Discussion Paper for Potential Measures to Reduce Drayage Truck Emissions
Prepared for the Ozone Transport Commission (OTC)
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Name of potential measure: Port Emission Reduction Measures—Drayage Vehicles

Background:
Marine Ports play a critical role in our daily lives; they bring great economic benefits to the regions in which they are located. For example, the Port of New York and New Jersey is an economic engine that creates 233,000 jobs, provides $12 billion in wages, and generates $6 billion in taxes. However, marine terminals, along with similar segments of the transportation chain, are major sources of pollutant emissions including nitrogen oxides (NO_X), fine particulate matter ($PM_{2.5}$), hydrocarbons (HC), carbon monoxide (CO), and sulfur oxides (SO_2). Transportation chain-related freight movement emissions contribute to poor air quality in the Ozone Transport Region. In addition, the effects of diminished air quality are experienced disproportionately in areas closer to the transportation operations.

Marine terminal emissions can be separated into five main sources: ocean-going vessels, drayage trucks, railroad locomotives, cargo handling equipment, and harbor craft. The measure being considered here addresses emissions from drayage trucks that transport marine-related cargo to its "first-point-of-rest,"where the marine-related cargo is combined with domestic and other goods for further transportation to regional consumers. Of the entire PANYNJ marine terminal emissions inventory, drayage trucks contribute 25% of total NOx emissions and 12% of total $PM_{2.5}$. They are also responsible for 39% of CO, 21% of VOC, and 1% of SO_2 marine terminal emissions.[1]

Drayage trucks are vehicles weighing 33,001 pounds or greater GVWR that pick up and deliver containers, bulk, and break-bulk goods to and from marine terminals and intermodal yards. Along with locomotives, drayage trucks transport marine terminal-related cargo to an inland transportation hub, such as a warehouse center, where this freight is mixed with domestic and other goods for further transportation to regional consumers. Drayage truck emissions occur while they are waiting in line to enter a terminal, while idling inside the terminal awaiting their freight transfer, and in transit between the marine terminal and the source or destination of their freight. A survey of truck driver interviews operating drayage trucks at the PANYNJ and the Global marine container terminals found that the average wait time to enter a container terminal was 51 minutes and the average on terminal time to on- or off-load their cargo was 2 hours 20 minutes.[2] However, information provided by the container terminal operators derived from their gate statistics indicates an average on-terminal idling time of 1 hour 40 minutes.[3]

Existing regulations that apply to drayage trucks:
In the OTC region, the emissions regulations that apply to drayage trucks are those that also apply to other heavy-duty motor vehicles. For example, Washington, DC and each state in the OTR have some form of anti-idling regulation for on-road vehicles including drayage trucks. To date, there are no regulations that apply exclusively to drayage trucks.

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[1] "The Port Authority of New York and New Jersey, Port Commerce Department, 2006 Baseline Multi-Facility Emissions Inventory, November 2008," Available at http://www.panynj.gov/about/pdf/2006-BASELINE-MULTI-FACILITY-EMISSIONS-INVENTORY.pdf.
[2] Starcrest 2008. "Drayage Truck Characterization Survey at the Port Authority and the Global Marine Terminals." Starcrest Consulting Group, December, 2008.
[3] "The Port Authority of New York and New Jersey, Port Commerce Department, 2006 Baseline Multi-Facility Emissions Inventory, November 2008", page 85

The PANYNJ, working with its partners EPA Region 2, the NJDEP, NYSDEC, NY City Mayor's Office of Sustainability, NYCEDC, NY Shipping Association and the cities of Newark, Bayonne, Jersey City and Elizabeth, has developed a Clean Air Strategy for the Port of NY and NJ, which contains a menu of actions to reduce pollutant air and greenhouse gas emissions from all port-related sources. The recommended actions to reduce emissions from port-related trucks include a Truck Phase Out Plan, which was developed by a Truck Work Group (TWG) composed of representatives from the port and trucking industry, labor, federal, state and city agencies and environmental and community groups. Under the TWG-developed Truck Phase Out Plan, starting in January 2011 any drayage truck equipped with an engine of model year 1993 or older will not be permitted to pick up, deliver or move cargo on any Port Authority marine terminal; and starting January 1, 2017, only drayage trucks equipped with engines that meet or exceed federal Environmental Protection Agency emission standards for 2007 model year heavy-duty diesel-fueled engines will be permitted to pick up, deliver or move cargo on any Port Authority marine terminal. Additional actions to reduce port-related truck emissions include the Truck Replacement Program, which provides financial incentives and low-interest financing to truck owners desiring to replace their older vehicles and an Emission Reduction Loan Program, which offers financing options to truckers for the acquisition of newer vehicles equipped with EPA verified retrofits. These two programs are designed to support independent owner operators during the Truck Phase Out Plan.

Outside the OTC region, the California Air Resources Board (CARB) has implemented a regulation that requires owners of all drayage trucks doing business at a port or intermodal rail yard to register their vehicles in a Drayage Truck Registry database prior to commencing operations. The regulation further requires that marine or port terminals and intermodal rail yards collect and report information on drayage trucks that are not compliant with CARB model year requirements or emission control standards to their respective port and rail yard authorities, which in turn must report that information to CARB. CARB's model year requirements and emission control standards are similar to the measure described below, with two differences: 1) the first phase begins in 2010, instead of 2011, and 2) during the first phase, MY 1994-2003 trucks must be equipped with a verified diesel emission control strategy (VDECS) to control PM. It is important to recognize that VDECS cannot be universally applied to all trucks in a given model year group. Duty cycle, engine configuration, engine condition, and available space on the vehicle can all impact the applicability of a VDECS to a particular truck. Actively regenerated VDECS can potentially address some of these technical concerns (particularly regarding duty cycle) but at a cost significantly higher than passive devices. For example, an actively regenerated VDECS can cost $15,000 to $25,000; matching or exceeding the value of a 1994-2003 truck.

Description of the measure being considered:
At the request of PANYNJ's TWG, EPA's subcontractor (Eastern Research Group) modeled five strategies for the truck phase out plan. This included a variety of potential MY and DPF retrofit requirements and considered different phase-in schedules for their implementation. The objective of the modeling was to identify which strategy was most effective in terms of emission reductions and incremental cost per lifetime ton reduced. The measure considered here – as noted above - is strategy 1 and has two phases. Phase I, which begins in January 2011 would deny access to PANYNJ marine terminals to pre-1994 trucks. Phase II would take effect in January 2017 and deny access to PANYNJ marine terminals to all pre-2007 trucks. In analyzing a number of possible options, the study for the Port of Baltimore also identified addressing emissions from MY 1994 and older trucks as a top priority for a future truck emissions reduction program.

Emissions estimates:
In the OTC region, estimates of drayage emissions have been developed separately for the PANYNJ marine terminals and Hampton Roads facilities. Additional trucking studies have been conducted for the Port of

Baltimore.[4] NESCAUM has used data from the PANYNJ 2006 Baseline Multi-Facility Emissions Inventory completed by Starcrest in 2008[5] (the Starcrest Inventory). In it, the PANYNJ marine terminal emissions are broken down into the five sources listed above, and there is considerable detail regarding the data collection and emissions estimates for drayage truck emissions. We use this inventory as a basis to estimate drayage inventories for other Ports in the region[6]. This is consistent with the information in EPA's "Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories" Final Report, prepared by ICF International, April 2009.

The PANYNJ marine terminals, which were included in the inventory, include:

- Port Newark (which includes container, auto marine, and on-terminal warehousing operations);
- Elizabeth Port Authority Marine Terminal or EPAMT (which includes container, auto marine, and on-terminal warehousing operations);
- Auto Marine Terminal (which includes auto marine operations);
- Howland Hook Marine Terminal (which includes container operations); and
- Brooklyn Port Authority Marine Terminal

In order to estimate the impact of the measure discussed in this paper, it was necessary to estimate drayage emissions for other ports in the OTR. To do this, we assume a relationship between emissions and tonnage of freight, as well as assume that the emissions in the Starcrest Inventory represent the total for the Port of NY & NJ, even though only the PANYNJ marine terminals had been inventoried. In this way we established a port drayage emission factor with the unit tons of pollutant per million tons of freight shipped. We then apply the ratio of emissions to tonnage calculated for PANYNJ to all OTC ports.[7] This gives a rough idea of Port drayage truck emissions throughout the region, and enables us to estimate potential emission reductions. It is important to note that should drayage truck emissions reduction strategies be incorporated into state SIPs, port-specific information would need to be used in order to estimate the emissions reduced.

There are two areas where the above described method could result in an underestimate of drayage emissions. First, since the ratio of emissions from the PANYNJ drayage activity has been applied to the total tonnage of freight moved through the entire Port, the NESCAUM estimate of emissions per ton of freight may be

[4] Emissions Reductions from Port of Baltimore Drayage Trucks, draft report prepared for Maryland Port Administration, Maryland Department of the Environment and Maryland Environmental Services, March 10, 2010, Prepared by TA Engineering, Inc.

[5] The PANYNJ, Port Commerce Department, 2006 Baseline Multi-Facility Emissions Inventory.

[6] It should be noted that the Starcrest Inventory only considers emission sources related to the PANYNJ marine terminals. The inventory does not include emissions from activities linked to the various marine terminals that are entirely privately owned and operated – such as Global Container Terminal, and the many petroleum and bulk terminals located in the Port of NY and NJ – as they are not under the aegis of the PANYNJ. These facilities, along with the Port Authority facilities included in the Starcrest Inventory, make up the Port of New York and New Jersey (the "Port"). Accordingly, the emissions reflected in the Starcrest Inventory do not include all maritime-transportation related emissions in the Port.

[7] Tonnage data for all ports comes from the American Association of Port Authorities' (AAPA) "2007 US Port Rankings by Tonnage." This is consistent with the method described in EPA's "Current Methodologies" document prepared by ICF. Starcrest emissions estimates are for year 2006 at Port Authority only marine terminals; AAPA Freight Data includes tonnages from non-Port Authority facilities.

underestimated. Second, since the time the original emissions estimates were prepared, EPA has released MOVES2010 which predicts substantially higher emissions of NOx and PM from drayage trucks. PM emissions from trucks in the drayage fleet could potentially be 2 to 3 times higher than the estimates included in this white paper. Thus, if drayage strategies to reduce drayage truck emissions are included in any state SIPs for the 2006 $PM_{2.5}$ NAAQS or the 2010 ozone NAAQS, the baseline emissions and emissions reductions would be based on the higher emissions predicted by MOVES.

Emission benefits from control measure:
The Eastern Research Group analysis mentioned above describes emissions reductions that can be achieved through the introduction of a number of different control strategies at the PANYNJ marine terminals. One scenario evaluates emissions saved by replacing pre-1994 drayage vehicles with 2004 vehicles in 2011, and subsequently replacing pre-2007 trucks in 2017 with trucks equipped with 2007-emission compliant engines. The results of the analysis show that with implementation of this strategy for a fleet of 16,286 drayage trucks and an assumed average of 35 miles/day for all truck model years, the PANYNJ marine terminals would realize annual reductions of 190 tons (10%) in NOx and 5 tons (9%) in PM from drayage trucks calling at their facilities. The annual benefits were also calculated for a lifetime period of 24 years. The annual and lifetime reductions were greater, at 290 tons for NOx and 9 tons for PM, when the average miles/day is varied based on truck age, with newer trucks traveling several more miles/day than older vehicles. Table 1 shows NESCAUM's estimated baseline drayage emissions for each port in the OTR as well as the estimated annual and lifetime impacts from expansion of the control measure.

Major Issues:
It will be important to consider whether state air quality agencies or port authorities are better positioned to implement rules that apply to drayage trucks specifically, and to marine terminals in general. One option is for states to take the lead in regulating marine terminal activity. This approach would ensure equal treatment of all marine terminals within a single state and would provide greater emission reduction benefits, especially if identical measures are adopted throughout the OTR. The adoption of identical measures throughout the OTR would also ensure consistency for the industry throughout the region. Another option is to encourage Port Authorities to voluntarily take action such as the drayage truck Phase Out Plan, as described above, at their marine terminals. PANYNJ has taken the initiative to create an emissions inventory and examine a broad range of emission reduction options. Because of its size, PANYNJ may be in a unique position among OTR Port Authorities to act on its own. Other Port Authorities may prefer their autonomy in choosing which measures are most appropriate to curb emissions associated with their marine terminal operations. A third option is for states, Port Authorities, along with marine terminal operators and other stakeholders in the transportation chain, to work jointly to reduce emissions, such as was done by the Truck Working Group at the PANYNJ in the development of the truck phase out plan.

The facilities of different ports in the OTR vary considerably which affects the logistics and feasibility of implementing state- or region-wide marine terminal measures. For example, marine terminals without gates would have difficulty charging gate fees or regulating which MY trucks enter facility grounds. Therefore, even if a statewide regulation were adopted, enforcement cost and capability would vary significantly from port to port within the state, potentially creating a situation where older trucks are merely funneled to marine or inland terminals without gates, rather than taken off the road.

Opposition to a drayage truck measure will likely come from the trucking industry. The Drayage Truck Characterization Survey done for the PANYNJ estimates that 16% of drayage trucks frequently calling at its marine container terminals are equipped with engines MY 1993 or older, all of which would need to be replaced when the phase out plan is implemented. Discussions with trucking companies suggest that profit margins are very slim, and any requirements forcing owners to make what they consider unnecessary capital investments will likely face resistance. California is currently encountering significant opposition to their truck retrofit rule although compliance with the local port authority truck bans is 2 years ahead of schedule with truck pollution cut nearly

80%. There has also been concern over cargo diversions due to regulation and/or the imposition of fees that increase the cost of doing business at California ports. This could also be a concern in the Northeast and mid-Atlantic.

Another concern is the fate of the retired drayage trucks. Though lacking access to the region's marine terminals, they still may be utilized in other freight transportation activities. A question to consider is whether additional measures need to be taken to ensure that total emissions are reduced and not re-categorized.

Control Cost Estimate:
EPA has estimated the cost to modernize the drayage truck fleet calling at PANYNJ marine terminals under the Truck Phase Out Plan to be $84 million. This cost will be spread between the two phases of the proposed plan. Sources to fully fund this transition have not yet been established. The first phase, which takes effect in 2011, will affect 2,406 vehicles, and the second phase which begins in 2017, will affect 13,880 vehicles. Lifetime NOx and PM savings as a result of this program are 4,555 tons and 131 tons, respectively. The cost is $13,079 per ton of NOx and $456,005 per ton of PM.

Table 1. States' port emissions and drayage regulation impact.[8]

STATE	PORTS		NOx			PM		
		Annual freight (mill tons)	2006 Emissions (tpy)	Annual Benefit—10% (tpy)	Lifetime Benefit—24 years (tons)	2006 Emissions (tpy)	Annual Benefit—9% (tpy)[9]	Lifetime Benefit (tons)
NY/NJ	**Port of NY/NJ[10]**	**157**	**1935**	**190**	**4555**	**54**	**5.0**	**131**
CT	New Haven, Bridgeport	17	212	21	499	6	0.5	13
DE	New Castle, Wilmington	11	137	13	324	4	0.4	9
MA	Boston, Fall River	26	320	31	755	9	0.8	20
MD	Baltimore	41	508	50	1197	14	1.3	31
ME	Portland, Searsport	26	320	31	755	9	0.8	20
NH	Portsmouth	4	50	5	117	1	0.1	3
NJ	Paulsboro, Camden-Gloucester	45	553	54	1302	15	1.4	34
NY	Albany, Buffalo, Port Jefferson	10	125	12	295	3	0.3	8
PA	Pittsburgh, Marcus Hook, Penn Manor, Chester	103	1263	124	2976	35	3.3	78
RI	Providence	9	114	11	268	3	0.3	7
VA	Hampton Roads	55	673	66	1587	19	1.7	42
	TOTAL	**504**	**6210**	**610**	**14629**	**173**	**16.0**	**396**

[8] PANYNJ drayage emissions were calculated using MOBILE 6.2. According to EPA, NOx emissions for heavy-duty trucks are "higher than previously estimated" by MOBILE 6.2 and PM emissions are "significantly higher." Please see EPA Releases MOVES2010 Mobile Source Emissions Model: Questions and Answers.

[9] One decimal place is shown in this column to indicate non-zero emission levels.

[10] Includes Port Authority and non-Port Authority freight; limit of Starcrest emissions inventory scope was Port Authority-only marine terminals

Additional measures in the region and outside of the region:
In Maryland and Virginia, initiatives to retrofit or replace older drayage trucks are in place. In addition, the Clean Air Council has been awarded a grant from EPA to reduce diesel emissions from drayage trucks and other sources at ports in Philadelphia and Wilmington, Delaware. In New Haven, the Port is introducing truck stop electrification in 14 truck bays.

In addition to CARB's drayage truck regulation (described previously), California's southern ports have comprehensive truck programs. In addition, the Ports of Seattle and Tacoma have been providing incentives to reduce trucking emissions as part of their Pacific Northwest Ports Plan.[11]

Benefit for other pollutants:
In addition to reducing NOx and PM, this measure will reduce HC, global warming agents CO_2 and black carbon, as well as toxins such as formaldehyde and acetaldehyde.

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[11] See for example http://www.portoflosangeles.org/ctp/idx_ctp.asp and http://www.polb.com/environment/cleantrucks/default.asp