

Emissions Impact of Recent Congestion at California Ports

September 13, 2021

Quantifying emissions impacts of freight movement increases and congestion in container vessels, locomotives, and heavy-duty trucks near major seaports in California.

- Major seaports in California have been experiencing a substantial increase in cargo imports, resulting in significant congestion at terminals and in surrounding areas. This has led to emissions increases from freight-related sources which can negatively impact air quality especially in communities near ports.
- Congestion has led to an abnormally high number of container vessels at anchor, which use auxiliary engines continuously to provide power for shipboard functions. Additionally, increased cargo imports are expected to increase the activity of trucks and locomotives moving these containers in/out of the ports.
- In March 2021, the San Pedro Bay Ports (SPBP), which include the Ports of Los Angeles and Long Beach, saw an average increase of 50 percent in cargo movement (twenty-foot equivalent units – TEU) compared to the same time in 2019 prior to the COVID-19 pandemic (see Table 1 below). Furthermore, TEU movement in March 2021 was 58% higher than the average of Port of Los Angeles and Port of Long Beach TEUs for the past 10 years.

Table 1. San Pedro Bay Ports TEU Trends (2019-2021)

Ports	March 2019	March 2020	March 2021	Percent increase since <u>2019</u>
Port of Los Angeles	650,977	449,568	957,599	47%
Port of Long Beach	552,821	517,664	840,387	52%

- Combining container vessels, locomotives, and heavy-duty trucks, as of **March 2021**, the increased cargo movement and congestion has resulted in overall emissions increases of **14.5 tons per day (tpd) of oxides of nitrogen (NOx) and 0.27 tpd of particulate matter (PM)** in the South Coast Air Basin relative to average pre-pandemic baseline levels. Table 2 below shows staff’s estimate of the emission impacts broken down by source category. Details of each analysis can be found in Appendix A, B, and C for vessels, rail, and trucks, respectively.

Table 2. Summary of Excess NOx and PM Emissions by Source Category in the South Coast Air Basin (March 2021)

Emissions Source Category	Estimated Increase in NOx Emissions (tpd)	Estimated Increase in PM Emissions (tpd)
Trucks	4.8	0.03
Rail (On-Port)	0.2	0.007
Regional Rail (Off-Port)	2	0.03
Container Vessels at Anchor	7.5	0.2
Total	14.5	0.27

- To put these numbers into context, this increase in NOx emissions is equivalent to almost 14 percent of the additional 108 tpd NOx reductions needed to attain with the 80 ppb ozone standard in the South Coast Air Basin by 2023. Additionally, the increased PM emissions is comparable to exhaust PM emissions from almost 50,000 Class 8 diesel trucks.
- Although the analysis here estimated excess emissions in March 2021, higher than average congestion and cargo imports have persisted through August 2021; therefore, excess emissions are also expected to continue.
- According to the Marine Exchange of Southern California¹, as of August 31, 2021, there were 43 container vessels (total of 70 vessels) at anchor near the SPBP. This is similar to the number of container vessels at anchor reported in February 2021.

Figure 1. Container Vessels at Anchor on August 10, 2021 Near the SPBP²

Port of Oakland: A lesser, but still significant, number of vessels have been anchored near the Port of Oakland over the same period. Compared to March 2019, these vessels are estimated to increase **NOx emissions by 5.2 tpd and PM emissions by 0.14 tpd** in the San Francisco Bay Area as of March 2021. The increase in freight movement at the port is less extreme than the SPBP (a 13 percent increase from 2019, compared to 50 percent for the SPBP).

¹ <https://mxsocal.org/>

² Courtesy of MXSOCAL: <https://twitter.com/MXSOCAL/status/1425223127374598149>

Appendix A: Emission and Health Impacts from Vessels at Anchor at California’s Major Ports

- The following two figures illustrate how estimated NOx and PM emissions associated with anchored container vessels at California’s major ports, including the San Pedro Bay Ports (SPBP) and Port of Oakland (POAK). Emissions increased sharply beginning in November 2020 and peaked in February 2021. Despite short term relief between March and July 2021, the congestion has again spiked to record levels in August 2021 at the SPBP.

Figure A1. NOx Emissions from Anchored Container Vessels at the San Pedro Bay Ports and the Port of Oakland

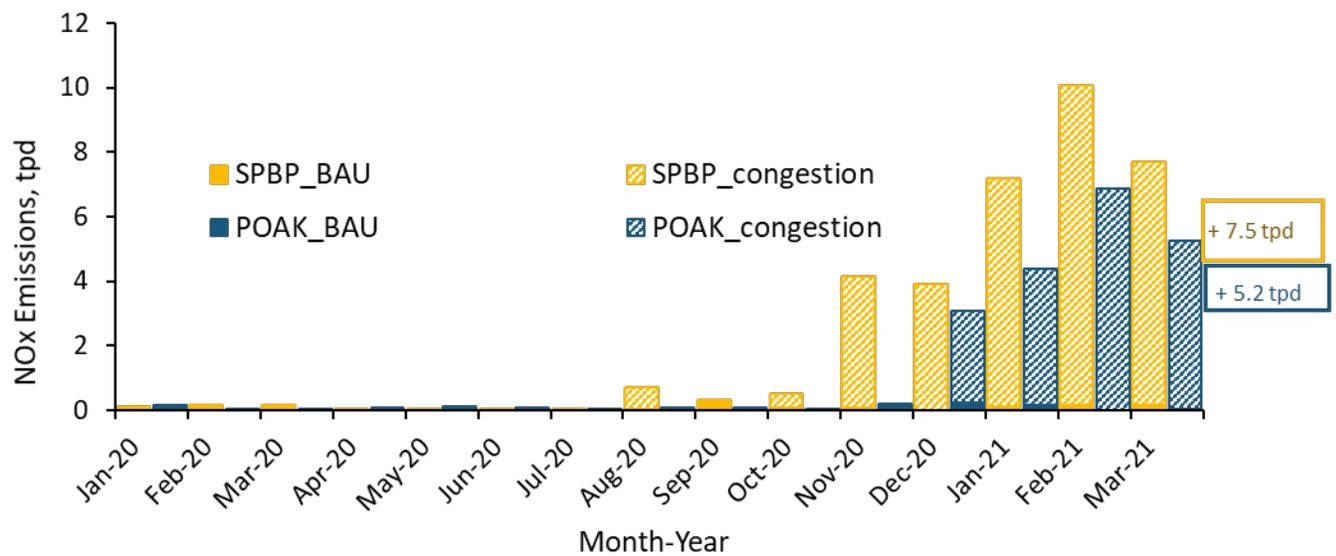
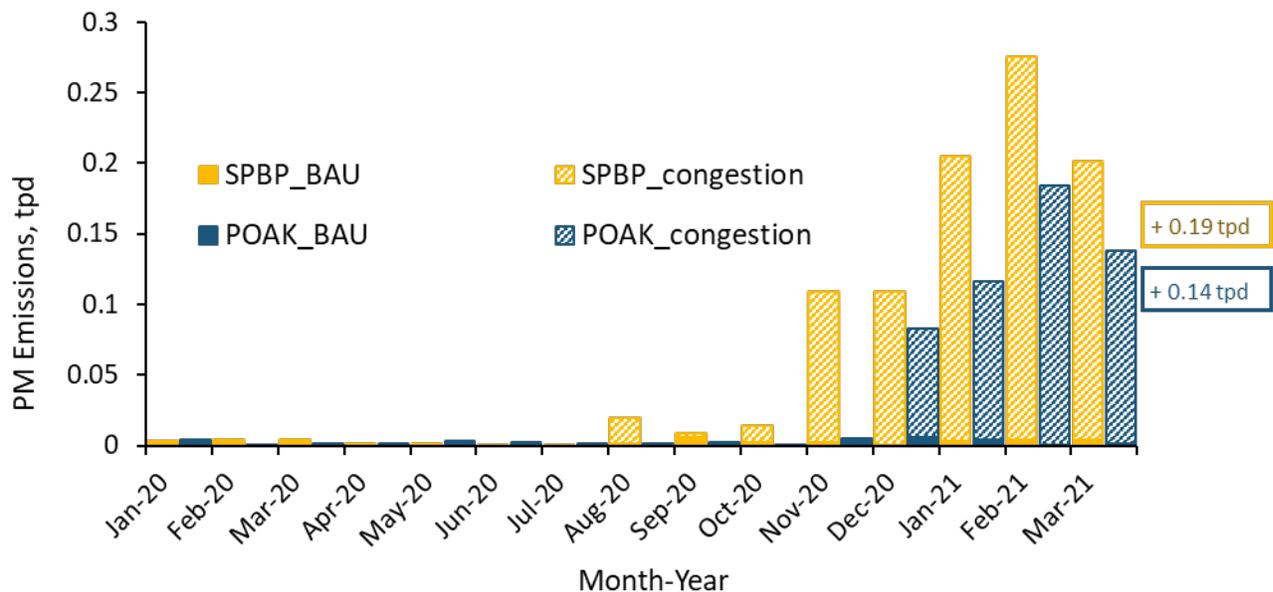


Figure A2. PM Emissions from Anchored Container Vessels at the San Pedro Bay Ports and the Port of Oakland



- To put this into context, CARB's current emissions inventory estimates that all Ocean Going Vessels (OGV) categories within 3 nautical miles (nm) of the coast of the South Coast Air Basin emit approximately 0.4 tons per day (tpd) of PM, and 13.8 tpd of NOx.
- In the San Francisco Bay Area, all OGVs contribute approximately 12.8 tpd of NOx and 0.25 tpd of PM within 3 nm of the coast. These include emissions associated with at-berth, at-anchorage, and transit/maneuvering operations.
- To provide context and qualitative information on potential health impacts in the South Coast Air Basin from the increased anchorage emissions at the Ports of Long Beach and Los Angeles, CARB staff relied on the estimates of health benefits developed for the At Berth Regulation.
- The estimated annual emission increases³ (both NOx and PM) from higher anchorage activities are quite similar to the emission reductions from implementing the At Berth regulation in the South Coast Air Basin in 2025 (from all OGV vessel types). Therefore, in comparison, the annual health disbenefits associated with increased anchorage emissions will likely be comparable to the estimated numbers of cases of avoided mortality and illness listed in Table A1 below for the At Berth Regulation in the year 2025.

Table A1. Health Benefits Associated with Implementing the At Berth Regulation in the South Coast Air Basin in 2025

Outcomes	Incidence Reduction
Cardiopulmonary mortality	20
Hospitalizations for cardiovascular illness	3
Hospitalizations for respiratory illness	3
Emergency room visits for asthma	10

- CARB staff is evaluating anchorage emissions as a component of the required 2022 Interim Evaluation for the At Berth Regulation. In the At Berth Regulation Resolution, the CARB Board directed staff to review the potential feasibility of control technologies for vessels at anchor and to publish the findings in a report by December 1, 2022.
- The following two figures provide vessel locational information from 2016 AIS⁴ data that was the basis for the emissions estimates provided in this analysis.

³ Between April 2020 and March 2021

⁴ The automatic identification system (AIS) is an automatic tracking system that uses transceivers on ships that provide vessel-specific information including position, course, and speed.

Figure A3. Locations for Anchored Vessels at the San Pedro Bay Ports

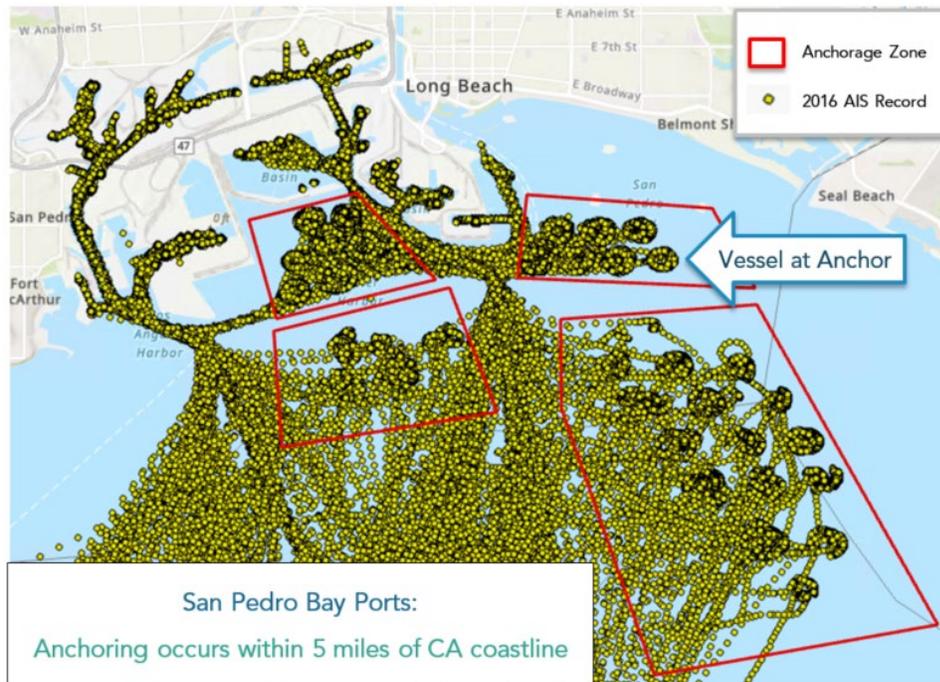


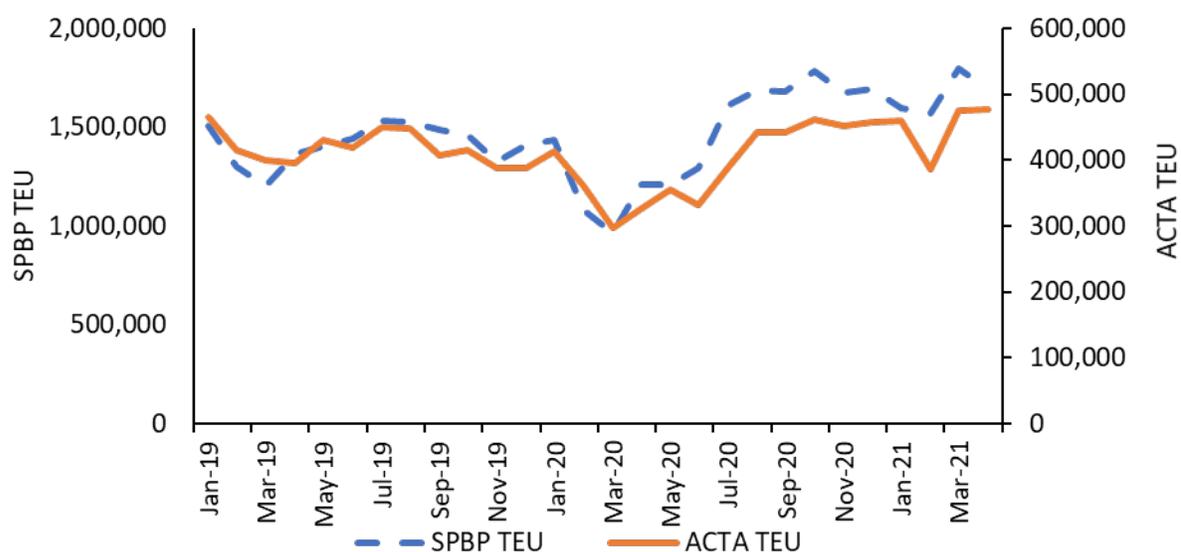
Figure A4. Locations for Anchored Vessels at Port of Oakland



Appendix B: Quantifying emissions related to recent changes in locomotive activity near the Ports of Los Angeles and Long Beach (SPBP)

- In 1998, CARB and the major railroads operating in California entered into a memorandum of understanding (MOU) agreeing to accelerated adoption of cleaner locomotives in the South Coast region. In conjunction with the MOU, the railroads agreed to ensuring the South Coast locomotive fleet meet a Tier 2 engine average by 2010. To verify Fleet Average Targets in the MOU are being met, the Union Pacific (UP) and Burlington Northern Santa Fe (BNSF) railroads agreed to track and report locomotive usage in the South Coast Nonattainment Area by recording megawatts-hours (MWhrs) and fuel consumption.
- According to data provided as part of the 1998 MOU, locomotive activity in the South Coast Air Basin is correlated with cargo movement at the SPBP as well as TEU data provided by the Alameda Corridor Transportation Authority (ACTA). While POLA and POLB TEUs were reduced by 20% of 2019 cargo movement, 1998 MOU data also indicated 15~20% lower locomotive activity in 2020 in the South Coast Air Basin compared to 2019.
- For this analysis, staff used the historical TEU data provided by ACTA⁵ as a surrogate to estimate the increased emissions from rail activity in the South Coast Air Basin. Figure B1 below shows that TEU data provided by ACTA is generally correlated with SPBP container throughput.

Figure B1. A Comparison Between SPBP and ACTA TEU Data



⁵ https://1popqd1sgf8034z1s33q7dj6-wpengine.netdna-ssl.com/wp-content/uploads/2020/12/Monthly_TEUREV_History.pdf

- CARB's current emissions estimate from the 2021 Line-Haul and Switcher Locomotive Emission Inventory⁶ shows that off-port activity of locomotives contribute approximately 10.9 tpd of NOx and 0.16 tpd of diesel PM emissions in the South Coast Air Basin.
- At the same time, the emissions inventory developed by the Ports of Los Angeles and Long Beach show that on-port rail contributes to approximately 1.2 tpd of NOx emissions and 0.04 tpd of diesel PM emissions.
- As a result of significant increases in cargo movement, NOx and PM emissions from locomotives are assumed to have increased in recent months.
- Staff assessment shows that in March 2021, regional (off-port) emissions from locomotives operating in the South Coast Air Basin is likely to have increased by 2 tpd for NOx and 0.03 tpd for diesel PM.
- Likewise, staff has estimated the increased cargo movement has resulted in an additional 0.2 tpd of NOx and less than 0.01 tpd of diesel PM emissions from on-port rail operations at the San Pedro Bay Ports.
- The following figures illustrate how estimated NOx and PM emissions associated with on-port rail at the San Pedro Bay Ports as well regional rail operation in the South Coast Air Basin have increased sharply beginning in July 2020 and have continued increasing since then. Here, business as usual or "BAU" represents emissions under a scenario where TEUs were assumed to follow the same trend as in 2019, whereas the "Congestion" represents estimated emissions using actual TEU data in 2020 and 2021.

⁶ https://ww2.arb.ca.gov/sites/default/files/2021-02/2021_line_haul_locomotive_emission_inventory_final.pdf

Figure B2. NOx Emissions from Off-Port Rail in the South Coast Air Basin

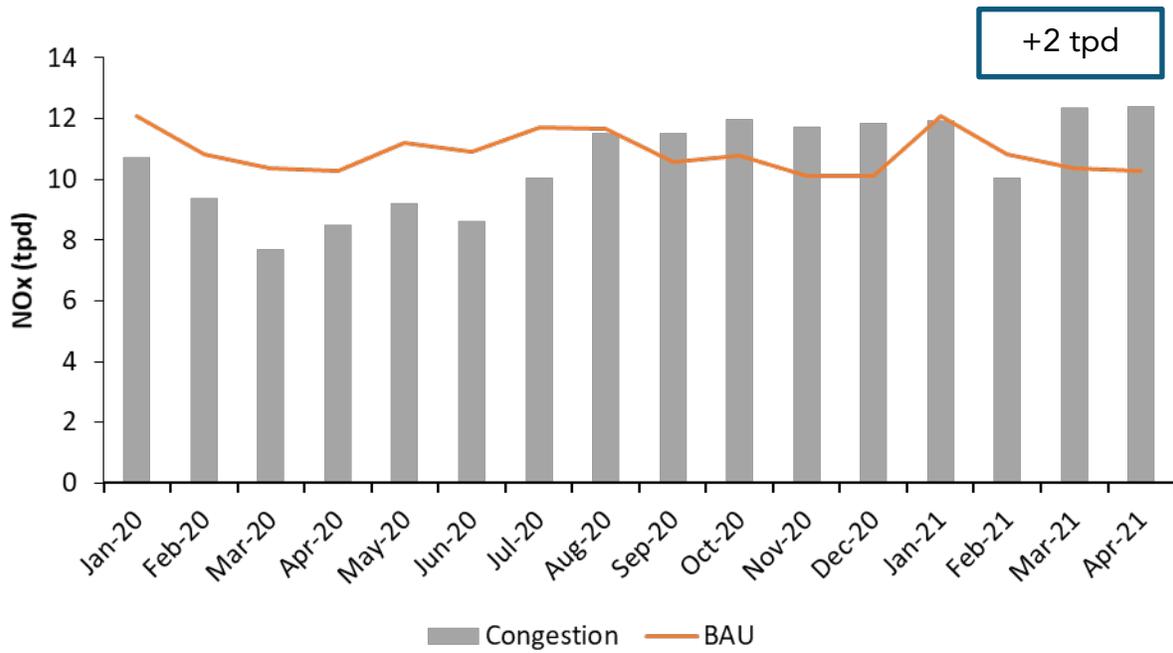


Figure B3. NOx Emissions from On-Port Rail in the South Coast Air Basin

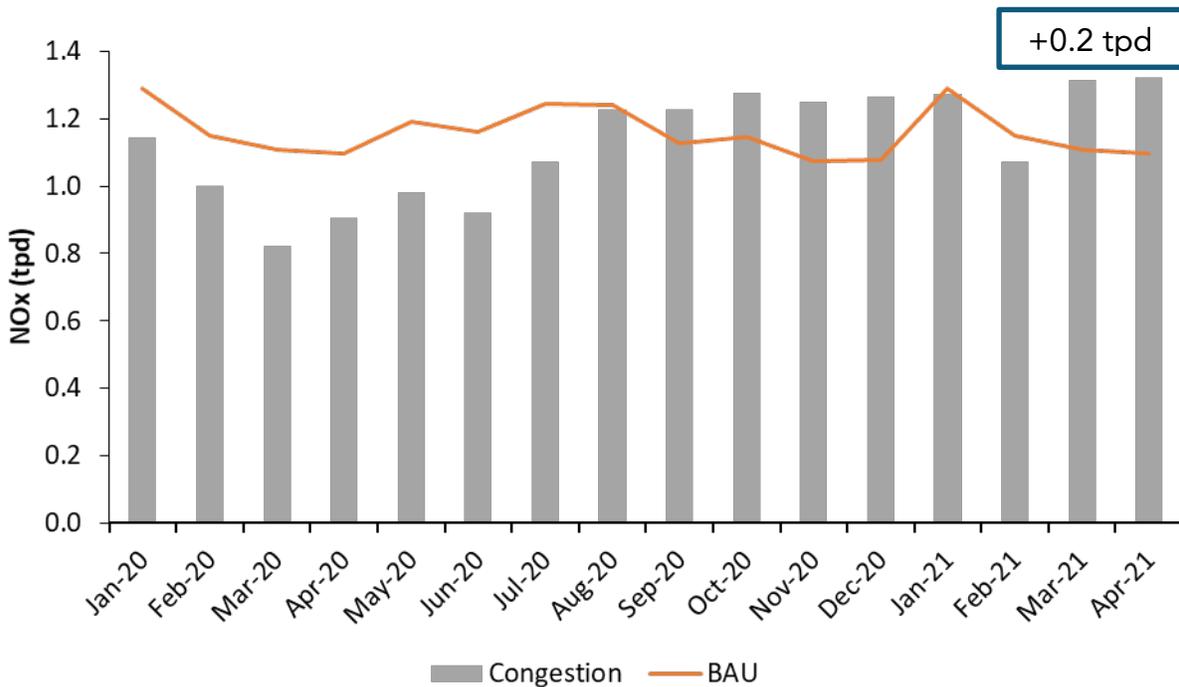


Figure B4. PM Emissions from Off-Port Rail in the South Coast Air Basin

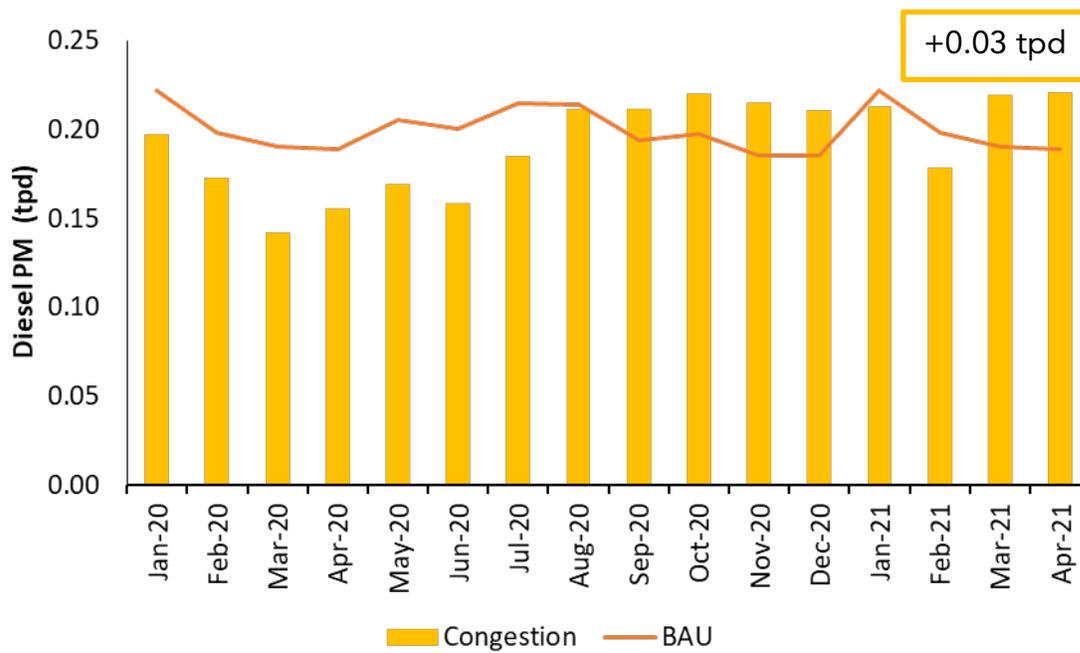
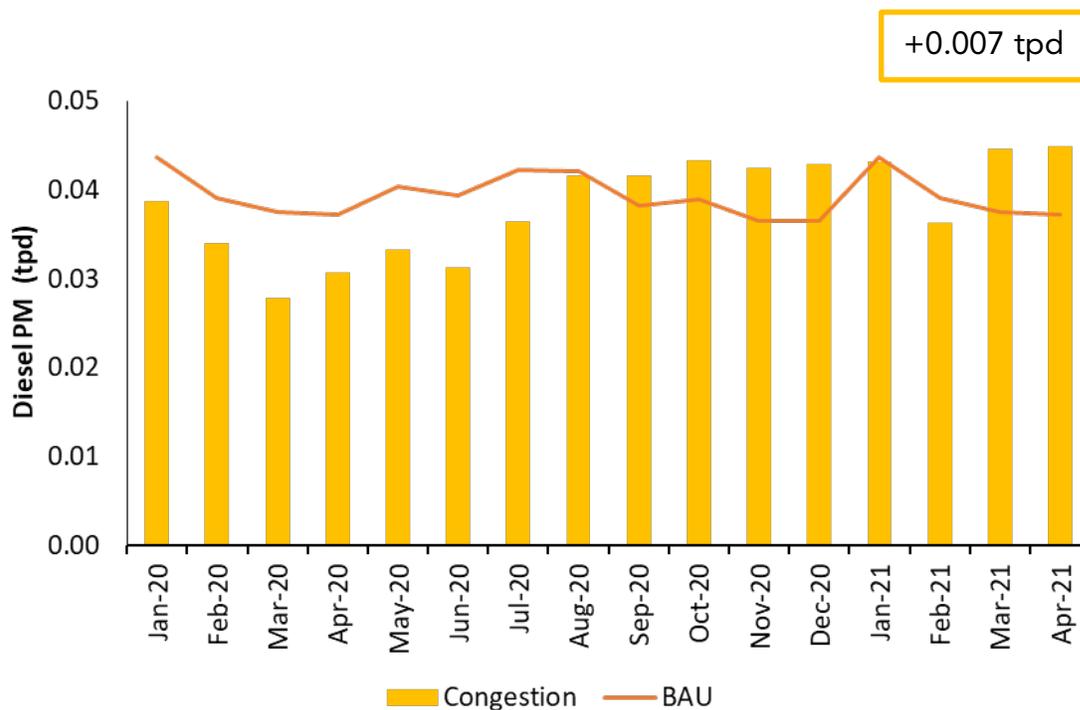


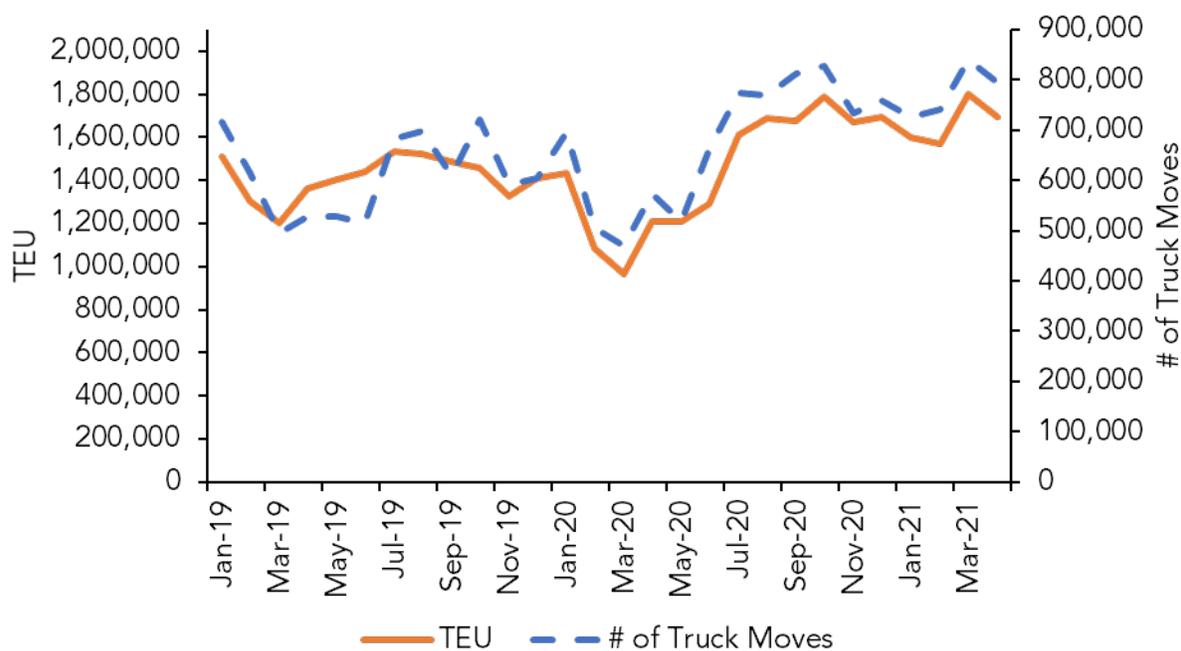
Figure B5. PM Emissions from On-Port Rail in the South Coast Air Basin



Appendix C: Quantifying emissions related to recent changes in truck activity near the Ports of Los Angeles and Long Beach (SPBP)

- According to truck traffic data provided by the San Pedro Bay Ports (SPBP), truck trips related to the SPBP are closely correlated with the monthly increase and decrease of cargo movement. Figure C1 below compares truck moves and cargo movement (twenty-foot equivalent units - TEU) between January 2019 and May 2021. This correlation illustrates that changes in port truck activity is highly correlated to cargo movement.

Figure C1. Comparison Between SPBP Truck Moves Data and TEU



- CARB's current emissions estimate from EMFAC2021⁷ shows that port trucks contribute approximately 8.5 tpd of nitrogen oxides (NOx) and 0.05 tpd of particulate matter (PM) emissions in the South Coast Air Basin, and 1.7 tpd of NOx and 0.01 tpd of PM emissions in the San Francisco Bay Area.
- As a result of the significant increase in cargo movement, NOx and PM emissions from heavy-duty port trucks are assumed to have increased in recent months.
- For the analysis described below, the number of truck moves were used as a metric for truck activity associated with the SPBP. TEU counts were used as a

⁷ <https://arb.ca.gov/emfac/>

surrogate for truck activity within the Port of Oakland (POAK), which did not provide truck moves data.

- The analysis shows that in March 2021, estimated emissions from trucks operating at the SPBP have increased by 4.8 tpd of NO_x and 0.03 tpd of diesel PM as compared to the same timeframe in 2019.
- Likewise, at the POAK, the increase in cargo movement has resulted in an additional 0.22 tpd of NO_x and 0.002 tpd of diesel PM from trucks as compared to the same timeframe in 2019.
- The following figures illustrate how estimated NO_x and PM emissions associated with port trucks increased sharply at California's major ports beginning in July 2020 and have continued increasing since then. Here, business as usual or BAU represents emissions inventory estimates using 2019 TEU data, whereas the "Congestion" represents estimated emissions using actual TEU data in 2020 and 2021.

Figure C2. NOx Emissions from Port Trucks Operating at the San Pedro Bay Ports

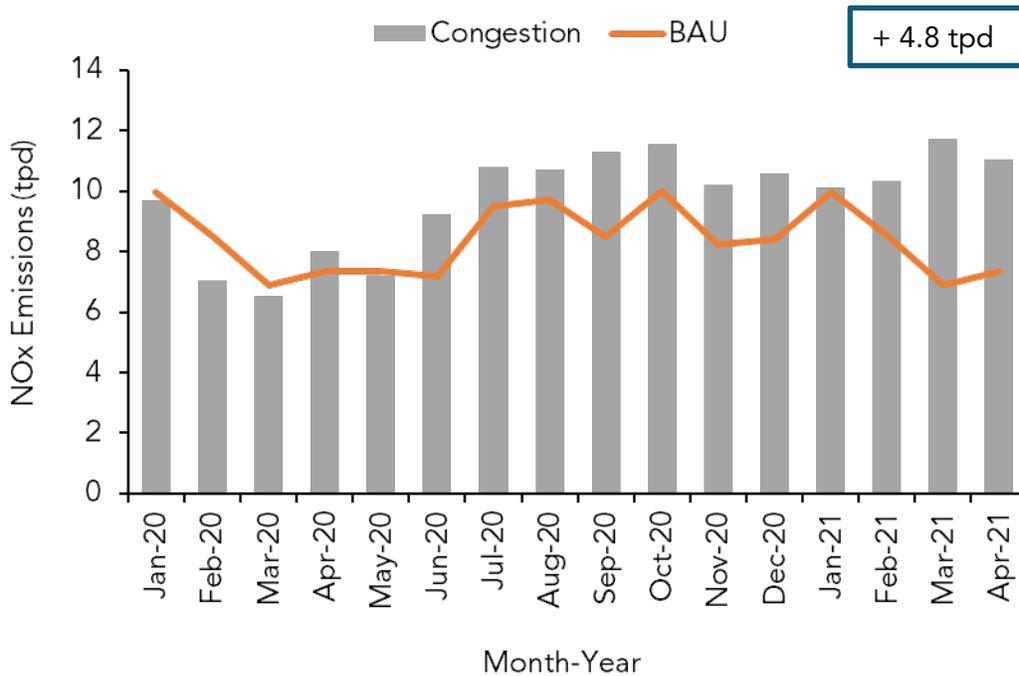


Figure C3. PM Emissions from Port Trucks Operating at the San Pedro Bay Ports

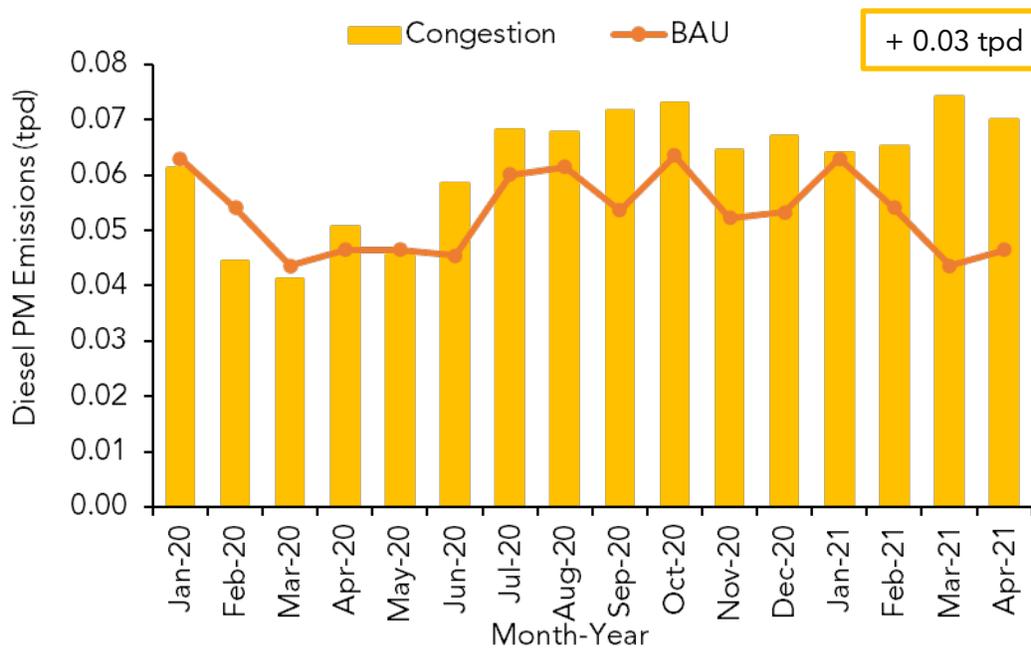


Figure C4. NOx Emissions from Port Trucks Operating at the Port of Oakland

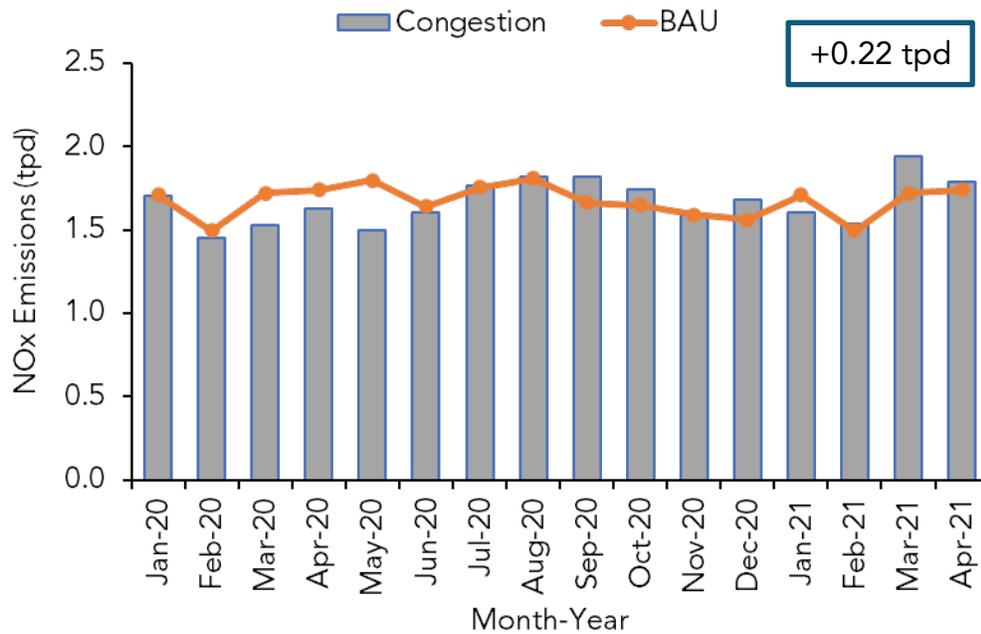


Figure C5. PM Emissions from Port Trucks Operating at the Port of Oakland

