November 2023
Maryland Port Administration

2020 Criteria Air Pollutant and Greenhouse Gas Emissions Inventory
Summary Report

Prepared for Maryland Port Administration (MPA)

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1 Introduction

The Port of Baltimore (POB) is a major maritime shipping port comprising of private marine terminals, and public marine terminal facilities owned by the Maryland Port Administration (MPA) located in the upper Chesapeake Bay in Baltimore, Maryland. The POB is one of the most diverse ports in terms of cargo in the United States and a key shipping location on the East Coast. The MPA owns six marine terminals and various port facilities, the World Trade Center Baltimore (WTC), a centralized office building in downtown Baltimore, and four dredged material containment facilities (DMCFs) (Figure 1). MPA acts as a landlord at many of its terminals, leasing improved port facilities and open terminal space to private terminal operators and office space to tenants at the WTC, while providing a variety of maintenance activities, common infrastructure, and security. MPA is a leader in environmental stewardship and is committed to advancing sustainable environmental practices to promote efficient and resilient operations at the POB.

Over the past two decades, MPA has worked diligently to identify and implement meaningful environmental sustainability programs, with a focus on reducing criteria air pollutants (CAPs) and greenhouse gas (GHG) emissions. In alignment with state initiatives and as an integral part of its environmental program, MPA has created a series of emissions inventories (EI) for its port facilities. This 2020 CAP and GHG EI builds on past inventories and presents a comprehensive look at emissions for MPA's tenants' and visitor's sources.

MPA's emission reduction programs are based on established internal policies and state initiatives for protecting public health and the environment and addressing climate change. Recently, the Maryland General Assembly enacted the Climate Solutions Now Act of 2022. The Act took effect on June 1, 2022, and is one of the most ambitious climate laws in the country setting new state-wide emission requirements, as well as specific market sector requirements. Specifically, the Act calls for Maryland to reduce GHG emissions by 60% (compared to a 2006 baseline) by 2031 and requires the state to achieve net-zero statewide GHG emissions by 2045.

This summary presents an overview of the 2020 EI; including methods, assumptions and results, identification of areas for additional reduction

Climate Solutions Now Act of 2022 (SB 528)

Requires a 60% statewide GHG emissions reduction by 2031 and net-zero statewide GHG emissions by 2045.

Establishes new and alters existing energy conservation requirements for buildings.

Establishes requirements for the purchase of zero-emission vehicles (ZEVs) in the State fleet.

Requires state agencies to consider the climate impact of the agency's decisions relative to Maryland's GHG emissions reduction goals and the impact of the agency's decisions on disproportionately affected communities when conducting long-term planning, developing policy, and drafting regulations.

strategies, and a discussion of how current emission reduction efforts and strategies employed by MPA are reducing GHG and CAP emissions at MPA owned terminals, the WTC and DMCFs.

The data in this EI covers all of 2020 which coincided with SARS-CoV-2 (COVID-19) pandemic. As noted, MPA performs regular EI's and had planned for a 2020 EI prior to the pandemic. While the POB remained open throughout 2020 as an essential service, cargo supply chains and some MPA facility operations were disrupted as global supply chains reacted to pandemic shutdowns; MPA facility operations during the spring of 2020 were markedly down as compared to 2019. Because the movement of cargo through port terminals drives most of the equipment and related operations that are the source of emissions that are inventoried as part this EI, MPA staff considered whether to delay the EI for a year. However, by the end of 2020 MPA tenant cargo volumes largely rebounded and MPA tenants saw increases in month-over-month volumes as compared to 2019 for October, November, and December 2020. Therefore, while cargo was slightly lower in 2020 compared to 2019, operations were not markedly different in 2020 year over year. This report therefore does not weigh cargo volume differently due to the global pandemic.

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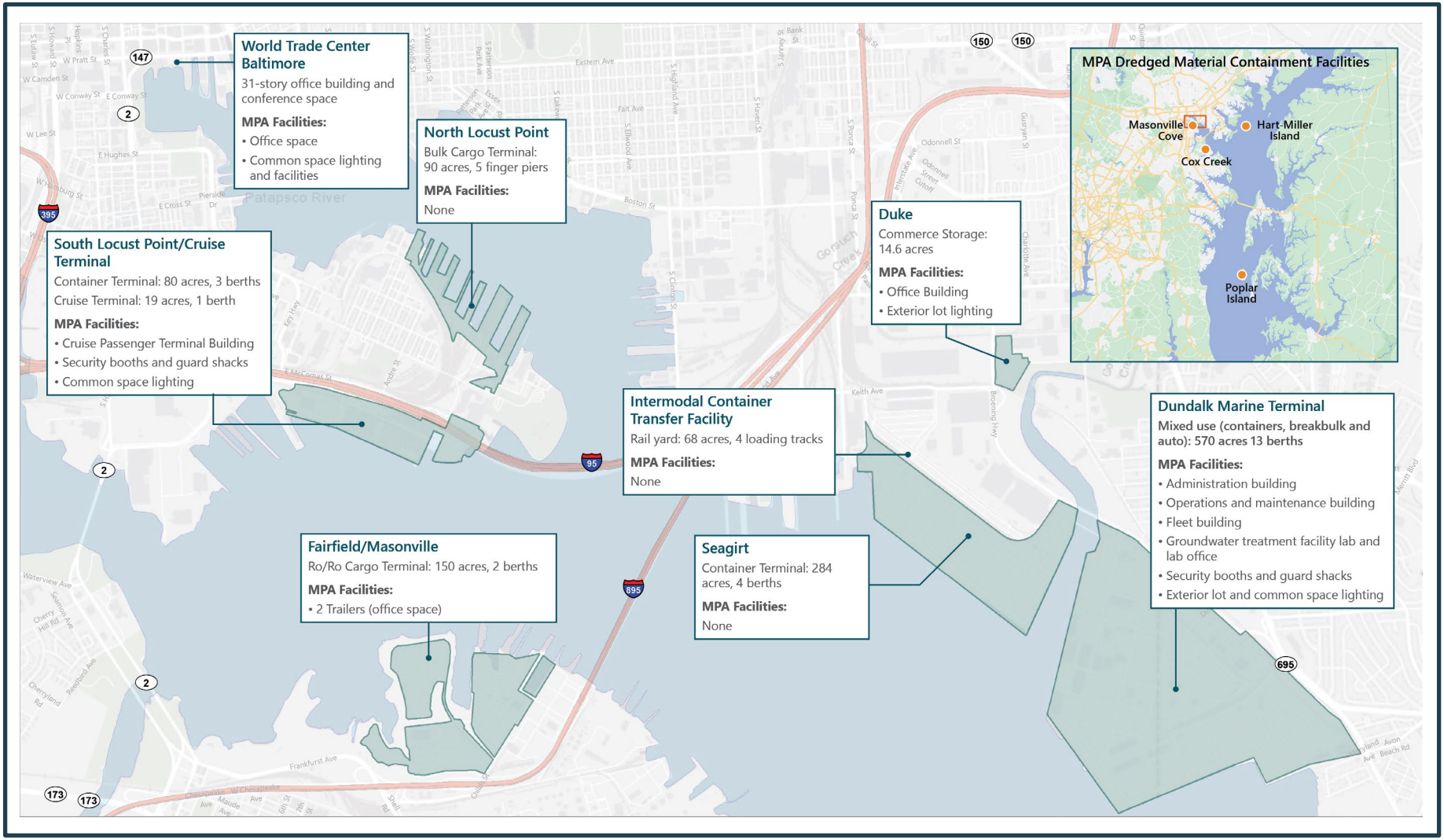
Figure 1
MPA Facilities Included in the 2020 CAP and GHG EI



MPA's Emission Reduction Strategy

MPA is a leader in environmental stewardship and is committed to advancing broad sustainable environmental practices that not only protect and care for our land, air, and marine environment, but also protect and care for our local neighborhoods, public health, and the quality of life for our tenants and workers. MPA has developed a voluntary emission reduction program and has invested in clean equipment and practices in line with federal and state guidance and requirements. MPA and its tenants have also actively participated in U.S. Environmental Protection Agency (USEPA) and other federal and state programs to upgrade a wide variety of diesel engines including cargo handling equipment, heavy duty trucks and rail engines. As zero emission electric vehicles and equipment become more readily available and able to meet heavy-duty operational requirements, MPA will continue investing in such technology to reduce both CAP and GHG emissions.

Table 1 presents a snapshot of some of MPA's emission reduction strategies.

Table 1
Select MPA Emission Reduction Strategy Programs

Program	Emission Targets	Details
Clean Diesel Program	CAP and GHG	MPA's Clean Diesel Program "Dollars for Drays" is a grant program that provides up to $30,000 towards the purchase of a new drayage truck. As of 2022, 280 trucks have been replaced. This program also works with tenants to fund the replacement or upgrade of existing diesel cargo-handling equipment with newer model equipment.
Energy Audits	GHG	MPA has worked with Energy Service Companies (ESCOs) to perform energy audits of buildings and facilities and then design, build, and fund projects that save energy at POB and tenant facilities.
Electrification	CAP and GHG	MPA has worked with tenants to support the replacement of diesel-powered gantry cranes with larger more efficient electric cranes and is actively working to identify other areas for POB electrification through infrastructure upgrades and equipment purchases. MPA was recently approved to replace two terminal tractors and two diesel forklifts with one electric terminal tractor and one electric forklift funded through the Volkswagen Diesel Emissions Environmental Mitigation Trust Fund.
Renewable Energy: Algal Flow-way	CAP and GHG	MPA developed an algal flow-way to harvest turf algae for biomass to create biofuel that can then be converted to renewable diesel. This demonstration project was the first of its kind to link an algal flow-way with an algal digester that produced biogas to fuel a fuel cell.
Renewable Energy: Microgrids	CAP and GHG	MPA was awarded a $25,000 grant to conduct a feasibility study on the use of a microgrid at the Dundalk Marine Terminal.

Program	Emission Targets	Details
Renewable Energy: Solar	GHG	MPA is actively pursuing solar. With expansive terminals and large rooftop areas on warehouses, solar may be especially suited to the POB. Small direct solar panels could also power high-mast light poles, electronic signage, and charging stations for electric vehicles and cargo handling equipment. Solar has been installed on South Locust Point with other installations planned.
Sequestration	GHG	Carbon sequestration provides the opportunity to directly remove existing CO_2 from the atmosphere, while providing green space and recreational areas, mitigating urban heat island effects, and providing stormwater control. MPA has an active multi-year tree planting effort and coastal wetland habitat restoration at the MPA's DMCFs is another program that could potentially result in carbon sequestration, marrying GHG reduction, habitat benefits, and costs savings.

2 Methods

This 2020 CAP and GHG EI was conducted consistent with previous CAP and GHG EI developed for the MPA and in general accordance with widely accepted CAP and GHG accounting protocols, as well as the *2020 U.S. Environmental Protection Agency Guidance Document for Conducting Port Related Inventories* (USEPA 2020a). Using standard protocols ensures transparency by identifying the emission sources, emission factors, and whether emissions were calculated directly or estimated using surrogates consistent with widely accepted methods. Using established standards allows for comparison across inventories.

Consistent with reporting protocols, CAP and GHG emissions are measured using different standards of measurements. CAPs are reported in US pounds or US tons consistent with National Ambient Air Quality Standards (NAAQS). GHGs are measured in metric tons ("mt" or "mty") to provide consistency with international protocols that allow for global comparisons of GHG emissions. The USEPA and Maryland have adopted international standards and report annual GHG emissions in metric tons.

Criteria Air Pollutants

CAP emissions were calculated in accordance with the USEPA's 2020 port inventory guidance. CAP emissions are a function of equipment type, engine horsepower [hp], age, and model year, fuel type, activity (annual hours of operation), and load[1] data (reported as the fraction of total engine output) (ICF International 2009).

Greenhouse Gas Emissions

GHG emissions were calculated in general accordance with widely accepted GHG accounting protocols including the World Resources Institute and World Business Council for Sustainable Development (WRI/WBCSD) 2004 and The Climate Registry (TCR 2019a). Emissions-accounting protocols (e.g., WRI/WBCSD 2004TCR 2019a,) specify establishing "operational boundaries" for the emission-generating entity under consideration (referred to as the reporting entity).

Emissions

Criteria air pollutants (CAP) are pollutants for which the U.S. Environmental Protection Agency (USEPA) has set health-and welfare-protective ambient air quality standards referred to as national ambient air quality standards (NAAQS).

CAPs include reactive organic gases (ROG), nitrogen oxides (NO_X), sulfur oxides (SO_X) and particulate matter, which includes particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) and particulate matter less than 10 microns in diameter (PM_{10}).

Greenhouse gases (GHG) trap infrared radiation emitted from the Earth's surface and contribute to global warming and cause climate change.

GHGs include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Certain refrigerants, including chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs) also contribute to climate change and are reported here.

GHGs are often expressed as carbon dioxide equivalent (CO_2e), which is a metric that is used to compare the different gases based on their different global warming potentials.

[1] Engine load is the amount of work an engine is doing. For example, the engine in truck carrying a heavy load will work harder than a truck carrying a lighter load.

This process involves identifying emission sources associated with MPA facility operations and categorizing these sources into Scope 1, 2 and 3 categories. In addition to sources, the GHG EI also estimated annualized emissions sequestered by MPA's tree planting programs.

Sources

The 2020 CAP and GHG EI includes MPA and MPA tenant and visitor emission sources. The geographic boundary includes sources operating within the fence line of MPA operated public terminals facilities at the POB, the WTC, and the DMCFs. Data was collected from MPA and tenant sources via centralized energy records, vehicle inventories, tenant questionnaires, and direct communication.

Sources included in the analysis are presented in Table 2.

Table 2
2020 Emission Sources

Source Category	Emissions	Details
MPA Direct (Scope 1) Sources		
Operation and Maintenance (O&M) Equipment	CAP and GHG	**Includes**: MPA operated mobile equipment such as excavators, forklifts, several types of loaders, and lawn and garden equipment. **Emissions**: Based on MPA-provided equipment specifications (type, engine age and hp) and usage (hours of operation). *This source category could also include construction equipment. There were no major MPA led construction projects at the POB in 2020.*
Yard Vehicles	CAP and GHG	**Includes:** All MPA owned and operated cars and trucks used on terminals and by MPA staff to support MPA operations. **Emissions**: Based on MPA-provided vehicle specifications and usage (vehicle miles traveled (VMT) and fuel).
Harbor Craft	CAP and GHG	**Includes: W**ork boats and ferries owned and/or operated by MPA. **Emissions: B**ased on MPA provided vessel specifications (engine, hp) and usage (hours of operation).
Heating and Air Conditioning	CAP and GHG	**Includes**: MPA purchased fuel for heating (heating oil and natural gas) and refrigerant use. **Emissions**: Based on use records provided by MPA.
Generators and Pumps	CAP and GHG	**Includes:** MPA stationary source generators and pumps. **Emissions**: Based on fuel use records provided by MPA. *The DMCFs operate dredging equipment and pumps which was not captured in this inventory. These sources will be added to future EIs.*

Source Category	Emissions	Details
MPA Indirect (Scope 2) Sources		
Electricity	GHG	**Includes:** All electricity used by MPA for direct use in buildings and for services such as terminal and security lighting in shared spaces. **Emissions**: Based on MPA-provided electricity usage and building data.
Tenant and Visitor Direct and Indirect (Scope 3) Sources		
Cargo Handling Equipment	CAP and GHG	**Includes**: Tenant equipment used on site to move and sort cargo including ship-to-shore cranes, rubber-tired gantry cranes, forklifts, and yard hostlers. **Emissions**: Based on tenant provided equipment specifications (type, engine age and hp) and usage (hours of operation).
Yard Vehicles	CAP and GHG	**Includes:** Cars and light duty trucks used on terminals to support tenant operations. **Emissions**: Based on tenant provided vehicle specifications and usage (vehicle miles traveled (VMT) and fuel).
Roll on/Roll off (Ro/Ro) and Automobile Cargo	CAP and GHG	**Includes**: Cargo equipment and automobiles that are driven on terminal as Ro/Ro cargo. **Emissions**: Based on tenant provided vehicle specifications (type and age) and usage (number of moves, average distance driven). *Activity captured in the EI for these sources include running and cold-start emissions, and volatile organic compounds (VOC) emissions from auto-painting operations.*
Heavy Duty Diesel Vehicles (HDDV; Trucks)	CAP and GHG	**Includes:** Heavy-duty trucks that move cargo to and from the MPA. **Emissions**: Based on gate count data provided by MPA that includes truck identifiers (engine year). *This GHG and CAP EI only includes emissions from these sources within the MPA's fence line. Both running exhaust and idling activities are considered.*
Rail	CAP and GHG	**Includes:** Switcher and mainline locomotives. **Emissions:** Based on data provided by MPA. *This GHG and CAP EI only includes emissions from these sources within the MPA's fence line.*
Delivery Trucks, and Employee and Customer Vehicles	CAP and GHG	**Includes:** Light duty delivery vans and trucks (for example UPS or FedEx deliveries), all MPA, tenant and labor employee vehicles and customers including cruise passenger vehicles. **Emissions**: Based on MPA and tenant provided vehicle specifications and usage. *This GHG and CAP EI only includes emissions from these sources within the MPA's fence line.*

Source Category	Emissions	Details
Heating Air and Conditioning	GHG	**Includes: T**enant fuel purchased for heating (heating oil and natural gas) and refrigerant use. **Emissions**: Based on use records provided by tenants. *Only refrigerant data was available and therefore only GHG were calculated.*
Generators and Pumps	CAP and GHG	**Includes**: Stationary generators and pumps. **Emissions**: *Tenant data not available and therefore not included in the inventory.*

3 Results

Like all annual emission inventories, the results presented in this inventory are a snapshot of the conditions in 2020. Future inventories will continue to enhance the existing and long-term understanding of emission trends.

3.1 Results by Emissions

CAP emissions are reported in tons per year (tons) in Table 3. GHGs are presented in metric tons per year (mty) in Table 4. As shown and consistent with other U.S. port inventories, tenant and customer Scope 3 sources are the dominant source of emissions.

Table 3
Total 2020 CAP Emissions, All Sources (tons)

Scope	Emissions			
	NO_x	SO_x	PM_{10}	$PM_{2.5}$
MPA Direct Emissions (Scope 1)	2	0.011	0.076	0.072
Tenant and Customer Direct Emissions (Scope 3)	169	1.97	8.69	8.36
Total Emissions	**171**	**1.98**	**8.77**	**8.44**

Note:
Result values are rounded to three significant figures and may not add.
Indirect emissions related to electricity use are not captured as the electricity production occurs at a location outside of the area of influence for CAP emissions.

Table 4
Total 2020 GHG Emissions, All Sources (mty)

Scope	Emissions			Total CO_2e	% Total CO_2e
	CO_2	CH_4	N_2O		
MPA Direct Emissions (Scope 1)	1,420	0.126	0.00724	1,430	3%
MPA Indirect Emissions (Scope 2)	1,550	0.118	0.016	1,920	4%
Tenant and Customer Direct and Indirect Emissions (Scope 3)	42,000	37.6	0.792	43,300	93%
Total Emissions	**45,000**	**38**	**0.82**	**46,700**	**100%**
Sequestration	-370	N/A	N/A	-370	-0.80%
Net Total Emissions	**44,630**	**38**	**0.82**	**46,330**	**99.2%**

Notes:
Percentages represent the percentage of total emissions for the associated value.
Result values are rounded to three significant figures and may not add.
N/A: not applicable

3.2 Results by Sources

Table 5 presents emissions by sources. As shown, most emissions are attributed to mobile sources.

Table 5
Total 2020 Emissions, by Source

	Source Category	NO_x (CAP, tons)	SO_x (CAP, tons)	PM_{10} (CAP, tons)	$PM_{2.5}$ (CAP, tons)	CO_2e (GHG, mty)
Mobile Sources	MPA Operated Equipment and Vehicles	1.82	0.011	0.065	0.062	782
	Tenant Operated Equipment and Vehicles	131	1.87	7.47	7.22	22,500
	HDDV (Trucks)	26	0.051	0.779	0.723	1,030
	Rail	12.6	0.053	0.44	0.427	626
	Delivery Trucks and Employee & Customer Vehicles	0.001	0	0.001	0.001	8,540
Electricity	MPA Electricity Use	N/A	N/A	N/A	N/A	1,920
	Tenant and Customer Electricity Use	N/A	N/A	N/A	N/A	9,980
Stationary Sources	MPA Stationary Sources	0.186	0	0.011	0.01	650
	Tenant Stationary Sources	N/A	N/A	N/A	N/A	627
Total		**171 tons**	**1.98 tons**	**8.77 tons**	**8.44 tons**	**46,700 mty**

Notes:
Result values are rounded to three significant figures and may not add.
N/A: not applicable

Mobile Sources

As detailed in Table 5, the largest source of both MPA and tenant emissions come from mobile sources. Mobile sources include a variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place. Such equipment inventoried include terminal and port equipment operated by MPA and tenants (O&M equipment, MPA and tenant vehicles, tenant cargo handling equipment, Ro/Ro cargo, HHDV, rail [locomotives and switchers], delivery trucks and employee and customer vehicles). Because most mobile equipment is diesel powered at the POB, emissions are generally proportional to the number and type (size) of equipment and usage. For the purposes of this inventory, activity, usage, and engine age were the

main determiners of CAP and GHG emissions from mobile sources. Because tenants use more equipment in general than the MPA, tenant emissions are higher.

Figures 2 and 3 further breaks down mobile source category to identify emissions by mobile vehicle type. As shown, tenant cargo handling equipment represents the largest emission source, followed by HDDV (cargo trucks) and rail (locomotives) for both CAP and GHG emissions, and NOx is the primary CAP. While HDDV and rail are proportionally larger sources of port emissions as compared to most mobile cargo handling equipment, this inventory only includes emissions within the MPA fence line which only captures the on-port portion of truck and rail trips. Based on these results, MPA will continue to focus emission reduction efforts on CHE and other diesel-powered equipment and vehicles.

Figure 2
2020 CAP Mobile Source Emissions (tons/year)

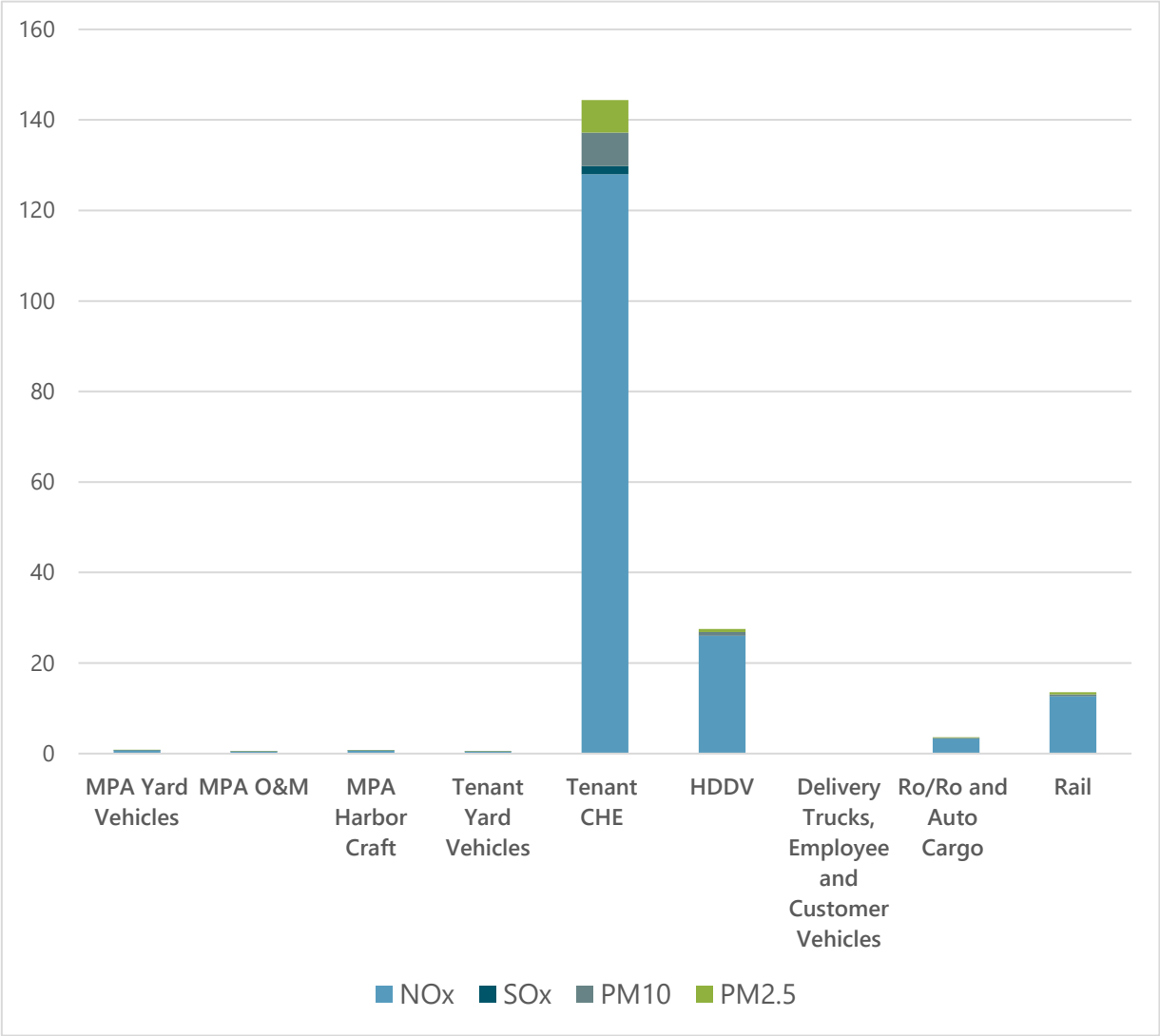
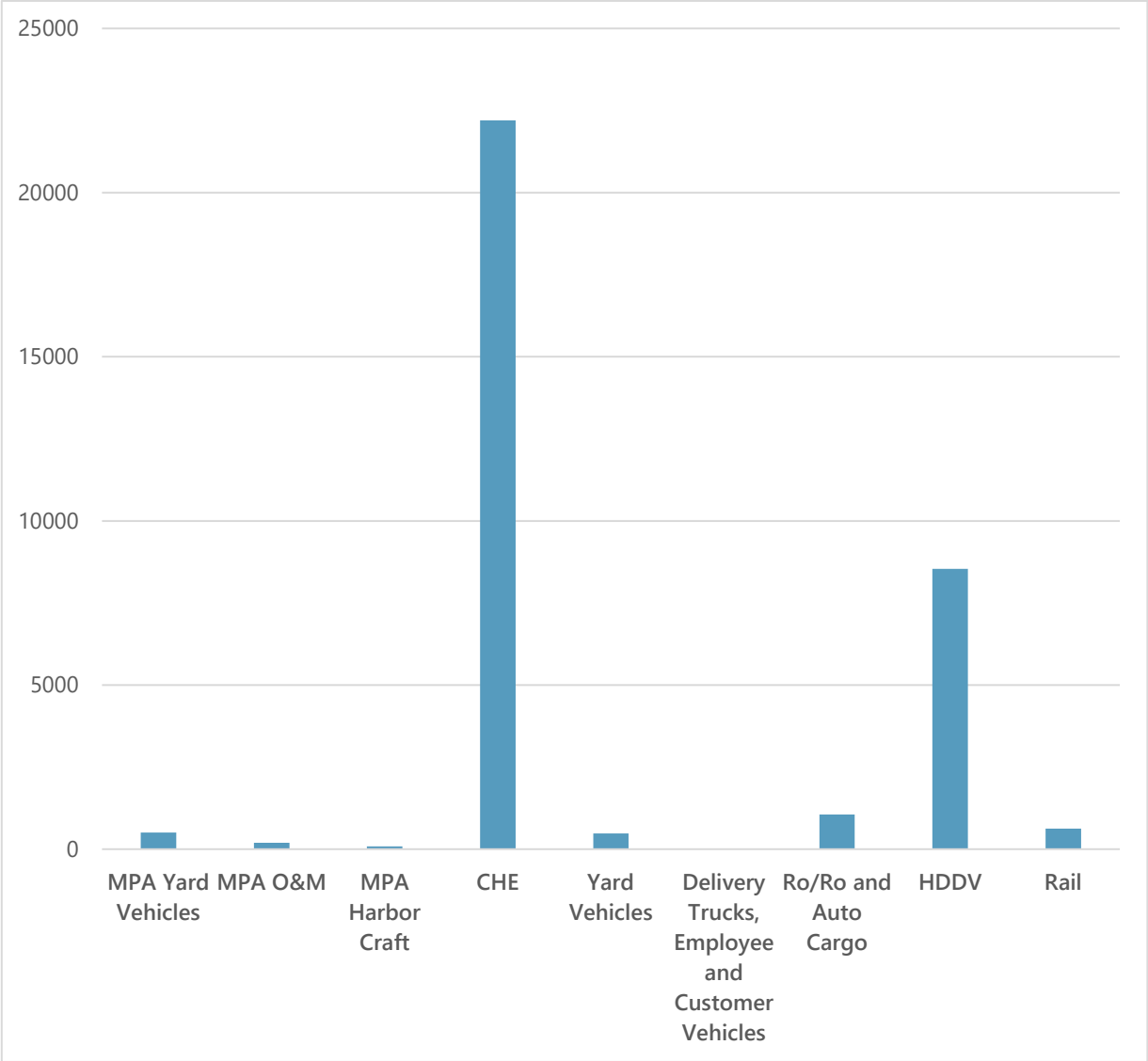


Figure 3
2020 CO_2e Mobile Source Emissions (mty)

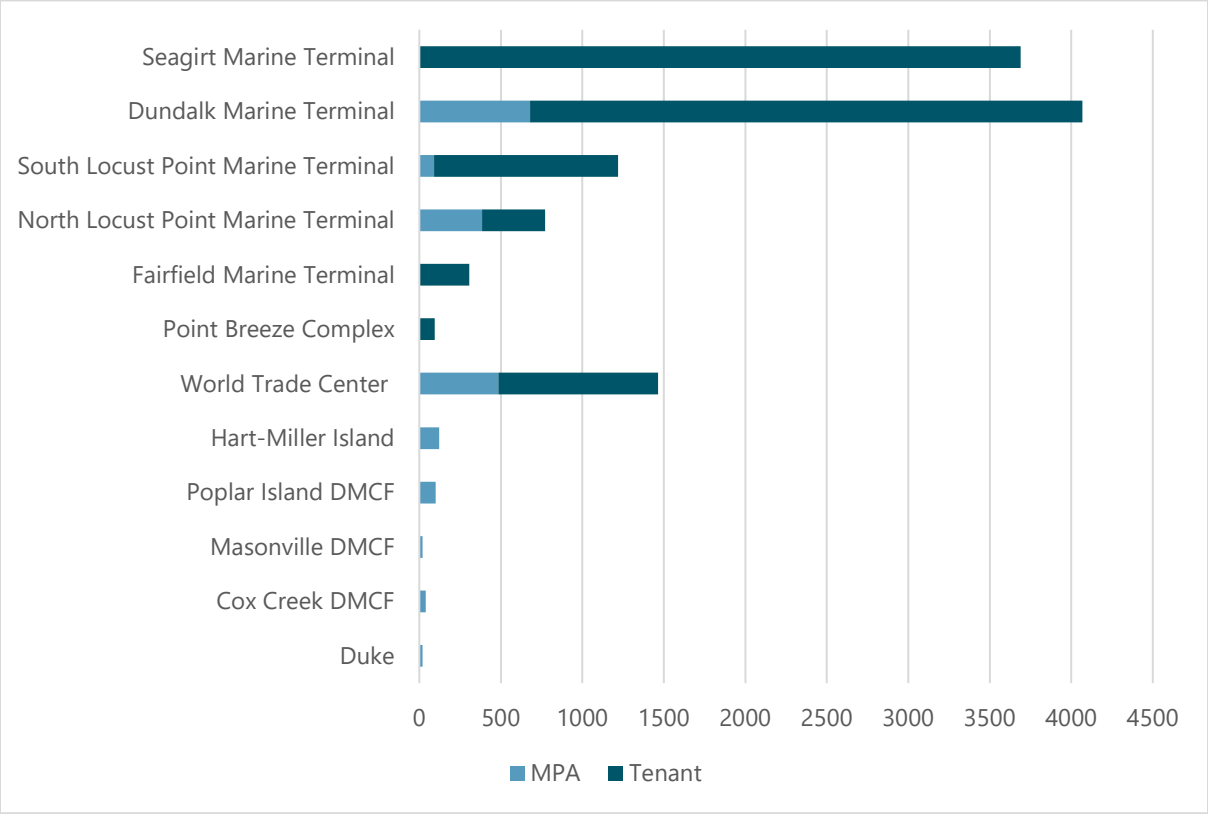


Electricty

Electricity is the second highest source of MPA and tenant GHG emissions. Figure 4 presents the emissions associated with electricity use from both MPA and tenant sources. As shown, tenant emissions are higher than MPA emissions because of increased usage rates, with Dundalk and Seagirt terminals consuming the most electricity due to their elevated activity levels and the utilization of electric ship-to-shore cranes. Electricity use will likely increase in future inventories as more electric powered equipment vehicles become available. While the increase in GHG emissions

from electricity use will offset fossil fuel generated emissions, a focus on renewable energy such as solar at the port will further facilitate total emission reductions. Future inventories will account for solar and other renewable energy installations at MPA facilities.

Figure 4
2020 Electricity Emissions CO_2e (mty) by Facility



Stationary Sources

Stationary emissions are low and may be partially underestimated due to data availability. However, stationary source emissions presented are within normal error range based on results from other similar port and industrial facilities.

Carbon Sequestration

Through its multi-year tree planting plan which began in 2014, MPA has planted 14.5 acres of trees. MPA and Blue Water Baltimore also planted 1,500 trees from 2017-2019. Based on annualized rates, 370 mty of CO_2 were sequestered in 2020 due to these planting efforts.

3.3 2020 Compared to 2016

The 2020 CAP and GHG EI builds on previous reports and allows for comparisons and trends where available. Comparing data between inventories will allow MPA to track progress towards emission reduction goals. As noted in Section 1, 2020 coincided with the COVID-19 pandemic. The POB remained open throughout 2020 as an essential service. As a result of the pandemic, spring 2020 cargo volumes were markedly down as compared to 2019 but cargo volumes largely rebounded by the end of 2020 and cargo increased month-over-month as compared to 2019 for October, November, and December. This report therefore does not weigh cargo volume differently due to the global pandemic. However, where results are directly attributed to the pandemic shutdowns (for example cruise terminal operations that did not resume until 2021), such results are noted to track for future inventories.

The *2016 Scopes 1 and 2 CAP and GHG EI* did not include Scope 3 emissions. In addition, there were several data gaps related to Scope 1 sources in the 2016 GHG EI where results were estimated using surrogates such as fuel records instead of equipment specification and usage. A sizable portion of these data gaps were resolved during the 2020 EI, resulting in updates to the 2016 totals for a more accurate comparison, but some gaps remain. Scope 2 data is more consistent between the 2016 and 2020 datasets, and robust data exists for the years between the two inventories.

Where available, comparable data shows emissions have decreased between 2016 and 2020. Figure 5 illustrates this trend for MPA sources of engine-generated NOx and PM10, and Figure 6 shows the trend for GHG emissions.

MPA Emission Inventories

Previous Emissions Inventories Include:

2006 Comprehensive Baseline Inventory of Landside Air Emissions (Arcadis 2008)

CAP Emissions

Air Emissions Inventory for Landside Operations at the Port of Baltimore Cargo Terminals in 2012 (Anchor QEA 2016)

CAP Emissions

2016 Landside Air Emissions Inventory for Maryland Department of Transportation Maryland Port Administration-Owned Public Terminals (Anchor QEA 2018)

CAP Emissions

2016 Scopes 1 and 2 CAP and GHG Emissions Inventory (Anchor QEA and Spectrum Environmental 2020).

Scope 1 (CAP) and Scope 1&2 (GHG)

Figure 5
MPA Engine Based NO_x and PM_{10} Emissions (tons/year) 2016 vs 2020

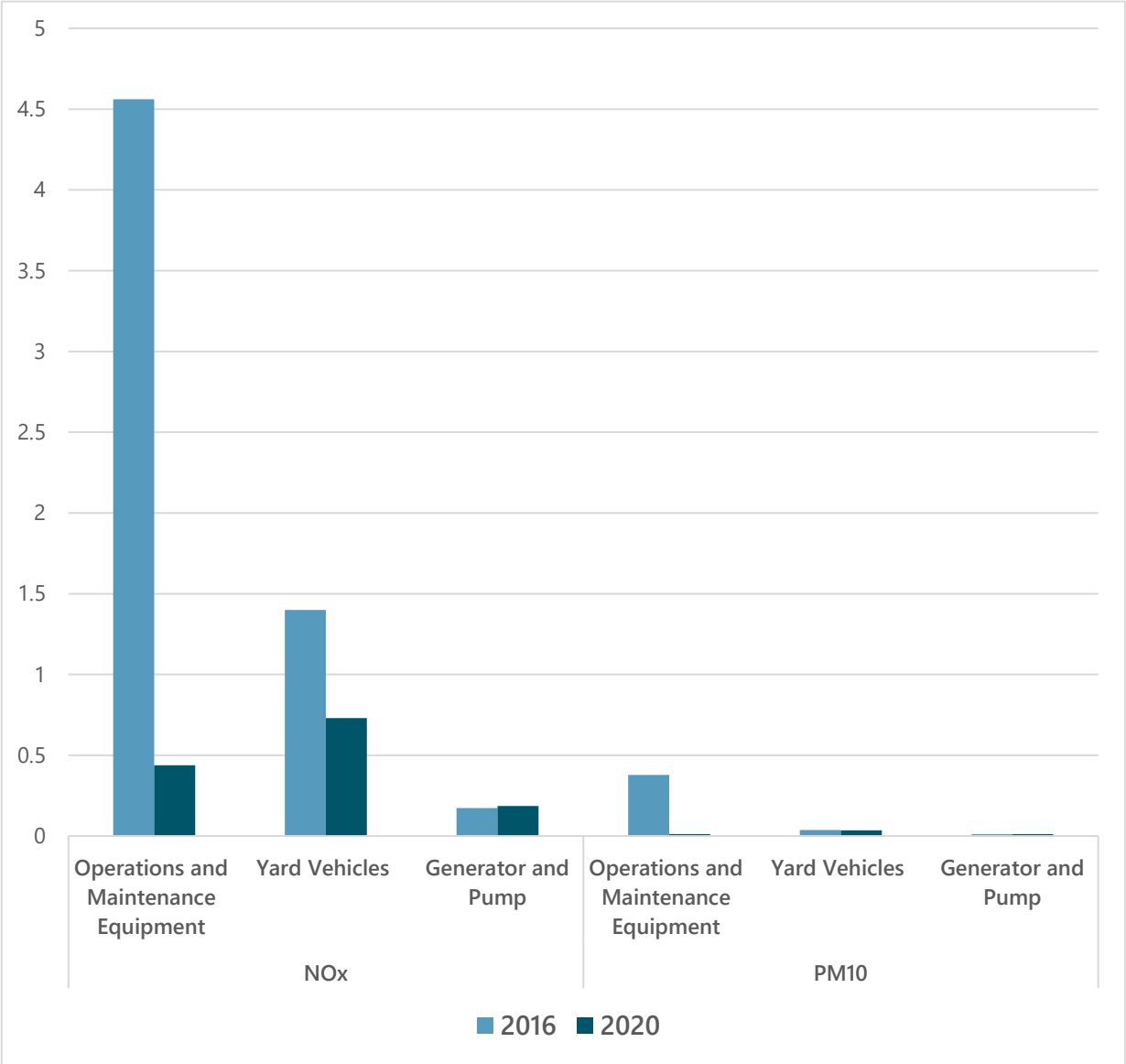
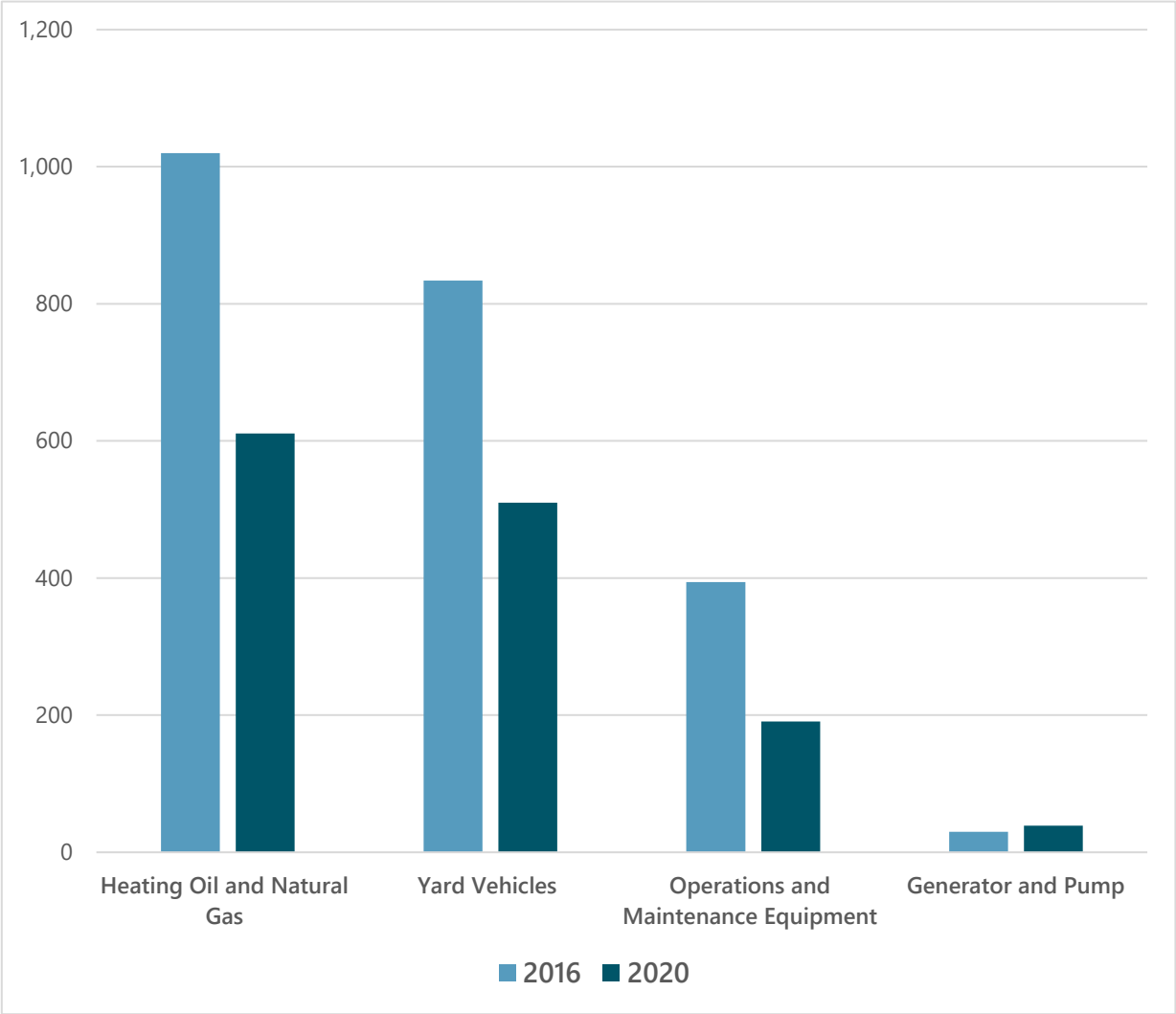


Figure 6
MPA Engine Based CO_2e Emissions (mty) 2016 vs 2020

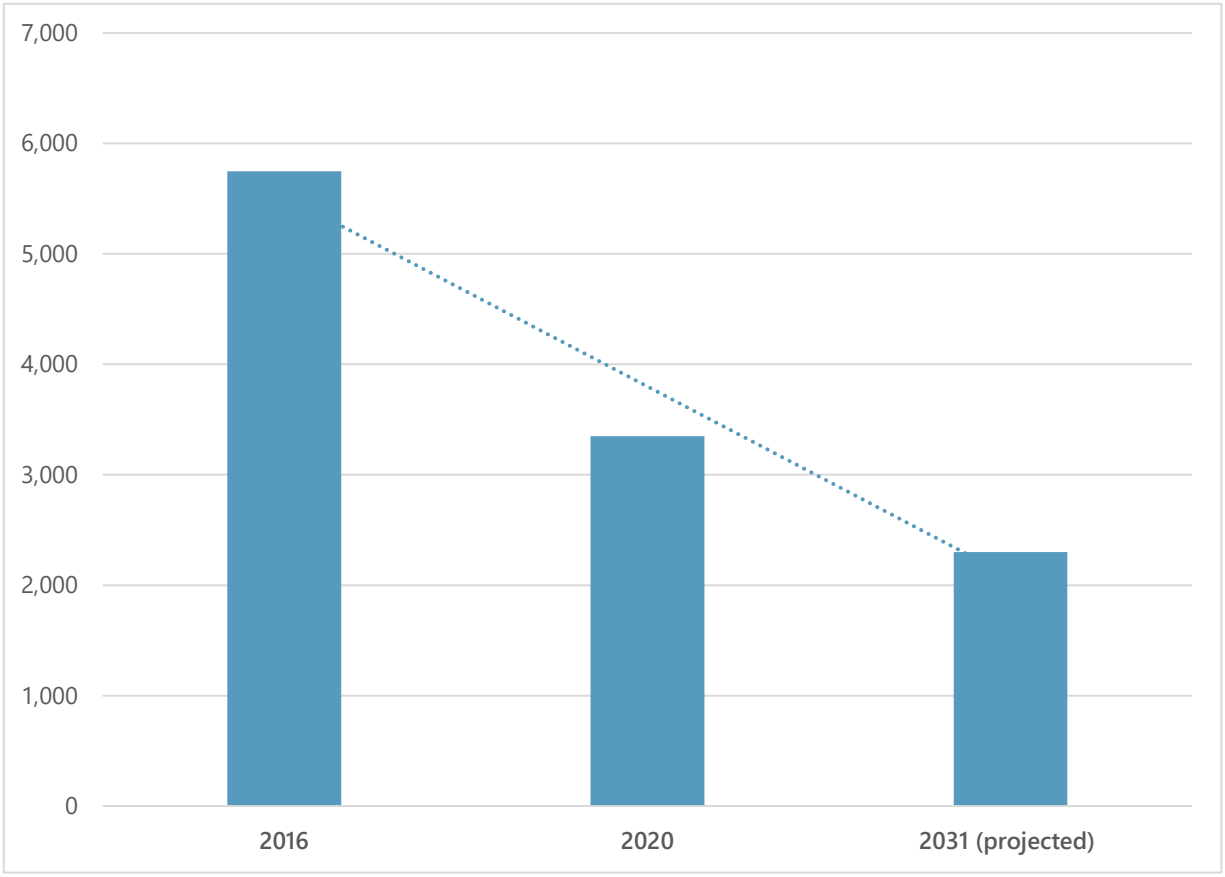


3.4 MPA Emissions as Compared to State GHG Emissions

The Greenhouse Gas Reduction Act (GGRA) requires the Maryland Department of the Environment (MDE) to prepare and publish an updated inventory of statewide GHG emissions on a 3-year cycle using 2006 as the baseline year for analysis. The first statewide GHG EI was done in 2011, with updates in 2014, 2017, and 2020. Based on the *State of Maryland 2020 Greenhouse Gas Emission Inventory Documentation* (MDE 2023), the principal sources of GHG emissions in the state of Maryland include transportation, as well as residential, commercial, and industrial (RCI) fossil fuel use.

Activities in Maryland accounted for approximately 85.06 million metric tons[2] (MMT) of gross CO_2e emissions in 2020. Emissions in 2017 were 87.67 MMT representing about a 3% decrease in GHG emissions between 2017 and 2020. Alternatively, MPA reduced GHG emissions from direct operational sources by about 60% between 2016 and 2020 and by about 20% from indirect use of electricity. Overall, 2020 emissions are below the projected trajectory to reach state emission reduction goals of 60% by 2031 as shown in Figure 7.

Figure 7
MPA Scope 1 and 2 GHG Emissions (mty) 2016 to 2020



[2] "Metric ton" is also reported as "tonne," which is used in this report.

4 Conclusion

This 2020 CAP and GHG EI is a follow up report to 2016 baseline EIs to help MPA identify emission source trends consistent with its environmental program, the Climate Solutions Now Act goals, and other state initiatives. Mobile sources represent the largest CAP and GHG emission contributors, with tenant cargo handling equipment as the single largest source. MPA will continue to drive down its emissions and work with tenants to reduce their emissions.

Emissions in most categories have notably decreased since 2016, while activity has generally remained constant or slightly increased in some cases. MPA has an active CAP emission reduction program and is considering several strategies to reduce diesel emissions. Moving forward, MPA will also focus on strategies that reduce GHG emissions, such as electrification consistent with state GHG emission reduction goals. Electric vehicles will necessitate investments in infrastructure and equipment but will yield longer lifespans and long-term cost benefits due to reduced operating and maintenance expenses. In the future, electricity emissions can be reduced by producing the necessary electricity locally through solar arrays, fuel cells, or small-scale wind technologies providing resilient and renewable sources of energy. MPA has already begun initial testing of these types of energy sources at the Port and will continue to explore these alternatives.

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