



SAN PEDRO BAY PORTS
CLEAN AIR ACTION PLAN 2017

Economic and Workforce Considerations
for the Clean Air Action Plan Update

JULY 2017

Economic and Workforce Considerations for the Clean Air Action Plan 2017 Update

July 2017



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I. INTRODUCTION

The Port of Long Beach and Port of Los Angeles, known collectively as the San Pedro Bay Ports (SPBP), have introduced the draft final Clean Air Action Plan 2017 Update (CAAP 2017), which will serve as high-level policy guidance for continued emission reduction activities in collaboration with industry stakeholders, local communities, environmental groups, and regulatory agencies for the next 20 years.

CAAP 2017 calls for aggressive new strategies to transition port-related equipment to cleaner technologies, in some cases, near-zero emissions and zero-emissions; to significantly reduce emissions from ships at berth and while transiting; to invest in emerging technology development; and to explore opportunities to enhance efficiency.

The costs to achieve many of these strategies are expected to be significant, in the range of \$6 billion to \$13 billion depending on exact implementation and technologies, according to “Preliminary Cost Estimates for Select 2017 Clean Air Action Plan Strategies” (June 2017). These costs come at a time when the shipping industry is experiencing massive consolidation and disruptions in traditional goods movement delivery, and as such, these strategies may have economic effects on the San Pedro Bay Ports and our private industry partners. Understanding these effects is critical for our decision-makers and stakeholders.

The purpose of this document is to raise considerations for the implementation of CAAP 2017, particularly as they relate to financial impacts on the industry, potential effects on the SPBP’s market share relative to other United States ports, and implications for the local and regional workforce. Additionally, this document considers the public health benefits of implementing CAAP 2017.

Of note, the CAAP is a high-level planning document and does not contain details on implementation, timing, or dollar amounts for proposed incentives or rate-based disincentives. Without these details, it is difficult to construct a robust economic analysis with any certainty. As such, this document assesses economic effects only at a high level. As specific CAAP strategies are implemented over the coming years, the Ports will conduct more thorough economic analyses. To that end, this document does not:

- Contain a detailed economic impacts analysis of individual CAAP 2017 strategies,
- Evaluate appropriate pricing levels for incentives or rates,
- Conduct a cost-benefit analysis of CAAP 2017; in other words, this assessment does not purport to determine the net effect of the CAAP 2017 strategies on the industry or public health.

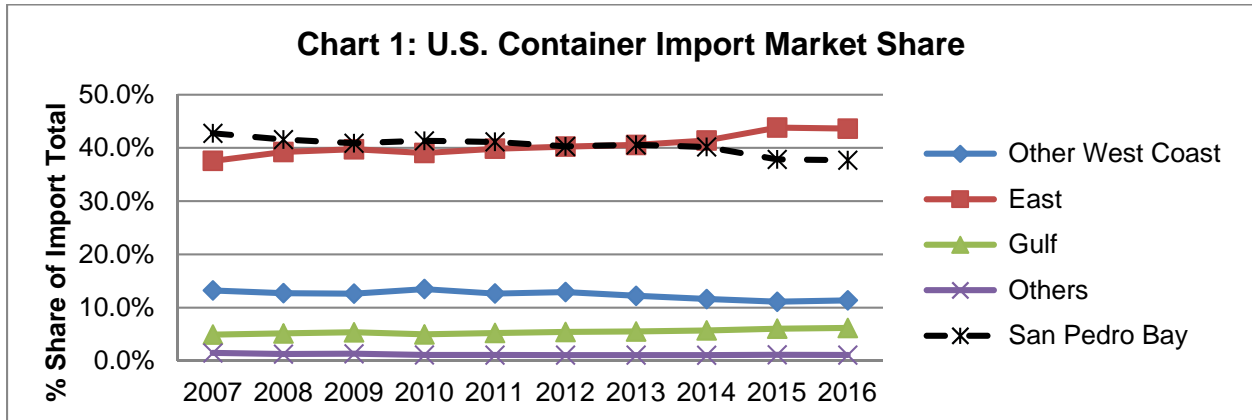
This document presents high-level economic considerations for decision-makers and stakeholders in evaluating the adoption and implementation of CAAP 2017.

II. BACKGROUND

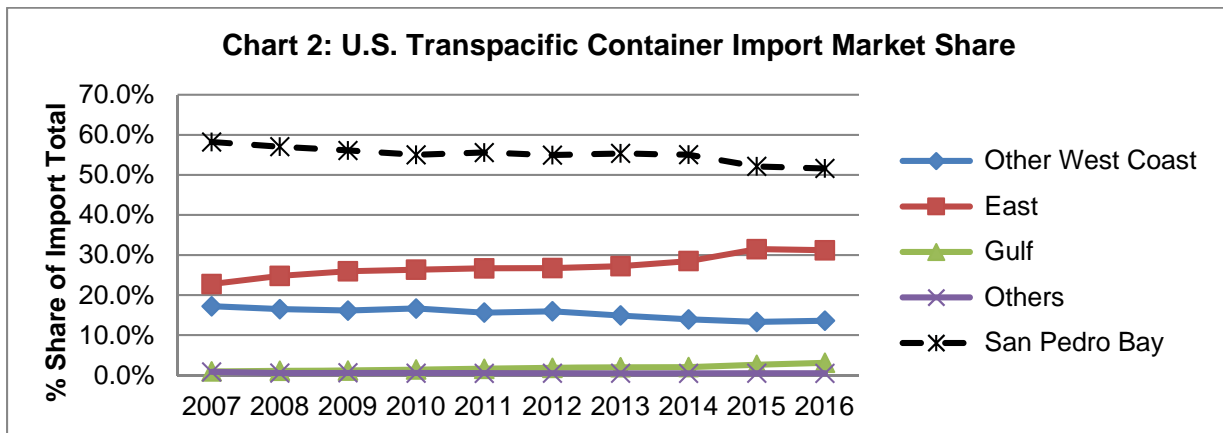
This section presents information on historical SPBP market share, the drivers of that market share, and how changes in those drivers – including those related to new environmental requirements or programs – have affected our market share in the past.

San Pedro Bay Ports Market Position

Together, the San Pedro Bay Ports are the nation’s leading container port complex, collectively handling 37% of the nation’s containerized waterborne imported cargo (Chart 1). Prior to the congestion at West Coast container ports in late 2014/early 2015, the SPB ports’ share of the nation’s container imports held steady at over 40%.



Over 90% of the San Pedro Bay ports’ trade is with Asia. This U.S.-Asia trade is also referred to as the transpacific trade, and the San Pedro Bay ports are the leading U.S. transpacific trade ports, handling 52% of the nation’s containerized trade with Asia in 2016 (Chart 2).



The San Pedro Bay ports have enjoyed significant market share for three major reasons:

- **Access to a large local market.** The SPB Ports serve a very large local market, consisting primarily of Southern California but with a hinterland extending throughout much of the western U.S. In this mega-region of 22 million people and the surrounding hinterlands area, there are no comparably priced alternatives to the San Pedro Bay ports for moving waterborne goods to and from Asia.
- **Outstanding connectivity to non-local markets.** In addition to the large local market, the San Pedro Bay ports connect Asia to the more populous eastern U.S. through rail service provided by two competing Class 1 railroads, the UP and the BNSF. There are multiple high-capacity trains

each day taking cargo from the San Pedro Bay ports to major freight hubs like Chicago and Memphis. Compared to sending cargo through the Panama Canal to an East Coast port and then inland, routing cargo from Asia through the San Pedro Bay ports can get cargo on store shelves 10-14 days faster. For time-sensitive cargo and high-value cargo, where lost time could mean lost sales or a higher inventory carrying cost, the San Pedro Bay ports have a competitive advantage over slower routings.

- **Proximity to a robust logistics and goods movement industry cluster.** The Ports are in close proximity to 1.8 billion square feet of warehouses and distribution centers, which means that a beneficial cargo owner can operate much of its national supply chain out of Southern California, making more efficient cargo routing and inventory stocking decisions.

Importantly, the cost to move goods through the San Pedro Bay Ports – which may be higher than in other gateways – is one of many factors that impact the routing decisions of cargo owners. The economic benefits generated by the flexibility of operation out of Southern California are self-evident, and often cargo owners choose to operate here even when there could be cost savings generated through less expensive cargo routing.

The result of these three factors has meant that as the U.S. has increased its trade with Asia, the San Pedro Bay ports have seen their cargo volumes continue to grow. In the years following China’s growth as a major exporter, the San Pedro Bay ports saw double-digit annual growth in their container volumes, and their share of all waterborne imported U.S. containers rose to a peak of over 43% in 2007.

San Pedro Bay Market Share Drivers

As shown in Chart 1 and Chart 2, the San Pedro Bay Ports’ market share has fallen since its 2007 peak. There are a number of factors that have been driving that change, specifically:

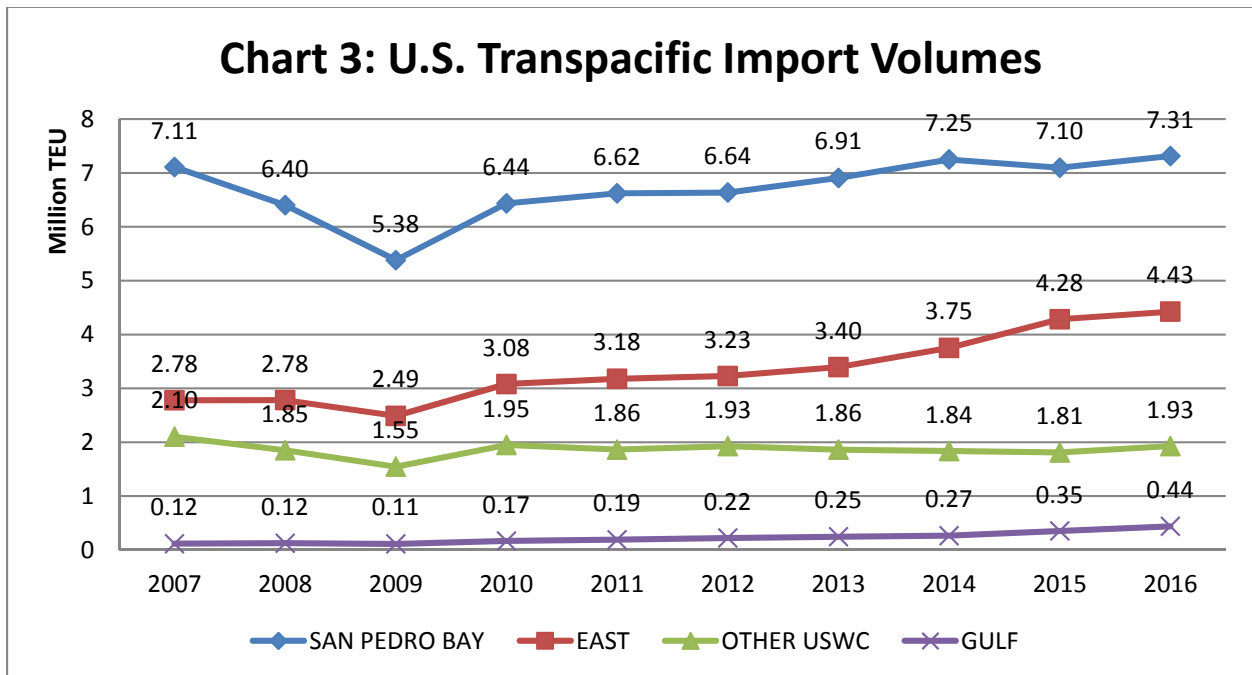
- congestion in 2002,
- the Great Recession,
- the emergence of other port gateways, and
- congestion in 2014-2015.

Congestion in 2002

In 2002, the Ports experienced the West Coast labor lockout during that year’s ILWU/PMA contract negotiations. West Coast ports were shut down for 10 days during the peak season, and the ensuing backlog of goods at the ports took many more weeks to fully clear, disrupting supply chains nationwide. This experience led the leading U.S. retailers to shift from having a single import distribution center (DC) in Southern California to what has been termed a “four corners” strategy, with at least four import DCs spread out across the West and East coasts. A four corners strategy, in addition to lowering a firm’s vulnerability to disruption, also lowers a firm’s transportation costs compared to using a single import DC. While firms with limited scale still generally have only a single import DC supplied through the San Pedro Bay ports, the shift to a four corners strategy by very large scale retailers like Wal-Mart and Home Depot has been the primary driver behind the gradual decline of the San Pedro Bay ports’ market share.

The Great Recession

The Great Recession started with the bursting of a bubble in the housing market, which particularly impacted Southern California. The San Pedro Bay ports experienced a greater drop in import cargo volume because the recession had a large impact on the Ports' local market of Southern California, and a large impact on demand for high-value and time-sensitive goods from Asia that predominantly flow through the San Pedro Bay ports. While Chart 2 shows that the San Pedro Bay's share of transpacific imports fell from 58.2% in 2007 to 56.1% in 2009, Chart 3 shows that this was primarily due to the San Pedro Bay ports experiencing a greater drop of volumes during this period, not due to competing gateways taking volumes away from the San Pedro Bay (Chart 3).



Emergence of Other Gateways

Transpacific market shares have also been impacted by the introduction of Prince Rupert in Canada as a competing destination for transpacific cargo bound for the U.S. Midwest via rail. A modern container terminal expansion project for Prince Rupert was completed in September 2007. Prince Rupert is competitive with Southern California because it lies about one sailing day closer to Asia and because imports through a Canadian port are not subject to the same Harbor Maintenance Tax (HMT) that is collected on cargo at U.S. ports. However, Prince Rupert is still relatively small, handling just 437,000 TEU of import cargo in 2016 (equal to the volume through all U.S. Gulf Coast ports). About 60% of this volume is destined for the U.S. rather than Canadian markets; even if 100% were U.S.-bound, it would represent just 3% of the U.S. transpacific imports. Prince Rupert has primarily drawn its volumes from the U.S. Pacific Northwest ports of Seattle and Tacoma, themselves beneficiaries of the four corners strategy.

East and Gulf Coast ports have also seen some small benefit from the widened Panama Canal lowering transportation costs on all-water service when compared to shipping to the West Coast; however,

diversion has been limited because low-value and time-insensitive goods that would most benefit from a reduction in transportation costs are *already* using all-water routings to East and Gulf Coast gateways. It is not clear if further cost reduction from Panama Canal expansion is significant enough to attract high-value or time-sensitive cargo that prefers speed to market.

Congestion in 2014-2015

The last major notable impact on market share is the result of the 2014-2015 congestion at West Coast container terminals experienced during the most recent ILWU/PMA contract negotiations. Congestion worsened through late summer and fall 2014; by early 2015, vessels were being forced to wait at anchorage. Cargo owners reacted to this slowdown by shifting significant volumes away from the West Coast to East and Gulf Coast ports. As a result, the SPB share of U.S. transpacific imports fell significantly, down from 55.1% in 2014 to 52.1% in 2015; this is also why the SPB share of all U.S. imported waterborne containers fell below 40% (37.9%) for the first time that year. While the Port of Los Angeles was able to recover some of this lost market share in 2016, the Port of Long Beach lost additional market share in 2016 due to the bankruptcy of the Hanjin shipping line, leaving the combined SPB market share almost unchanged at 37.7% in 2016.

Impact of Environmental Requirements on SPB Market Share

As stated previously, SPB's market share has been driven primarily by the size of the Southern California consumer market, the robust surface transportation network and the quick time to market. These drivers have historically outweighed the cost of moving goods through these two Ports, which tends to be higher than in other gateways.

Part of this increased cost may be due to environmental requirements unique to California. California has some of the world's most stringent environmental regulations for freight movement, among them:

- Requirements for trucks and yard equipment to use low-sulfur fuel
- Requirements for ships to plug into shore power while at berth
- Requirements to upgrade terminal equipment, harbor craft, and trucks to newer, cleaner models

Additionally, the Ports adopted the original CAAP in 2006 with an update in 2010. The CAAP has largely accelerated state regulations, compelling our industry partners to make earlier investments than would otherwise be required. The CAAP also has used financial incentives to change industry behavior, such as programs for vessel speed reduction and cleaner ships. Financial incentives are not a cost to the industry. In some cases, however, the CAAP has placed requirements on the industry beyond state regulation, for example, by requiring more aggressive transitions to cleaner cargo-handling equipment or the use of shore power through terminal leases.

Undoubtedly, these environmental efforts have raised the cost of moving goods through San Pedro Bay. State regulations have necessitated replacement of equipment prior to the end of its useful life and the use of more expensive equipment, and the CAAP may have increased costs on a case-by-case basis for operators subject to green leases. Since 2006, the Ports estimate that as a result of state regulations and accelerated CAAP timelines, the industry and Ports have spent nearly \$2 billion for cleaner trucks, cleaner

cargo-handling equipment, shore power infrastructure and shipside shore power retrofits. In addition, around the same time, the PIERPASS program introduced a traffic mitigation fee on truck moves to the terminals during peak daytime hours, with the fees being used to subsidize operations during off-peak hours.

These added costs, however, have not appeared to be a primary driver in changes to the SPBP's market share. Given the option of diverting cargo away from the SPB or complying with the CAAP measures, it appears that the industry chose compliance. As shown in Chart 2, the San Pedro Bay market share of U.S. imports from Asia through the post-recession period of 2010-2014 stayed steady at about 55% each year despite the costs of CAAP and state regulatory compliance.

Cost, it seems, has historically been less important to cargo owners than all of the other factors that make San Pedro Bay a preferred gateway. The estimated cost of the proposed CAAP 2017 strategies, however, is significantly higher than the previous efforts; additional study of the costs and their impact on the market segments they impact is necessary to assess the market implications of program implementation.

III. FINANCIAL CONSIDERATIONS FOR INDUSTRY

The CAAP 2017 proposes strategies to transition to cleaner equipment using a mix of incentives, higher rates for older equipment, and requirements. Like the previous versions of the CAAP, the Ports are also proposing to support – and advance where possible – state regulations.

Key CAAP 2017 strategies for consideration of this document include:

- Transition to near-zero and zero-emissions trucks with interim milestones and a final milestone of 2035
- Transition to up to 100% zero-emissions terminal equipment by 2030 in support of the impending State regulation
- Requirements for up to 100% reductions in at-berth ship emissions by 2030 in support of the impending State regulation
- Differentiated rates for older ships to begin no earlier than 2025
- Incentives for cleaner ships, vessel speed reduction, and cleaner harbor craft
- Efficiency strategies to enhance cargo flow while reducing emissions

The Ports have estimated the potential costs associated with implementing select CAAP 2017 strategies related to cleaner equipment. Given the uncertainty of implementation and technologies, the Ports have presented the costs associated with implementing these strategies in ranges. The costs are outlined below in Table 1. For a full description of these costs and assumptions, please consult the source document.¹

¹ "Preliminary Cost Estimates for Select 2017 Clean Air Action Plan Strategies." June 2017. EnSafe, Inc. www.cleanairactionplan.org

Table 1: Potential Incremental Costs of Select CAAP 2017 Strategies

	Low-End	High-End
Zero-emissions terminal equipment	\$914,000,000	\$2,100,000,000
Infrastructure to support terminal equipment	\$2,200,000,000	\$2,200,000,000
Cleaner trucks	\$2,900,000,000	\$8,300,000,000
At-berth emission reduction control systems	\$144,000,000	\$144,000,000
TOTAL	\$6,158,000,000	\$12,744,000,000

The Ports estimate that transitioning to cleaner equipment in support of the CAAP 2017 strategies and impending state regulations, could result in costs of \$6.1 billion to \$12.7 billion for the Ports and its industry partners. Additionally, CAAP 2017 calls for higher rates on older ships. These costs are not reflected in these estimates because the rate has not yet been established and is not expected to take effect until 2025 at the earliest. Still, such rates must be considered.

These costs represent a significant expense for the Ports and the industry. No one entity or organization appears able to fund or finance that expenditure. If the transition is implemented evenly over 15 years (2020-2035), the annual costs would average nearly \$850 million; however, as described below, it seems more likely that some years may see higher costs than others.

As stated previously, the prior CAAP strategies resulted in costs of nearly \$2 billion, primarily over 8 years between 2006 and 2014, or an annual average of \$250 million. Actual annual expenses varied based upon the timelines for implementation milestones.

Thus, in total, CAAP 2017 implementation may be 3 to 5 times more expensive for the industry than previous efforts, and even with the longer timeframe, the average annual costs are significantly higher than the first iteration. The costs will be borne primarily by 5 sectors: the Ports themselves, shipping lines, terminal operators, and the trucking industry, and the beneficial cargo owners. The section below describes some of the possible financial impacts.

San Pedro Bay Ports

The CAAP proposes to support the State’s effort to transition to up to 100% zero-emissions terminal equipment by 2030. Terminal operators cannot buy zero-emissions equipment in mass quantities without a way to charge or fuel this equipment; thus, in order to transition to zero-emissions terminal equipment, the supportive infrastructure must be installed first. For the Ports, installing this infrastructure represents the largest expense and poses serious budgetary challenges.

In order to give terminal operators ample time to purchase the necessary equipment and put it in use by 2030, the Ports have assumed a 5-year window for the installation of electrical infrastructure in the San Pedro Port complex from roughly 2018 to 2022. This timeframe results in annual costs to the Ports of about \$400 million. These costs are eventually passed onto the terminal operators through the leases, amortized over a period of many years; however, historically the Ports have shouldered the upfront costs of terminal improvements.

Combined, in the current year, the two Ports have budgeted \$750 million for their entire capital improvement program, which includes approved terminal redevelopments, transportation network improvements, and environmental and security upgrades. Thus, the expected annual expenditures on electric infrastructure represent more than half of San Pedro Bay's entire capital improvement budget. At this time, these expenditures are not reflected in the Ports' capital program projections. Without the identification of significant outside funding opportunities, the addition of this work to the Ports' near-term capital plans would present a significant strain on Port finances.

Shipping Lines

The CAAP 2017 Update calls for increased at-berth emission reductions and a higher rate on older ships (i.e., those with Tier 0 or Tier 1 engines as defined by the International Maritime Organization). The CAAP also calls for incentive programs to encourage the deployment of cleaner ships to San Pedro Bay. Voluntary incentive programs are expected to have only a financial benefit for shipping lines that choose to participate.

To reduce at-berth emissions, shipping lines may need to invest in new equipment or technologies, or they may need to pay for third-party control systems that charge hourly or fixed rates based on a service contract. Either of these options are expected to result in higher costs for shipping lines.

As for the higher rate on older ships, because the amount of the rate will be determined at a later date after a more exhaustive economic study, it is premature to speculate on the financial impact of this strategy, which would begin no earlier than 2025. The strategy may encourage some shipping lines to replace their older vessels with newer ones to avoid the higher rate, which could have minimal financial impact if there is an appropriately sized vessel available that meets the cleaner standards.

Both of these strategies, however, are expected to disproportionately impact certain segments of the shipping industry, in particular, non-container vessel operators. Many container lines already made investments in ship-side retrofits and have reduced at-berth emissions through the use of shore power, which is not the case for non-container ships, which would be facing potentially costly upgrades for the first time. Additionally, while most container ships calling SPB have at minimum Tier 1 engines, the non-container ships primarily have older engines.

Although a higher rate in 2025 for Tier 0 vessels would affect less than 1 percent of the calls, nearly all of these calls are made by tankers and cruise ships.² If the Ports impose a higher rate on Tier 1 vessels shortly after, this rate would affect more than one-third of vessel calls, particularly auto carriers, smaller container ships, cruise vessels, and tankers. Most larger container ships (i.e., greater than 10,000 TEU capacity) are expected to be Tier 2 by that time.

The impact on non-container vessel operators is expected to be more significant than in prior CAAP efforts and heavily dependent on the cargoes handled and the efforts of terminal operators to prepare for these strategies. Previous efforts targeted the vessels most likely to make multiple calls at the San Pedro Bay Ports, primarily through retrofitting container vessels. Extending these strategies to all vessels calling the

² Draft Final Clean Air Action Plan 2017 Update, www.cleanairactionplan.org

two ports will potentially impose more significant financial impacts on non-container operations. Again, the specific costs and implementation details require further study for a more complete view of the financial impacts.

Terminal Operators

The Ports have estimated that terminal operators may spend between \$914 million and \$2 billion to convert their cargo-handling equipment to zero emissions above what they would spend on diesel equivalents. The container terminals will absorb the brunt of this cost as they represent roughly 95% of that total.

The Ports expect these purchases will take place between 2022 and 2030, once the charging or fueling infrastructure is in place, which gives the terminal operators 8 years to make these expenditures, or an average of \$188 million a year. If, however, the infrastructure is not available by 2022, and the 2030 replacement deadline remains, the operators have fewer years over which to spread their costs. For example, if a terminal does not have the necessary infrastructure until 2027, the operator will have just 3 years to turn over an entire fleet with very expensive replacements. Additionally, in the meantime, the operator may need to purchase diesel equipment. If this diesel equipment needs to be replaced before the end of its useful life, the operator also incurs the cost associated with this lost value. These situations could impose a significant financial burden.

The financial picture worsens if and when the operators begin to pay for the charging and fueling infrastructure through their leases. If the Ports are unable to absorb the full cost of electrical infrastructure improvements, some of that cost may need to be recovered through lease terms, pushing some additional cost of the transition to the terminal operators. The ability of individual terminal operators to absorb that cost is unclear and the timing of that change would depend on the terms of individual agreements.

On the other hand, zero-emissions equipment is expected to have lower maintenance and operations costs, which support the possibility of a positive return on investment (ROI). With electric or fuel-cell equipment, there are fewer parts to replace and fewer consumables, such as diesel fuel. Although highly dependent on the price of energy, an electric piece of equipment is likely to generate substantial savings from the elimination of fuel. A recent study found that one electric rubber-tire gantry crane can save \$131,000 a year in maintenance and operating costs.³ With 177 RTGs in the port complex, this savings amounts to more than \$23 million annually.

The challenge, however, is whether terminal operators can manage the near-term costs to replace their fleets with zero-emissions equipment in order to realize the long-term ROI.

Trucking Industry

The proposed Clean Trucks Program strategy also calls for a rate on all trucks with exemptions for near-zero emissions and zero-emissions trucks. The rate has not yet been established; following adoption of the CAAP 2017 Update, the Ports plan to undertake a comprehensive pricing study to determine the

³ Moffat & Nichol, "Technical Memorandum – Sustainable Freight Strategy Impact Study." December 4, 2015.

optimal rate. Depending on the amount, it may make financial sense for a trucking company to pay the rate rather than replace the truck with a cleaner option. Over time, that calculation may change.

If it makes more sense to upgrade to a cleaner truck, the regional trucking industry is expected to face significant costs with the transition to near-zero emissions and ultimately zero-emissions trucks, anywhere from \$3 billion to \$8 billion. The impact of these costs on the regional trucking market is dependent on who bears the costs, including the terms of any potential financing and the availability of grants or other funding sources that mitigate the cost to truck owners. Although the previous Clean Trucks Program was ultimately successful in transitioning the port drayage operators to cleaner trucks, further study of how to implement a transition to zero/near-zero emissions equipment is needed.

Beneficial Cargo Owners (BCOs)

The incremental additional costs of CAAP implementation will be shared through the supply chain, with participants absorbing some portion of the cost and passing on additional cost to the customer. Ultimately, this is likely to result in higher costs for BCOs (i.e., retailers and cargo owners) moving cargo through the gateway. For many lines of business, these cost increases will cause BCOs to evaluate other gateways and consider if they should route their cargo through lower cost alternatives. It is very difficult to say, however, how much cargo would truly be at risk. The following section discusses the possible impacts of the routing choices made by cargo owners.

IV. MARKET SHARE EFFECTS

Undoubtedly, the CAAP strategies will result in significant costs to the shipping industry and, although it cannot be quantified at this time, these efforts will raise the cost of moving goods through this complex. The Ports assessed whether higher costs could result in diversion of cargo to other ports without the same environmental initiatives, thus reducing the SPB complex's market share. The answer is highly dependent on the type of cargo.

San Pedro Bay's container throughput is nearly three times higher than any other port area in North America, largely as a result of high volumes of non-local cargo. If the SPB Ports only served the local Southern California market, the port complex would be expected to handle only 8% of the total North American container volumes. In 2014, however, the SPB Ports handled just over 31% of North America's port's container throughput.

Cargo destined for the local market here in Southern California is known as "non-discretionary cargo." Cargo that arrives in San Pedro Bay and then leaves by truck or rail to other parts of the country is known as "discretionary cargo." The CAAP strategies and associated financial impacts are expected to have the greatest impact on discretionary cargo, which can more easily be diverted to other ports.

More specifically, the Ports evaluated the following cargo types for susceptibility to diversion:⁴

⁴ Mercator International, LLC and Oxford Economics. "San Pedro Bay Long-Term Unconstrained Cargo Forecast," July 2016.

- **International Local Cargo:** Cargo that arrives in the Ports for the local Southern California market
- **Trans-Loaded Movements by Rail:** Cargo that arrives in the Ports, is handled locally by truck, is sorted into domestic containers, and is then routed and delivered to inland destinations by rail
- **Inland Point Intermodal (IPI):** Cargo that arrives in the Ports and then leaves the region by rail for other North American destinations

The following section describes how the CAAP strategies could affect these different cargo segments.

International Local Cargo

This segment, comprising about one-third of the cargo volumes, is seen to have very little susceptibility to diversion, because the cargo is intended to be used in the local market. Routing to alternate port gateways could require significant additional cost associated with moving cargo back to the Ports' local market. The extra costs of using alternate gateways would be expected to outweigh the added cost of CAAP implementation. Also the concentration of population around these ports makes it an essential call for ocean carriers.

Trans-Loaded Movements by Rail

Cargoes transloaded to domestic containers and delivered to remote inland destinations by rail comprise roughly one-third of the cargo volumes. These cargoes are viewed as less divertible to other ports because of the unique benefits offered by San Pedro Bay:

- *Lower ocean shipping costs:* The cost to move goods by ship is cheaper to the West Coast than the East Coast. Based on the Shanghai Freight Exchange, spot rates as of June 2015 were \$1,455 per container to West Coast ports versus \$3,115 per container to East Coast ports.
- *Shorter transit times:* Transit times from Asia to SPB Ports are 11 to 14 days faster than to East and Gulf ports – this quick time to market is relevant for high-value goods.
- *Access to greater number of services:* SPB Ports currently receive first-inbound calls from 28 transpacific vessel strings, versus 17 for New York/New Jersey, 20 for Savannah, and 2 for Houston.
- *Market access:* Using SPB Ports as a gateway for trans-loading allows importers the option to supply their operations in the Southern California local area, or across a number of larger markets in the Midwest, Southeast, and Gulf Coast.

Inland Point Intermodal

Import movements that leave SPB Ports by rail, comprising one-third of the cargo volumes, are seen to be highly divertible, as there are a number of port areas along the Pacific Coast that are well positioned to handle this volume, and the increased availability of services between Asia and East/Gulf ports makes all-water routing a viable alternative for certain inland destinations.

The cargo forecast used gateway cost as a factor for characterizing alternative competitive scenarios to be applied to the three macroeconomic forecast scenarios developed by Oxford Economics.⁵ One competitive scenario projected diversion impacts given a 15% to 20% increase in the route cost differential for the SPB gateway compared to alternative gateways serving various inland markets. When applied to cargos identified as more sensitive to route cost, the result was the additional diversion away from the SPB gateway of nearly 400,000 twenty-foot equivalent units (TEUs) per year, or 2.9% of the gateway's expected throughput.

Importantly, at this time the Ports cannot predict the increase to the route cost differential as a result of the CAAP strategies. More study is needed. Historically, increases in route costs through San Pedro Bay – including those as a result of environmental initiatives – have had limited impact on market share. It is uncertain whether this trend will continue given the projected magnitude of the CAAP 2017 implementation costs and the expected financial impacts.

V. WORKFORCE EFFECTS

The Ports assessed possible effects on jobs as a result of the CAAP 2017 strategies, considering potential job changes tied to market share; possible “green” job increases as a result of increased investment in cleaner equipment; and possible job increases as a result of construction activity necessary to build the supporting infrastructure for cleaner equipment.

Port-Related Jobs

The SPB Ports are a major generator of jobs in the region. The Port of Long Beach generates about 1 in 8 jobs in the City of Long Beach, and the Port of Los Angeles generates about 1 in 14 jobs in the City of Los Angeles. Together, the Ports support 1 million jobs in California and 2.8 million jobs nationwide. These jobs include longshore labor, freight forwarding and logistics, and other transportation-related sectors.

The Ports have estimated the number of regional jobs linked to container throughput, specifically, to twenty-foot equivalent (TEU) containers. Although different types of container moves support different levels of employment in the region, it is estimated that, on average 1,000 TEUs of Port throughput supports between 18 to 27 jobs in the region.⁶

The direct effects of CAAP implementation would not be expected to have significant immediate job impacts; however, meaningful cargo diversion resulting from the increased CAAP-related costs would be expected to have a negative impact on those jobs. Direct jobs such as longshoreman, truckers, and warehouse and logistics operators would likely be directly impacted by cargo loss. Indirectly, companies supporting the goods movement industry (fuel suppliers, maintenance, and financial firms among others) would be impacted. Finally, the spending and consumption of employees in the Port and transportation

⁵ Mercator International, et al., July 2016.

⁶ Port of Long Beach. “Pier S Marine Terminal + Back Channel Improvements Project Final Environmental Impact Report,” November 2012.

system support jobs and business activity in all sectors of the economy, which would also be at risk from lost activity at the Ports.

“Green” Jobs

Implementing the CAAP 2017 strategies will require significant investment in cleaner equipment and technologies over the next 10 years, including the potential purchase of thousands of new trucks and pieces of terminal equipment and new emission-control capture systems for ships at berth. The Ports investigated whether this investment could spur new local and regional “green” jobs associated with the development, manufacturing, sale and operation of this cleaner equipment. The answer depends highly on where the work will occur.

Increased demand for new equipment and vehicles is likely to provide benefits for the manufacturing sector. Unless that equipment is manufactured within the region, however, it is unlikely the new jobs will be created here. Given the present manufacturing locations of these equipment and vehicle providers, the jobs will accrue to the places where the new equipment is manufactured, likely out of state and possibly out of the country.

Equipment retrofits are more likely to generate local and regional jobs as they require on-site labor. Examples of such work includes repowering rubber-tired gantry cranes to electric. Also, the manufacturing of at-berth emission-control systems is likely to occur in or near the Ports as these systems may be integrated into a terminal or require waterway access for barge-based systems.

Some technologies may require on-site operational labor. For example, the at-berth ship emission-control systems currently in use require 2 to 3 employees to operate the system during a ship’s stay as well as support staff for scheduling, invoicing, and maintenance. It is unclear whether future emission control systems would operate under a similar model; however, if they do, the Ports could see some additional local jobs.

Overall, the bulk of investment for implementing the CAAP 2017 strategies will go toward new equipment. As stated previously, the purchase of new equipment is unlikely to generate significant new jobs locally or regionally because the manufacturing is expected to occur outside of the Region. Thus, it is unlikely that implementing the CAAP 2017 strategies will result in significant job generation from manufacturing in the local or regional economy. Regional sales support and the delivery and deployment of new equipment would support local jobs, but that would represent a small percentage of the overall equipment spending. Further analysis of the manufacturing location for new equipment and the regional spending associated with its delivery would be needed to quantify this impact.

Construction Jobs

The Ports have estimated the need for more than \$2 billion in new infrastructure to support the transition to zero-emissions terminal equipment, primarily electrical infrastructure – new substations, transformers, and conduit. Additionally, the Ports have identified more than \$1 billion in infrastructure projects to support on-dock rail.

These projects would generate local temporary jobs during construction.

Historically, the Ports have estimated 10 regional jobs (direct, indirect, and induced) are supported for every \$1 million in annual infrastructure spending. Thus, infrastructure spending associated with CAAP 2017 implementation could support roughly 32,000 new temporary regional jobs as outlined in Table 2.

Table 2: Projected Construction-Related Jobs Attributed to CAAP 2017

	Projected Spending	Construction-Related Jobs Supported
Terminal Infrastructure	\$2,164,974,300	21,650
On-Dock Rail	\$1,045,500,000	10,455
Total	\$3,210,474,300	32,105

The spending in infrastructure improvements would be expected to have beneficial regional economic impacts in line with typical Port infrastructure projects.

Other Workforce Considerations

New technologies and equipment may require a different skill set. For example, terminals will need workers to maintain battery-electric or fuel cell equipment and to understand the operations of electric charging or hydrogen fueling.

These new requirements, however, do not necessarily translate to more jobs. Importantly, the Ports have assumed that each piece of equipment or vehicle would be replaced one-for-one with a near-zero emissions or zero-emissions piece of equipment. More likely, the existing workforce will acquire the necessary skills to operate and maintain this equipment as has been the case during previous introductions of new technologies, such as shore power and diesel engine retrofits. This shift would not require additional labor, only different skills for that labor.

A more highly skilled workforce could result in more highly paid workers, which would impose additional costs on employers but generate positive economic effects for the workers. To support the CAAP, the Ports have proposed expanding upon their workforce development initiatives and partnerships with local colleges and trade unions. Support for workforce development programs can help ensure that today's workers are equipped to manage the transition to new technologies with few to no job losses.

VI. PUBLIC HEALTH BENEFITS

The costs associated with implementing CAAP 2017 are significant and could have impacts on the SPBP's market share and jobs. Yet there is also a cost with not reducing air emissions, namely, the public health costs associated with air pollution. CAAP 2017 aggressively targets reductions of nitrogen oxides (NO_x), sulfur oxides (SO_x), particulate matter (PM), and greenhouse gases (GHGs) due to Port operations. These

reductions are expected to provide environmental, health, and monetary benefits to the local community, which is disproportionately impacted by Port operations.

Health Effects from Air Pollution

Numerous studies have established the link between air pollution and various health impacts.⁷ These impacts, in turn, have economic consequences in terms of lost productivity and missed work days. The South Coast Air Quality Management District (SCAQMD) identified the following impacts associated with poor air quality in Los Angeles County in its Final Socioeconomic Report for the 2016 Air Quality Management Plan (2016 AQMP)⁸:

- Air pollution is linked to increased mortality
- Air pollution is linked to asthma-related emergency department visits, hospital admissions related to asthma, cardiovascular, or respiratory conditions, lost work days and school absences
- Air pollution reduces visibility and causes damage to agriculture, local ecology, buildings and other materials

The State also has identified health impacts associated with freight emissions. In Appendix G of the Sustainable Freight Action Plan, the State reported that in 2012, statewide freight emissions were associated with 2,200 premature deaths, 330 hospitalizations for respiratory and cardiovascular ailments, and 950 emergency room visits for respiratory and cardiovascular ailments.⁹ By 2050, the State's clean-air efforts are expected to cut those numbers in half.¹⁰ Although these numbers represent impacts from the statewide freight system, the Port of Long Beach and Port of Los Angeles undoubtedly contribute to these adverse health effects. Many communities surrounding the Ports have asthma rates higher than the county average, as described in the Draft Final Clean Air Action Plan 2017 Update.

Economic Impacts of Air Pollution

These pollution-related health impacts have economic costs in the form of premature death, hospitalizations, health care, and lost work productivity. The State calculated that health effects associated with freight-related air pollution amount to roughly \$20 billion.¹¹ This cost is expected to decline to \$9 billion in 2030 and then rise slightly to \$10 billion in 2050.

Thus, emission-reduction strategies, such as those in the CAAP 2017, have economic benefits. The State has estimated the economic value of avoiding freight-related health impacts as the following:

- Today, savings of \$16 billion to \$24 billion
- In 2030, savings of \$7 billion to \$11 billion

⁷ The Clean Air Act and the Economy, Environmental Protection Agency. <https://www.epa.gov/clean-air-act-overview/clean-air-act-and-economy>

⁸ http://www.aqmd.gov/docs/default-source/clean-air-plans/socioeconomic-analysis/final/sociofinal_030817.pdf?sfvrsn=2

⁹ Sustainable Freight Action Plan, Appendix G. 2016. State of California. http://www.casustainablefreight.org/documents/PlanElements/AppendixG_FINAL_07272016.pdf

¹⁰ Ibid.

¹¹ Ibid.

- In 2050, savings of \$7 billion to \$12 billion¹²

The EPA has provided additional estimates of cost-savings by looking at dollars saved per reduction in health outcome; avoidance of one heart attack saves about \$100,000 and one asthma attack saves around \$50.¹³ For each sector, Table 3 shows benefits per ton of emissions reduced per year in 2016 at a 3% discount rate. These numbers originate from the BenMAP model, used by the EPA to perform cost-benefit analyses of environmental regulations/policies.⁵

Table 3: Summary of the Total Dollar Value (Mortality and Morbidity) Per Ton of Pollution¹⁴

Sector	PM _{2.5}	SO ₂	NO _x
Aircraft, locomotives, and marine vessels	\$240,000; ^A \$530,000 ^B	\$85,000; \$190,000	\$6,900; \$16,000
Non-road mobile sources	\$300,000; \$690,000	\$43,000; \$97,000	\$6,600; \$15,000
Ocean-going vessels	\$45,000; \$100,000	\$12,000; \$26,000	\$1,800; \$4,200
On-road mobile sources	\$360,000; \$810,000	\$19,000; \$43,000	\$7,300; \$17,000
<i>Dollar amounts represent mortality and morbidity cost savings related to directly emitted PM_{2.5} and PM_{2.5} precursors reduced by sector in 2016 (in 2010 dollars at a 3% discount rate).</i>			
^A Krewski et al. (2009) mortality estimate ^B Lepeule et al. (2012) mortality estimate			

Economic Health Benefits of CAAP 2017

Determining the monetary value of the health benefits achieved by the CAAP 2017 is difficult. Addressing the difficulty of calculating such benefits in dollars, AQMD stated: “A full assessment of public health benefits in dollar terms is not possible until further advances occur in human health sciences, physical science, and economic disciplines that will allow monetary estimates to be made for currently unquantifiable areas.”¹⁵

For the same reason, the Port has not attempted to monetize the public health benefits of the CAAP although it is clear that CAAP strategies will result in significant health cost savings.

Moreover, the primary beneficiaries of these reductions are the disadvantaged communities surrounding the Ports, as these communities experience the greatest per-capita public health benefit from the emission reduction strategies in the South Coast Basin,¹⁶ of which the Ports are a part.

¹² Ibid.

¹³ <http://www.airqualitylekgotla.co.za/assets/day-3-1.5-lamson-presentation-south-africa-final.pdf>

¹⁴ <https://www.epa.gov/sites/production/files/2014-10/documents/sourceapportionmentbpttsd.pdf>

¹⁵ AQMP

¹⁶ AQMP

Public health benefits, however, could be offset by workforce effects. The Ports provide local jobs which give workers livable wages, health insurance, and a sense of identity and purpose. The potential loss of jobs due to diversion could have significant public health ramifications for the people who lose their employment.

According to the Centers for Diseases Control and Prevention, there is a well-established correlation between unemployment and reduced health outcomes, including poor physical and mental health. Annual illness rates and risk of death are higher among the unemployed, and illness can further reduce the likelihood of obtaining and maintaining new employment, worsening the socioeconomic situation of the unemployed. Unemployed adults also are less likely to receive medical prescriptions and medical care due to the costs than employed adults, even if they have insurance.¹⁷

VII. OTHER CONSIDERATIONS

The costs associated with the transition to cleaner equipment to support the CAAP and impending State regulations are unprecedented, and as described in the previous sections, are expected to have significant financial impacts for the Ports and related industries. The Ports, however, also are proposing CAAP strategies and supportive efforts that could mitigate these impacts, specifically freight efficiency strategies and funding advocacy.

Freight Efficiency Strategies

In support of the State's Sustainable Freight Action Plan, which includes efficiency as a major goal, the Ports have committed to a number of efficiency-related strategies in the CAAP. Improved efficiency – defined by the State as increasing the value of the goods movement sector in relation to air emissions – could help offset the costs of cleaner equipment. The Ports plan to study ways to improve efficiency, such as off-dock chassis facilities, off-dock container staging yards, and short-haul rail. If the Ports can keep emissions low but increase cargo throughput, the entire supply chain could see economic benefits. These benefits, in turn, make the investment in cleaner equipment more feasible.

For example, the Ports have proposed establishing a universal appointment system for trucks. Such a system could reduce the time it takes for a truck to get in and out of a terminal and allow the trucker to better coordinate dual transactions (dropping off a container and picking up a container in the same visit), thus allowing the trucker to make more visits in a day and make more money. Over time, the added revenue would help offset the cost of a cleaner truck.

It is not yet known if efficiency strategies will produce economic benefits and to what extent; however, it is possible that greater efficiency could mitigate the financial impacts associated with the cleaner equipment.

Funding Advocacy

Efficiency alone cannot offset the substantial costs of transitioning to zero emissions, and no sector of the supply chain can absorb these costs. Thus, the Ports have proposed an aggressive funding advocacy effort

¹⁷ 2009-2010 National Health Interview Survey

to obtain grants and subsidies for cleaner equipment. Public funds to help offset the costs of cleaner vehicles and equipment would mitigate the financial impacts on the private sector, reducing the likelihood of diversion to other ports and of regional job losses.

The extent to which public funds may help mitigate these financial impacts is dependent on the amount of available funding and the amount of private match required.

VIII. FURTHER STUDY

This document has raised economic and workforce considerations for decision-makers and stakeholders as they evaluate the potential impacts of implementing the CAAP. It is not intended to be a comprehensive study or quantified analysis. To better understand the impacts, the Ports must conduct more detailed analyses once there is more information about how certain measures are implemented, how they may be financed, and what the overall costs will ultimately be.