

# Emissions Impacts of Vessel Congestion and Freight Movement Changes at Ports of Los Angeles and Long Beach

February 2023 Update

## Background

As a result of the COVID-19 pandemic and other factors, freight movement and vessel congestion at California's seaports have substantially fluctuated since 2020. CARB staff has monitored trends at the Port of Oakland and the San Pedro Bay Ports (SPBP, which includes the Ports of Los Angeles and Long Beach) and estimated emissions increases for periods of increased congestion and freight movement. Fact sheets estimating emissions resulting from these trends have been released every three to six months since June 2021, which are available on CARB's Mobile Source Emission Inventory website<sup>1</sup>. These emissions occur in addition to the emissions from business-as-usual (BAU) operations and are referred to in this document as 'excess emissions'.

In these previous fact sheets, CARB staff highlighted how freight movement of containerized goods through the SPBPs decreased in early 2020 relative to pre-pandemic levels, but trends reversed by the end of 2020. Increased freight movement continued into the next year, and by November 2021, there was a historically high number of containerships at anchorages. In response, Pacific Maritime Management Services (PacMMS) implemented a queuing system to encourage vessels to wait for a berthing assignment outside of the "Safety and Air Quality Area", which is 150 nautical miles off the shore of California. In the July 2022 update of this fact sheet, CARB staff reported that containership congestion had dissipated and the numbers of vessels at anchorages had returned to pre-pandemic levels. However, freight movement was still at record-high levels of 1.7 million containers (twenty-foot-equivalent units or TEUs), a value 27 percent higher than in the same period in 2019.

## Summary of January 2023 Update

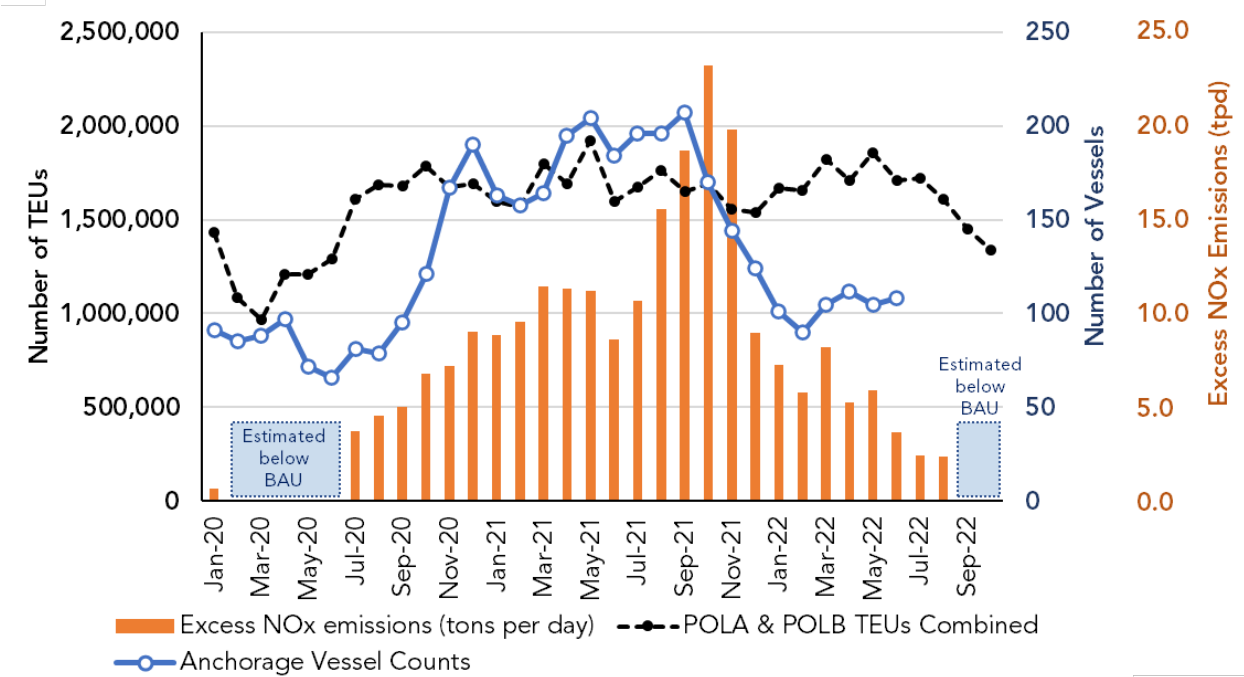
- This update focuses on the increased emissions at the SPBP (Port of Los Angeles and Port of Long Beach only) and expands the evaluation of ocean-going vessel anchorage activity to include tankers and cruise vessels, in addition to containerships. Tanker and cruise vessels appear largely unimpacted by freight movement increases or congestion at the ports. The scope of excess emissions from increased throughput of cargo on port trucks, cargo handling equipment (CHE), and locomotives remains unchanged from past fact sheets.

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<sup>1</sup> CARB's Mobile Source Emissions Inventory (MSEI) Port Congestion Impacts web site, available at <https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-documentation-port-congestion-impacts>.

- Due to the changes in containerized freight volume, CARB estimates that freight-related equipment categories such as trucks, locomotives, and CHE used at the ports produced higher emissions than predicted in the current emissions inventories from fall 2021 to summer 2022. Figure 1 shows the total TEUs moving through SPBP, the number of vessels at anchorage, and the resulting excess oxides of nitrogen (NOx) emissions.
- Cargo volumes in early 2020, as well as September and October 2022 were lower than average 2019 levels, with October 2022 approximately 6 percent below the 2019 average. Figure 1 shows these periods as ‘Estimated Below BAU’.

**Figure 1. Freight Activity, Vessels at Anchorage, and Excess NOx Emissions**



- Tables 1 and 2 summarize excess NOx and particulate matter (PM) emissions by sector. In the months where freight movement was below the BAU, emissions are shown as “No Excess”.

**Table 1. Summary of Excess NOx Emissions (tpd) near San Pedro Bay Ports by Source Category**

Month-Year	Port Trucks	Regional Rail	Cargo Handling Equipment	Containers, Cruise, and Tanker Vessels at Anchor	Sum of Excess Emissions
November 2021	1.1	0.8	0.1	17.9	19.9
December 2021	1.3	0.6	0.1	7.0	9.0
January 2022	1.2	1.5	0.2	4.3	7.2
February 2022	0.7	1.4	0.2	3.5	5.8
March 2022	2.2	3.0	0.4	2.6	8.2

Month-Year	Port Trucks	Regional Rail	Cargo Handling Equipment	Containers, Cruise, and Tanker Vessels at Anchor	Sum of Excess Emissions
April 2022	1.1	1.9	0.2	2.0	5.2
May 2022	1.5	3.4	0.5	0.9	6.3
June 2022	1.4	2.0	0.2	0.4	4.0
July 2022	0.1	2.1	0.3	tbd	tbd
August 2022	1.3	1.0	0.1	tbd	tbd
September 2022	No Excess	No Excess	No Excess	tbd	tbd
October 2022	No Excess	No Excess	No Excess	tbd	tbd

**Table 2. Summary of Excess PM Emissions (tpd) near San Pedro Bay Ports by Source Category**

Month-Year	Port Trucks	Regional Rail	Cargo Handling Equipment	Containers, Cruise, and Tanker Vessels at Anchor	Sum of Excess Emissions
November 2021	0.007	0.019	0.003	0.452	0.480
December 2021	0.008	0.015	0.002	0.170	0.195
January 2022	0.008	0.036	0.006	0.101	0.151
February 2022	0.005	0.033	0.005	0.078	0.121
March 2022	0.015	0.072	0.014	0.060	0.161
April 2022	0.007	0.046	0.008	0.040	0.101
May 2022	0.010	0.080	0.016	0.015	0.121
June 2022	0.009	0.046	0.008	0.005	0.068
July 2022	0.001	0.049	0.008	tbd	tbd
August 2022	0.009	0.024	0.003	tbd	tbd
September 2022	No Excess	No Excess	No Excess	tbd	tbd
October 2022	No Excess	No Excess	No Excess	tbd	tbd

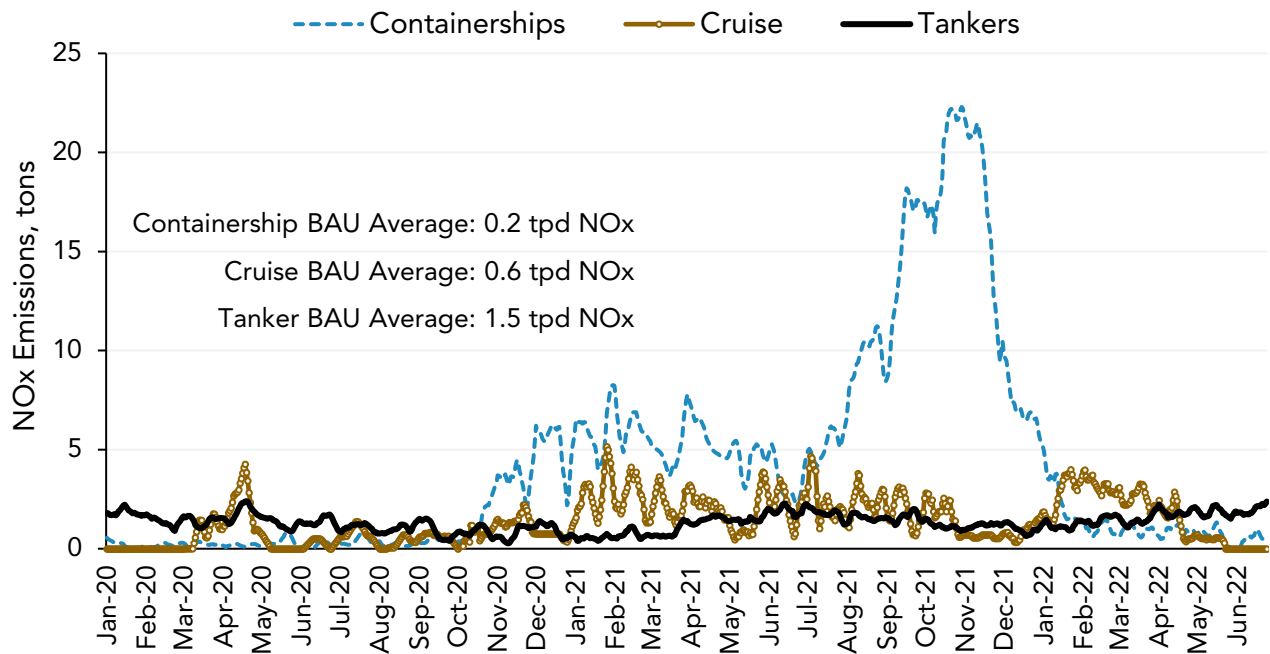
## Ocean-Going Vessel Emissions at Anchorage - Containership, Cruise, and Tankers

Figures 2 and 3 show a high-resolution time series of NO<sub>x</sub> and PM emissions from containerships, cruise, and tanker ocean-going vessels between January 2020 and June 2022. These figures show total emissions at anchorage, but BAU emissions for each vessel category are shown as a text inset. Trends show increased emissions from auxiliary engines and boilers used by the record number of vessels at anchorage in late 2020 through early 2022. However, since the implementation of the new queuing

system<sup>2</sup> described above, the number of anchored vessels significantly decreased and fluctuated around BAU conditions.

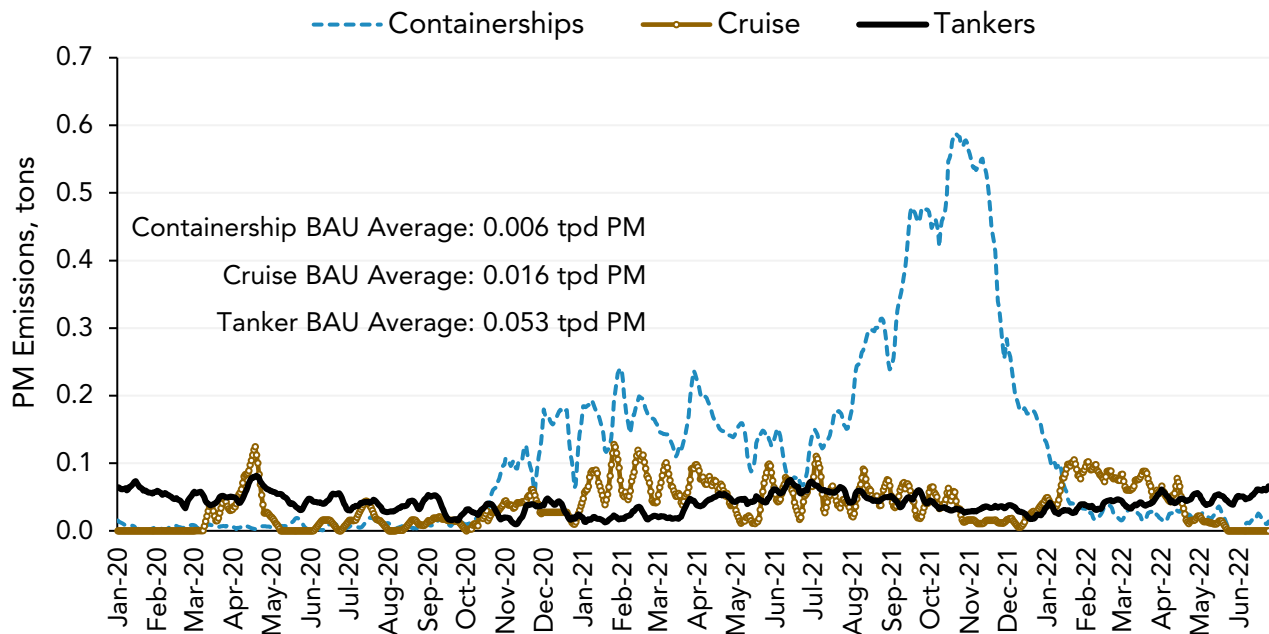
In addition to containership trends, Figures 2 and 3 also include observed trends for cruise and tanker vessels at anchor. Cruise vessels had a brief increase in anchorage activities and emissions during the initial stages of the COVID-19 pandemic in 2020. Tanker vessels have not seen significant variability in anchorage trends since 2020, and have remained near BAU average levels in 2020, 2021, and 2022. Based on these data, anchorage activities for cruise and tanker vessels do not appear to be significantly influenced by trends in freight movement or port congestion-related activities.

**Figure 2. NOx Emissions from Anchored Containerships at the San Pedro Bay Ports**



<sup>2</sup> <https://www.pacmms.org/one-page-express/stm/resources/>

**Figure 3. PM Emissions from Anchored OGV at the San Pedro Bay Ports**



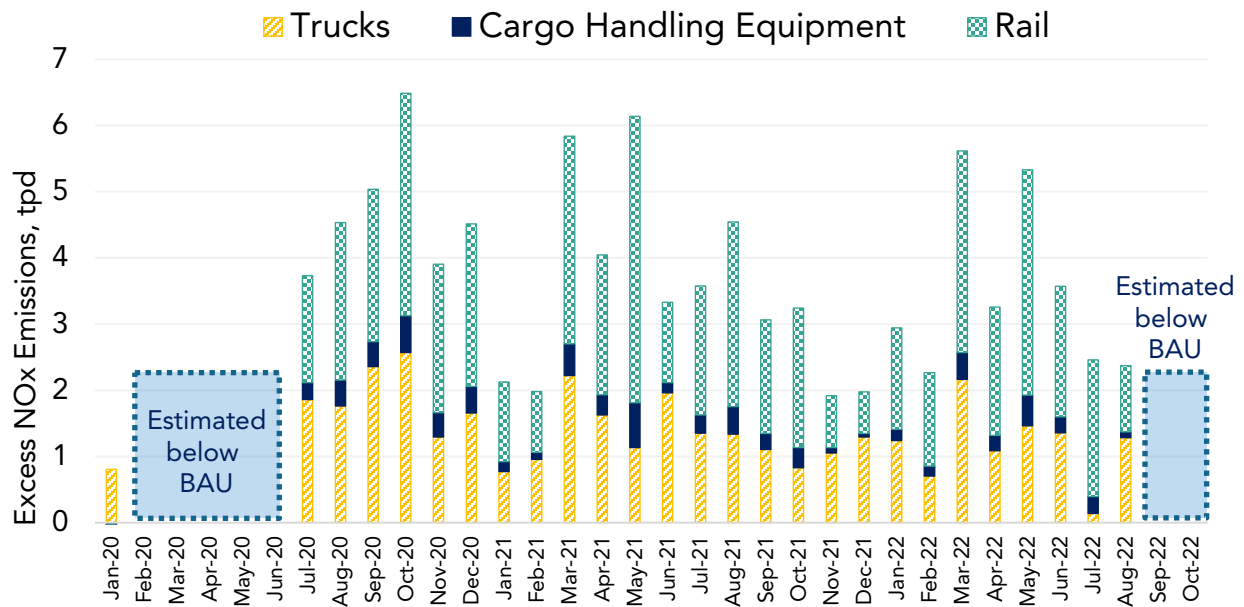
### Emissions from Activity Changes in Trucks, Locomotives, and Cargo Handling Equipment

The number of TEUs being moved through the SPBPs continued to be at historically high levels through the summer of 2022, then fell below pre-pandemic levels beginning in September 2022<sup>3</sup>. The increase in freight movement above BAU levels required additional activity by port trucks and/or rail that operate to support port operations, as well as cargo handling equipment used at the port itself.

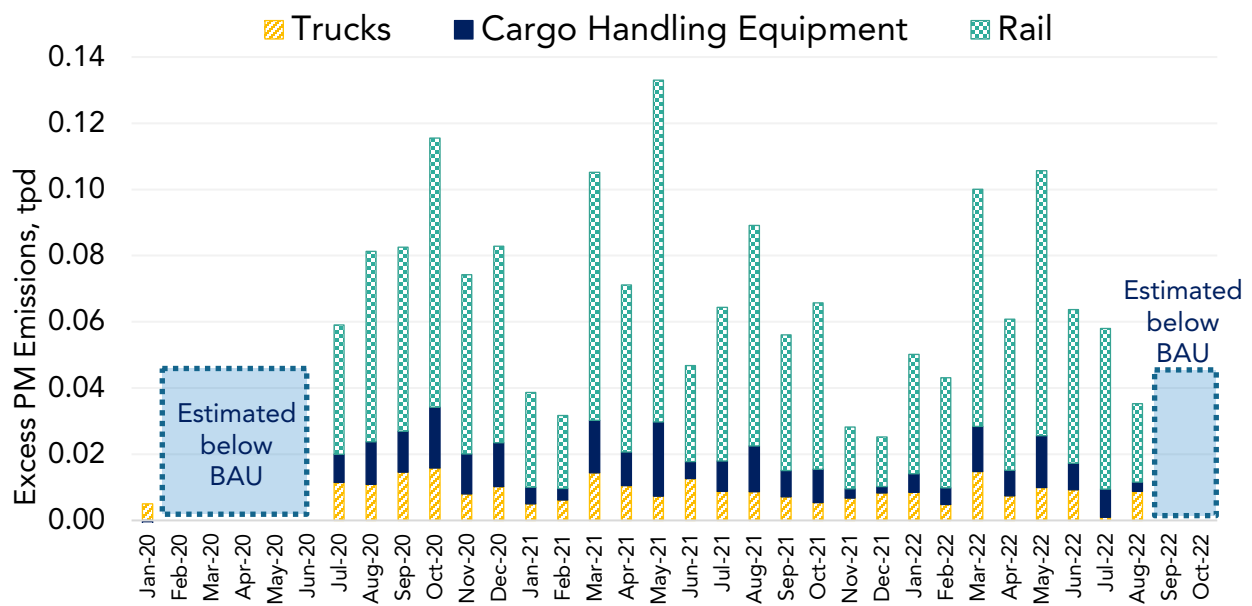
Figures 4 and 5 show the excess NO<sub>x</sub> and PM by specific source categories. For the analysis period, the three categories always show excess emissions together, implying the entire port increased activity and emissions as a result of increased throughput. As discussed previously, freight movement fell below the expected levels in early 2020 and late 2022, and these areas are labeled as “Estimated below BAU”.

<sup>3</sup> Port TEU data is available here <https://www.portoflosangeles.org/business/statistics/container-statistics> and here <https://polb.com/business/port-statistics/#latest-statistics>

**Figure 4. Excess NOx Emissions from Freight Movement by Trucks, Rail, and Cargo Handling Equipment near the San Pedro Bay Ports**



**Figure 5. Excess PM Emissions from Freight Movement by Trucks, Rail, and Cargo Handling Equipment near the San Pedro Bay Ports**



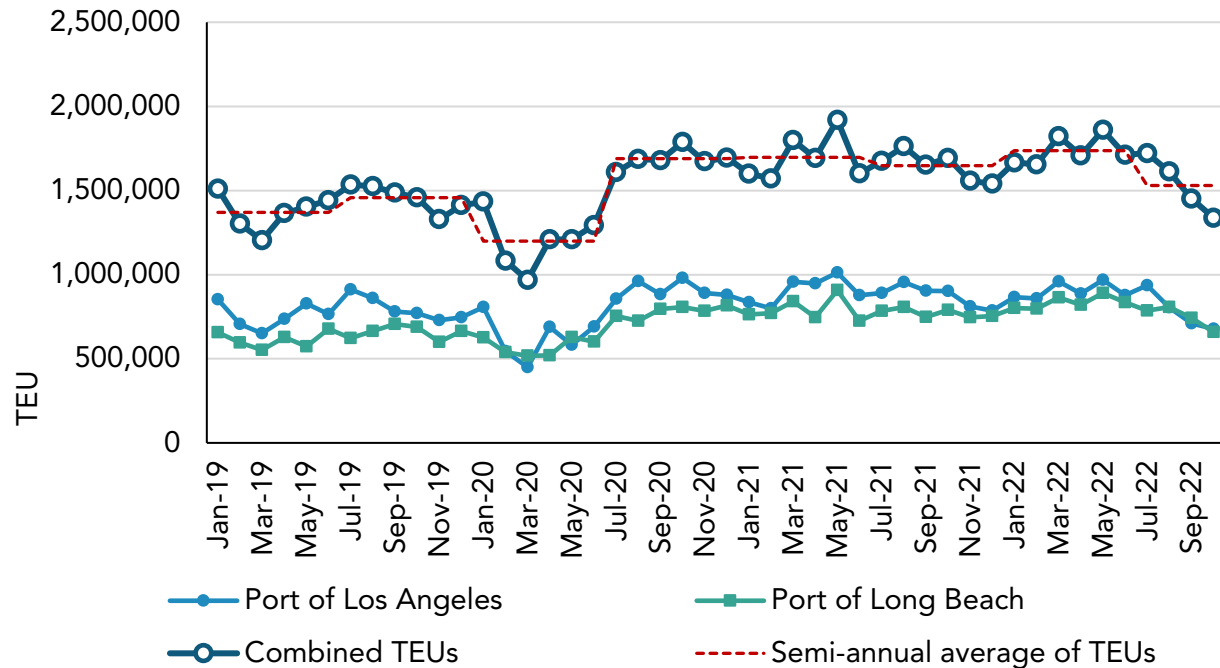
## Methodology

### TEU data from Port of LA (POLA) and Port of Long Beach (POLB)

One of the main input data for the port congestion analysis is POLA and POLB TEU data<sup>3</sup> which shows the monthly and annual number of containers. TEU volume is a

standardized maritime industry measurement used when counting cargo containers of varying lengths. Figure 6 shows that freight movement from July 2020 to October 2022 is approximately 18 percent higher than the average in 2019.

**Figure 6. Port of Los Angeles and Port of Long Beach TEU Data**



### Ocean-Going Vessels: Containerships, Tankers, and Cruise Vessels

This fact sheet update uses OGV data from January 2020 through June 2022 based on Automatic Identification System (AIS) reporting as released by the United States Coast Guard and National Oceanic Atmospheric Administration (NOAA)<sup>4</sup>, with data limited to only include activities within 100 nautical miles from the California shoreline<sup>5</sup>. AIS records include minute-by-minute speed and coordinate locations of each vessel, which is then matched with vessel registry information to estimate emissions from all engines, generators, and boilers onboard each vessel. This methodology<sup>6</sup> is consistent and was adopted from the CARB 2021 OGV emission inventory, described in detail on CARB’s emission inventory page.<sup>7</sup> In Figures 2 and 3, a seven-day moving average was

<sup>4</sup> AIS reporting for OGV activities were obtained for 2021 (<https://coast.noaa.gov/htdata/CMSP/AISDataHandler/2021/index.html>) and 2022 (<https://coast.noaa.gov/htdata/CMSP/AISDataHandler/2022/index.html>) calendar years for this analysis. AIS data is not yet available for the second half of 2022; however other data sources such as Marine Exchange of Southern California (<https://twitter.com/mxsocal?lang=en>) suggest there have not been additional increases in congestion through the end of 2022.

<sup>5</sup> Previous estimates of emissions from containerships at anchor or loitering relied on data from Marine Exchange of Southern California.

<sup>6</sup> OGV methodology has changed from using 2016 BAU to using the first half of 2020 calendar year as BAU, as described in the Background Section.

<sup>7</sup> OGV emissions modeling documentation, [https://ww2.arb.ca.gov/sites/default/files/2022-06/CARB\\_2021\\_OGV\\_Documentation\\_ADA.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-06/CARB_2021_OGV_Documentation_ADA.pdf)

used to smooth the daily observations from AIS, where each day’s value in the figure is the average of seven days of AIS observations (three days prior, the day of, and three days after).

## Trucks, Locomotives, and Cargo Handling Equipment

CARB staff used the EMFAC Web Platform<sup>8</sup> to define the baseline or BAU level of emissions from trucks, locomotives, and CHE from the 2019 calendar year. The EMFAC Web Platform extracts from the latest version of each model, namely EMFAC2021 for Port Trucks, the 2017 to 2022 inventories for Locomotives, and the 2021 emission inventory for CHE. In all three cases, the emissions reflect a baseline in 2019 that occurred prior to the global supply chain disruptions that began in 2020 from the COVID-19 pandemic.

**Table 3: 2019 Baseline Emissions from Port Trucks, Locomotives, and Cargo Handling Equipment in South Coast Air Basin**

Source	NOx Emissions (tpd)	PM Emissions (tpd)
Port Trucks	8.5	0.05
Locomotives	14.0	0.34
Cargo Handling Equipment (CHE)	2.4	0.08

- Excess emissions for port trucks<sup>9, 10</sup>, CHE, and locomotives that are calculated in this fact sheet use a ratio of actual activity to forecasted activity growth for 2020, 2021, and 2022 relative to 2019 levels. CARB staff presents all increased activity relative to the expected BAU growth as “excess emissions” that is associated with increased freight transport. This method is consistently applied and used for the truck, rail and CHE sectors.
- Note that the previous iterations of this fact sheet considered 2019 activity levels as the baseline in 2020, 2021, and 2022, and therefore, did not account for forecasted activity growth. This change in methodology has resulted in a slight adjustment to the excess emissions presented in this January 2023 update.

## Closing Remarks: CARB’s ongoing and future actions

The port congestion event that peaked in 2021 showed that the California freight system volumes and traffic can significantly increase during unexpected events, which can cause excess emissions that are harmful to the State and particularly nearby communities. If the on- and off-road mobile sources in the port area were cleanest-

<sup>8</sup> <https://arb.ca.gov/emfac/emissions-inventory>

<sup>9</sup> Port truck emission estimates for January through October 2022 were updated with truck trip data.

<sup>10</sup> Provided to CARB from the SPBPs. The last request for October data was made on December 1, 2022.



available combustion or zero-emission<sup>11, 12, 13</sup>, these impacts could be significantly reduced. Additionally, the freight sector ports demonstrate significant potential for zero-emissions equipment, and CARB has made and been making various efforts to reduce the emissions from the ports.

- New compliance requirements for the At Berth Regulation became effective beginning on January 1, 2023. The goal of this regulation is to reduce diesel NOx and PM from ocean-going vessels auxiliary engines while they are docked at California ports.
- Transitioning to zero-emissions would have significant benefits for disadvantaged communities near the ports, on an ongoing basis and during unexpected events.<sup>14, 15</sup>
- The 2030 requirement for zero-emission configuration in new locomotives<sup>16, 17</sup>, particularly in new switchers, will require zero-emission infrastructure at port rail locations. These requirements could be complementary, such as for infrastructure planning efforts, with zero-emission CHE deployments at seaports and non-seaport intermodal facilities.
- CARB is developing the Advanced Clean Fleets regulation and Zero Emission Truck Measure to achieve a zero-emission truck and bus fleet in California by 2045 where feasible and significantly earlier in certain market segments, such as drayage applications.

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<sup>11</sup> In-Use Off-Road Diesel-Fueled Fleets Regulation, <https://ww2.arb.ca.gov/our-work/programs/use-road-diesel-fueled-fleets-regulation>

<sup>12</sup> Potential Amendments to the Diesel Engine Off-Road Emission Standards: Tier 5 Criteria Pollutants and CO2 Standards, <https://ww2.arb.ca.gov/our-work/programs/tier5>

<sup>13</sup> 2022 Scoping Plan, <https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents>

<sup>14</sup> <https://www.latimes.com/opinion/story/2022-10-26/port-pollution-surge-pandemic>

<sup>15</sup> <https://www.bloomberg.com/news/articles/2022-07-28/us-s-supply-chain-recovery-leaves-la-port-community-in-its-dust>

<sup>16</sup> <https://ww2.arb.ca.gov/rulemaking/2022/locomotive>

<sup>17</sup> <https://www.railwayage.com/news/zero-emission-locomotives-on-u-s-railways/>