# The Push for Zero-Emissions: Lessons Learned from California Ports' Decarbonization Projects as Ports Eye Leveraging Green Technology into a Commercial Advantage

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## Executive Summary

Whether nudged by regulation or hoping to expand market share, many United States ports are adopting or considering decarbonization goals. For example, the California San Pedro Bay Ports Clean Air Action Plan targets reducing greenhouse gases from port-related sources to 40% below 1990 levels by 2030, and 80% below 1990 levels by 2050. On the East Coast, The Port of Virginia ("POV") has committed to be carbon neutral by 2040.

Reducing carbon emissions in marine terminal operations is challenging. Zero-emissions cargo handling equipment remains in its infancy and substantially more expensive than its fossil-fuel powered equivalent. Whether powered by electricity or alternative fuels, such as hydrogen, the new technology requires costly infrastructure upgrades that can quickly eat up capital budgets and valuable revenue generating terminal space. Selecting new equipment to help a port reach its goals requires detailed planning. Permitting and local collaboration, labor relations, space constraints, and the integration of new technology into existing terminal procedures must be carefully assessed. Ports further along on their journeys, such as the Ports of Los Angeles and Long Beach, undoubtedly have valuable "lessons learned" to share.

When assessing the capital spend, ports may ask: "Is there a commercial case for port investments in decarbonization?" The answer seems to be a resounding, "[i]t depends."

Perhaps obviously, achieving a positive return on zero-emissions turns in large part on the starting point of the port and the amount of investment required. Every port has different existing infrastructure and customers. The familiar adage is true, "if you have seen one port, you have seen one port." What may be minor upgrades for one port may be a complete reworking of the terminal operation for another.

For some, removing emissions from marine terminal operations is an achievable goal, and with shippers and carriers asking their suppliers to match their corporate environmental objectives, ports can use decarbonization efforts to differentiate themselves from their competitors. But for others, the capital cost of zero-emissions technology remains too great to justify the transition absent a regulatory requirement or remarkable change in customer demand.

## Introduction

During a keynote presentation at the Annual Meeting of the American Association of Port Authorities in Norfolk, Virginia in October, 2019, Ludovic Renou, then President of CMA CGM America LLC, provided a few jolting statistics: In 2017, 15% of the CMA Group's business, an estimated 2.9 million Twenty-foot Equivalent Units (TEUs), was covered by specific sustainability requirements; by 2025 the amount would swell beyond 40%. Shippers with environmentally conscious values are increasingly looking for vendors who share them, and that often equates to supply chain partners who are utilizing green technologies and reducing their greenhouse gas emissions.

Public port authorities are often in the position of stretching capital budgets by investing in equipment and infrastructure that deliver the greatest return. While environmental sustainability is often a consideration, projects that increase cargo flow and have the greatest economic impact on our constituencies receive priority. But as Mr. Renou's comments highlight, commercial and environmental considerations do not have to be mutually exclusive. Indeed, with changing

cultures and corporate priorities among their customers, ports can leverage their sustainable investments into a commercial advantage over their competitors.


Recognizing these simultaneous environmental and commercial benefits, POV has committed to be carbon neutral by 2040. POV believes that committing to sustainability is not only the right thing to do for the environment, but also aligns it with the world's leading retailers, manufacturers, suppliers, and multinational corporations. POV continues to make significant capital investments in electrifying its operations while obtaining its power from clean sources, replacing aging equipment with "greener" machines, and, generally, making greater use of technology. This is in contrast to some other large East Coast ports, which have publicly shown little interest transitioning from traditional carbon emitting equipment.

The road to carbon neutrality for a port authority is not easy. While large pieces of cargo handling equipment such as ship to shore cranes and automated stacking cranes are readily available in cleaner, electric format, mobile terminal equipment such as hustlers (yard trucks), forklifts, and pickup trucks powered by clean fuel sources are still in development and testing. Such new technology can negatively impact productivity if it is not ready to handle the demands of the working waterfront.


Existing in different regulatory environments, West Coast ports, including the Port of Los Angeles ("POLA") and the Port of Long Beach ("POLB"), are further along in their journeys to eliminate or reduce greenhouse gas emissions. In addition to clean truck operator and clean ship incentive programs, providing vessel shore power, and utilizing electric lifting equipment, several West Coast facilities are testing, or already utilizing, next generation electric and hydrogen fuel source mobile equipment in terminal operations. Because of their head

start, West Coast ports have valuable insights and "lessons learned" that will benefit other ports enhancing or embarking on sustainability projects and leveraging those projects into a commercial advantage with customers seeking green supply chain partners.

In this report, I summarize the current status of California's effort to combat greenhouse gas emissions at the Ports of Long Beach and Los Angeles as observed during my residency in October of 2022. Specifically, I will highlight the zero-emission demonstration projects I observed and lessons learned from meetings and interviews with each Port's environmental staff and other community stakeholders. I will then highlight opportunities and challenges associated with making a commercial case for green port infrastructure and equipment investment as observed through the experience of two very different California marine terminal operators. Finally, I will discuss how my residency experience has application at POV as it embarks on its decarbonizing goals.

# Background: Combating Greenhouse Gas Emissions at POLA and POLB

In the early 2000s, the Ports of Long Beach and Los Angeles had a problem. The air quality in Southern California was poor and there was growing awareness that the expanding port complex was affecting it. There was significant community mobilization to address air quality impacts from port operations, and as part of their respective city governments, the Ports were pressured to curb emissions.[1]

Rather than leave their air quality future solely to regulators, the Ports collaborated with the South Coast Air Quality Management District, the California Air Resources Board (CARB), and the United States Environmental Protection Agency (EPA) to develop and adopt the San Pedro Bay Ports Clean Air Action Plan (CAAP).[2] The CAAP was originally adopted in 2006 and subsequently updated in 2010 and 2017.

## San Pedro Bay Ports Clean Air Action Plan (CAAP)

At its passing, the CAAP was a landmark air quality plan establishing a comprehensive, far reaching strategy for reducing port-related air pollution and related health risks, while endeavoring to protect port development, job creation, and economic activity.[3] CAAP's anti-air pollution strategies are far reaching, including the Ports' Clean Trucks Programs, vessel pollution reduction programs, and the terminal Technology Advancement Program.[4]

### CAAP Technology Advancement Program

The CAAP Technology Advancement Program (TAP) provides funding, guidance, and POLA and POLB staff support to test promising clean air technologies in a real-world port environment. TAP describes its goal as getting successful technologies to the port market as quickly as possible. To achieve this, TAP collaborates with technology designers, regulatory agencies, and port

[1] *Case Study of the San Pedro Bay Ports' Clean Air Action Plan 2006-2018: Best Practices and Lessons Learned*, United States Environmental Protection Agency, March, 2021, https://www.epa.gov/sites/default/files/2021-03/documents/420r21011.pdf.
[2] *San Pedro Bay Ports Clean Air Action Plan – Overview*, Final 2016, https://kentico.portoflosangeles.org/getmedia/4a54591c-83f2-4b60-acee-8473d6e8dc14/CAAP_Overview_Final_2.
[3] *Clean Air Action Plan: About the Plan*, https://cleanairactionplan.org/about-the-plan/.
[4] *Id*.

industry partners to take port-related green technologies from testing to commercialization, and ultimately, widespread adoption.

TAP projects come together a variety of ways. POLA and POLB environmental staff report that, commonly, technology companies will come forward with a proposal, and the Ports will seek a terminal operator willing to support the project and test the equipment. Alternatively, private terminal operators develop ideas, often with a technology manufacturer in mind, and seek the funding and regulatory support of TAP. Finally, some projects originate within the Ports, building on previous projects or exploring the ideas of the port environmental staff. Interest from terminal operators in participating in a demonstration project commonly turns on whether the operator has (1) required matching funds (if any), (2) interest in working with a pre-identified Original Equipment Manufacturer ("OEM"), and (3) the necessary in-house staff resources to support the project.

TAP projects are commonly funded by the CARB, which utilizes funds from California's emission 'cap and trade' system and other sources. The use of CARB funds for TAP projects allows participation by foreign equipment and technology manufacturers, which can be excluded by the "Buy American" or "Buy America" requirements applicable in federal grants.

The COVID-19 pandemic had a significant impact on TAP projects. Supply chain disruption delayed delivery of equipment and replacement parts. Travel restrictions often prevented international technicians and project partners from attending demonstration sites and providing technical expertise. Finally, record cargo volumes during the pandemic put never-before-seen demand on test equipment or discouraged terminal operators from utilizing demonstration equipment altogether.

I attended the October 19, 2022 meeting of the TAP Advisory Committee and received an update on all CAAP Technology Projects currently underway or recently completed at POLA and POLB. I was also able to visit several demonstration projects and discuss the successes and challenges with terminal operator staff. In the following discussion, I'll highlight the TAP projects I reviewed pertaining to the implementation of zero-emission terminal equipment--the focus of my residency.

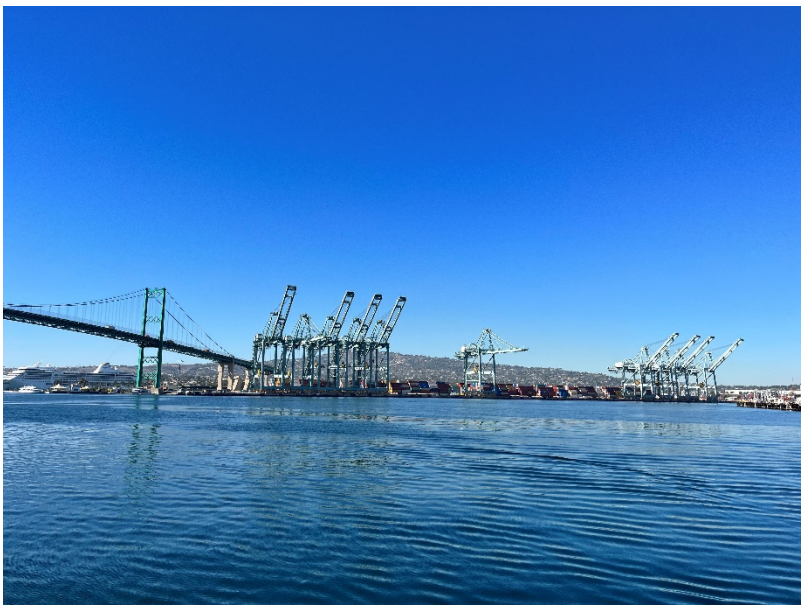
## Zero-Emission Technology Demonstration Projects at POLA

At the time of my residency, the Port of Los Angeles had a variety of zero-emission TAP projects in progress. POLA remains "fuel agnostic," but the majority of its current demonstration projects involve electric equipment. In the future, POLA environmental staff predict a mix of technologies will be used--each terminal operator utilizing a technology that works within its unique operation.

There have been successful hydrogen projects at the POLA, however, the equipment fuel cells were often too small to perform a complete terminal labor shift. POLA staff believe hydrogen projects will become more plentiful (and successful) once a reliable hydrogen distribution infrastructure is developed. POLA staff reported that electric equipment manufacturers are farther along with more established infrastructure than manufacturers using hydrogen as a fuel source. This may very well change with the $8 Billion committed from the United States Department of Energy to support the establishment of hydrogen distribution infrastructure in the Bipartisan Infrastructure Law passed in November, 2021.

CARB has indicated it will soon review the terminal handling equipment regulations. POLA environmental staff believe this fear of regulation may increase its terminal operators interest in participating in demonstration projects. The CAAP is aspirational for ports and optional for terminal operators—state regulations would not be.

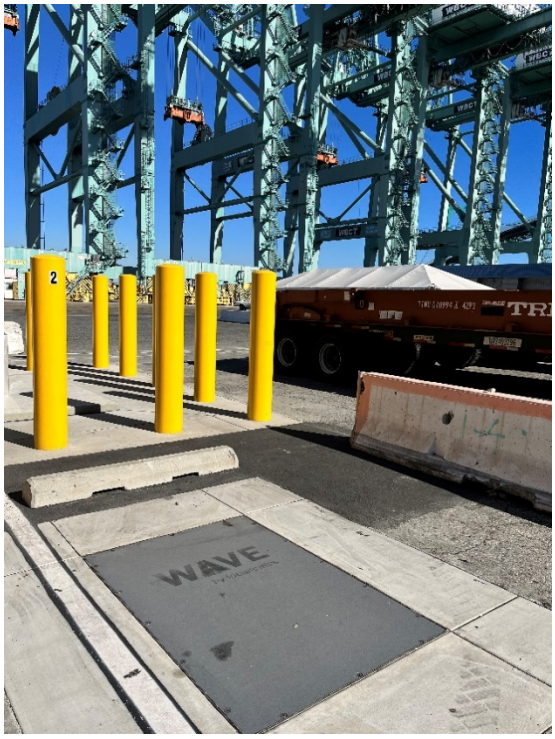
## Zero-Emission Freight Vehicle Advanced Infrastructure Demonstration ("AID") Project



One zero-emission TAP project in progress during my residence was POLA's Advanced Infrastructure Demonstration ("AID") Project at West Basin Container Terminal (WBCT). The AID Project expanded on existing zero-emission cargo handling equipment projects to demonstrate ten (10) BYD Motors second generation battery-electric yard tractors with an advanced, wireless inductive charging system. Twelve (12) charging stations are being installed—ten (10) stations where terminal staff currently park yard tractors when they are off-duty, and two (2) opportunity charging stations at a central longshoremen break facility. The project also demonstrates a battery storage system to receive and store energy from the electrical grid during off-peak hours at a lower cost. The energy can later be used to charge electric cargo handling equipment during peak charging times to save money and reduce strain on the electrical grid.

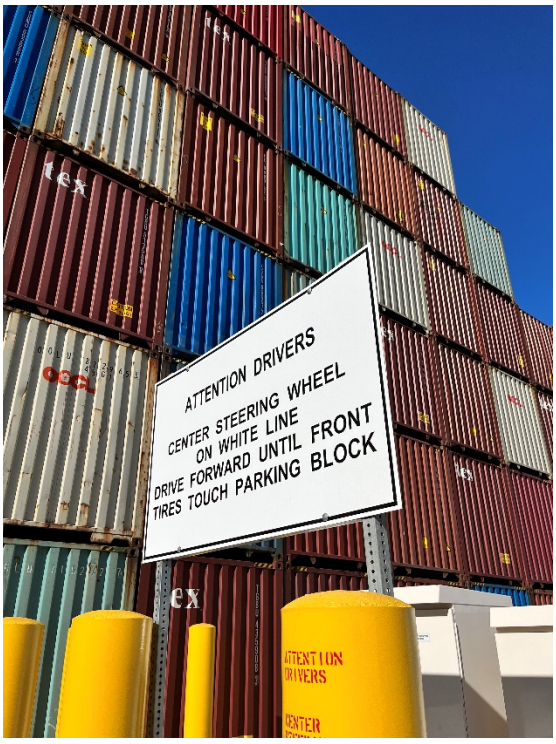
I attended the AID Project on October 25, 2022, with POLA staff and was provided a tour by Ports America's (WBCT's terminal operator) Engineering and Maintenance staff.

The AID Project design endeavors to solve three issues identified in prior demonstration projects: safety/efficiency, opportunity charging, and energy consumption. First, the wireless, inductive charging system is thought safer insofar as it does not require equipment operators or maintenance technicians to plug and unplug the yard tractors at the start and conclusion of the charging cycle or handle and work around power cords. Instead, the equipment operator simply parks the tractor overtop of the charging pad and the tractor begins to charge automatically. Inductive charging may also reduce labor costs associated with the plug and unplug function.




Second, by including opportunity charging stations in areas where equipment operators park equipment during meal breaks, the AID Project hopes to demonstrate that battery powered electric equipment can meet the demands of a full shift if given short recharges during the day.

Finally, the battery storage system targets the issues of energy costs and grid reliability by "trickle charging" the battery system during off-peak hours when energy costs less, and using that energy to charge yard tractors during peak energy periods when cost and demand are high.




The AID Project remained under construction during my visit, however, the terminal operator had already identified a few challenges. First, before delivery the manufacturer of the inductive charging pad and tractor OEM indicated that the tractor could charge with as little as 40 percent alignment between the tractor's charging plate and the charging pad. At the opportunity charging station, which was complete, the terminal staff determined proper charging required closer to 80 or 90 percent alignment. This required terminal staff to be precise with pavement striping and curb stops to ensure easy alignment for the equipment operator.

A second significant concern was the space required for the charging infrastructure. Space on a marine terminal is precious, and the substations required to support the inductive charging pads essentially occupied an entire lane previously dedicated to tractor parking. If scaled to WBCT's entire yard tractor operation (dozens of tractors), revenue generating cargo handling space will be lost.

Finally, costs remain high. WBCT Engineering and Maintenance Staff expressed concern that scaling the demonstration project to the terminal's full yard tractor fleet, including the required charging infrastructure, may be prohibitively expensive at equipment and construction current costs.

## Lessons Learned/Unexpected Challenges of Deploying Zero-Emission Technology at POLA and POLB

Being the first to embark on a decarbonization journey in the marine terminal industry, POLA and POLB learned many valuable lessons the hard way. In several cases, seemingly small decisions made during demonstration projects had a significant impact on the project outcome and the potential future implementation. Below are some of the most insightful lessons I learned during my residency.

### Permitting and Emergency Response Collaboration

Regardless of the jurisdiction, federal, state, and local permitting can be an arduous and tedious process. POLA and POLB found this especially true when attempting to obtain permits for the new technology utilized in TAP projects.

Zero-emission terminal handling equipment is in its infancy, and POLA and POLB found that the technology demonstrated in its TAP projects did not always comply with established safety standards and codes, complicating the permitting process. Often times, project technology involved retrofitting existing diesel or traditional fuel equipment for zero-emission power. In some instances, the retrofit or modification of an original equipment manufacturer's design was so significant that regulators required safety certifications by third-party engineers before equipment could be put into service. While obtaining the required permits, regulatory exemptions, or safety certifications was often possible, the process was time consuming and labor intensive.

POLA and POLB found that starting the permitting process early, and working collaboratively with the applicable regulatory agencies, helped smooth technology deployment.

Similar collaboration was required with the local first responders. For the earliest TAP projects, local fire departments and first responders were not familiar with the zero-emissions fuel sources in use in the port. In one particular instance, a piece of battery-powered, zero-emissions terminal handling equipment caught fire while in demonstration, and the responding fire department had no alternative to fight the fire other than to allow it to burn out. During interviews with local television news, first responders highlighted the challenges and dangers associated with vehicle battery fires, which challenged public perceptions of the safety of battery-powered equipment or overall credibility of the project.

POLA and POLB found that engaging with local first responders regarding new technology in use on terminal in advance of an incident was not only well appreciated by officials, but also ensured proper emergency response and reduced the potential for negative public relations impact.

### Labor Relations

With limited exception, terminal handling equipment requires skilled operators. Though performing similar functions to traditional models, zero-emissions equipment is operated and maintained differently and typically provides a unique (and improved) operator experience. POLA and POLB found that fully assessing the labor implications of new technology, thoughtfully

messaging new technology projects to the workforce, and labor engagement early and often were essential to the efficiency and overall success of zero-emission technology projects.

Green technology remains significantly more expensive than traditional equipment, driven in large part by the novelty of the involved technology. When assessing the cost of implementing a particular type of equipment and engaging in project design, the future labor cost of operating or maintaining that equipment should be considered. The efficiency and overall financial viability of the project can turn on the labor cost associated with a particular piece of equipment. In POLA and POLB, this lesson was most often highlighted when selecting the charging method for battery-powered equipment utilized in TAP projects.

For example, when electric yard tractors were first tested at POLA and POLB, a corded plug-in charging method was utilized. Historically on the West Coast waterfront, different labor union locals represented the longshoremen who operated and fueled terminal handling equipment. Plugging in a piece of battery-powered equipment at the end of the operator's shift was considered a refueling or "gear man" function rather than an operator function. In practice, this required a terminal operator utilizing battery-powered equipment to incur the labor cost of both an operator and a gear man, even though the gear man's work was limited to plugging in the equipment at the end of a shift.

In subsequent projects, POLA and POLB terminal operators tested charging methods for battery operated equipment that did not require a physical plug-in. For example, at WBCT, wireless inductive charging technology was utilized that automatically charged electric yard tractors when the operator parked the equipment on the designated inductive-charging pad. Not only was this method safer as it eliminated the need for handling high voltage charging cables, but it also reduced labor costs.

Other terminals, including Long Beach Container Terminal, tested an automatic robotic charging arm that, like the inductive charging pad, automatically commenced charging when the operator parked the yard tractor at the end of the shift or during a meal period. These advanced charging technologies added complexity and cost to the initial design and build of the zero-emissions project, but they also provided terminal operators with enhanced safety, efficiency, and reduced labor cost over the life of the equipment.

Another important aspect of labor relations related to deploying green technology is thoughtful and precise messaging. POLA and POLB found that in some instances, longshore labor equated "green" technology and initiatives with "automation." Of course, longshore labor unions are

sensitive to terminal automation projects that have the potential to eliminate longshore jobs. In order to minimize the potential for project opposition, POLA and POLB found it important to careful and clearly distinguish zero-emissions terminal projects, which in many cases simply substitute equipment used to perform a function rather than eliminate an operator, from terminal automation.

Finally, but relatedly, terminal operators in POLA and POLB found it helpful to engage with labor early and often during TAP projects to reduce skepticism of zero-emission technology. There can be natural skepticism to using new equipment, especially for green technologies that can carry the perception of being less reliable or capable than traditional diesel powered equipment. Because terminal labor is concerned about productivity, they may be reluctant to test or utilize new technology. Terminal labor may also have concerns related to the safety of new, unknown technology, especially following mishaps or accidents involving the equipment.

To combat this skepticism and reluctance, POLA and POLB found it helpful to include labor in the discussion, demonstration, and testing of new equipment. Emphasizing the environmental benefits, as well as the enhanced operator experience, were two themes that POLA and POLB found persuasive. Longshoremen and their families live near the port, so the transition to zero-emissions technology directly affects the air quality of their communities. Likewise, POLA and POLB found that labor positively noted how quietly zero-emissions equipment operated and reported feeling "cleaner" at the end of a shift than they did following a day of operating diesel-powered equipment.

## Real Estate/Terminal Space Constraints

A port's most valuable asset is its real estate. For many ports in the United States, every inch of on-terminal space is engaged for the movement of cargo.

Another important lesson learned during TAP projects at POLA and POLB was how challenging it can be to locate adequate space for the charging or refueling infrastructure required for zero-emissions terminal handling equipment. For example, Long Beach Container Terminal (LBCT), the most advance terminal at POLB, currently uses a variety of electric, zero-emissions equipment. However, when assessing the deployment of an electric yard tractor fleet, LBCT found it challenging to locate adequate space for the vehicle charging infrastructure. LBCT utilizes dozens of yard tractors each day. At the conclusion of the shift, these tractors are parked densely in tight rows. LBCT found that the electrical charging infrastructure for the yard tractors, either inductive charging or a robotic charging arm, would require reallocating space from other

terminal uses. West Basin Container Terminal (WBCT) encountered the same problem. WBCT is currently demonstrating electric yard tractors along with wireless inductive charging. Like LBCT, WBCT densely parks its existing fleet of more than 60 yard tractors each night. WBCT engineering staff found that the wireless charging infrastructure (and associated transformers) occupied as much as three times the terminal space as a traditional fleet.

The lesson learned from POLA and POLB was the need to fully assess the space requirements of a particular technology, along with the particular space constraints of the terminal, before pursuing a particular type of zero-emissions equipment. The required charging or fueling infrastructure may not be an issue for a terminal with surplus space, but could be a non-starter for a terminal fully occupied.

## Operation Specific Collaboration with Original Equipment Manufacturer

Another significant lesson learned by POLA and POLB during TAP projects was the need for detailed, operation specific collaboration with Original Equipment Manufacturers ("OEM") during technology selection, design, and testing. Terminal operators routinely provide OEMs with uptime and lifting capacity requirements for their operation. But POLA and POLB found that OEMs often design and build equipment for lab-like settings, without full cognizance of the actual demands of the working waterfront. For example, during one demonstration project at POLA, the terminal operation required yard tractors to routinely engage in a "jack-knife" parking maneuver to position containers on the terminal. When performing this maneuver, the chassis would strike the tractor's battery case, damaging the batteries. In another instance, an electric yard tractor caught fire after rain entered the tractor's battery compartment. Of course, terminal handling equipment operates outdoors in inclement weather, and any new technology must be able to perform in the elements.

POLA and POLB found that it was important to look beyond the zero-emission portion of proposed equipment. Many problems resulted from the terminal operator and OEM not fully collaborating on components of the equipment, such as fifth wheel operations and unique maneuverability requirements.

## "Proprietary" Charging Systems

One final lesson involved the use of proprietary charging systems on electric equipment. POLA and POLB found that, like Apple with its iPhones, iPads, and laptops, some OEMs would insist on specialized or unique plugs for its electric equipment. These proprietary plugs had the potential to become obsolete as technology evolved, or could even limit the usefulness of charging infrastructure if not all equipment utilized the same plug. Because charging infrastructure is such

a large portion of a zero-emissions project, POLA and POLB learned to resist proprietary charging systems unless there is high confidence that the charging system will adequately cover the life of the project and the desired portion of the electric vehicle fleet.

## The Commercial Case for Green Infrastructure and Equipment Investment: Two Perspectives

In addition to exploring the history and current state of POLA and POLB's carbon neutral journey and TAP demonstration projects, I connected with three terminal operators, and California regulatory counsel that represents them, to obtain their perspective. Specifically, I wanted to better understand the operational impacts of transitioning to zero-emissions terminal handling equipment, and whether the terminal operators believed that, in addition to the environmental justifications, a business case could be made in support of the transition to green equipment.

Generally, I found the terminal operators resistant to the CAAP 2030 emissions goals. Some operators noted that though there have been successful TAP projects, the technology simply is not suitable for all types of terminal operations. While electric technology has been tested and is starting to become commercially available, it is not clear whether the California power grid can support the dramatic increase in power demand. Moreover, each terminal operator has a slightly different operation, and the charging cycles required for electric equipment does not yet meet the needs for all operators.

For many terminal operators, the cost of transitioning from fossil fuel powered terminal handling equipment to zero-emissions equipment can be hundreds of millions of dollars. At such a price tag, few believe that absent compelling regulations, there is an economic case to justify the transition. To the contrary, some operators worry that complying with the CAAP goals will increase cost, which much be passed on to terminal customers, jeopardizing discretionary cargo.

On the other hand, some newer or more modern terminals already utilize significant amounts of electric equipment. For them, the final push to carbon neutral is much more attainable. In sum, whether a business case exists to support a green equipment transition turns heavily on the terminal's starting point.

### Fenix Marine Terminal Example

One of the largest container terminals in POLA, Fenix Marine Terminal operates its 292 acre container yard with 27 rubber tire gantry cranes ("RTGs"), 51 top loaders, and 210 yard tractors. The vast majority of this equipment is powered by traditional fossil fuels.

Fenix, which was acquired by French ocean carrier CMA CGM in January 2022, is committed to innovation and deploying the most environmentally efficient technologies commercially available. It is currently participating in a TAP project demonstrating a repowered, hydrogen fuel cell powered top loader. In the past, Fenix has tested a hydrogen-electric hybrid top loader and hydrogen-powered yard tractor. With respect to its container stacks, Fenix also continues to transition its diesel RTGs to diesel-electric hybrid models.

For Fenix to reach full carbon neutrality, the capital investment would be substantial. In addition to replacing hundreds of yard tractors and top loaders, Fenix would have to rework its entire stack yard of diesel-electric RTGs. If transitioning to electric RTGs, for instance, the installation of significant electrical infrastructure would be required.

Members of the CMA Group and CMA's OCEAN Alliance partners are Fenix's primary customers. Even if Fenix was in competition for the business of additional carriers, it is unlikely that customer demand for greener terminal operations could justify the upfront capital investment.

## Long Beach Container Terminal Example

Long Beach Container Terminal ("LBCT") is one of the world's most technologically advanced terminals. Spanning over 300 acres, the terminal utilizes almost exclusively electric and zero-emissions equipment to move a staggering 3.3 million TEUs annually. The only diesel terminal handling equipment in use are yard tractors that service the terminal's rail ramp. LBCT was recently modernized with the current phase completed in 2021.


LBCT is committed to meeting the CAAP's 2030 emissions goals. Because of the almost $2.5 billion that has already been invested in the facility, LBCT believes zero-emissions can be obtained for an estimated cost of $200 million, inclusive of equipment, infrastructure, on-site power generation, community programs, education and workforce training, and technical support.

LBCT is owned by Macquarie Asset Management, which shares LBCT's zero-emissions ambitions. LBCT also boasts that its 2030 carbon neutral goal beats that of major cargo owners like Amazon, Walmart, Target, and Unilever, which are shooting for 2040. Unlike a terminal operator requiring greater capital investment, LBCT believes a business case exists justifying the (relatively) small additional capital investment to reach zero-emissions.

Between the Fenix and LBCT examples, The Port of Virginia is more like LBCT. Because of recent infrastructure investments focused on transitioning from diesel powered stack yard and rail yard equipment to semi-automated electric equipment, POV is much closer to a carbon neutral future than its East Coast competitors. East Coast customers with discretionary cargo are looking for green supply chain partners. Therefore, POV is uniquely positioned to leverage investments in zero-emission technology as a competitive advantage.

## Application of POLA and POLB Experience in The Port of Virginia

The lessons learned by POLA and POLB during their TAP projects, and the experience I had during my residency, can have valuable application for the Port of Virginia (POV) as it embarks on its decarbonization goals. Perhaps the main theme of these lessons is the need for enhanced internal collaboration on zero-emissions technology deployment. Accordingly, and as a takeaway from my residency, I intend to advocate for a cross-divisional working group, including the departments discussed below, to help ensure the successful deployment of the decarbonization strategy in the Port.

POV just started its analysis of potential technology to help it reach its carbon-neutral goal. Four zero-emissions yard tractors and electric forklifts are currently being tested in production. Until now, the decarbonization project has been managed primarily by the Asset Management, Maintenance, and Environmental teams, without defined collaboration or a cross-functional working group with other POV colleagues. Drawing on the lessons learned by POLA and POLB, it seems as though many hiccups may be avoided by expanding the team working on the deployment of new technology.

For instance, POV has tremendous relationships with its local first responders, driven primarily by the POV Marine Incident Response Team (MIRT). In addition to coordinating the response to local marine incidents, the MIRT hosts an annual marine firefighting school to support first responders in training to fight fires on board vessels in the port. It seems as though this would be a natural opportunity to spread awareness of zero-emissions terminal handling equipment that local first responders may encounter when responding to an on-terminal incident.

Labor relations is another group that should be included in the decarbonization team. From ensuring the proper framing, messaging, and communication to the longshore workforce, to helping assess the labor implications of alternative fuel sources, the labor relations team can help ensure success of new technology with the men and women that will operate and maintain the equipment.

Part of the reason POV committed to its decarbonization goal is the demand from port customers and the ability to use clean operations as a competitive advantage over POV's East Coast competitors. The POV Commercial team should, therefore, be included in the decarbonization project to be sure new technology has the greatest impact when marketed to customers.

Zero-emissions equipment and associated infrastructure is expensive, and POV will undoubtedly rely on state and federal grant funding to support the transition to net-zero. Grant programs have complicated technical requirements that must be followed during the application for and administration of grants. Involving the POV Grants team early may help maximize funding opportunities for the project.

Finally, the POV Operations team should play a critical role in technology selection and deployment. It is the Operations team that will utilize zero-emissions technology and must confirm it can meet the demands of the terminal. As learned by POLA and POLB during several of their TAP projects, some of the most significant issues encountered involved equipment manufacturers failing to understand the day-to-day requirements of the working waterfront.

## Conclusion

Like many industries, many United States ports are adopting or considering decarbonization goals. However, reducing carbon emissions in marine terminal operations is challenging. Zero-emissions cargo handling equipment remains in its infancy and substantially more expensive than its fossil-fuel powered equivalent. Whether powered by electricity or alternative fuels such as hydrogen, the new technology often requires costly infrastructure upgrades that can quickly eat up capital budgets and valuable revenue generating terminal space.

During my residency, I learned that selecting new equipment to help a port reach its goals requires detailed planning. Permitting and local collaboration, labor relations, space constraints, and the integration of new technology into existing terminal procedures must be carefully assessed. Ports further along on their journeys, such as the Ports of Los Angeles and Long Beach, undoubtedly have valuable “lessons learned” to share.

When assessing the capital spend, ports may ask: “Is there a commercial case for port investments in decarbonization?” The answer seems to be a resounding, “it depends.”

Perhaps obviously, achieving a positive return on zero-emissions turns in large part on the starting point of the port and the amount of investment required. Every port has different existing infrastructure and customers.

For some, removing emissions from marine terminal operations is an achievable goal, and with shippers and carriers asking their suppliers to match their corporate environmental objectives, ports can use decarbonization efforts to differentiate themselves from their competitors. But for others, the capital cost of zero-emissions technology remains too great to justify the transition absent a regulatory requirement or remarkable change in customer demand.

I believe The Port of Virginia falls into the latter category. Because of recent infrastructure investment focused on transitioning to electric equipment, it is uniquely positioned to remove carbon emissions from the remainder of its operation for less capital investment than its East Coast competitors. Because its customers are looking for green supply chain partners, POV will be able to leverage these investments into a competitive advantage over its competition

## Acknowledgements

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## Author Biography

B. Jason Barlow serves as Vice President of Contracts and Risk Management for the Virginia Port Authority, where he leads VPA's Contracts, Real Estate, Compliance, Risk Management and Insurance teams, all of which service the three entities operating under The Port of Virginia brand (Virginia Port Authority, Virginia International Terminals, LLC, and HRCP II, LLC).

Specifically, Mr. Barlow leads the Contracts team in the negotiating, drafting, and interpreting of contracts for all Port of Virginia entities. He oversees the Real Estate team, which manages the access, licensing, and leasing of the Virginia Port Authority's real estate holdings. Mr. Barlow leads the Compliance team in the management of an internal compliance function, including the a comprehensive compliance audit and non-conformance investigation process. He manages the Insurance team, which facilitates the placement and policy management of liability, property, workers' compensation, and specialty insurance for all Port of Virginia entities. Finally, Mr. Barlow leads the Risk Management team, which investigates, adjusts, and resolves claims against all Port of Virginia entities, and manages a comprehensive Enterprise Risk Management program.

Prior to joining the VPA, Mr. Barlow practiced law with Troutman Sanders LLP (now Troutman Pepper Hamilton Sanders LLP). His practice focused on the transportation industry with an emphasis on maritime and admiralty law matters. Mr. Barlow routinely litigated in federal and state courts on behalf of ship-owners, towing and barge companies, dredging companies, terminal operators, cargo owners, shippers, and marine underwriters in marine casualty disputes, including maritime personal injury and death, vessel collisions/allisions, cargo damage, maritime salvage and marine pollution. He also advised clients through regulatory challenges, such as Coast Guard boarding and detentions, Oily-Water Separator ("Magic Pipe") violations, mariner licensure and credentialing, and commercial fishing regulations and fishery management.

Mr. Barlow represented clients in commercial maritime transactions, including maritime contracts, charter parties, towage agreements, marine insurance, vessel documentation and finance, and foreign-flag vessel registration. He specialized in unique Admiralty law procedures, including Federal Limitation of Liability Actions and ship arrest and attachment under the Supplemental Rules of Civil Procedure for Admiralty and Maritime Claims.

Mr. Barlow, a Virginia native, earned his a Juris Doctor with Maritime Law Certificate from Tulane Law School in New Orleans, Louisiana and a Bachelor of Arts from Randolph-Macon

College in Ashland, Virginia. He is a member of the Virginia State Bar and a Proctor in Admiralty of the Maritime Law Association of the United States.