THE I-95 CORRIDOR ALTERNATIVE FUELING READINESS ASSESSMENT

for Medium-/Heavy-Duty Vehicle (MHDV) Fleets in Maryland

Charging and Fueling Infrastructure (CFI) Grant Program

JUNE 2023

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

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1 PROJECT NARRATIVE

1.1 Executive Summary

The I-95 Corridor Alternative Fueling Readiness Assessment for Medium-/Heavy-Duty Vehicle (MHDV) Fleets in Maryland ("study") will provide a detailed assessment of two potential community sites for electric vehicle charging and alternative fueling infrastructure deployment. The Maryland Department of Transportation (MDOT) is seeking a grant award of $760,000 from the U.S. Department of Transportation's (USDOT) Charging and Fueling Infrastructure (CFI) discretionary grant program to fund this effort. The sites were selected to assess deployment considerations at distinctly different corridor locations. As the largest source of greenhouse gas (GHG) emissions in the United States (U.S.), the transportation sector will play a critical part in achieving the national goal of net-zero GHG emissions economy-wide by 2050. The *U.S. National Blueprint for Transportation Decarbonization,* released in 2022, recognized that decarbonizing the transportation sector requires "multiple strategies and resources to deliver, safe, effective, affordable, and sustainable solutions" to meet this challenge.

MDOT has identified two strategic sites for development phase activities to prepare for and assess the impact of charging and alternative fueling infrastructure deployment for MHDVs. The Travel Centers America #216 Baltimore City site is a heavily utilized privately owned truck fueling, rest, and service facility for MHDVs primarily serving the Port of Baltimore. However, the adjacent community is a transportation disadvantaged area that has borne a disproportionate impact from local industrial development and activities, leading, for example, to a 96th percentile rating for asthma prevalence (according to the EPA EJ Screen tool). The Maryland Transportation Authority (MDTA)'s Chesapeake House in Cecil County provides numerous amenities and fueling opportunities to all travelers and all vehicle types, making it an ideal site for charging and alternative fueling deployment. The deployment and development of alternative fueling infrastructure and freight operations at these two sites has the potential to improve air quality and positively impact quality of life for surrounding residents and communities, as well as MHDV drivers. Piloting deployments at both publicly and privately-owned sites, located in both urban and rural areas, presents a unique opportunity to evaluate barriers to deployment from a resource, stakeholder engagement, and community needs perspective.

The I-95 corridor is a nationally significant corridor for travel and freight, supporting freight movement and first-and-last-mile freight service connections. Medium and heavy-duty vehicles haul over 75% of freight in Maryland at an estimated freight value of $286 billion. While it is expected the National Electric Vehicle Infrastructure (NEVI) formula program will greatly assist Maryland in implementing a comprehensive electric charging network for personal vehicles, the state must consider and implement a multi-faceted fueling approach for MHDVs to meet unique fleet requirements, transportation infrastructure weight restrictions, gross weight regulations, and transportation decarbonization goals. The study will also provide invaluable insight to inform the Department's strategic efforts to provide a comprehensive network of alternative fueling and charging infrastructure for MHDVs across the entire 109-mile I-95 corridor to support freight movement throughout Maryland.

The I-95 Corridor Alternative Fueling Readiness Assessment for MHDV Fleets in Maryland meets several of USDOT's key criteria:

CFI PROGRAM VISION

The study aligns with the USDOT funding priority to expand the deployment of alternative fuel infrastructure in publicly accessible locations for MHDVs that serve and operate in or through communities.

EQUITY, COMMUNITY ENGAGEMENT, AND JUSTICE 40

The study will examine potential site-specific impacts to adjacent, sensitive communities, provide an education and outreach component to ensure community perspectives are incorporated in the study, and determine mitigation strategies with direct stakeholder input and engagement.

SAFETY ENHANCEMENT

The study will enable MDOT to appropriately mitigate any safety risks introduced by alternative fueling infrastructure at community sites and appropriately align project implementation to the National Roadway Safety Strategy and other best practices. Maryland is a Vision Zero state and is committed to zero motor vehicle-related fatalities or serious injuries by 2030.

CLIMATE CHANGE, RESILIENCE, AND SUSTAINABILITY

The project will examine potential greenhouse gas emission reductions that could be achieved from the deployment of alternative fuel infrastructure using the AFLEET CFI Tool to assess well-to-wheel emissions and vehicle operation air pollutant emissions in two unique locations in Maryland. In addition, MDOT will leverage existing state mapping tools and climate projections to assess potential impacts to disadvantaged communities, with a focus on natural hazards and the need to prevent, respond to, and recover from disruptions in these communities.

2 PROJECT LOCATION(S)

2.1 Introduction

Achieving corridor readiness starts with supporting communities that have borne a disproportionate burden from our transportation system and involving them in the decision-making process as we move towards a decarbonized future. Communities near or adjacent to freight facilities and highways are significantly impacted by fleet vehicles that serve and operate on their streets and through their neighborhoods. MHDVs are responsible for an outsized portion of harmful particulate matter emissions. While MHDVs make up approximately a 10% share of on-road vehicles nationally, they are responsible for 45% of on-road NOx emissions and 57% of direct $PM_{2.5}$ emissions. [1] Since they can deliver co-benefits including reductions in NOx and PM2.5 emissions, MHDV decarbonization efforts therefore represent a

[1] Fleming, Kelly, Austin Brown, Lew Fulton, and Marshall Miller. "Electrification of Medium- and Heavy-Duty Ground Transportation: Status Report." *Current Sustainable/Renewable Energy Reports,* Vol. 8, pp 180-188, 2021. https://link.springer.com/article/10.1007/s40518-021-00187-3.

significant, near-term opportunity to positively impact public health, air quality, roadway and facility safety, and the environment in communities.

The study will closely examine two community sites to determine the feasibility of deploying alternative fueling and charging infrastructure for MHDVs. Additionally, the feasibility study for these two locations will also help inform MDOT's efforts to address MHDV alternative fueling and charging infrastructure needs along the I-95 corridor, as these two strategic locations may serve as model in future deployment efforts along the corridor and throughout Maryland. In identifying these two community locations, MDOT focused on ensuring safety and accessibility at the sites, minimizing disproportionate community impacts, and meeting the range and fueling needs of MHDVs utilizing the I-95 corridor. These two distinct sites will provide MDOT with critical insights into the challenges and feasibility of deployment in both an urban and a rural location, and how alternatively fueled MHDVs may positively impact communities. Additionally, MDOT considers fueling locations that enhance public-private partnerships, are in historically disadvantaged and/or non-attainment areas, and already provide traditional fueling or rest facilities to be ideal for potential alternative fueling and charging infrastructure deployment.

Table 1: Locations – Transportation Disadvantage Comparison

	TA Baltimore #216	Chesapeake House
Land Use	Urban	Rural
Ownership	Private Facility	Public Facility
USDOT Transportation Disadvantaged Census Tracts[2] *(Six indicators are used to evaluate transportation disadvantage: transportation access, health, environmental, economic , resilience, and equity. If four or more indicators are identified, then the census tract is identified as Transportation Disadvantaged*)	Transportation Disadvantaged (*Health, Economic, Equity, and Environmental Disadvantage Indicators*)	Not Transportation Disadvantaged (*Transportation Access and Resilience Disadvantage Indicators*)
Climate and Economic Justice Screening Tool[3] (*Census Tract is identified as disadvantaged if the tract meets at least one of the tools categories of burden: (Climate Change, Energy, Health, Housing, Legacy Pollution, Transportation, Water and Wastewater, and Workforce Development*)	Disadvantaged (*Health, Housing, Legacy Pollution, Water and Wastewater, and Workforce Development*)	Not Disadvantaged
Maryland EJScreen Mapper[4] (*EJScore is calculated by multiplying the indicator scores for the Pollution Burden and Population Characteristics categories to get an EJScore at the census tract level. The EJScore represents percentile across MD, e.g. a score of .73 is higher than 73% of census tracts in MD, the higher the score the greater the EJ concern))*	EJScore - .73	EJScore - .54
Maryland Park Equity Mapper[5] (*The total score represents accessibility to parks and park quality. A higher score represents lower equity in park accessibility)*	Total Score .12 (*High Equity*)	Total Score .32 (*Close to Low Equity*)

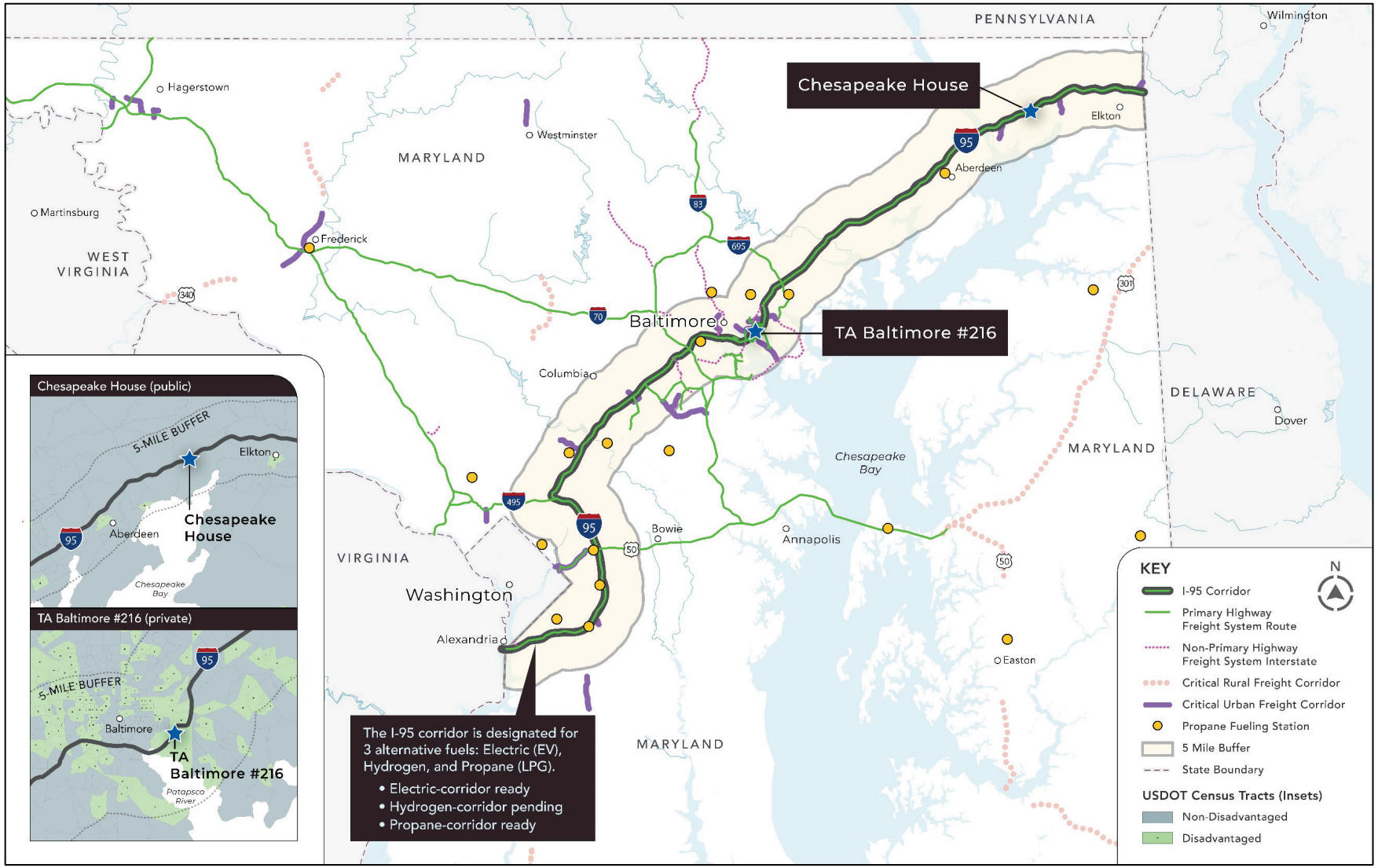
[2] https://usdot.maps.arcgis.com/apps/dashboards/d6f90dfcc8b44525b04c7ce748a3674a.
[3] https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5.
[4] https://p1.cgis.umd.edu/ejscreen/.
[5] https://p1.cgis.umd.edu/mdparkequity/.

LOCATIONS

Detailed Site Map

The study will examine the privately-owned, publicly accessible and urban site TravelCenters of America #216 in Baltimore City and the publicly owned, privately-operated and rural Maryland Transportation Authority Chesapeake House Travel Plaza located in the Town of North East, Maryland (see Figure 1).

Figure 1: Project Site Locations



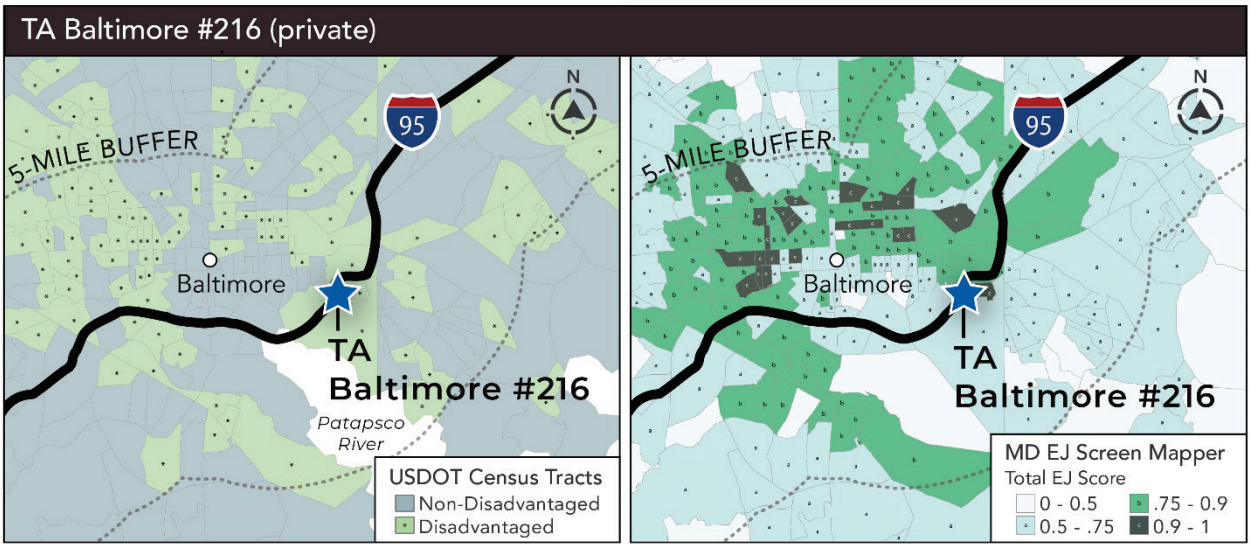
Location(s) Description

Location 1 - TravelCenters of America #216 in Baltimore City

TravelCenters of America, LLC, (TA), is a publicly traded, full-service truck stop and travel center company headquartered in Westlake, Ohio.[6] TCA employs more than 18,000 staff, supporting over 280 locations in 44 states, including three locations in Maryland that are directly adjacent to the I-95 corridor. TA's mission to return every traveler to the road better than they came strongly aligns with MDOT's commitment to roadway safety for all users. TA formed a dedicated business unit, eTA, to build on their comment to alternative energy and environmental sustainability. On average, TA's sites are 26 acres in size and are situated at strategic highway and freight locations, which provides TA a unique ability and opportunity to accommodate non-fossil fuel infrastructure and be an early adopter in supporting the decarbonization of MHDVs.[7]

While there are numerous privately-owned truck and travel service providers along the I-95 corridor, MDOT will partner with TravelCenters of America to determine the deployment feasibility of alternative fueling and charging infrastructure for MHDV at the TA Baltimore, MD #216 location. This study will help inform future MDOT partnerships with other truck and travel service providers along the corridor.

Figure 2: TA Baltimore #216, Exit 57: 5501 O'Donnell Street, Baltimore, MD 21224



TA Baltimore #216 is a strategic community fueling location due to its proximity to the public and private marine terminals at the Port of Baltimore, multi-modal freight terminals, local distributions centers, and TradePoint Atlantic. The site is located in the heart of the State's freight and logistics hub.

In 2022, the Port of Baltimore experienced another record year, moving 43.3 million tons of foreign cargo imports and exports valued at $74.3 billion. The Port is a complex mix of both public and private marine terminals, with approximately 90% of all general cargo moving through the six public marine terminals. It is the 12th largest in the nation for foreign cargo tonnage and 10th largest for cargo value,

[6] BP. *BP expands mobility and convenience network completing purchase of leading travel center operator, TravelCenters of America*. May 15, 2023. https://www.bp.com/en_us/united-states/home/news/press-releases/bp-expands-mobility-and-convenience-network-completing-the-purchase-of-leading-travel-center-operator-travelcenters-of-america.html.
[7] Travel Centers of America. *2021 Environmental, Social and Governance Report*. https://www.ta-petro.com/2021-environmental-social-and-governance-report.

generating 15,300 direct jobs with nearly 140,000 linked to Port activities, including vital trucking jobs.[8] The Port is located within the highly urbanized City of Baltimore and Baltimore County. Most of the marine terminals and supporting distribution centers are situated near residential neighborhoods, many of which are historically disadvantaged.

In 2020, there were more than 57,000 individual heavy-duty trucks that called on the public marine terminals that make up the Port of Baltimore, making more than a million round trip moves. MDOT's Maryland Port Administration is nationally recognized as a leader in the advancement of clean diesel programs, including receiving more than $20 million in USEPA grants for diesel equipment upgrades since 2008. The Port implements numerous air quality enhancement and community engagement programs to further reduce or eliminate emissions associated with cargo movement as the overall goal.

The Port's highly successful "Dollars for Drays" Program provides owners of eligible, older model dray trucks up to $30,000 to help defray the cost of upgrading to a newer, cleaner truck. Since 2012, a total of 290 dray trucks have been replaced as part of the program.[9] The Port received a $1.8 million Diesel Emission Reduction Act (DERA) grant in 2022 that includes funds to support the purchase of three electric dray trucks to replace existing diesel heavy-duty trucks that currently call at the public terminals. Two of the new, all-electric dray trucks will be purchased by RoadOne Intermodal Logistics, which moves cargo between Baltimore and IKEA's distribution center in Perryville, located in Cecil County. RoadOne also partnered with the Port, IKEA, and electric truck manufacturer Nikola Corporation to begin a pilot testing program to prove the concept of using electric dray trucks in its operations.

An exciting near-term application for battery-electric trucks (BETs) and MHDVs is for drayage operations. Drayage heavy-duty trucks are suitable candidates for electrification because of their limited daily mileage, return home trips, and unique trip characteristics that allow for regenerative braking.[10] A recent analysis found that 62% of drayage tours at the Port of Long Beach and Port of Los Angeles could be served by electric trucks. However, for drayage electrification benefits to be fully realized, charging infrastructure must be allowed and installed at home bases.[11] A feasibility analysis at the TA Baltimore #216 site would provide MDOT and the Port of Baltimore greater insight into the potential of battery-electric truck operations, particularly for drayage. The TA Baltimore #216 site is directly adjacent to I-95 and I-895, both of which are nationally significant freight corridors. It lies directly on Baltimore City's Critical Urban Freight Corridors (CUFC), which runs primarily through eastern Baltimore City and into Baltimore County. In an urbanized area with a population greater than 500,000, the Baltimore Regional Transportation Board, the designated Metropolitan Planning Organization, may designate CUFCs in consultation with the state. CUFCs must connect to an intermodal freight facility on the Interstate system, provide an alternative highway option important to freight and goods movement, serve a major freight generator, and be important to the general movement of goods and freight in a region.[12]

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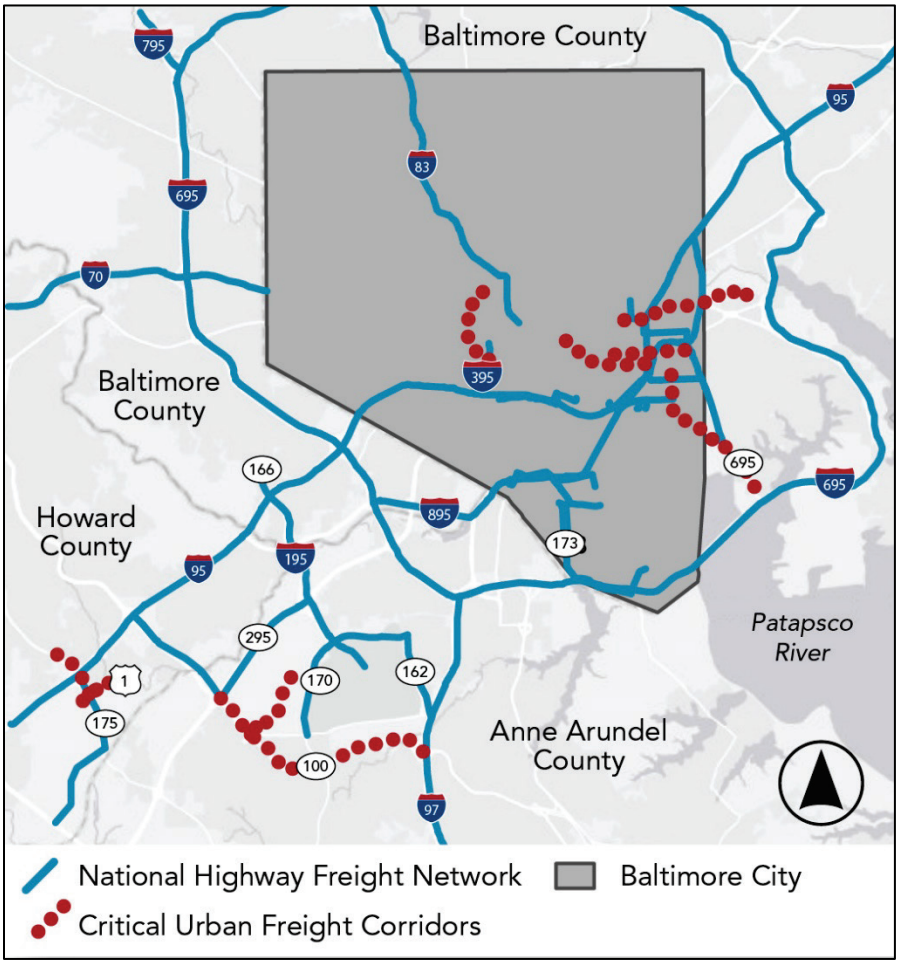
[8] Maryland Port Administration. *2017 Economic Impact of the Port of Baltimore in Maryland*. October 15, 2018. https://mpa.maryland.gov/Documents/EcononmicimpactofPOBMaryland2017_101518.pdf.
[9] Maryland Port Administration. *Port of Baltimore Encourages Truck Owners to Join 'Dollars for Drays' to Replace Older Vehicles*. February 16, 2021. https://mpa.maryland.gov/Press%20Releases/021621Press.pdf.
[10] Tanvir, Shams, Fuad Un-Noor, Kanok Boriboonsomsin, and Zhjiming Gao. "Feasibility of Operating a Heavy-Duty Battery Electric Truck Fleet for Drayage Applications." *Transportation Research Record*. Vol. 2675, pp. 258-268. 2021. https://journals.sagepub.com/doi/pdf/10.1177/0361198120957325.
[11] *Ibid.*
[12] 23 USC 167(f).

Figure 3: Maryland Major Freight Corridors Around Baltimore City[13]



The study will provide a detailed safety assessment and analyze current traffic and access conditions at the TA Baltimore #216 site. This will assist MDOT in determining any vehicular and pedestrian safety issues that may be created by the future deployment of alternative fueling or charging infrastructure. The study will closely examine issues to include MHDV idling, site accessing, MHDV queuing, truck parking capacity and identify appropriate infrastructure improvements needed to ensure MHDVs and other vehicles enter and exit the site safely and efficiently.

Location 2 - The Chesapeake House Travel Plaza in Cecil County

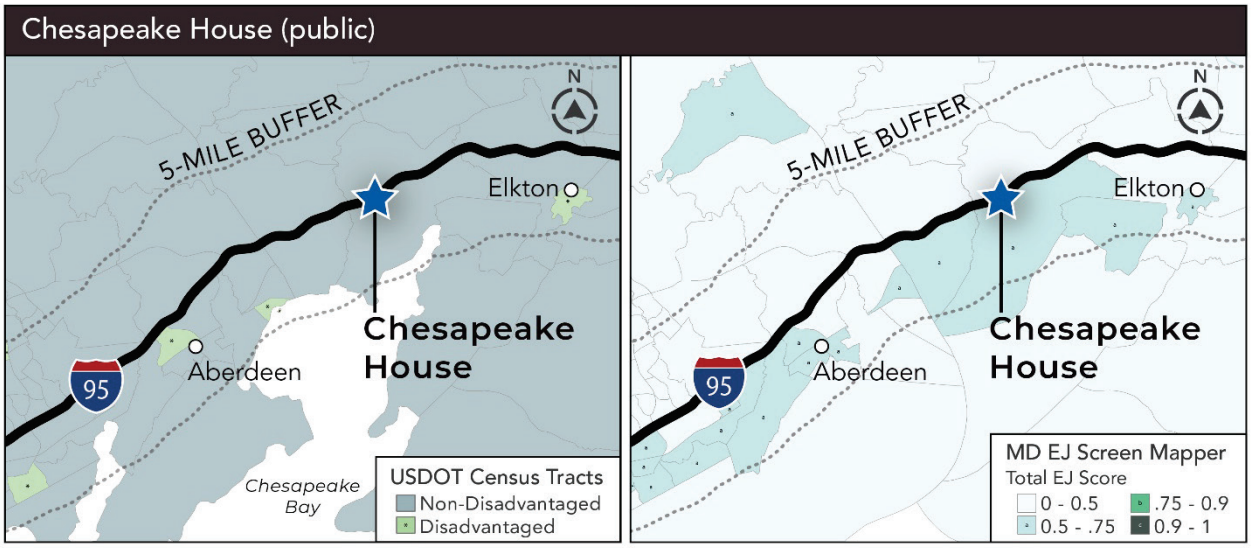
The Maryland Transportation Authority (MDTA) maintains two publicly accessible Travel Plazas on the I-95 Corridor. The plazas provide numerous amenities, rest, and re-fueling opportunities to all travelers and all vehicle types. The plazas are operated by a public-private partnership with Areas USA, though only the Chesapeake House Travel Plaza will be analyzed in this study.

[13] https://geo.sha.maryland.gov/images/Open-Data/Docs/Freight%20Corridors.pdf.

Figure 4: The Chesapeake House[14]

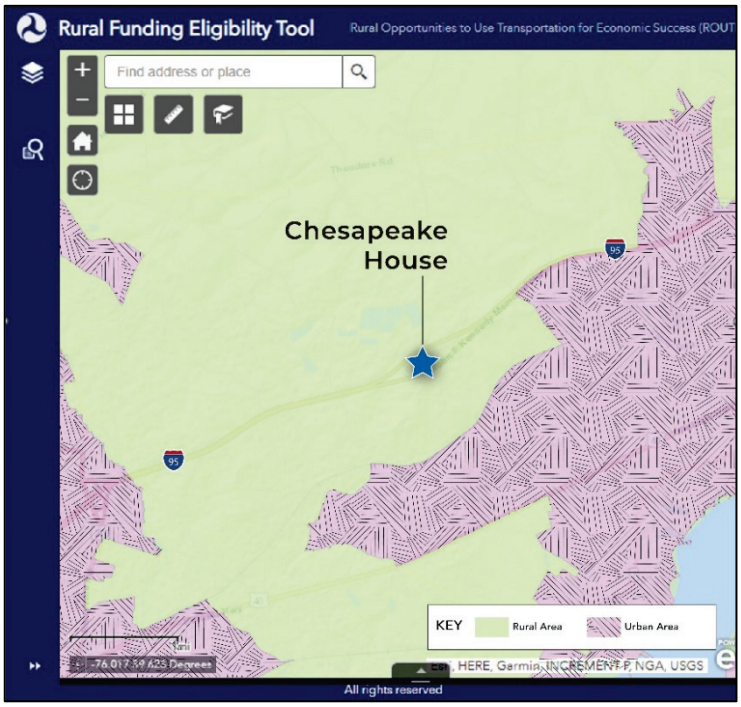
The Chesapeake House Travel Plaza ("Chesapeake House") is located at I-95-mile marker 97 between Exit 93 and Exit 100 in the Town of North East, Maryland. The site is in a USDOT defined rural area in Cecil County, Maryland. The site maintains 5 universal electric vehicle charging stations, including at a handicap-accessible parking space, and an additional 10 Tesla charging stations.[15]

Figure 5: Chesapeake House Site, Disadvantaged Census Tracts and Environmental Justice (EJ) Scores



[14] https://mdta.maryland.gov/MD_I-95_Travel_Plazas/Home.html.
[15] https://mdta.maryland.gov/index.php/blog-category/mdta-news-releases/electric-vehicle-charging-stations-now-operational-maryland-house.

Figure 6: DOT Rural Eligibility Map



The entirety of Cecil County is a moderate 8-hour Ozone area as determined by the Environmental Protection Agency (EPA).[16] The EPA considers any area that does not meet the national primary or secondary ambient air quality standard to be a nonattainment area. Utilizing the 2015 standard, a moderate area has a design value of 0.081 parts per million (ppm) up to but not including 0.093ppm. Community alternative fueling and charging sites located in nonattainment areas, such as the Chesapeake House, have the potential to improve air quality and reduce harmful particulate matter emissions that have been linked to worse public health outcomes in communities.

The Chesapeake House is a key fueling, rest area, and connection point to freight and logistics hubs in Cecil County. The IKEA Distribution Center opened at 100 IKEA Way in Perryville in 2002 and employs approximately 550 workers. The center receives significant amounts of cargo imported through the Port of Baltimore, and transports goods and products to 39 IKEA stores in the United States and Canada . The Amazon MDT2 Distribution Center and KRB5 Amazon Warehouse are located at 600 Principio Parkway West in the Town of North East. The 1.2 million square foot Amazon site was announced in 2017 with a projection to create approximately 700 new positions. The site is primarily focused on first-and-last mile freight deliveries to support customer fulfillment needs.[17] [18]

The study will provide a detailed safety assessment and analyze current traffic and access conditions at the Chesapeake House site, including to and from the nearby distribution centers. This will assist MDOT in determining any vehicular and pedestrian safety issues that may be created by the future deployment of alternative fueling or charging infrastructure for MHDVs. The study will closely examine issues including interactions of personal and intercity bus vehicles with MHDVs, spatial limitations and infrastructure needs for MHDV alternative fueling and charging deployment, issues with MHDV queuing, truck parking capacity, and appropriate infrastructure improvements - including grid capacity - needed to ensure MHD and other vehicles enter and exit the site safely and efficiently.

Maryland believes that vehicular crashes are preventable and views zero as the only acceptable number of motor vehicle deaths. In 2019, the Maryland legislature passed a Vision Zero bill that was later signed

[16] Environmental Protection Agency. *Nonattainment Areas for Criteria Pollutants (Green Book).* https://www3.epa.gov/airquality/greenbook/anayo_md.html.
[17] Cecil County Chamber of Commerce. *IKEA Distribution Services, Inc.* http://www.cecilchamber.com/list/member/ikea-distribution-services-inc-830.
[18] Maryland Department of Commerce. *Amazon Plans Fulfillment Center in Cecil County, 700 New Jobs.* January 18, 2017. https://commerce.maryland.gov/media/amazon-plans-fulfillment-center-in-cecil-county-700-new-jobs.

into law. The law set a goal of zero motor vehicle-related fatalities or serious injuries by 2030. Maryland uses a multi-disciplinary approach to crash prevention and severity mitigation, including strategies that address roadway design, driving behaviors, technology, and policies by working with our wide network of partners. Maryland's Strategic Highway Safety Plan utilizes a Safe Systems Approach and is informed by USDOT's National Roadway Safety Strategy. The Maryland State Department of Education, Office of Pupil Transportation is participating in USDOT's Call to Action campaign for the NRSS.[19] The study will closely follow these principles in determining potential safety and access impacts from alternative fueling or charging deployments for MHDVs.[20]

2.2 Addressing Gaps in Community Fueling Infrastructure

Community alternative fueling and electric charging infrastructure for MHDVs will play a critical role in decarbonizing the nationally significant I-95 freight corridor and improving air quality and greenhouse gas emissions in freight corridor and site-adjacent neighborhoods. The study will provide MDOT with greater insights into the existing gaps for community alternative fueling and electric charging infrastructure for MHDVs across the I-95 corridor.

The efficient movement of freight through Maryland supports our economy and helps to create sustainable, living-wage jobs and career opportunities for residents. Freight-related industries represent a significant portion of Maryland's overall economy; freight-related businesses make up approximately 32% of Maryland's business establishments and 31% of total employment. While economic and freight demands are dynamic and constantly evolving, the Maryland State Freight Plan projects a 53% increase in freight tonnage by 2050 and an over 100% growth in value to over $700 billion. Medium and heavy-duty vehicles haul over 75% of freight in Maryland at an estimated freight value of $286 billion.[21] Ensuring the smooth and collaborative decarbonization of MHDV operations is critical to improving our state's environment and public health, while supporting continued economic growth.

The I-95 Corridor is a nationally significant freight corridor, supporting freight movement and first-and-last-mile freight service connections. At 109 miles, I-95 is the longest expressway in the state and runs through or borders 9 jurisdictions and counties including Anne Arundel, Baltimore, Cecil, Harford, Howard, Montgomery, and Prince George's counties and Baltimore City. It is one of the two most traversed expressways in Maryland. Despite accounting for just 2% of the roadway miles in the state, Interstate routes account for nearly 1/3 of the state's vehicle miles traveled. The I-95 North of I-695 and I-95/I-495 North of US 50 segments experience the highest average daily truck volumes (ADTV) in the state, at 29,300 and 23,200 tractor trailers per day respectively. While personal vehicle trips experienced a significant reduction due to the COVID-19 pandemic, truck volumes in Maryland did not experience as dramatic a decline. While truck volumes were reduced by 20% in the peak of COVID-19, volumes increased by 6% over the last four months of 2020.[22]

[19] U.S. Department of Transportation. *Allies in Action*. Updated May 31, 2023. https://www.transportation.gov/nrss/allies-in-action.
[20] Maryland Department of Transportation - State Highway Administration. *Maryland Strategic Highway Safety Plan 2021-2025.* https://zerodeathsmd.gov/wp-content/uploads/2021/06/2021_2025_MD_SHSP_FINAL.pdf).
[21] Maryland Department of Transportation. *Maryland State Freight Plan 2022*. Pp. 3-9. https://www.mdot.maryland.gov/OPCP/MDOT_State_Freight_Complete_2022_12_06.pdf.
[22] Maryland Department of Transportation – State Highway Administration. *Maryland State Highway Mobility Report 2020.* Pp. 52-59. https://roads.maryland.gov/OPPEN/2020_mobility_report.pdf.

Freight operators experience congestion and related costs due to cargo and driver delays, fuel loss, and emission costs along the freeway system. Several stretches of I-95 experience a Travel Time Index (TTI) ratio of greater than 1.25 during AM/PM peaks and summer hours. These congested segments are at key interchange or tunnel locations, harming the travel time of the entire system. Truck travel times and reliability are important components of just-in-time deliveries that serve manufacturing operations throughout Maryland. Additionally, MHDV idling and stalling due to congestion increase emissions of air pollutants and greenhouse gas. Prior to the onset of the COVID-19 pandemic, expressway congestion costs were between $2.7 and $3.6 billion annually.[23]

Establishing a network of alternative fueling infrastructure along the I-95 corridor in publicly accessible locations will be critical to meeting Maryland's net zero-emission goals by 2045, as mandated by the Climate Solutions Now Act of 2022. Working with the Federal Highway Administration (FHWA), Maryland has established a robust network of Alternative Fuel Corridors (AFCs), successfully designating corridors for all five alternative fuels. Currently, there are 23 electric vehicle (EV) AFCs, one compressed natural gas (CNG) AFC, one liquid natural gas (LNG) AFC, two liquefied petroleum gas (LPG) AFCs, and three hydrogen AFCs (pending) designated in Maryland.

However, significant gaps are present in Maryland's electric charging and alternative fueling infrastructure for MHDVs. LPG is a well-established alternate fuel with a developed market that has been used in light, medium, and heavy-duty vehicles for several decades.[24] Propane powers approximately 60,000 on-road vehicles in the United States and more than 14 million worldwide.[25] In addition to newly manufactured vehicles, converting conventional vehicles is a viable option for incorporating propane into MHD vehicle fleets, which may lower cost and increase the speed of private MHDV fleet conversion. 20 These characteristics have led to a developed LPG market for school buses, shuttles buses, and light-duty trucks. While LPG has several advantages for fleets, including lower cost per gallon than diesel, reduced NOx and SOx emissions, and reliable performance, when considering GHG emissions, it has only a 6 percent reduction over diesel.[26]

Maryland has 20 primary and 7 secondary propane fueling stations. Most of these stations are operated by U-Haul and offer both commercial, recreational, and personal fueling services for both vehicle and non-vehicle purposes. While the stations are geographically dispersed throughout Maryland, there are no LPG fueling locations adjacent to the Port of Baltimore or in Cecil County. Additionally, existing sites are not all adjacent to the nationally significant I-95 freight corridor. The proposed study locations in Baltimore City and Cecil County would help to address gaps in community propane fueling sites and assist in determining the feasibility in expanding LPG fueling infrastructure for MHDV near the I-95 corridor.

Many MHDVs travel long distances, carry heavy loads, and their drivers may be subject to hours-of-service (HOS) and electronic logging devices (ELDs) requirements. MHDVs present unique electrification challenges due to their specialized service characteristics. In freight and heavy trucking operations,

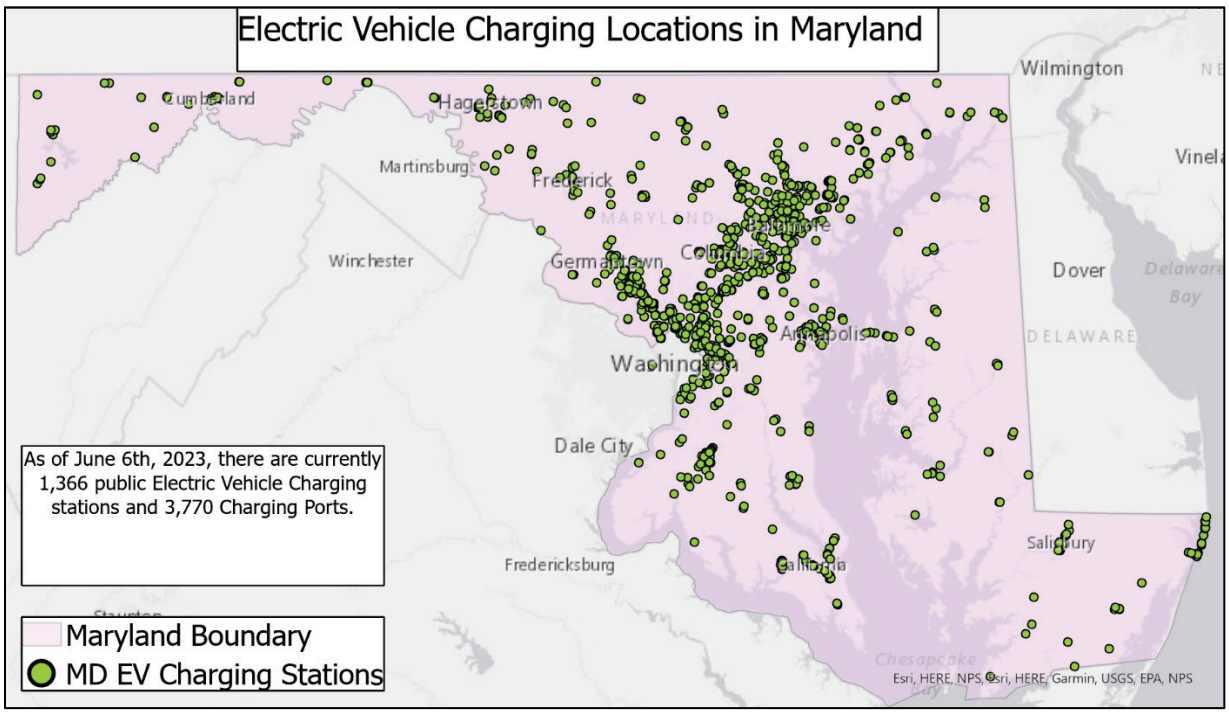
[23] *Ibid.*
[24] Federal Highway Administration. "Refueling America." *Public Roads*, Vol. 81, No.4. Winter 2018. https://highways.dot.gov/public-roads/winter-2018/refueling-america.
[25] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. *Propane Basics.* March 2010. https://energy.sc.gov/files/propane_basics.pdf.
[26] https://propane.com/wp-content/uploads/2019/06/20890-GTI-GHG-Emissions-Analysis-Final-Report.pdf.

energy density is extremely important given freight services carry goods and cargo over long distances.[27] Energy density is the amount of energy a battery contains compared to its weight or size. Benchmark, an independent Price Reporting Agency, estimated that a heavy-duty truck would require an electric battery size of between 800-1,000 kWh for 500 miles of range. In 2019, the battery weight to achieve this range would be approximately 5 tons. This could significantly impact the payload capacity for long-haul trucks. Heavy trucking and freight operations involving MHDVs will require several low and zero emission strategies to meet the state of Maryland's decarbonization goals, while ensuring the efficient movement of freight that supports economic growth and creates value for both public and private sector partners.

The ability to fast charge MHD vehicles may overcome potential range and energy density concerns for long-haul trips. If fast charging infrastructure can be deployed along the I-95 corridor, this will support the U.S. National Blueprint for Transportation Decarbonization's 2030-2040 strategy to ensure infrastructure needed to support clean technologies is in place. It also aligns with the July 2022 ZEV Task Force - Multi-State Medium and Heavy-Duty Zero-Emission Vehicle Action Plan (MHD ZEV Plan). Today, there are 1,366 electric vehicle charging locations in Maryland that provide 3,770 EVSE ports. Of those 3,770 EVSE ports, approximately 20 percent are direct current fast chargers (DCFC). There are currently no publicly accessible community sites for MHDV fast charging in Maryland. MHDV fast charging supports the long-haul or enroute corridor charging and requires significantly more power than what is required for DCFC. According to the Great Plains Institute, DCFCs range from 50kW to 350kW. A 600-kWh electric truck would require six hours to charge using a 100kW DCFC. The proposed study locations in Baltimore City and Cecil County would help to address gaps in community electric charging sites and assist in determining the feasibility in expanding electric charging infrastructure for MHDV near the I-95 corridor. The study will carefully consider the availability of fast-charging technology and market feasibility, electrical grid integration needs, and the potential of electrifying certain drayage truck operations near the Port of Baltimore.

[27] Gross, Samantha. "The Challenges of Decarbonizing Heavy Transport." *Brookings Institute: Foreign Policy.* October 2020. https://www.brookings.edu/wp-content/uploads/2020/09/FP_20201001_challenge_of_decarbonizing_heavy_transport.pdf.

Figure 7: Electric Vehicle Charging Locations in Maryland



Source: Maryland EV - https://marylandev.org/.

Today, there are no publicly accessible community sites for hydrogen fueling operations in Maryland. According to the Alternative Fuels Data Center (https://afdc.energy.gov/), there are only fifty-seven publicly available hydrogen fueling stations in the United States, fifty-six are in California and one is in Hawaii. However, interest by Maryland-based manufacturers and freight companies is growing rapidly in hydrogen's potential to decarbonize MHDV operations and fleets.

Major original equipment manufacturers (OEMs) and freight-related employers in Maryland have signaled their interest in utilizing hydrogen, particularly hydrogen sourced from green sources, in their vehicle operations and fleets. Since 1961, the Volvo Group has maintained a major presence in Hagerstown, MD and, today, operates a 1.5 million sq. ft. powertrain manufacturing facility that employs over 1,700 individuals. The facility develops and produces heavy-duty engines transmissions and axles for Volvo Trucks, Buses, and other MHDVs. Earlier this year, Volvo Trucks announced that their HFCTs had been successfully tested on public roads and in extreme cold conditions.[28] Volvo expects its HFCTs trucks to be commercially available as soon as 2025 and has expressed interest in utilizing hydrogen derived from green sources.[29]

[28] Volvo Trucks. *Volvo Trucks test hydrogen-powered electric trucks on public roads.* May 5, 2023. https://www.volvotrucks.com/en-en/news-stories/press-releases/2023/may/volvo-trucks-tests-hydrogen-powered-electric-trucks-on-public-roads.html.
[29] *Ibid.*

Amazon maintains major distribution and inventory facilities adjacent to the Port of Baltimore and throughout Maryland.[30] Their 1 million sq. ft. BWI2 Fulfillment Center employs approximately 3,000 associates and, through Amazon Business, they have partnered with the Baltimore City and John Hopkins University's purchasing programs to support Maryland-based small business and certified minority- and woman-owned businesses. Last year, Amazon announced an agreement with Plug Power to supply nearly 11,000 tons of green hydrogen per year for their transportation and building operations, starting in 2025. Amazon expects the green hydrogen will support as many as 30,000 forklifts and 800 heavy-duty trucks.[31]

IKEA and Maryland have long collaborated on green energy projects. Over the past decade, IKEA has expanded its solar power system in Perryville and the Maryland Energy Administration (MEA) provided funding to IKEA to install a solar canopy and accompanying electric vehicle charging stations in Baltimore.[32] IKEA also participated in a one-month pilot program of a BET to transport containers between the Port and its Perryville location.[33] Last year, IKEA committed to transition its MHDV fleet to zero-emission in the United States by 2040 and introduced hydrogen-powered trucks into its service network in Shanghai.[34]

Trucks using fuel cells and hydrogen are essentially electric vehicles that utilize on-board pressurized hydrogen and a fuel cell to generate power. Additionally, braking energy is recuperated and stored in a battery making them also hybrid vehicles. However, compared with battery-only vehicles, hydrogen provides a higher energy density source that is ideal for long-haul truck travel and freight operations.[35] Hydrogen refueling, while operationally complex, can take place in short timeframes, and may eventually nearly match traditional liquid fuel refueling times. This makes hydrogen MHDVs attractive for freight and long-haul operations as refueling times may not negatively impact HOS, cause operational delays, and negatively impact on-time performance and just-in-time deliveries. However, hydrogen fueling locations are extremely limited, as California is currently the only state with active, public hydrogen fueling sites.

Hydrogen fuel cell trucks (HFCTs) that utilize hydrogen produced or derived from green sources, through electrolysis or other methods, are true zero-emission vehicles that result in zero tailpipe emissions. Under Maryland's Business Regulation Article, §10–321.1, beginning on July 1, 2026, a person may not sell hydrogen as motor fuel in the State if the hydrogen was produced by natural gas reforming. The adaptation of HFCTs, focus on green hydrogen sources, and build out of reliable, accessible, and safe

[30] Mirabelle, Lorraine. "Amazon opens last-mile delivery center in Baltimore, seeks 5,000 workers in region." *The Baltimore Sun*. September 14, 2021. https://www.baltimoresun.com/business/bs-bz-amazon-baltimore-expansion-hiring-20210914-aa5fq6kqdzevbdjk7pr3wenmrq-story.html.
[31] Amazon. *Amazon adopts green hydrogen to help decarbonize operations. August 25, 2022.* https://www.aboutamazon.com/news/sustainability/amazon-adopts-green-hydrogen-to-help-decarbonize-its-operations.
[32] Department of Energy, Office of State and Community Energy Programs. *EERE Success Story: Maryland-IKEA Partnership Spurs Energy Savings and Electric Vehicle Infrastructure.* November 22, 2021. https://www.energy.gov/scep/articles/eere-success-story-maryland-ikea-partnership-spurs-energy-savings-and-electric.
[33] Maryland Department of Energy. *Maryland Green Registry Member Profiles: Maryland Port Administration*. Last Updated April 2023. https://mde.maryland.gov/marylandgreen/Documents/Maryland_Port_Administration_Profile.pdf.
[34] IKEA. "Climate Report FY22." https://gbl-sc9u2-prd-cdn.azureedge.net/-/media/aboutikea/newsroom/publications/documents/ikea-climate-report-fy22.pdf.
[35] International Energy Agency. *"The Future of Trucks: Implications for energy and the environment."* Second edition. 2017. https://iea.blob.core.windows.net/assets/a4710daf-9cd2-4bdc-b5cf-5141bf9020d1/TheFutureofTrucksImplicationsforEnergyandtheEnvironment.pdf.

alternative fueling infrastructure will be critical in meeting Maryland's Clean Trucks Act mandates and, statewide emissions reductions goals. HFCTs can dramatically improve air quality and reduce particulate matter emissions in communities adjacent to freight facilities that have historically borne a disproportionate public health and harmful economic impact from freight operations. The May 2022 DMV Hydrogen Greenprint document produced by Connected DMV, highlighted the role that hydrogen fueling can play for the District of Columbia, Maryland, and Virginia (the DMV). Within their modelling assumptions, they assumed a 14% adoption in HFCT heavy trucks, a 10% adoption in HFCT medium trucks, and an 18% adoption in HFCT urban buses in the DMV by the year 2030 based on concentration of providers, asset turnover rates, and green ambitions.[36]

This feasibility study will assist Maryland in building out community-sensitive alternative fueling and charging infrastructure that does not negatively impact long-haul truck and freight operating requirements and has the potential to dramatically improve air quality in freight and site-adjacent communities.

> *"[Hydrogen] fuel cell trucks are one of the few technology options capable of resulting in zero tailpipe emissions and deeply decarbonizing heavy-duty, long-haul road freight transport."* [37]

Based on the AFleet CFI Emissions Toolv1.1, if we assume low utilization of DCFC EVSE, Hydrogen and LPG stations and the inclusion of four of each station type at each location, we may see a reduction in approximately 504 short tons of GHGs annually (see Table 2).

Table 2: Emissions Reductions as Derived from Annual CFI Tool

AFV Fueling Infrastructure	GHGs (short tons)	CO (lb)	NOx (lb)	PM10 (lb)	PM2.5 (lb)	VOC (lb)	SOx (lb)	Fuel Dispensed (fuel unit)	Fuel Unit
Level 2 EVSE									kWh
DCFC EVSE	45.6	152.4	240.6	2.0	1.9	11.6	0.4	104,000	kWh
Hydrogen	469.6	3,252.8	5,134.4	43.2	39.8	246.7	24.0	112,000	kg
Propane	-11.3	-4,875.1	735.4	6.7	-1.1	-173.8	3.7	44,000	gal
CNG									GGE
LNG									gal
Fueling Infrastructure Total	**503.9**	**-1,469.8**	**6,110.5**	**51.9**	**40.6**	**171.4**	**28.2**		

Source: Annual CFI Tool

[36] https://www.hydrogengreenprint.org/greenprint-pdf.
[37] International Energy Administration – *The Future of Trucks: Implications for energy and the environment*. Page 103.

Under a moderate utilization scenario across both sites, GHG reduction potential more than doubles to approximately 1,015 short tons annually (see Table 3).

Table 3: Emissions Reductions as Derived from Annual CFI Tool

AFV Fueling Infrastructure	GHGs (short tons)	CO (lb)	NOx (lb)	PM10 (lb)	PM2.5 (lb)	VOC (lb)	SOx (lb)	Fuel Dispensed (fuel unit)	Fuel Unit
Level 2 EVSE									kWh
DCFC EVSE	98.2	324.4	518.3	4.4	4.0	24.9	0.9	224,000	kWh
Hydrogen	939.2	6,506.6	10,268.9	86.5	79.6	493.5	48.1	224,000	kg
Propane	-22.7	-9,750.10	1,470.9	13.3	-2.2	-173.8	7.5	88,000	gal
CNG									GGE
LNG									gal
Fueling Infrastructure Total	**1,014**	**-2916.2**	**12,258.0**	**104.2**	**81.5**	**344.6**	**56.5**		
Source: Annual CFI Tool									

A high utilization scenario could yield a reduction of nearly 2,016 short tons of GHG emissions annually (see Table 4).

Table 4: Emissions Reductions as Derived from Annual CFI Tool

AFV Fueling Infrastructure	GHGs (short tons)	CO (lb)	NOx (lb)	PM10 (lb)	PM2.5 (lb)	VOC (lb)	SOx (lb)	Fuel Dispensed (fuel unit)	Fuel Unit
Level 2 EVSE									kWh
DCFC EVSE	182.3	609.8	962.5	8.1	7.5	46.3	1.7	416,000	kWh
Hydrogen	1,878.5	13,011.2	20,537.7	172.9	159.2	986.9	96.2	448,000	kg
Propane	-45.3	-19,500.3	2,941.7	26.7	-4.4	-347.5	15.0	176,000	gal
CNG									GGE
LNG									gal
Fueling Infrastructure Total	**2,015.5**	**-5,879.3**	**24,442.0**	**207.7**	**162.3**	**685.6**	**112.8**		
Source: Annual CFI Tool									

Based on the AFleet tool estimate of well-to-wheel greenhouse gas emissions and vehicle operation air pollutant emissions at these two sites, assessing the feasibility of charging and alternative fueling options has the potential to significantly move the needle for on-road transportation sector emissions when scaled up to meet anticipated future industry demands.

2.3 Description of How Funds Will Be Spent

MDOT is seeking $760,000 of grant funding to perform the I-95 Corridor Alternative Fueling Readiness Assessment for MHDV Fleets in Maryland. Maryland's commitment to small, minority-owned businesses will ensure that wealth created from the transition to cleaner MHDVs contributes to generational-capacity and wealth building opportunities for all Marylanders. This feasibility study will align with MDOT's high standards for fairness, equity, and small and minority business participation.

The total budget estimate is based on direct labor needed, data acquisition, public engagement, various assessment needed for this project. Direct labor cost is the number of hours needed to work on the program, multiply that by an hourly rate for professional services. In addition, multiple datasets including traffic data, Origin-Destination data, and other data will be purchased to support the emission

reduction analysis and other assessments. In addition to the direct labor and data acquisition cost, other expenses such as polling, printing, postage, other consultants, and items such as travel and graphic design are also included in the budget. The study scope with proposed budget allocations is as follows:

SITE DEVELOPMENT STUDY

Project Planning and Development

1: Site Specific Development Scenarios - $300,000

A thorough evaluation of each individual site considering a variety of factors including: development constraints, emissions reduction analysis, land use due diligence, safety and emergency response, land acquisition and ROW, and capacity for long-term maintenance and operation. Performing these evaluations will require extensive multidisciplinary research combined with site visits and potential stakeholder interviews.

2: Community Engagement and Education Program - $150,000

MDOT proposes a robust community outreach and engagement plan to provide an understandable, transparent, and cohesive strategy for informing, consulting, and empowering site-adjacent communities.

The community outreach and engagement plan will use an integrated and multi-faceted engagement approach that includes both digital and traditional outreach and communications methods. Digital outreach will include a dedicated webpage that serves as a hub and entry point for engagement, virtual workshops, e-blasts and newsletters, and targeted social media, including the potential for targeted advertisements. Traditional outreach tactics will include in-person workshops, public meetings, public presentations to community associations, and, as funding permits, focus groups and advertising.

3: Readiness Assessment - $300,000

Site-specific, comprehensive analyses of market conditions, funding gaps, accessibility gaps, environmental justice, administrative and regulatory needs, and a preliminary environmental assessment. Performing these assessments will require considerable multidisciplinary research combined with site visits and potential stakeholder interviews.

4: Recommendations - $200,000

Informed by subtasks 1-3, this final subtask of the Project will require consolidating all the information from the study into recommendations and lessons learned. This concluding subtask will require document review and drafting. The findings will be made publicly available, likely in a manner and through mechanisms established in subtask 2.

Table 5: Project Budget

Subtasks	Federal	Non-Federal	Total
1. Site Specific Development Scenarios	$275,000	$25,000	$300,000
2. Community Engagement and Education Program	$38,000	$112,000	$150,000
3. Readiness Assessment	$262,000	$38,000	$300,000
4. Recommendations	$185,000	$15,000	$200,000
	$760,000	**$190,000**	**$950,000**

2.4 Additional Narrative Criteria: Fleet Vehicles that Serve and Operate in Communities

In March 2022, the Environmental Protection Agency proposed new, stronger standards to promote clean air and reduce pollution from MHDVs starting on model year 2027. Approximately 72 million individuals live near truck freight routes across the United States. Many of these individuals are more likely to be low-income and people of color and have borne a disproportionate impact resulting from direct exposure to truck emissions. The EPA estimates that its proposal would prevent up to 2,100 premature deaths and result in 3.1 million fewer cases of asthma symptoms and allergic rhinitis symptoms and 18,000 fewer cases of asthma onset in children.[38]

The communities adjacent to the TA Baltimore #216 site face similar public health and economic challenges and historical divisions to include infrastructure separation, industrial development, and access to educational and job opportunities. MDOT will closely coordinate and inclusively engage with these communities to invite their participation in the decarbonization of MDHVs, which may provide positive air quality and quality of life benefits to area residents. The communities directly adjacent to the TA Baltimore #216 site include O'Donnell Heights, Medford-Broening, Graceland Park, and Saint Helena are directly impacted by MDHV and freight-related emissions.

The entirety of Cecil County is a moderate 8-hour Ozone area. The EPA considers any area that does not meet the national primary or secondary ambient air quality standard to be a nonattainment area. Utilizing the 2015 standard, a Moderate area has a design value of 0.081, up to but not including 0.093ppm. Community alternative fueling and charging sites located in nonattainment areas, like the Chesapeake House, have the potential to positively impact air quality and reduce harmful particulate matter emissions that have been linked to worse public health outcomes in communities. The Chesapeake House is a key fueling, rest area, and connection point to the freight and logistics hub of Cecil County. Freight and industrial areas can have a significant impact on air quality. This study will help to spur the decarbonization of MHDVs in Maryland, positively impacting air quality and public health in industrial areas and adjacent communities and furthers Maryland's leadership in vehicular emission reduction efforts.

This year, the Maryland General Assembly passed HB 230, the Department of Environment – Zero Emission MHD Vehicles – Regulations, better known as the Clean Trucks Act of 2023. The bill establishes requirements for the sale of new zero-emission MHDVs in Maryland, adopts the California Air Resource Board's (CARB) Advanced Clean Trucks (ACT) regulations, requires development of a collaborative deployment and needs assessment plan across Maryland state agencies, and takes effect starting with model year 2027.[39] The Clean Trucks Act matches the 2027 model year standard set forth by the EPA and will help Maryland to realize many of the estimated public health objectives and outcomes.

In 2009, Maryland adopted the Greenhouse Gas Emissions Reduction Act (GGRA), which required the State to reduce greenhouse gas (GHG) emissions 25 percent from a 2006 baseline by 2020, in a way that

[38] Environmental Protection Agency. *EPA Proposes Stronger Standards for Heavy-Duty Vehicles to Promote Clean Air, Protect Communities, and Support Transition to Zero-emission Future.* March 7, 2022. https://www.epa.gov/newsreleases/epa-proposes-stronger-standards-heavy-duty-vehicles-promote-clean-air-protect.
[39] Maryland General Assembly - Department of Legislative Services. HB 0230: Fiscal Policy Note. 2023. https://mgaleg.maryland.gov/2023RS/fnotes/bil_0000/hb0230.pdf.

ensures a positive impact on Maryland's economy, protects existing manufacturing jobs and creates new jobs in the State. This legislation was amended in 2016, incorporating additional reporting and mid-course reaffirmation goals as well as setting a new benchmark requiring a 40 percent reduction of emissions from 2006 levels by 2030 ("40 by 30"). The 2020 GGRA Plan presents MDOT's approach to meet the requirements of the GGRA.[40] In 2022, Maryland adopted one of the nation's most aggressive GHG reduction targets with the passage of the Climate Solutions Now Act (CSNA). This landmark legislation increased the goal for GHG reductions to meet a 60 percent reduction in emissions by 2031. MDOT continues to work in coordination with MDE, other agencies, and partners to develop and implement strategies that achieve emission reductions within the transportation sector to support Maryland's economy-wide "60 by 31" goal, including advancing electrification and alternative fuel deployment.

Maryland is a national leader in reducing vehicular-related emissions, the second largest transportation sector source of greenhouse gas (GHG) emissions.[41] MHDVs are responsible for an outsized portion of harmful particulate matter emissions, especially in communities adjacent to freight facilities and fueling sites. While MHDVs make up about a 10% share of on-road vehicles nationally, they are responsible for 45% of on-road NOx emissions and 57% of direct $PM_{2.5}$ emissions.[42] MHDV operations can negatively impact air quality, public health, and outcomes in communities, particularly disadvantaged communities located near freight corridors and freight facilities.

In addition to environmental, air quality, and public health impacts, fleet vehicles that operate in and serve communities may negatively impact the roadway safety of all community users. The National Highway Traffic Safety Administration's (NHTSA) data routinely reports 5,000+ truck fatalities a year. Additionally, 150,000 individuals are injured annually. While heavy-duty vehicles represent just over 4% of the U.S. vehicle fleet, they are involved in 7% of pedestrian fatalities and 11% of cyclist fatalities. Due to their size, MHDVs have larger blind zones and blind spots, making it difficult for both drivers and community members to safely navigate streets and roads with MHDVs.

In 2021, the Maryland Port Administration renewed its voluntary commitment as a partner with the Maryland Department of Environment, the Maryland Energy Administration and MDOT working together to reduce diesel and greenhouse gas emissions and increase energy efficiency at the State-owned public marine terminals. Building on, and expanding, the highly successful five-year old collaboration among the agencies, the agreement continued the Port Air Quality Working Group, which meets regularly to foster interagency cooperation in identifying projects and programs to improve air quality around the Port and in surrounding communities.

As a committed Vision Zero state, MDOT will closely examine MHDVs community safety impacts and ensure that the future deployment of alternative fueling or electric charging infrastructure does not negatively impact the roadway safety of all users at community sites.

[40] Maryland Department of Transportation. *MDOT Greenhouse Gas Reduction Act Plan, 2022*. Updated in 2022. https://www.mdot.maryland.gov/tso/pages/Index.aspx?PageId=88.
[41] Environmental Protection Agency. *Fast Facts on Transportation Greenhouse Gas Emissions.* Updated May 11, 2023. https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions
[42] Fleming, Kelly. MHD Ground Electrification: Status Report.

PROJECT ELIGIBILITIES

Charging and Fueling Infrastructure grants are authorized in 23 USC 151.

The MDOT is an eligible entity to receive a grant as it is a political subdivision of a state (23 USC 151 3(a)). MDTA also meets the eligibility criteria for community grants as a state or local authority with ownership of publicly accessible transportation facilities.

The Secretary of the United States Department of Transportation may provide community grants for a project that is expected to expand or fill gaps in access to publicly accessible hydrogen fueling and propane fueling infrastructure to include development phase activities, including planning, feasibility analysis, revenue forecasting, environmental review, preliminary engineering and design work and other activities. MDOT's I-95 Corridor Alternative Fueling Readiness Assessment for MHDV Fleets qualifies as a project development phase activity to fill gaps in access to publicly accessible alternative fueling infrastructure.