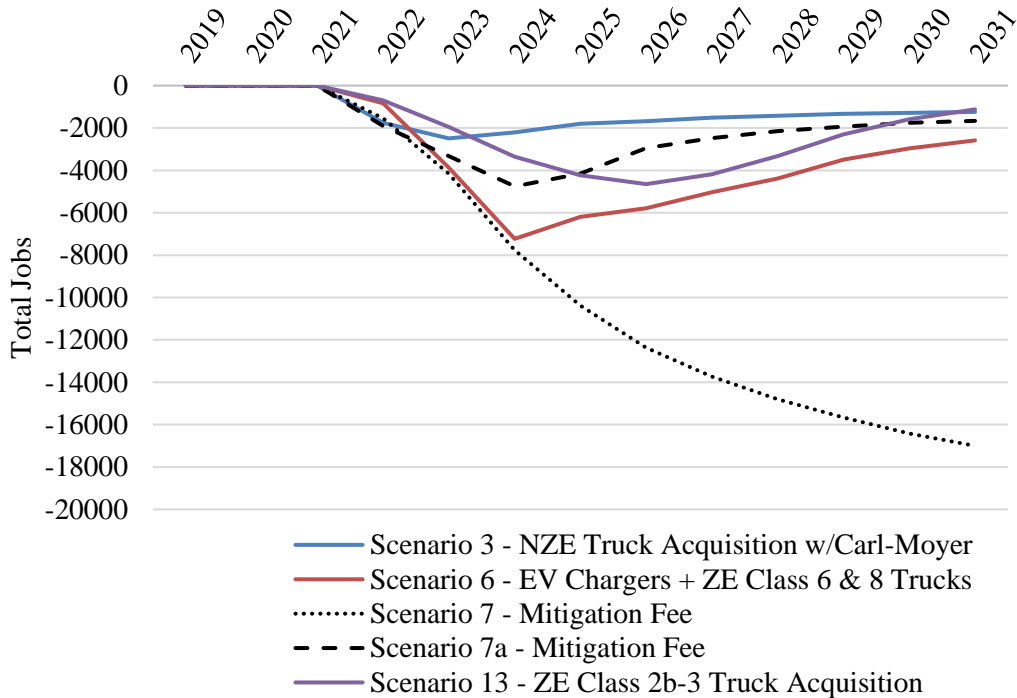
^{7a} Indicates this compliance cost source and respective demand are included in Scenario 7a.

¹³ Indicates this compliance cost source and respective demand are included in Scenario 13.

³⁰ Warehouse operator NAICS and square footage used from CoStar warehouse single-tenant operators and Dun and Bradstreet data matching described in the “Affected Industries/Facilities” section of this report. Industry-by-county shares of total compliance costs were estimated from this data based on total square footage. Any industry-by-county-by-year expected compliance cost was estimated from total annual compliance cost multiplied by the industry’s respective industry-by-county square-footage share relative to total square footage of warehouse space potentially affected by PR 2305.

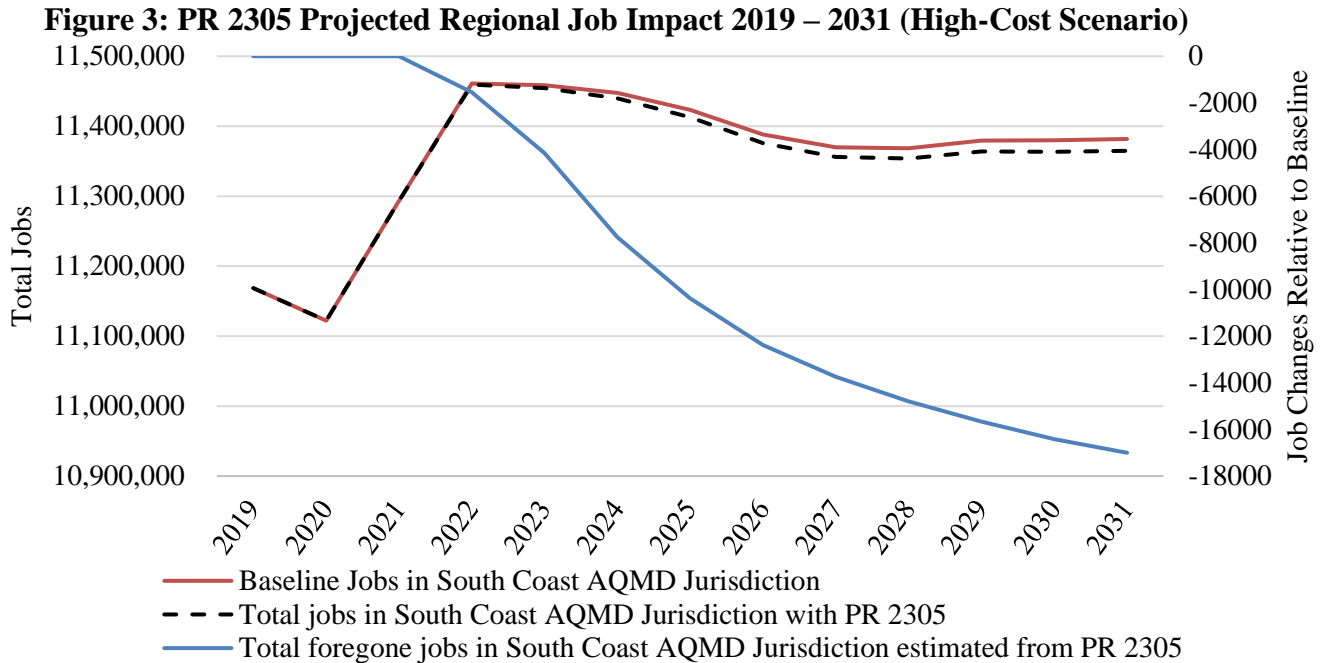
As presented in Figure 2, PR 2305 is expected to result in an average of about 1,700 to 11,400 jobs foregone annually from 2022 to 2031 for the low-cost (Scenario 3) and high-cost (Scenario 7) scenarios respectively. The projected job impacts represent about a 0.01% to a 0.1% decrease of total employment in the four-county region for both low- and high-cost scenarios.

Figure 2: PR 2305 Projected Regional Foregone Jobs, 2022 – 2031



Jobs foregone can come from currently existing jobs or future new jobs. Figure 3 plots predicted foregone jobs, baseline jobs, and total jobs following adoption of PR 2305 through Scenario 7 (high-cost scenario) in 2019 to 2031. Figure 3 illustrates the predicted job impacts from PR 2305 are small relative to the total predicted jobs.

Tables 26-29 present expected job impacts of PR 2305 for each scenario modeled, presenting the top 10 industries with negative job impacts, one industry with expected positive job impacts, and the remaining industries grouped together. Overall, job losses are expected from 2022 to 2031 due to PR 2305. Retail trade (NAICS 44-45) and construction (NAICS 23) are expected to bear most of the estimated total compliance cost of PR 2305, with around an estimated total 1,700 jobs forgone on average annually between 2022 to 2031 for the low-cost scenario (Scenario 3), and an estimated total 11,400 jobs forgone on average annually between 2022 to 2031 for the high-cost scenario (Scenario 7).



Job losses in retail trade and construction are highest across all scenarios for two reasons. First, and most importantly, retail trade and construction are sectors that are highly linked to all other sectors. Since this rule imposes costs on a broad group of industries, each of those industries is expected to have less money to spend on other projects/activities, affecting to a greater proportion retail trade and construction. Historically around 10% of jobs losses predicted in many socioeconomic impact assessments performed by the South Coast AQMD come from construction, and another 10% from retail trade, even for rules not directly affecting facilities in those sectors. This same occurrence is estimated to occur for implementation of PR 2305. Second, some of the warehouse operators affected by PR 2305 are in the retail trade or construction sector.

In all scenarios warehousing and storage (NAICS 493) is also estimated to experience a reduction in jobs.³¹

Sectors experiencing job increases from adoption of PR 2305 vary by scenario due to different compliance actions being taken. For example, in Scenario 3, South Coast AQMD staff estimates job increases in the automotive repair and maintenance sector (NAICS 8111) due to increased maintenance costs for natural gas trucks compared to diesel trucks. Whereas for Scenario 7, job increases in other electrical equipment and component

³¹ Although this is a rule designed to affect trucking activities going to warehouses, most businesses with warehousing activities are not classified formally as being in the “warehousing and storage” industry. Thus the largest job reductions occur from indirect effects of a large group of facilities directing funds away from projects/spending into sectors like retail trade and construction.

manufacturing sector (NAICS 3359) are due to mitigation fee revenue being spent on electric vehicle chargers.³²

Table 26: PR 2305 Job Impacts (Low-Cost Scenario, Scenario 3)

Industry	REMI NAICS	2019	2022	2027	2031	Average annual jobs change (2022-2031)	Baseline annual jobs (2022-2031)	% Change from average baseline (2022-2031)
Retail trade	44-45	0	-327	-197	-172	-241	947,862	0.0%
Construction	23	0	-270	-155	-73	-212	505,066	0.0%
State and local government	92	0	-66	-171	-158	-152	945,760	0.0%
Wholesale trade	42	0	-74	-91	-76	-89	422,236	0.0%
Food services and drinking places	722	0	-79	-84	-80	-87	795,336	0.0%
Warehousing and storage	493	0	-40	-69	-60	-65	130,131	-0.1%
Apparel, leather and allied product manufacturing	315, 316	0	-38	-57	-50	-57	62,634	-0.1%
Real estate	531	0	-70	-43	-37	-54	588,058	0.0%
Business and other support services; investigation and security services	5614, 5616, 5619	0	-31	-38	-33	-38	235,512	0.0%
Truck transportation	484	0	-23	-39	-33	-37	105,660	0.0%
Automotive repair and maintenance	8111	0	-33	107	117	77	99,205	0.1%
	Other	0	-705	-673	-587	-717	6,568,346	0.0%
	Total	0	-1,755	-1,512	-1,243	-1,673	11,405,806	0.0%

Note: Adding all industry values may not add to total amount due to rounding.

³² Scenario 7 assumes collected mitigation fee revenue is spent 50% on electric vehicle chargers and 50% on natural-gas and electric trucks. Spending on trucks scales linearly from 100% spent on natural-gas trucks in 2022, to 100% spent on electric trucks in 2031.

Table 27: PR 2305 Job Impacts (High-Cost Scenario, Scenario 6)

Industry	REMI NAICS	2019	2022	2027	2031	Average annual jobs change (2022-2031)	Baseline annual jobs (2022-2031)	% Change from average baseline (2022-2031)
Retail trade	44-45	0	-273	-705	-403	-671	947,862	-0.1%
Construction	23	0	40	-542	68	-403	505,066	-0.1%
State and local government	92	0	135	-407	-268	-251	945,760	0.0%
Wholesale trade	42	0	-69	-257	-150	-221	422,236	-0.1%
Food services and drinking places	722	0	-50	-256	-179	-219	795,336	0.0%
Apparel, leather and allied product manufacturing	315, 316	0	-38	-220	-154	-179	62,634	-0.3%
Warehousing and storage	493	0	-37	-200	-135	-163	130,131	-0.1%
Real estate	531	0	-47	-157	-75	-144	588,058	0.0%
Business and other support services; investigation and security services	5614, 5616, 5619	0	-23	-105	-62	-89	235,512	0.0%
Offices of health practitioners	6211- 6213	0	-28	-89	-51	-86	394,661	0.0%
Other electrical equipment and component manufacturing	3359	0	21	-1	0	4	6,654	0.1%
	Other	0	-472	-2,093	-1,174	-1,815	6,371,897	0.0%
	Total	0	-841	-5,030	-2,582	-4,239	11,405,806	0.0%

Note: Adding all industry values may not add to total amount due to rounding.

Table 28: PR 2305 Job Impacts (High-Cost Scenario, Scenario 7)

Industry	REMI NAICS	2019	2022	2027	2031	Average annual jobs change (2022-2031)	Baseline annual jobs (2022-2031)	% Change from average baseline (2022-2031)
Retail trade	44-45	0	-309	-2,078	-2,451	-1,746	947,862	-0.2%
Construction	23	0	-203	-1,761	-1,421	-1,319	505,066	-0.3%
State and local government	92	0	-26	-805	-1,252	-674	945,760	-0.1%
Wholesale trade	42	0	-77	-678	-834	-561	422,236	-0.1%
Food services and drinking places	722	0	-72	-661	-887	-559	795,336	-0.1%
Apparel, leather and allied product manufacturing	315, 316	0	-37	-516	-710	-428	62,634	-0.7%
Warehousing and storage	493	0	-39	-484	-663	-403	130,131	-0.3%
Real estate	531	0	-64	-473	-541	-390	588,058	-0.1%
Automotive repair and maintenance	8111	0	-31	-259	-827	-313	99,205	-0.3%
Offices of health practitioners	6211-6213	0	-41	-288	-350	-244	394,661	-0.1%
Other electrical equipment and component manufacturing	3359	0	19	90	99	77	6,654	1.2%
	Other	0	-665	-5,825	-7,163	-4,823	6,508,204	-0.1%
	Total	0	-1,544	-13,736	-17,000	-11,383	11,405,806	-0.1%

Note: Adding all industry values may not add to total amount due to rounding.

Table 29: PR 2305 Job Impacts (High-Cost Scenario, Scenario 7a)

Industry	REMI NAICS	2019	2022	2027	2031	Average annual jobs change (2022-2031)	Baseline annual jobs (2022-2031)	% Change from average baseline (2022-2031)
Retail trade	44-45	0	-336	-320	-246	-397	947,862	0.0%
Construction	23	0	-284	-248	-20	-322	505,066	-0.1%
State and local government	92	0	-74	-270	-204	-229	945,760	0.0%
Food services and drinking places	722	0	-84	-137	-114	-140	795,336	0.0%
Wholesale trade	42	0	-93	-137	-97	-139	422,236	0.0%
Warehousing and storage	493	0	-43	-111	-82	-100	130,131	-0.1%
Apparel, leather and allied product manufacturing	315, 316	0	-38	-109	-81	-99	62,634	-0.2%
Real estate	531	0	-74	-72	-49	-88	588,058	0.0%
Business and other support services; investigation and security services	5614, 5616, 5619	0	-34	-58	-41	-58	235,512	0.0%
Offices of health practitioners	6211-6213	0	-49	-40	-35	-54	394,661	0.0%
Automotive repair and maintenance	8111	0	-34	78	63	38	99,205	0.0%
	Other	0	-765	-1,051	-763	-1,120	6,279,346	0.0%
	Total	0	-1,909	-2,474	-1,668	-2,707	11,405,806	0.0%

Note: Adding all industry values may not add to total amount due to rounding.

Table 30: PR 2305 Job Impacts (High-Cost Scenario, Scenario 13)

Industry	REMI NAICS	2019	2022	2027	2031	Average annual jobs change (2022-2031)	Baseline annual jobs (2022-2031)	% Change from average baseline (2022-2031)
Retail trade	44-45	0	-147	-494	-70	-338	947,862	0.0%
Automotive repair and maintenance	8111	0	-15	-438	-416	-328	99,205	-0.3%
Construction	23	0	-116	-530	129	-303	505,066	-0.1%
State and local government	92	0	-24	-351	-197	-229	945,760	0.0%
Food services and drinking places	722	0	-33	-189	-80	-129	795,336	0.0%
Wholesale trade	42	0	-20	-183	-43	-114	422,236	0.0%
Apparel, leather and allied product manufacturing	315, 316	0	-18	-127	-44	-82	62,634	-0.1%
Real estate	531	0	-29	-122	-16	-81	588,058	0.0%
Warehousing and storage	493	0	-16	-127	-40	-81	130,131	-0.1%
Offices of health practitioners	6211-6213	0	-19	-74	-13	-50	394,661	0.0%
Insurance carriers	5241	0	-2	13	22	11	50,524	0.0%
	Other	0	-264	-1,569	-357	-1,015	6,464,334	0.0%
	Total	0	-1,909	-2,474	-1,668	-2,707	11,405,806	0.0%

Note: Adding all industry values may not add to total amount due to rounding.

Competitiveness

PR 2305 may raise the cost of operating a warehouse in the South Coast AQMD jurisdiction relative to warehouses operating outside the South Coast AQMD jurisdiction, both near and far. South Coast AQMD staff examined the potential for warehouse operators possibly relocating their operations outside the South Coast AMQD jurisdiction, as well as warehouse operators that remain in the South Coast AQMD jurisdiction possibly losing customers due to the desire of warehouse operators to pass on some of the regulatory costs of PR 2305 to their customers.

South Coast AQMD staff is aware of two studies which consider the effects of heightened costs on the goods movement sector, and how those heightened costs might affect warehouse relocation or goods diversion from the ports of Los Angeles and Long Beach.

The first study was completed in 2020 by Industrial Economics, Inc. (IEc) on behalf of the South Coast AQMD. IEC's study investigates the likelihood warehouses within the South Coast AQMD jurisdiction may relocate due to PR 2305 implementation to other regions in southern California, southern Nevada, and western Arizona. A warehouse is estimated to relocate to another region if the estimated cost of operating within the South Coast AQMD jurisdiction is higher than the estimated cost of performing the same operations in the relocation region considered, constrained by available warehouse space.

The IEc study considers the costs of operating each warehouse in the South Coast AQMD jurisdiction for another 20 years. The IEc study includes warehouse rental, labor, power, and goods transportation costs of operating in both the South Coast AQMD jurisdiction along with each relocation region. The cost of operating in the South Coast AQMD jurisdiction is raised by the \$ per square foot cost of complying with PR 2305, conservatively assuming the annual compliance cost occurs immediately upon rule passage for all warehouses greater than 100,000 square feet. The cost of operating after relocating outside the South Coast AQMD jurisdiction is raised due to estimated moving costs, as well as a possibility of new warehouse development costs when considering a scenario where land yet to be zoned for warehousing may become zoned and built on over the next 20 years.

The IEc analysis results indicate at compliance cost ranges of \$0.00-\$1.50 per square foot, no warehouses in the South Coast AQMD jurisdiction would relocate. The IEc analysis results also indicate approximately five to six warehouses may relocate to the Bakersfield region of California if PR 2305 compliance costs were in the range of \$1.50-\$2 per square foot. South Coast AQMD staff interprets the IEc analysis as indicating no warehouses would relocate outside the South Coast AQMD jurisdiction under the currently proposed PR 2305 stringency which could result in a high end mitigation fee of about \$0.82 per square foot.

In preparation for implementing a clean truck fund rate at the Port of Los Angeles (POLA) and Port of Long Beach (POLB), POLA and POLB hired Davies Transportation Consulting Inc. to perform a study estimating the amount of goods diversion away from the POLA/POLB due to a range of clean truck fund rates, considering \$0 to \$70 per twenty-foot-equivalent unit (TEU) container. The latest draft of this report was released December 2019. Based on the results of this study, the ports of Los Angeles and Long Beach have decided to implement a \$10 per TEU clean truck fund rate.

South Coast AQMD staff's current high-cost estimate of PR 2305 is approximately \$650 million annually assuming all warehouses subject to PR 2305 complied with PR 2305 by paying a mitigation fee.³³ Estimates of TEUs through POLA and POLB in 2020 total approximately 17.3 million annually.³⁴ Thus PR 2305 could be viewed as adding on a cost of around \$55/TEU for TEUs which move through the South Coast AQMD jurisdiction. As estimated by the POLA/POLB commissioned study, a \$55/TEU fee would likely result in about one percent of goods diverted away from POLA/POLB to other ports.

The POLA/POLB commissioned study did not allow for the possibility of warehousing goods to be performed outside the South Coast AQMD jurisdiction to avoid the cost of paying the clean truck fund rate as containers landing at the San Pedro Bay Ports would

³³ This scenario assumes a compliance cost of \$0.75 per square foot, a mitigation fee of \$1,000 per WAIRE point, and no usage of mitigation fee revenue to replace trucks visiting warehouses with near-zero-emission or zero-emission vehicles.

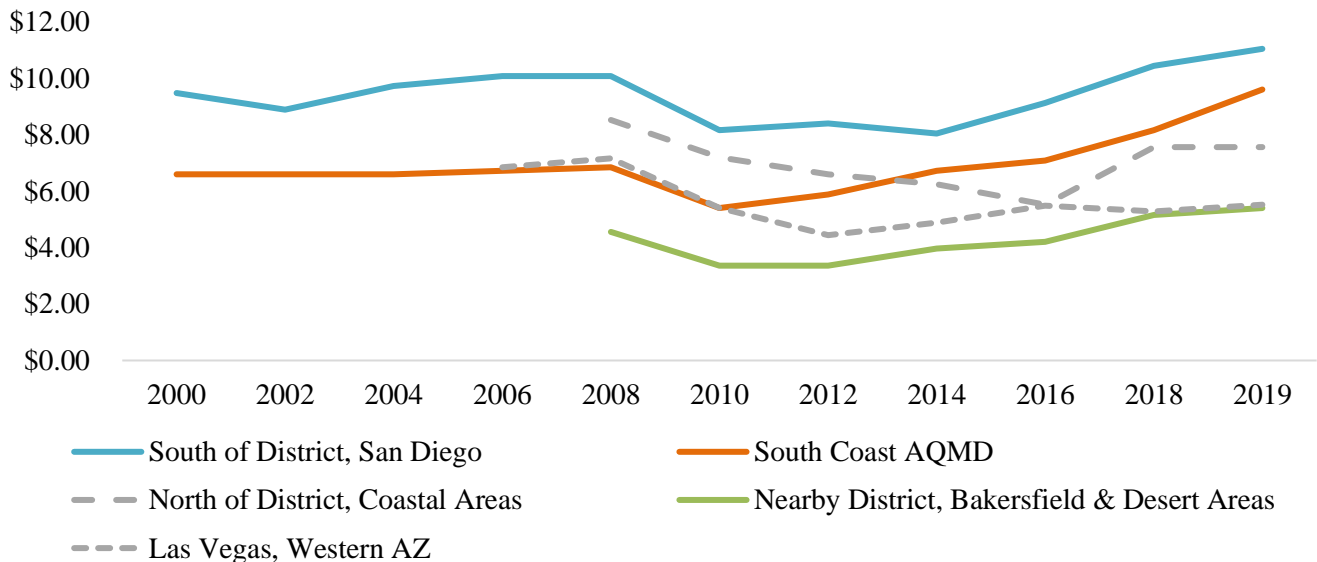
³⁴ South Coast AQMD staff calculations from POLA and POLB data;
<https://www.portoflosangeles.org/business/statistics/container-statistics/historical-teu-statistics-2020>;
<https://polb.com/business/port-statistics/#yearly-teus>;

pay the fee whether the warehouse is in the South Coast AQMD jurisdiction or outside it. In contrast, warehouses and/or warehouse operators can potentially relocate in response to PR 2305 to avoid paying the costs to comply with PR 2305.

As noted in the POLA/POLB commissioned study, shipping goods to other ports, e.g. ports in Texas, the U.S. Southeast, and New York/New Jersey ports could increase shipment times by over a week. Thus, if goods suppliers wished to avoid paying the compliance costs of PR 2305, it is more likely they would relocate to a nearby air district’s jurisdiction than shipping their goods to another port entirely. South Coast AQMD staff expects if any goods diversion were to occur away from POLA/POLB due to PR 2305, it would be a diversion of less than one percent.

Figure 4 below presents regional industrial property rental prices. The data in Figure 4 comes from the CoStar Analytics™ module’s quarterly reporting only for industrial properties with more than 100,000 square feet. Industrial is the most refined category within this CoStar module which contains warehouses, and recent discussions with our consultant Industrial Economics, Inc. indicate almost all of the industrial category is likely warehousing. As Figure 4 shows, industrial rental prices in the South Coast AQMD jurisdiction have risen around 63% from 2012 to 2019, from \$5.88 per square foot to \$9.60 per square foot.³⁵

Figure 4: Annual Rental Prices for Industrial Properties (in 2019 \$)



Over the same time industrial rental prices in the San Diego region rose around 31% from \$8.40 per square foot to \$11.04 per square foot. Before 2010 industrial rental prices in San Diego seem to have maintained a price premium of between \$3-\$4.

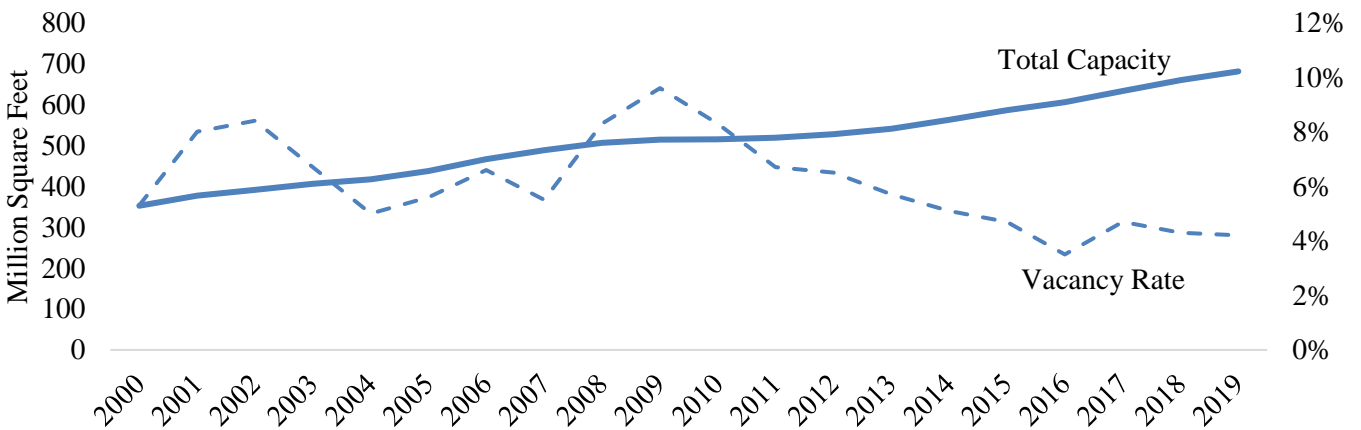
Even though rental prices have been rising in both San Diego and the South Coast AQMD jurisdiction, the rental price premium has fallen by over half to \$1.40 by 2019. The

³⁵ Industrial Economics, Inc., 2020. [http://www.aqmd.gov/docs/default-source/planning/fbmsm-docs/iec_pr-2305-warehouse-relocation-report-\(12-23-20\).pdf?sfvrsn=8](http://www.aqmd.gov/docs/default-source/planning/fbmsm-docs/iec_pr-2305-warehouse-relocation-report-(12-23-20).pdf?sfvrsn=8).

industrial rental price premium which previously existed in the coastal areas north of the South Coast AQMD jurisdiction, e.g. Santa Barbara, is now gone, and it is now costlier to rent industrial space in the South Coast AQMD jurisdiction.

Figure 5 below presents regional warehouse vacancy rates along with available capacity. The data in Figure 5 also comes from the CoStar Analytics™ module’s quarterly reporting only for industrial properties with more than 100,000 square feet. As Figure 5 shows, available warehouse capacity in the South Coast AQMD jurisdiction has been around four percent from 2014-2019. Over the same time total warehouse capacity in the South Coast AQMD jurisdiction has grown by about 120 million square feet. Even though warehouse capacity located in the South Coast AQMD jurisdiction has grown about 20% over the past five years, available capacity has consistently maintained its lowest level observed over the past 20 years at four percent.

Figure 5: South Coast AQMD Vacant Industrial Property and Capacity



Source: CoStar Analytics™

South Coast AQMD staff interprets this combination of sizably higher increases in warehouse space rental prices over the past decade, along with a maintained low amount of available warehouse capacity while total warehouse capacity grew within the South Coast AQMD jurisdiction, as a strong indication the South Coast AQMD jurisdiction is highly competitive for warehousing operations.³⁶

PR 2305 proposes a stringency/compliance cost of *at most* \$0.82 per square foot on warehouses with at least 100,000 square feet of space. This \$0.82 per square foot compliance cost represents an increase in the rental cost of doing business for warehouses operating in the South Coast AQMD jurisdiction that is less than 30% of the increase in

³⁶ This point was also made by warehouse staff interviewed by Industrial Economics, Inc during development of PR 2305. Warehouse staff pointed out the South Coast AQMD jurisdiction has several [hard to monetize] benefits, specifically the very developed transportation network of multiple ports, railways, and interstate highways, along with a large labor pool that is difficult to access in more remote regions.

rental cost this same industry has experienced over the past seven years while showing little evidence of relocation.³⁷

With all the above points in mind, South Coast AQMD staff believes it is highly unlikely that warehouses located in the South Coast AQMD jurisdiction would relocate outside the South Coast AQMD jurisdiction due to PR 2305. Moreover, South Coast AQMD staff believes it is highly unlikely that any goods diversion would occur away from POLA/POLB due to PR 2305.

Warehouses operating in the South Coast AQMD jurisdiction have seen rental price increases of around \$3.70 per square foot over the past decade, which has not seemed to deter expansion of warehousing operations in the South Coast AQMD jurisdiction over the past decade as indicated by vacancy and capacity data presented in Figure 2. Since PR 2305 is expected to at most raise the price of warehouse rent by 30% compared to the increases warehouses in the region have experienced over the past decade, South Coast AQMD staff believes it highly unlikely warehouse relocation and goods-movement relocation would occur due to PR 2305 implementation.³⁸

CEQA ALTERNATIVES

Five alternatives to the proposed project have been developed for PR 2305. Alternative A – No Project, Alternative B – Decreased Emission Reductions, Alternative C – Increased Emission Reductions, Alternative D – All Natural Gas Options Only, Alternative E – All Electric Options Only. The primary components of the alternatives that have been modified are the WAIRE Program applicability in terms of warehouse size in square feet, the proposed rule stringency, the proposed initial compliance period, and the actions available on the WAIRE menu, which could make the WAIRE Program more prescriptive by including a limited number of actions that warehouse operators can select and implement.

For purposes of this document, the no project alternative assumes that the WAIRE Program would not be implemented. This means warehouse operators operating at least 50,000 square feet of warehousing activity located in existing or new warehouses in the South Coast AQMD’s jurisdiction with an indoor warehouse floor space equal to or greater than 100,000 square feet within a single building would not be required to meet their WPCO. The WPCO compliance strategies in the form of WAIRE Menu actions, a Custom WAIRE Plan, and/or the payment of the optional mitigation fee would not be implemented.

Under Alternative B, the warehouse size requirement is increased from “greater than or equal to 100,000 square feet” to “greater than or equal to 200,000 square feet”, such that the number of affected warehouses under Alternative B would decrease. Second, the beginning of the initial compliance and reporting dates are delayed by one year, such that the regulated warehouses would have a longer time period to plan for and phase in any actions that they would need to undertake to meet their WPCO. Third, the rule stringency is relaxed, such that the rule stringency factor for the proposed project is below 0.0025

³⁷ Average rent in the South Coast AQMD jurisdiction for industrial properties from 2000-2008 and again in 2014 was around \$6.70 per square foot, while the same average rent figure was \$9.60 in 2019.

³⁸ $\$0.75/\text{sq.ft.}/\$3.20/\text{sq.ft.} = 20.27\%$ increase.

WAIRE Points per WATT and could be as low as 0.0001 WAIRE Points per WATT. The WPCO compliance strategies such as the WAIRE Menu (all of the actions), a Custom WAIRE Plan, and/or the payment of optional mitigation fee at a cost of \$1,000 per WAIRE Point to South Coast AQMD would not change.

Alternative C consists of a version of the proposed project that would result in greater emission reductions of NO_x and PM_{2.5}. Although it is possible for this to be achieved in a number of ways, for the purpose of this analysis, two ways have been identified and are discussed as follows. First, the applicability of WAIRE Program is broadened to increase the number of affected warehouses. Specifically, the warehouse size requirement of “greater than or equal to 100,000 square feet” is removed and all warehouses, regardless of their size, will be subject to the WAIRE Program. Second, the rule stringency is increased, such that the rule stringency factor for the proposed project is above 0.0025 WAIRE Points per WATT and could be as high as 0.0050 WAIRE Points per WATT. The three-year initial compliance period and WPCO compliance strategies such as the WAIRE Menu (all of the actions), a Custom WAIRE Plan, and/or the payment of optional mitigation fee at a cost of \$1,000 per WAIRE Point to South Coast AQMD would not change.

Alternative D is based on the currently proposed applicability and rule stringency factor for the proposed project 0.0025 WAIRE Points per WATT. However, this alternative limits the number of actions on the WAIRE Menu that warehouse operators could select and implement to earn WAIRE Points. Specifically, the only actions allowed to earn WAIRE Points under Alternative D are related to the use of all natural gas equipment such as the acquisition and/or use of natural gas. Alternative D limits the range of compliance actions on the WAIRE Menu as constraints. Other WPCO compliance strategies such as a Custom WAIRE Plan and/or the payment of optional mitigation fee at a cost of \$1,000 per WAIRE Point to South Coast AQMD would still be available to use by warehouse operators to comply with the proposed project.

Alternative E limits the number of actions on the WAIRE Menu that warehouse operators could select and implement to earn WAIRE Points. Specifically, the only actions allowed to earn WAIRE Points under Alternative E are related to the use of all electric equipment such as the acquisition and/or use of all electric trucks and installation and/or use of ZE fueling or charging infrastructure. Alternative E limits the range of compliance actions on the WAIRE Menu as constraints. Other WPCO compliance strategies such as a Custom WAIRE Plan and/or the payment of optional mitigation fee at a cost of \$1,000 per WAIRE Point to South Coast AQMD still be available to use by warehouse operators to comply with the proposed project.

Table 34 provides a summary of the elements of each of the alternatives and compares them to the proposed project. Assuming a 4% real interest rate, average annual compliance costs for the CEQA alternatives range from \$19 million to \$1 billion between 2022 and 2031, as shown in Table 34. Jobs forgone for the CEQA alternatives range from 380 – 16,700 between 2022 and 2031.

Table 31: Average Annual Cost and Job Impacts of CEQA Alternatives

Alternatives	Average Annual, 2022 - 2031		Cost-Effectiveness (\$/ton) ¹
	Cost	Job Impacts	
Proposed Amendments	\$76,133,655 - \$663,563,162	1,700 – 11,400	\$43,835 - \$94,998
Alternative A - No Project	-	-	
Alternative B - Decreased Emission Reductions	\$19,315,935 - \$34,567,127	380 – 630	\$164,944 - \$357,011
Alternative C - Increased Emission Reductions	\$71,754,630 - \$1,006,909,962	1,600 – 16,700	\$27,706 - \$94,839
Alternative D - All Natural Gas Options Only	\$76,133,655 - \$663,563,162	1,700 – 11,400	\$43,835 - \$94,998
Alternative E - All Electric Options Only ²	\$79,992,980 - \$663,563,162	2,700 - 11,400	\$49,491 - \$94,998

Note: High cost option is the highest-cost mitigation fee option (Scenario 7), as no warehouse operator is expected to comply in a costlier manner than the mitigation fee. The low-cost option in the proposal of PR 2305 AND CEQA Alternative D is Scenario 3, as it is the lowest compliance option estimated by South Coast AQMD staff, and is an action involving purchase and usage of natural gas trucks.

¹ Cost-effectiveness is calculated using the discounted cash flow method (DCF) and a 4% real interest rate. This method is consistent with prior South Coast AQMD rules and the 2016 AQMP.

² The low-cost option for Alternative E is Scenario 10.

Public Health Benefits Estimation

Public health benefits resulting from compliance with PR 2305 are calculated using an incidence per ton (IPT) methodology, developed by the U.S. Environmental Protection Agency (Fann et al. 2009, 2012, 2018). The IPT methodology is an approximation based on the general assumption that the relationship between emissions and adverse health outcomes is linear. In addition, the IPT methodology relies on the following assumptions, (1) changes in health incidence are proportional to ambient PM = concentrations; (2) changes in primary pollutant concentrations (PM2.5) are proportional to changes in emissions (PM2.5); and (3) changes in secondary pollutant concentrations (nitrate PM2.5) are also proportional to changes in emissions (NOx). This final assumption can vary for individual actions due to the complex chemical reactions that occur to create regional pollutants. However, as warehouse ISR is part of a larger emission reduction strategy, a simplifying assumption is that the health benefits for every ton of NOx reduction in that strategy yields equal benefits.

Incidence Per Ton Methodology

Because of the assumed linear relationship between emissions and health outcomes, estimates of reductions in health endpoints resulting from PR 2305 can be found by multiplying expected PM2.5 and NOx emission reductions by an IPT factor for each health

endpoint.³⁹ The IPT factors for each health endpoint were estimated using estimated control strategy emissions reductions, air quality modeling in the U.S. EPA’s Community Multiscale Air Modeling System (CMAQ), and public health benefits estimation using the U.S. EPA’s Environmental Benefits Mapping and Analysis Program – Community Edition (BenMAP-CE) from the 2016 Air Quality Management Plan (AQMP).

For example, a NOx IPT factor is calculated by dividing the estimated reduction in incidence of a given health endpoint by the total NOx emission reductions in the years 2023 and 2031.⁴⁰ Linear interpolation is used to generate IPT factors for the remaining years (2022, 2024-2030). IPT factors for PM2.5 are calculated similarly.⁴¹

NOx contributes to the formation of ambient concentrations of PM2.5. For the sake of calculating contribution to ambient PM2.5 concentrations, it was assumed that each ton of NOx emitted is equivalent to 0.03 tons of directly emitted PM2.5.^{42,43}

Total emissions reductions in years 2023 and 2031 resulting from 2016 AQMP control strategies are shown in Table 32 below, while the corresponding reductions in modeled health outcomes in 2023 and 2031 are shown in Table 33 below.

Table 32: 2016 AQMP Projected Emission Reductions by Pollutant (in TPD)

	2023	2031
VOC	64	72
NOX	124	128
PM2.5	0.22	3.4

Note: Projected emission reductions are the average of the summer planning period (May 1 to September 30).

³⁹ <https://ww2.arb.ca.gov/sites/default/files/2019-08/Estimating%20the%20Health%20Benefits%20Associated%20with%20Reductions%20in%20PM%20and%20NOx%20Emissions%20-%20Detailed%20Description.pdf>

⁴⁰ Reductions in health incidence were estimated for 2023 and 2031 in the 2016 AQMP.

⁴¹ IPT factors also increase over time reflecting the projected increases in population by age class underpinning health effects modeling.

⁴² U.S. EPA’s February 2018 Technical Support Document, “Estimating the Benefit per Ton of Reducing PM2.5 Precursors from 17 Sectors,” estimates the average monetary public health benefits of NOx emissions is roughly 3% of direct PM emissions (https://www.epa.gov/sites/production/files/2018-02/documents/sourceapportionmentbpttsd_2018.pdf).

⁴³ The ratio of NOx to PM2.5 could potentially be higher than the 0.03 assumed here. Previous work done on the 2007 AQMP suggested that each ton of NOx emitted is equivalent to 0.1 tons of directly emitted PM2.5 in regards to annual PM2.5 concentrations. A higher NOx to PM2.5 ratio would lead to an increase in IPT factors for NOx and corresponding decrease in IPT factors for directly emitted PM2.5. Given that NOx emission reductions from PR 2305 are projected to be over 100 times greater than directly emitted PM2.5, an increase in the NOx IPT factor will outweigh the corresponding decrease in PM2.5 IPT factors and result in an overall increase in total benefits. In this analysis we present results assuming a ratio of 0.03 in an attempt to provide conservative estimate of public health benefits.

Table 33: 2016 AQMP Modeled Reductions in Incidence Due to PM2.5 Exposure

	2023	2031	Average Annual
Premature Deaths Avoided, All Cause			
Long-Term PM2.5 Exposure	1,394	2,716	1,512
Short-Term PM2.5 Exposure ¹	100	194	108
Reduced Morbidity Incidence			
<i>Long-Term PM2.5 Exposure</i>			
Acute Bronchitis	1,039	1,890	1,087
<i>Short-Term PM2.5 Exposure</i>			
Acute Myocardial Infarction, Nonfatal	33	71	38
Asthma Exacerbation (Wheeze, Cough, Shortness of Breath)	23,321	42,780	24,495
Asthma, New Onset (Wheeze)	2,956	5,577	3,151
HA, All Cardiovascular (less Myocardial Infarctions)	164	337	183
HA, All Respiratory (less Asthma) ²	136	290	155
HA, Ischemic Stroke	79	171	91
HA and ED Visits, Asthma	142	260	149
Lower Respiratory Symptoms	12,268	22,387	12,850
Upper Respiratory Symptoms	24,342	44,720	25,587
Minor Restricted Activity Days ³	528,869	961,248	552,809
Work Loss Days ³	91,689	166,826	95,892

* Each health effect represents the point estimate of a statistical distribution of potential outcomes. Please see Appendix 3-B of the 2016 AQMP Final Socioeconomic Report where the 95-percent confidence intervals are reported. Health effects for other years during the period 2017 to 2031 were based on interpolated, as opposed to modeled, air quality changes. The study population of each C-R function utilized can be found in Appendix 3-B of the 2016 AQMP Final Socioeconomic Report.

¹ Premature deaths avoided due to short-term exposure to PM2.5 are likely to partially overlap with those due to long-term PM2.5 exposure. Therefore, the total premature deaths associated with PM2.5 will be lower than simply summing across mortality effects from both short-term and long-term exposure (Industrial Economics and Thurston 2016a; Kunzli et al. 2001).

² This is the pooled estimate of two health endpoints: HA, Chronic Lung Disease (less Asthma) (18-64 years old) and HA, All Respiratory (65 or older).

³ Expressed in person-days. Minor Restricted Activity Days (MRAD) refer to days when some normal activities are avoided due to illness.

IPT factors for NO_x and directly emitted PM_{2.5} were calculated using the modeled emission reductions and corresponding health outcomes in Tables 32 and 33 above. These estimated IPT factors were then used to generate estimates of the reductions in health incidence resulting from expected emission reductions resulting from PR 2305 compliance. Emission reduction estimates vary based on the modeled compliance scenario.

Here we present results based on emissions reduction estimates from PR 2305 resulting from Scenario 1 (NZE Truck Acquisitions and Subsequent Usage) net of existing CARB regulations. Table 34 below lists the NO_x and diesel PM (DPM) emissions reductions in

each compliance year by modeled compliance scenario, and Table 35 shows the corresponding reductions in health incidence derived using IPT factors.⁴⁴

**Table 34: Estimated Modeled Emissions Reductions For Compliance Scenario 1
(Total ISR Emissions Net of Existing CARB Regulations)**

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
NOx Reductions (tpd)	0.000	1.008	2.188	3.330	3.632	3.420	3.217	3.135	3.105	2.998
DPM Reductions (tpd)	0.000	0.008	0.018	0.027	0.029	0.028	0.026	0.026	0.025	0.024

Table 35: Estimated Reductions in Incidence Resulting From Compliance Scenario 1 Emission Reductions (Total ISR Emissions Net of Existing CARB Regulations)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Premature Deaths Avoided, All Cause										
<i>Long-Term PM2.5 Exposure</i>	0	13	29	45	49	47	44	43	43	42
<i>Short-Term PM2.5 Exposure</i>	0	1	2	3	4	3	3	3	3	3
Reduced Morbidity Incidence										
<i>Long-Term PM2.5 Exposure</i>										
Acute Bronchitis	0	10	22	33	36	34	32	31	30	29
<i>Short-Term PM2.5 Exposure</i>										
Acute Myocardial Infarction, Nonfatal	0	0	1	1	1	1	1	1	1	1
Asthma Exacerbation (Wheeze, Cough, Shortness of Breath)	0	223	484	736	801	760	713	695	688	661
Asthma, New Onset (Wheeze)	0	28	62	94	103	98	92	90	89	86
HA, All Cardiovascular (less Myocardial Infarctions)	0	2	3	5	6	6	5	5	5	5
HA, All Respiratory (less Asthma)	0	1	3	4	5	5	5	5	5	4
HA, Ischemic Stroke	0	1	2	3	3	3	3	3	3	3
HA and ED Visits, Asthma	0	1	3	4	5	5	4	4	4	4
Lower Respiratory Symptoms	0	117	255	387	421	399	374	364	360	346
Upper Respiratory Symptoms	0	233	506	769	837	794	745	726	719	691
Minor Restricted Activity Days	0	5058	10969	16658	18113	17153	16076	15646	15467	14854
Work Loss Days	0	877	1902	2889	3141	2975	2789	2715	2684	2578

⁴⁴ To calculate PM2.5 emission reductions, DPM emission reductions are multiplied by a scaling factor (0.92). Scaling factor can be found in “Final –Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Thresholds”, [http://www.aqmd.gov/docs/default-source/ceqa/handbook/localized-significance-thresholds/particulate-matter-\(pm\)-2.5-significance-thresholds-and-calculation-methodology/final_pm2_5methodology.pdf?sfvrsn=2](http://www.aqmd.gov/docs/default-source/ceqa/handbook/localized-significance-thresholds/particulate-matter-(pm)-2.5-significance-thresholds-and-calculation-methodology/final_pm2_5methodology.pdf?sfvrsn=2)

Valuation of Public Health Benefits

Monetary valuations of all reductions in adverse health outcomes were calculated. The 2016 AQMP calculated total monetary valuation for each endpoint by multiplying the number of reduced outcomes for each endpoint by an estimate of the economic value of reducing individual outcome for each endpoint. For reductions in premature mortalities, an estimate of the value of a statistical life (VSL) was used. To generate value estimates for morbidities such as hospital admissions or emergency room visits, a cost-of-illness (COI) methodology was typically used. A detailed description of VSL and COI estimates can be found in Chapter 3 of the 2016 AQMP Final Socioeconomic Report. A summary of all monetary values and their associated reference(s) can be found in Appendix 3B of the 2016 AQMP Final Socioeconomic Report.

Staff estimated benefits per ton (BPT) factors for each health endpoint analyzed in the 2016 AQMP. BPT factors are calculated by dividing monetized public health benefits by modelled emission reductions from the AQMP. For example, a NO_x BPT factor is calculated by dividing the estimated monetized health benefits of a given health endpoint by the total NO_x emission reductions in the years 2023 and 2031. Linear interpolation is used to generate BPT factors for the remaining years (2022, 2024-2030). BPT factors for PM_{2.5} are calculated similarly.⁴⁵ Table 36 below shows total monetized health benefits for each modeled compliance scenario summed over the entire compliance period (2022-2031). All dollar figures are in millions of 2018 dollars.⁴⁶

Uncertainty in Public Health Benefits Estimation

The IPT methodology employed in this methodology is a proven reduced-form tool to estimate public health benefits and currently utilized by CARB and the U.S. EPA. However, the linearity assumption underpinning the IPT and BPT methodologies employed here is necessarily an approximation, and does not account for complex chemistry, precursor pollutant interactions, and finer-scale geographical effects in the same way that detailed modeling can, like in the 2016 AQMP (using CMAQ and BenMAP). In addition, the relative contribution of NO_x to PM_{2.5} concentrations is subject to uncertainty and may vary by location. Actual changes in PM_{2.5} concentration may be higher or lower than what is projected in this analysis. The approximations shown here however are consistent with the detailed and holistic 2016 AQMP analysis to the extent that the proposed rule is included as a part of that overall strategy.

⁴⁵ BPT factors increase over time reflecting the projected increases in population by age class and increases in VSL due to projected increases in future incomes.

⁴⁶ 2015 dollar figures presented in the 2016 AQMP Final Socioeconomic Report have been adjusted using a price inflator of 4.64% based on the October 2020 Marshall & Swift price index (average, all industries).

Table 36: Projected Monetized Health Benefits for Each Compliance Scenario in Millions of 2018 Dollars (Total ISR Emissions Net of Existing CARB Regulations)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	NPV (1%)
Sc1	\$0	\$138	\$307	\$476	\$529	\$511	\$489	\$486	\$490	\$480	\$3,664
Sc2	\$0	\$182	\$330	\$556	\$550	\$540	\$526	\$497	\$479	\$468	\$3,877
Sc3	\$0	\$555	\$924	\$707	\$655	\$620	\$586	\$556	\$539	\$529	\$5,360
Sc4	\$138	\$256	\$446	\$516	\$530	\$487	\$455	\$421	\$399	\$386	\$3,809
Sc5	\$0	\$642	\$394	\$471	\$515	\$531	\$542	\$550	\$553	\$551	\$4,473
Sc6	\$0	-\$1	\$56	\$144	\$204	\$248	\$263	\$271	\$271	\$264	\$1,603
Sc7	\$0	\$416	\$1,016	\$1,782	\$2,158	\$2,391	\$2,498	\$2,608	\$2,720	\$2,834	\$17,204
Sc8	\$0	\$68	\$186	\$334	\$412	\$445	\$465	\$485	\$511	\$526	\$3,204
Sc9	\$187	\$228	\$395	\$464	\$497	\$498	\$504	\$512	\$523	\$536	\$4,087
Sc10	\$200	\$249	\$432	\$514	\$560	\$575	\$589	\$603	\$615	\$627	\$4,666
Sc11	\$0	\$13	\$177	\$124	\$191	\$1,525	\$1,871	\$2,398	\$2,504	\$2,612	\$10,535
Sc12	\$0	-\$1	\$48	\$99	\$158	\$325	\$382	\$432	\$433	\$445	\$2,151
Sc13	\$0	\$56	\$116	\$460	\$537	\$225	\$214	\$206	\$197	\$187	\$2,072
Sc14	\$63	\$140	\$223	\$245	\$247	\$234	\$222	\$211	\$200	\$189	\$1,864
Sc15	\$0	\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$1	\$10
Sc16	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Sc17	\$0	\$10	\$41	\$81	\$106	\$103	\$88	\$65	\$34	\$8	\$505
Sc18	\$0	\$6	\$12	\$20	\$21	\$22	\$24	\$25	\$26	\$27	\$172

REFERENCES

CoreLogic® Marshall & Swift® Equipment Cost Index (M&S index). Last update received 10/2020.

Dun & Bradstreet Enterprise Database. 2020.

Economic Modeling Specialists International (EMSI), accessed February 26th, 2021, <https://www.economicmodeling.com/>. EMSI Datarun 2021.1.

Regional Economic Modeling Inc. (REMI). Policy Insight® for the South Coast Area (160-sector model). Version 2.4.1, 2020.

South Coast Air Quality Management District. Proposed Rule 2305 – Warehouse Indirect Source Rule - Warehouse Actions and Investments to Reduce Emissions (WAIRE) Program and Proposed Rule 316 – Fees for Rule 2305, March 2021.

Fann N, Fulcher CM, Hubbell BJ. 2009. The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution Air Quality. Atmosphere & Health. 2:169-176.

Fann N, Baker KR, Fulcher CM. 2012. Characterizing the PM2.5-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S. *Environ Int.* 2012 Nov 15;49:141-51.

Fann N, Baker K, Chan E, Eyth A, Macpherson A, Miller E, Snyder J. 2018. Assessing Human Health PM2.5 and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025. *Environ. Sci. Technol.* 52 (15), pp 8095–8103.