Electric Vehicle Accelerator Plan for the Port of Hueneme

July 5, 2019

Prepared by Ventura County Regional Energy Alliance, Community Environmental Council, and EV Alliance

Funded by the EV Ready Communities Challenge Grant from the California Energy Commission

Contents

Introduction

Governor Brown's Executive Order B-32-15 revealed a strong vision for a more sustainable goods movement system and mandated the development of the California Sustainable Freight Action Plan.[1] The plan addressed how the goods movement industry could support California's goal to reduce greenhouse gas (GHG) emissions 40 percent below 1990 levels by 2030, while maintaining economic competitiveness. Given the 'hub' nature of freight terminals, focusing on terminals as a mechanism to drive goods movement sustainability creates both significant climate impacts as well as local air quality improvements.

The largest goods movement hub in the County of Ventura is the Port of Hueneme (Port). Port sustainability initiatives have the ability to both reduce climate impacts and benefit underserved communities. Statewide, freight equipment produces approximately half of asthma-causing particulate matter (PM) emissions and 45 percent of nitrogen oxide emissions.[2] While is important to note that smaller ports such as Hueneme make up a small portion of state emissions (e.g. the Port of Hueneme is projected by CARB to emit only five percent of the NOx in 2021 of that emitted by the Port of Los Angeles/Long Beach complex[3]), these tend to disproportionately impact communities adjacent to goods-movement hubs, which are often already economically marginalized. In fact, Ventura County's largest CalEnviroScreen 3.0 designated Disadvantaged Communities are located adjacent to and north of the Port of Hueneme. A strong push to electrify and reduce local emissions can have significant effects on the public health of such communities.

As the County's fourth largest employer, the Port of Hueneme plays a major role in the region's economic activity, and any sustainability initiatives must take port competitiveness into account. The Port has already moved forward with many sustainability initiatives, including several shore power installations and an electrification master plan. To further strengthen the Port's dual focus on sustainability and economic competitiveness, this Electric Vehicle (EV) Acceleration Plan explores areas that have not been the focus of previous initiatives. These take two forms:

- **Drayage and Heavy-Duty Truck Transport:** What are the potential economic and climate impacts of transitioning to electrified drayage and heavy-duty trucks for Port-adjacent goods-movement activity?
- **Off-port warehouses and facilities**: What are the potential economic and emissions reduction opportunities for off-port warehouses and facilities to transition to local generation and electrification?

Both elements will examine details of particular operators at the Port of Hueneme, as well as previous research on Port impacts. From there, the project team will estimate the Port-wide impact of applying these measures across similar Port operations. This plan should complement the Port's already extensive sustainability work.

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[1] For the full text of Executive Order B-32-15, please see: http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/Documents/CSFAP_AppendixA_FINAL_07272016.pdf

[2] California Sustainable Freight Action Plan, 2016, page 6. Available online at: http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/Documents/CSFAP_Mainpercent20Document_FINAL_07272016.pdf

[3] Draft at Berth Emissions Estimates, 2018. Available online at: https://www.arb.ca.gov/ports/shorepower/shorepower.htm

Furthermore, coalitions of entities that can present integrated projects to address systematic challenges that drive both operational inefficiencies and unnecessary GHG emissions can be very successful in gaining both project funding and stakeholder support. Evidence is in the Port of Hueneme's success with the Zero- and Near Zero-Emission Freight Facilities Project (ZANZEFF) project (further discussed below). By highlighting savings opportunities in Port-adjacent activities that are often overlooked, this Plan seeks to foster collaborative approaches with operators and tenants to further the Port of Hueneme's sustainability mission. Key recommendations to emerge from this Plan include:

Local Drayage and Goods Movement

- Once the results from the Emissions Study are released, develop clear targets for reducing this segment of emissions
- Target the dirtiest vehicles to harvest the most immediate emissions reduction and enable local compliance
- Explore battery financing and other innovative business models to reduce the upfront costs of EVs and enable drayage operators to capture operating savings
- Collaborate with drayage providers with exclusive contracts with ships to ensure awareness of EV opportunities as heavy-duty vehicles become commercialized

Off-Port Facilities

Port of Hueneme

The Port is owned and operated by the Oxnard Harbor District, as a special district of the State of California. The Port, located in the City of Port Hueneme, in Southern Ventura County, is the only deep-water port between Los Angeles and San Francisco, and plays a crucial role in both the economies of Ventura County and of California as a whole. The Port is responsible for $1.5 billion of economic activity, and supports over 13,633 direct, indirect, induced and influenced jobs in the area.[4] The Port specializes in transport of automobiles and fresh produce, with a location that allows easy connections to both the California highway system and rail networks. In the fiscal year of 2018, the Port processed 1.6 million tons of cargo from over 350 ocean-going vessels. Recognizing the benefits of reducing air pollutants for both the local community and California, the Port has developed many initiatives to integrate sustainability, including several efforts to electrify.

2014 Shoreside Power Investment

In 2014, the Port received $4.5 million from the California Air Resources Board (CARB) and an additional $250,000 of funding from the Ventura County Air Pollution Control District (APCD) to install a shoreside power system (also known as 'cold ironing'). Shoreside power systems allow docked ships to plug into the electrical grid to power their at-berth operations, instead of relying on their marine fuel powered main engines. Ventura County APCD has stated that the Port's shoreside power system is estimated to have caused the largest single air pollution improvement in the South Oxnard/City of Port Hueneme area.

Despite occasionally having extra capacity, the Port is required by the California Public Utilities Commission (CPUC) contract to use the shoreside power system's extensive electrical infrastructure exclusively for powering vessels. In 2017, as part of its efforts in increase the adoption of emissions

[4] 2018 Port of Hueneme Comprehensive Annual Financial Report. Available online at: https://www.portofhueneme.org/wp-content/uploads/2019/01/FY-2018-CAFR-Oxnard-Harbor-District.pdf

reducing technology, the Port began to explore additional electrification measures for providing power to future zero and near zero cargo handling equipment. This effort would require substantial investments in both equipment and power distribution infrastructure including new capacity upgrades and infrastructure installations. These were developed through a separate CARB-sponsored project, the ZANZEFF Project.

Zero- and Near Zero-Emission Freight Facilities Project

In 2018, the Port, in collaboration with the Port of Los Angeles, Shell, Toyota, and Kenworth, received a grant as part of the CARB ZANZEFF Project. The primary focus of this project for the Port is the addition of $3 million of electrical infrastructure and cargo handling equipment investment on the Port's south wharf. This electrical capacity and infrastructure is designed to usher in a "new era of zero and near-zero emission cargo movement at the Port,"[5] and includes transformers, switch gear and plugs for the installation and utilization of future electric cargo handling equipment.

The ZANZEFF Project not only funds significant electrical infrastructure improvements needed to power goods movement technology with electricity, but it also includes the first vehicles scheduled to use this equipment. In 2020, as part of the ZANZEFF Project, the Port will receive its first two electric yard tractors for on-port cargo operations. These will be joined by a hydrogen fuel-cell big-rig truck, utilized in conjunction with Mission Produce to transport avocados to and from Hueneme to local warehouses and the Port of Los Angeles (Mission Produce's fuel-cell truck, and additional sustainability efforts, will be discussed later in this document).

Other Sustainability Efforts

The Port is involved in many other sustainability efforts. A major one currently underway is the development of an Electrical Master Plan. The Electrical Master Plan is exploring a wide variety of approaches to Port electrification, including electric gantry cranes, electric utility tractor rigs (UTRs), battery storage, solar photovoltaic (PV) installation, micro-grids and a number of other technologies. The Port is working closely with their electricity utility, Southern California Edison (SCE) on the capacity and service implications of these changes on regional distribution infrastructure. The Port and SCE are collaborating to examine several scenarios to understand the implications of different timelines and potential power loads on distribution infrastructure capacity requirements. The Port will also begin working with SCE's Charge Ready program to make possible future investments in additional infrastructure and to conduct site assessments for additional vehicle chargers.

The Port is making several other independent pushes for emissions reduction and air quality monitoring. The Port is working with third parties to conduct an extensive emissions inventory, scheduled for completion in third quarter of 2019. The emissions inventory should provide clarity on exactly which pollutants come from which arena of Port operations, and should support regional air quality planning efforts. Similarly, the Port is investing $150,000 to install the first Environmental Protection Agency (EPA) reference grade air quality monitor adjacent to the Port. This monitor will be the first and only reference grade air quality monitor in Oxnard south of Highway 101. Data from this monitor will be used by Ventura County ACPD and other relevant parties and will be available to the public as well.

[5] *Application for the Zero-Emission Freight "Shore-to-Shore" Project*. July 2018, Presented by the Port of Los Angeles, page 6.

Additionally, the Port recently installed public facing EV chargers at two different Port locations, which have reported quite high utilization rates. At least one Port employee credits access to the EV charging stations as the primary reason they purchased an EV.

As the Port is currently undergoing extensive electrification planning and emissions analyses on many fronts, the project team needed to identify complementary areas of focus for this EV Acceleration Plan that would not duplicate pre-existing efforts. After extensive discussions with the Port, the project team identified two areas in which an electrification analysis could further support pre-existing efforts. These are an analysis of drayage and heavy-duty goods movement vehicles in the South Oxnard/City of Port Hueneme area, as well as electrification potential for off-port facilities.

Drayage and truck traffic

Heavy-duty trucks used for goods movement between the Port and nearby warehouses and other facilities are known as 'drayage' vehicles. Drayage vehicles associated with Port of Hueneme operations, in addition to heavy-duty trucks transporting goods from the Port through the Cities of Port Hueneme and Oxnard en-route to other destinations, create a major air pollution impact in the local vicinity. In this section of the plan, the project team examines this impact, and potential of transitioning both long-haul big-rigs and drayage vehicles to electric. To accomplish this, the project team estimated the total number of vehicles entering and leaving the Port, the mileage traveled within the relevant area, and the impact both of utilizing conventional diesel as well as converting to electric.

Estimating Truck Traffic

In 2008, the Port collaborated with IBI Group and the Southern California Association of Governments to compile the *Cities of Port Hueneme/Oxnard Truck Traffic Report*. The study examined truck traffic in the area, with a focus on traffic origination from both the Port and the Naval Base. The focus of the Report is understanding truck routes, impacts on local traffic, and intersections that need expansion; however, the vehicle volume and route data provide insight into the potential impact of electrification. The Truck Traffic study concentrated on the City of Port Hueneme as well as the adjoining area of the City of Oxnard south of Highway 101, as can be seen in the map below.

Region Examined in 2008 Truck Traffic Analysis

Source: *Cities of Port Hueneme/Oxnard Truck Traffic Study.* Prepared for Southern California Association of Governments by IBI Group, June 5, 2008.

For the purpose of this analysis, the project team examined a similar boundary. As all the trucks arriving and leaving the Port are either staying within Ventura County or moving beyond, this plan examines two routes: a common route from the Port to warehousing facilities, and the most common route from the Port to Highway 101.

Route Traveled to Access 101 Highway from Port

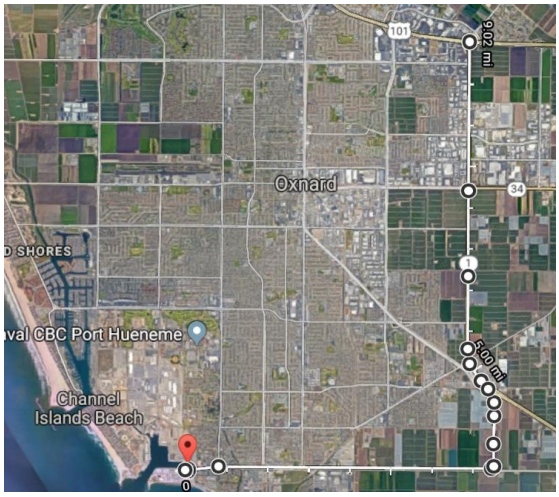
Route	Percentage of Total	Trucks
Hueneme Road to Rice Avenue	72.8%	786
Ventura Road to Channel Island Boulevard to Victoria Avenue	13.7%	148
Ventura Road to Gonzales Road to Oxnard Boulevard	3.5%	38
Other	17.8%	192
Responses Received		1,080
Declined to State/Not Available		165

Source: *Cities of Port Hueneme/Oxnard Truck Traffic Study.* Prepared for Southern California Association of Governments by IBI Group, June 5, 2008. Page 41.

The Truck Traffic study surveyed trucks entering and leaving the Port about the route taken to or from Highway 101. Almost three quarters of truck traffic entering and leaving the Port accesses Highway 101 by Hueneme Road, followed by Rice Avenue/Pacific Coast Highway. When mapped out, this distance

measures approximately nine miles one way. For the purposes of this analysis, the project team will use this distance to approximate truck travel to and from the Port to Highway 101.

Most Common Route to/from Highway 101



For vehicles remaining within the County of Ventura, many travel to and from the Port and nearby warehousing facilities. One example was provided by project partner, Anacapa Fresh. Anacapa Fresh's vehicles travel from the Port to their facilities at 771 Mountain View Avenue, in Oxnard. Their five-mile route is similar to many drayage routes in the area. In order to approximate the impact of drayage traffic in the area, the project team uses Anacapa Fresh's route as a proxy for heavy duty traffic that remains within the County of Ventura.

Common Route between Port and Local Warehousing Facilities

From there, the project team estimated the total quantity of heavy-duty trucks entering and leaving the Port each day, as well as the portion of vehicles with origins and destinations within the County of Ventura, compared to the portion traveling outside of the county.

Early 2000s Truck Volumes from Truck Traffic Study

Month	2003		2004		2005		2006		2007	
	Trucks	Autos	Trucks	Autos	Trucks	Autos	Trucks	Autos	Trucks	Autos
January	184	*619*	124	*340*	122	*305*	163	*398*	147	*449*
February	201	*615*	121	*412*	137	*281*	148	*424*	148	*424*
March	197	*639*	131	*401*	137	*287*	148	*394*	139	*414*
April	206	*556*	106	*381*	161	*363*	157	*442*	146	*463*
May	147	*474*	110	*463*	163	*369*	131	*414*	145	*437*
June	163	*526*	127	*398*	137	*391*	118	*430*	130	*367*
July	130	*442*	148	*376*	116	*352*	140	*415*	119	*364*
August	88	*331*	83	*287*	137	*391*	143	*431*	114	*360*
September	81	*85*	76	*278*	116	*352*	117	*412*	109	*309*
October	102	*331*	110	*432*	128	*447*	127	*420*	118	*334*
November	119	*257*	149	*408*	138	*362*	132	*412*	154	*337*
December	113	*471*	136	*345*	122	*305*	145	*391*	130	*290*
Average Annual Daily ENTERING Trips	144	*445*	118	*377*	134	*350*	139	*415*	125	*379*
Average Annual Daily Truck Trips (ENTER and EXIT)	**288**		**236**		**268**		**278**		**250**	

Source: *Cities of Port Hueneme/Oxnard Truck Traffic Study.* Prepared for Southern California Association of Governments by IBI Group, June 5, 2008. Page 36.

The 2008 Truck Traffic Study analyzed truck traffic volumes leaving and entering the Port from 2003 to 2007, and found that though there was significant monthly variation, truck traffic volume remained fairly consistent on an annual basis over the time period of study, averaging around 264 trips over the five-year study period. According to a 2017 truck count by Port staff, this volume has remained relatively constant since the 2008 study. Recent counts on weekdays have averaged 295 trucks entering and leaving the Port. When averaged to include limited traffic on weekends, Port staff have counted 221 trucks per day.[6] For the purpose of this analysis, the project team will utilize 221 trucks per day as an estimate of daily truck traffic to and from the Port.

Origins and Destinations of Trucks at the Port – 2008 Truck Traffic Study

	Origins	Destinations
Within Ventura County	48.0percent	21.2percent
Outside of Ventura County	52.0percent	78.8percent

Source: *Cities of Port Hueneme/Oxnard Truck Traffic Study.* Prepared for Southern California Association of Governments by IBI Group, June 5, 2008. Page 40.

[6] From a conversation with Giles Pettifor, Port Environmental Manager, on April 9th, 2019.

The 2008 Truck Traffic Study also analyzed the origins and destinations of trucks entering and leaving the Port. In 2008, the study found that 48 percent of vehicles originate from within the County of Ventura, and 52 percent originate from outside of the county. 78.8 percent of trucks were headed to a destination outside of the County of Ventura upon departure from the Port, while 21.2 percent were remaining within the county. Since no comparable data has been collected since the 2008 truck study, the project team will use these percentages to estimate the origins and destinations of trucks entering and leaving the Port today.

Impact of Drayage and Truck Traffic South of 101

To examine the impact of truck traffic entering and leaving the Port on the City of Port Hueneme and the area of the City of Oxnard south of Highway 101, the project team used the assumptions described above about daily truck traffic and combined them with CARB emissions factors. These emissions factors assume all vehicles have undergone the retrofits mandated by CARB's 2008 Statewide Bus and Truck Rule and Heavy-Duty Vehicle GHG Emission Reduction measure. As the Department of Motor Vehicles will not renew registrations for vehicles not emissions-compliant by 2020, this assumption seems both conservative and realistic.

Grams per-mile Emissions Factors – Class 8

	ROG	CO	Nox	PM2.5
2012-2014	0.1	0.6	2.8	0.006
2015+	0.1	0.5	1.2	0.003
Average	0.1	0.55	2	0.0045

Source: https://www.arb.ca.gov/planning/tsaq/eval/evaltables.pdf

The project team then compiled the assumptions described above about portion of traffic originating from and departing to areas within Ventura County and areas beyond it, route length approximations for vehicles going to Highway 101 and to local warehouses, and finally, the number of heavy-duty trucks entering and leaving the Port each day. From these assumptions, the project team calculated the total mileages of Port-related truck travel within the City of Port Hueneme and South Oxnard (south of 101). In total, we estimated that trucks travel approximately 3,366 miles per day in the study area. This daily travel is equivalent to one truck traveling from the Port to Kansas City, Missouri, and back to the Port.

Total Port-related Truck Mileage in Study Area per Day

	Per Trip Mileage Approximation	Total Miles per Category		Total Miles
		Arriving at Port	Departing Port	
County of Ventura	5	530	234	**765**
101	9	1,034	1,567	**2,602**
Total		1,565	1,802	**3,366**

After calculating the total daily truck mileage within the study area, the project team multiplied the total mileage by the heavy-duty truck emissions factors identified by CARB to understand the impact of heavy-duty truck and drayage traffic in the area surrounding the Port.

Total Local Air Pollution Impact per Day

	ROG	CO	NOx	PM2.5
Average grams per mile	0.1	0.55	2	0.0045
Total grams for 3,366 miles	336.6	1,851.5	6,733	15.1

In total, traffic in the study area creates 336.6 grams of Reactive Organic Gases (ROG), 1,851.5 grams of CO, 6,733 grams of Nitrogen Oxide (NOx), and 15.1 grams of Particulate Matter – 2.5 (PM2.5) per day.

Local Port-related truck traffic also creates a major GHG impact in the area. An average gallon of diesel fuel contains 10.22kg of C02e, or carbon dioxide equivalent.[7] The average fuel economy of a class 8 truck is 5.9 miles per gallon of diesel fuel.[8] Given this, a class 8 truck produces 1.73 kg CO2e per mile. The 3,366 miles of local Port-related truck traffic create 5,831kg or 5.83 MT of CO2e per day.

Total Greenhouse Gas Impact per Day

	Kg CO2e	MTCO2e
Per mile	1.73	.002
Per 3,366 miles	5,831.07	5.83

This daily impact adds up. Over the course of a year, Port-related truck traffic in the area adjacent to the Port drives 2,128.3 metric ton (MT) of CO2e, the equivalent of the annual emissions of 452 passenger cars or 371 homes' electricity use for one year.[9] If just 10 percent of truck traffic was electrified, this would save 213 MT of CO2e per year.

Financial benefits of drayage electrification

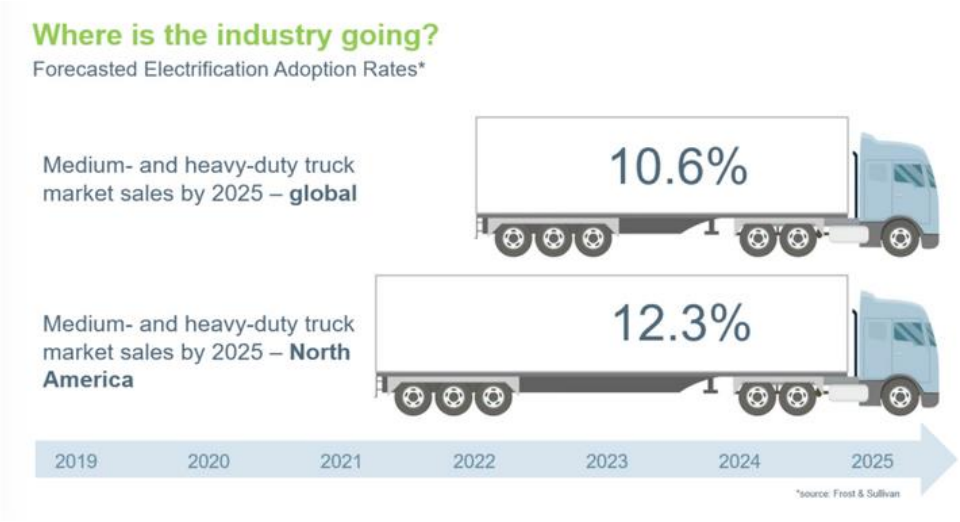
Not only does drayage and regional trucking electrification create climate and local air quality benefits, but it also can create cost savings for operators. As battery costs decline, electric vehicles are becoming more and more cost effective for different sectors of the transportation industry. Drayage, port operations, and regional delivery are no exception. With shorter routes than the long-haul trucking

[7] EPA's Pollution Prevention Program GHG Calculator. Available for download at https://www.epa.gov/sites/production/files/2017-06/p2_ghg_calculator_with_cost_apr-7-2016.xlsm.

[8] Alternative Fuels Data Center, https://afdc.energy.gov/data/10310.

[9] EPA Greenhouse Gas Equivalencies Calculator: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

industry, drayage has been identified as a major opportunity for fleets to realize the financial benefits of heavy duty EVs without end users needing to alter utilization patterns.[10] According to industry sources, they can achieve payback periods of under two years based on fueling and maintenance savings, not including additional funding from Low Carbon Fuel Standard (LCFS) credits.[11]



Electrification of Class 6-8 trucks is expected to grow between now and 2025.

Source: https://www.truckinginfo.com/326160/axletech-focuses-on-electrification-for-commercial-vehicles

As many of these vehicles are pre-commercialization and have only been deployed in pilot scenarios, exact savings estimates are difficult to come by. However, we can look at preliminary data that has been released by Tesla, XOS (formerly Thor Trucks) and BYD. To understand the implications of substituting electric drayage vehicles for diesel, the project team uses data from Anacapa Fresh, a drayage provider for the Port of Hueneme, as an example vehicle duty cycle from which to estimate cost impacts.

Tesla

Tesla, primarily known for popularizing light-duty electric vehicles, has described plans to develop an electric class 8 tractor. While production has been delayed until 2020, this vehicle, if it comes to fruition, should present a compelling alternative to diesel tractors.

[10] Conversation with BYD Trucks Director of Business Development, John Gerra, on March 15, 2019.
[11] Ibid.

Manufacturer	Tesla
Model	Semi
Range	300-500 mi
Horsepower	1000
Availability	2020-21

Tesla has not provided exact specifications for fueling or maintenance cost, but they have provided operating cost per mile estimates. According to Tesla, the vehicle will cost $1.26 per mile to drive, compared with a conventional diesel truck at $1.51 per mile.[12] However, no details behind the cost breakdown have been provided.

	Diesel	Electric
Cost/mile	1.51	1.26
Annual mileage	40,000	
Utilization	5.5 days/week, 52 weeks/year	
Upfront cost	$75K	$150K
Annual operating savings	**~$10K**	
Payback period	**7.5 years**	

If the Tesla vehicle were operated with Anacapa Fresh's duty cycle, payback would be achieved within 7.5 years from operating costs alone. This does not include the potential additional revenues from Low Carbon Fuel Standard Credits, which will be discussed below. It also excludes Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) and other incentives. However, whether Tesla will be able to deliver a semi-truck that delivers the operating savings quoted, at the relatively low upfront cost of $150,000, remains to be determined.

XOS (formerly Thor) Trucks

XOS (formerly Thor) is a heavy-duty vehicle manufacture based in Los Angeles. Their approach differs slightly from both Tesla and BYD as they have primarily partnered with existing manufacturers for parts and components, rather than developing their own supply chain.

[12] https://futurism.com/tesla-semi-priced-150000

Manufacturer	XOS (formerly Thor Trucks)
Model	ET-One
Range	100-300 mi
Horsepower	700
Availability	2019-20

XOS currently plans to release their vehicle commercially in 2019. They quote a similar range price range as Tesla for their vehicle, approximately $150,000-180,000. They do not quote specific per-mile costs compared with conventional vehicles, but instead state that their vehicle will provide 60 percent per-mile maintenance savings and 70 percent per-mile fuel savings.

As XOS does not provide the cost breakdown between maintenance savings and fuel savings, for the purpose of analysis, the project team assumes 70 percent per-mile savings for both fuel and operating and uses the Tesla $1.51 operating cost per mile as a baseline conventional diesel operating cost.

	Diesel	Electric
Cost/mile	1.51	1.06
Annual mileage	40,000	
Utilization	5.5 days/week, 52 weeks/year	
Upfront cost	$75K	$150K
Annual operating savings	**~$18K**	
Payback period	**4.1 years**	

If XOS's claims of 70 percent per-mile costs were accurate, a vehicle used with the average duty cycle of Anacapa Fresh would stand to save $18,000 in operating costs a year. Assuming no incentives, the upfront cost differential would be able to be paid off within 4.1 years. If incentives were available, and if Low Carbon Fuel Standard Credits were captured, this period would shrink even further.

BYD

BYD, a Chinese company with a US division based in California, has also focused their U.S. expansion in the medium- and heavy-duty vehicle space. While they have many E-bus deployments within the state of California, their heavy-duty truck division is earlier in development. Drayage is one of the key markets that BYD has identified for early deployment of their electric trucks. While they have a Class 8-yard tractor

developed for this space, they are also developing a Class 8 tractor-trailer for short-haul operations. With operating savings alone, they expect their customers to experience a two-year payback period. [13]

Manufacturer	BYD
Model	Class 8 Day Cab
Range	124-167 mi
Horsepower	483
Availability	Currently in pilot deployment

Challenges and Opportunities for Drayage Electrification

Stakeholder Agency

Unfortunately, while off-port operators can be very supportive of drayage electrification efforts, the structure of their relationship with ships can limit any opportunities to implement drayage electrification. Many ships contract with a specific drayage provider to manage all their unloading. This drayage provider then delivers directly to off-port warehouses. If a distributor wants goods from a certain ship, they must work with the pre-selected drayage provider. Therefore, the decision-making agency to electrify can rest solely with the drayage provider.

While this is a challenge in that third-party distributors cannot control the local emissions from their drayage, it also presents an opportunity. These drayage 'common carriers' are well positioned to take advantage of the economic benefits of conversion to electric vehicles. A concentrated effort on the behalf of the Port to develop collaborations with third-party drayage providers as more and more of these heavy-duty vehicles become commercialized could result in both significant Port-related emissions reductions and as well as economic benefits for drayage providers.

Upfront capital costs

High upfront capital costs of electric vehicles relative to conventional gasoline, diesel, or CNG vehicles can impede fleet electrification efforts, especially in the heavy-duty sector. The primary source of the price differential between conventional and electric vehicles lies in the battery cost. While battery costs have been declining by approximately seven percent per year, it is projected that because of high battery costs, EVs will remain more expensive than their fossil fueled counterparts at least until the 2020-2025 period. As a result, innovative third-party battery financing arrangements are being developed that enable fleet operators to realize the long-term fueling and maintenance savings of EVs through a monthly payment that takes advantage of existing operating budget structures. This approach can reduce the upfront acquisition cost of heavy-duty EVs to a cost equal to or below that of the equivalent conventional vehicle, while enabling a substantially lower total cost of ownership over the lifetime of the

[13] Conversation with BYD Trucks Director of Business Development, John Gerra, on March 15, 2019

vehicle. In a port context, battery financing can offer drayage operators the potential to reduce their upfront EV acquisition costs, while still owning core drayage assets.

Battery Financing in the E-Bus Market Segment and Applications to Heavy-Duty Trucks

To date, most third-party battery financing has been implemented in the electric bus market segment. Bus manufacturers Proterra and BYD currently have electric bus battery financing programs that offer customers the ability to purchase an electric bus less the cost of the battery, while leasing the battery over time through the securitized vale of avoided fuel and maintenance costs. Key features of both battery leasing programs include:

- 12-year financing terms matched with a battery warranty and flexible leasing terms
- Interest rates ranging from 2.5 percent - 3.8 percent
- Financing options inclusive of mid-life battery replacement
- Positive cashflows that result in lifetime total cost of ownership savings
- Potential second life for battery technology as standalone energy storage capacity

In a battery leasing program context, the manufacturer can extract additional value from the battery through recycling and reuse strategies – and thereby relieve the vehicle owner of uncertainty regarding end-of-life battery values.

Creating similar programs could create significant opportunities for drayage providers at the Port of Hueneme. In particular, discussions with BYD may have potential, as BYD has both a pre-existing battery lease program and port-ready yard tractors and drayage vehicles in pilot deployment. As demonstrated in the E-bus market context, third party capital lease providers are increasingly comfortable with battery technology. The combination of these factors could unleash a new area of opportunity for drayage battery finance.

Highest pollution impact concentrated in dirtiest vehicles

Not all drayage vehicles are created equal. Studies indicate that in the context of California ports, a minority of vehicles are responsible for an oversized share of non-CO2 emissions.[14] As can be seen below, the dirtiest ten percent of vehicles are responsible for 30 percent of total NOx emissions, 65 percent of black carbon emissions, and 80 percent of ultrafine particulate emissions. Fortunately, CARB's drayage vehicle emissions standards should lead to the improvement of most of the dirtiest vehicles by 2020.

Pollutant	Percent of Pollution Created by top 10percent polluting vehicles
NOx	30
Black Carbon	65
Ultrafine Particles	80

Source: Harley, Robert A. On-Road Measurement of Emissions from Heavy-Duty Diesel Trucks: Impacts of Fleet Turnover and ARB's Drayage Truck Regulation.

[14] Harley, Robert A. *On-Road Measurement of Emissions from Heavy-Duty Diesel Trucks: Impacts of Fleet Turnover and ARB's Drayage Truck Regulation*. Prepared for the California Air Resources Board, November 2014. Available online at: https://ww3.arb.ca.gov/research/apr/past/09-340.pdf

This also creates an opportunity for the Port to prioritize vehicle electrification. By targeting the dirtiest of vehicles, the Port can potentially make significant gains in reducing local pollutants and support local compliance with CARB vehicle standards.

Drayage and local goods movement – an opportunity

Off-port local goods movement and drayage operations present a meaningful opportunity to reduce Port-related emissions impact and Port-related local air pollution. Additionally, if heavy-duty trucks are commercialized at the purchase prices and with the savings benefits described by manufacturers, this presents an immediate savings opportunity for many use cases.

The Port of Hueneme has an opportunity to partner with local drayage providers to ensure these measures are executed successfully. The project team recommends that the Port of Hueneme begin by:

- Identify major drayage providers, especially those with exclusive contracts with ships. Begin discussing partnership opportunities to pursue state funding for innovative electric drayage deployments.
- Begin discussions with BYD and other electric truck manufacturers about possibilities to implement a battery financing program to enable fleets to overcome the barrier of high upfront costs and immediately take advantage of operating savings.
- Work with local fleets to understand which vehicles have the biggest emissions impact and collaborate to ensure local fleet compliance with CARB standards and target highest impact vehicle replacements.

Off-port Warehouse Operations

Significant operations tied to the Port of Hueneme actually happen in the area adjacent to the Port, but not on the Port itself. Many operators have drayage providers bring goods and produce from the Port to off-site distribution centers. These goods are then transferred to trucks or rail and continue their journey.

Off-site distribution centers, in particular temperature control facilities designed for produce, present a significant opportunity to simultaneously reduce greenhouse gas emissions impact and create financial savings for distribution center managers. One of the most forward-thinking distribution center operators in the Port of Hueneme area is Mission Produce. This Plan examines the steps that Mission Produce has taken to increase efficiency and sustainability of operations. Finally, this plan examines potential energy cost savings gained by solar PV installations on temperature-controlled facilities that serve the Port of Hueneme.

As this plan only examines operating savings and does not model a full discounted cash flow analysis to compare upfront capital costs against operating savings, it cannot count as an endorsement of solar PV over grid electricity. However, by understanding the operating savings potential of solar PV, distribution center managers have a baseline of savings against which to compare capital costs of project installation.

Case Study: Mission Produce

Mission Produce was founded in Oxnard in 1983 by two avocado growers. Since then, Mission Produce has expanded operations worldwide, with distribution in Europe and Asia, and distribution and production in South and Central America. Mission Produce focuses on distributing ripe avocadoes globally, leveraging seasonal growing conditions in different regions to create a flexible and diverse supply chain.

Avocado Growing Season

This regional growing cycle has logistical implications for Mission Produce's Oxnard facility. During the California growing season, Mission Produce sources avocadoes from Central California and transports them by land to the Port of Los Angeles for export to Central and South America. In California's production off-season, Mission Produce imports avocadoes at the Port of Hueneme, and from there, distributes them across the country.

Mission Produce has pursued a number of innovative opportunities, both in partnership with the Port of Hueneme and independently. These include:

- **On-site Solar Photovoltaic Generation:** When constructing the Oxnard distribution facility, Mission incorporated a 1 MW solar PV system. This fixed system was constructed on-site and

purchased up-front rather than via a power-purchase agreement (PPA). From approximately 11am to 3-4pm, Mission is able to run facility operations entirely from local generation.[15]

Solar PV at Mission's Oxnard Facility

Source: *https://m.andnowuknow.com/bloom/mission-produce-completes-its-2015-seasons-california-and-peru/christofer-oberst/47312*

- **Battery Storage:** Mission has also been pursuing a battery storage installation to support demand management and ultimately lower demand charges. Additionally, as Mission receives fruit at all hours, batteries will enable load shift to off-peak times, and the operation can minimize electricity costs during expensive periods. Battery storage will also allow Mission to store its excess solar PV onsite instead of selling it back to the grid, further reducing their emissions footprint. Instead of lithium-ion batteries, which are commonly used for commercial load regulation, Mission has been exploring vanadium flow batteries. The primary reason for this is the increased discharge rate provided by vanadium flow batteries compared to lithium-ion. This battery project is still in development and would provide an interesting opportunity to develop an integrated project in collaboration with the Port of Hueneme.

- **Zero-Emission Vehicles:** Through the ZANZEFF project, Mission Produce partnered with the Port of Hueneme and Port of Los Angeles to acquire a zero-emission Nikola fuel cell Class 8 tractor-trailor. This vehicle will be used to service two segments of Mission's supply chain in different seasons. In the California production season, the vehicle will transport avocadoes from the distribution center in Oxnard to the Port of Los Angeles for export. In California's production off-season, the vehicle will be used locally to transport from the Port to the Oxnard distribution center.

  In addition to the fuel-cell vehicle, Mission Produce has also installed two workplace EV charging stations on-site in Oxnard. While they are not yet heavily utilized, Mission Produce staff have witnessed a steady increase in their utilization.

[15] Conversation with Mission Produce Senior Project Engineer Freddy Martinez, on April 22nd, 2019.

- **Smart building design and management:** Mission has installed multiple smart building management systems in the Oxnard facility, including LEDs throughout the warehouse facility, a smart lighting system from Digital Lumen, and an energy management system. The building refrigerator envelope has an R value of 32-34 and is Title 24 compliant. Mission is diligent about maintaining a cold chain throughout the building envelope.

- **Ripening gas reuse:** Instead of releasing ripening gas into the atmosphere, Mission reuses it and recycles it in their operations.

Source: Mission Produce website, available at: https://worldsfinestavocados.com/mission-global/our-history

- **Water management:** In the Oxnard facility, Mission has developed a wastewater re-use system. Through this, they have almost eliminated wastewater discharge into the local water system. [16]

Solar Generation for Temperature-Controlled Distribution Centers

One of the major cost centers and source of environmental impact in off-Port temperature-controlled facilities like Mission Produce is electricity use. The Port of Hueneme is served by five off-site distribution centers offering temperature-controlled facilities:

- Mission Produce
- Channel Island Cold Storage
- Seaboard
- Del Norte Distribution
- Lineage Logistics

[16] *Sustainability*. Mission Produce's website, accessed May 5th, 2019 at https://worldsfinestavocados.com/mission-global/sustainability

In total, these sites compose one million square feet of space. Based on conversations with distribution center managers, the project team estimated potential operating savings if on-site solar was installed to allow 75 percentage of electricity usage to be met through self-generation.

As this approach only takes into account operating savings and does not model a full discounted cash flow analysis to compare upfront capital costs, it cannot be interpreted as an evaluation of solar PV compared to grid electricity. However, by understanding the operating savings potential of solar PV, distribution center managers have a baseline of savings against which to compare capital costs of project installation. Additionally, if the upfront costs of system purchase were too high, managers could examine a PPA structure, in which a distribution center purchases the power generated from an on-site system and captures the savings over electricity purchased from the grid but does not have to shoulder the up-front capital costs.

Operating Savings of Solar PV Self-Generation over Grid Electricity

	$ Savings		GHG Savings	
	$/Month	$/Year	MT CO2e /Month	MT CO2e /Year
Savings if all refrigerated centers had similar generation	$261K	$3.1M	478	5,740

Note: Electricity costs based on average California retail electricity price, excluding demand charges. C02e estimates based on average California grid mix. Electricity usage and savings estimates per square foot based on conversations with distribution center managers.

If all centers installed solar PV, they would cumulatively similar sites have the opportunity to save a total of $261,000 per month. Over the course of a year, the cumulative sites have the potential to save over $3 million with on-site self-generation. Additionally, this would lead to a total reduction of 5,740 MT C02e annually, the equivalent of removing 1,219 passenger cars from the road.

Challenges and Opportunities

In low-margin commodity businesses like goods movement, maintaining economic competitiveness is crucial. Unlike consumer-focused brands, goods movement companies have limited ability to gain consumer capital from 'green branding' initiatives that produce sustainability impact alone. As a result, they are constrained to measures that not only have sustainability and local public health impacts, but also low costs. While this may initially seem like a barrier, forward-thinking organizations like Mission Produce demonstrate the abundance of measures that address this 'triple bottom line'. Mission Produce proactively seeks out opportunities to reduce their environmental impact. Due to the nature of the goods movement industry, Mission Produce is constrained to projects that do not create an undue cost burden. However, as can be seen by their multitude of innovative practices, these opportunities are plentiful.

Another challenge that exists for off-Port distribution center operators is that many operators rent buildings. This creates the split agent dilemma often faced in the context of energy efficiency; renters are responsible for operating costs, and owners are responsible for capital costs. Therefore, owners are not incentivized to make capital improvements that would reduce operating costs, and renters are only incentivized to invest when a project's payback period is shorter than their term of lease.

There are a number of ways to overcome this challenge, including contractual collaboration between owners and tenants with accommodations for capital improvements with payback periods that fall outside of that tenant's lease period. These allow tenants to support upfront capital investments and reap the benefits. Another structure worth exploring is MEETS (http://www.meetscoalition.org/how-meets-works/), in which a third party 'energy tenant' is created that both pays the upfront costs of the efficiency measure and harvests the operating savings.

Regardless of the approach, the Port of Hueneme can support local off-Port distribution center operators and facility owners in understanding the savings potential of various efficiency measures and harvesting the benefits.

Funding Opportunities

Many funding opportunities exist through both state agencies and other organizations. The section below presents general strategies through which the Port of Hueneme can present a compelling case for funding opportunities.

- **Regional Framing:** State-level organizations typically respond favorably to integrated regional approaches that involve collaboration rather than competition among key stakeholders and demonstrate maximum engagement of relevant local partners. Similar to the strategy utilized in the ZANZEFF grant, the Port of Hueneme should explore regional partnerships that enable innovative deployments of electric infrastructure.
- **Creation of Ad Hoc Funding Groups:** In addition to exploring funding opportunities independently, the Port can also explore collaborations with tenants to assist in the funding procurement process. Like the Port of San Diego, the Port of Hueneme could encourage the development of a Port Tenants Association, which could cooperate with Port management to obtain emissions reduction funding that would ultimately benefit both management and tenants.
- **Pre-Planning Key Initiatives:** It is advisable to have initiative concepts "ready to hit the ground running" when a GFO is issued in order to have adequate time to refine the proposal (rather than spending weeks in teaming and partnership development processes.)
- **Use of Grant Professionals:** Use of grant firms with a proven track record of success is advisable and can yield a very substantial ROI. (For example, an investment of approximately 30,000 in proposal development could improve the chances of winning a multi-million dollar grant from 50 percent to 95 percent). Sharing the cost of a proposal writer among multiple agencies defrays the cost and can enhance team cohesion and commitment.
- **Disadvantaged Community Outreach:** Many funding opportunities give additional priority to projects located in disadvantaged communities. By continuing to strengthen and develop relationships with key public agencies and community-based organizations working the area surrounding the Port, the Port of Hueneme will be well-positioned to partner with such entities to pursue projects that support both emissions impact reduction and local environmental justice.

California Funding Opportunities

Several Federal and State incentive programs provide funding for EVs and EVSE for which the Port and its tenants are eligible. As Port stakeholders have already experienced, public funds can significantly reduce the otherwise prohibitive cost of procuring and installing first-generation electric fueling infrastructure, vehicles, and equipment. Currently available funding sources for vehicle electrification include but are not limited to:

Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

The California Air Resources Board oversees the HVIP to accelerate the deployment of zero-emission trucks and buses, hybrid trucks and buses, as well as internal combustion engine (ICE) vehicles that meet the low-NOx standard. E-truck HVIP rebates have been constrained by limited supply. However, multiple OEMs are anticipated to begin shipping products in greater volume in 2020, and HVIP incentive utilization for E-trucks is expected to grow substantially. In most cases, these vouchers bring the net purchase price of the electric vehicle to near-parity with the ICE equivalent, though this can differ by market segment.

HVIP - Zero Emission Truck Voucher Amounts (2018-2019)[17]

GVWR (lbs)	Base Vehicle Incentive	
	Outside Disadvantaged Community	In Disadvantaged Community
5,001 – 8,500	$20,000	$25,000
8,501 – 10,000	$25,000	$30,000
10,001 – 14,000	$50,000	$55,000
14,001 – 19,500	$80,000	$90,000
19,501 – 26,000	$90,000	$100,000
26,001 – 33,000	$95,000	$110,000
>33,000	$150,000	$165,000
>33,000 Hydrogen Fuel Cell Truck	$300,000	$315,000

Currently, the allocation of HVIP funding is managed by CalSTART under the auspices of the CARB Air Quality Improvement Program (AQIP.) HVIP funding is awarded on a formula basis to qualified vehicles, based on a first-come, first-served system, with vouchers funded at the prescribed amounts until funding for the relevant fiscal year is exhausted. While funding for HVIP has increased significantly in recent years, its future is not guaranteed, as program funding must compete with other priorities under the state's Greenhouse Gas Reduction Fund (GGRF) programs, which in turn are supported by variable Cap and Trade program proceeds. According to a University of California, Davis study, "in general, the HVIP program is not expected to serve as a reliable, long-term funding source . . . but it is likely the state will continue to provide some form of subsidies for fleet electrification, perhaps in a reduced form."[1]

Given the longer-term uncertainties of HVIP, Port stakeholders are highly encouraged to make use of the current allocation of generous incentives. Additive "Plus up" incentives are also offered through the program, and fleets located within Disadvantaged Communities can qualify for additional incentives support of $5,000-$15,000. Applications are managed through the HVIP website at https://www.californiahvip.org/.

Low Carbon Fuel Standard (LCFS) Credits

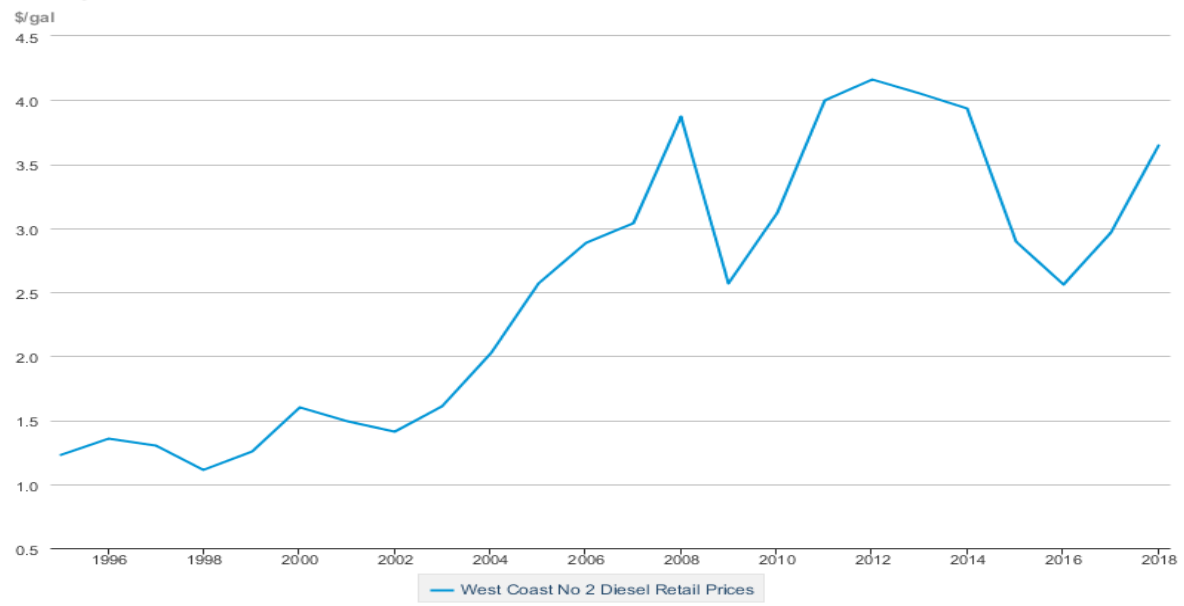
Supported by Cap and Trade Funds, LCFS incentives provide fueling subsidies for zero emission and alternative fuels. In the first three months of 2019, the monthly average for LCFS credit prices ranged from $186 to $190 per MT CO2, which translate into significant savings on electric fueling for organizations

[17] California HVIP. HVIP FY18-19 Funding tables. Retrieved from: https://www.californiahvip.org/wp-content/uploads/2018/11/HVIP-FY18-19-Funding-Tables-11-19-2018.pdf

that claim the credits.[18] The credit values may range outside these boundaries over time, though the increase LCFS values is the expected long-term trend. In a conservative case, a $150 LCFS credit price would amount to a credit of $0.16-$0.18 per kWh consumed for EV charging. Given that the average retail cost for electricity in California is $0.16 per kWh, there is high potential to offset fueling costs with this credit. However, the revenue potential of LCFS capture and sale needs to be worth the administrative costs for tracking credits as well as the installation of a separate meter or submeter.

In the context of the Port, LCFS credits reduce risk exposure to ongoing diesel price volatility and increase the existing efficiency advantage of electric fueling. As shown in the figure below, Diesel prices have fluctuated substantially from 2008 to 2018 -- with lows of approximately $2.60 per gallon and highs of approximately $4.20 per gallon. With future fossil fuel prices notoriously hard to predict, electricity represents a relatively safe harbor from ongoing price volatility.

West Coast Diesel Prices Per Gallon, 1996-2018



eia Source: U.S. Energy Information Administration

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The California Air Resources Board administers credits based on fueling pathways rather than based on individual vehicles. As result, electric fueling of diverse vehicles are eligible for credit-claiming. These include electric and hydrogen powered forklifts, and workplace charging of all types of electric vehicles, including via Level 1, Level 2, and DC Fast Charging stations.[20] CARB currently facilitates applications for LCFS credits through the web-based LCFS Data Management system, which comprises the following three modules:

1. LCFS Reporting Tool (LRT)

[18] California Air Resources Board (CARB) (2018). Proposed Amendments to the Low Carbon Fuel Standard Regulation and Regulation on Commercialization of Alternative Diesel Fuels. Staff Report: Initial Statement of Reasons. March 6, 2018. Available: https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf.

[19] US Energy Information Administration. Weekly Retail and Gasoline Prices. Retrieved from: https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r50_a.htm

[20] CARB. LCFS Basics. Retrieved from: https://www.arb.ca.gov/fuels/lcfs/background/basics.htm

2. Credit Bank and Transfer System (CBTS)
3. Alternative Fuel Portal (AFP)[21]

Guidance documents outlining the LCFS credit-claiming process are available on the ARB website at https://www.arb.ca.gov/fuels/lcfs/guidance/guidance.htm#guidance.

The Carl Moyer Memorial Air Quality Standards Attainment Program

The Carl Moyer Program is a state supported grant program administrated by local air districts that funds incremental costs of engine upgrades, as well as procurement of new all-electric equipment. Since 1998 the program has provided funding focused on replacing older heavy-duty diesels with electric, alternative-fuel, or cleaner diesel technologies.[22]

In Ventura County, the Ventura County APCD evaluates Carl Moyer Program proposals with several other funding opportunities in the Ventura County Combined Clean Air Incentive Program. Qualified projects for the program that could be relevant to the Port of Hueneme include:

- Replacing heavy duty diesel trucks domiciled in a disadvantaged community with new, zero-emission (electric) trucks or trucks powered by low NOx engines certified to a 0.02 g per bhp-hr NOx standard.
- Developing, converting or expanding battery charging/alternative fueling stations.
- Infrastructure projects other than battery charging or alternative fueling stations, such as further expansion of the Port's shore-power system.

The opportunity to submit project proposals for the 2019 Ventura County APCD Ventura County Combined Clean Air Incentive Program concluded on June 12, 2019. Funding is replenished annually, so the project team encourages the Port to continue communications with the Ventura County APCD on potential opportunities.

SCE Charging Infrastructure Programs

Since the 2015 enactment of SB 350, the CPUC has directed the six investor-owned electric utilities in the state to file applications for programs that accelerate widespread transportation electrification.[23] The most relevant of these programs to the Port includes the Medium/Heavy-Duty Infrastructure program of SCE. This program provides $343 Million for EV and EV Service Equipment projects, along with the Pilot Medium and Heavy-Duty Programs - which provides $27.9 Million in funding for projects that may include port equipment electrification. The most recent SCE program, approved in January 2018, will support make-ready installations at a minimum of 870 sites to support the electrification of at least 8,490 medium- or heavy-duty fleet vehicles. The program requirements include:

- A maximum of 10 percent of the infrastructure budget may serve forklifts
- A minimum of 25 percent of the infrastructure budget must serve vehicles operating at ports and warehouses

[21] CARB. LCFS Data Management System. Retrieved from: https://www.arb.ca.gov/fuels/lcfs/reportingtool/datamanagementsystem.htm#lrt-cbts

[22] AQMD. Incentives & Programs: Carl Moyer Memorial Air Quality Standards Attainment Program. Retrieved from: http://www.aqmd.gov/home/programs/business/carl-moyer-memorial-air-quality-standards-attainment-(carl-moyer)-program

[23] CPUC. SB350 Transportation Electrification. Retrieved from: http://www.cpuc.ca.gov/sb350te/

- A minimum of 40percent of the program budget must be located in Disadvantaged Communities
- SCE must offer rebates of up to 50percent of the cost of the EVSE for sites in Disadvantaged Communities and sites that support electric transit and school buses[24]

As mentioned above, the Port has already been collaborating with SCE's fleet charger program. The project team encourages the Port to continue this close collaboration.

Conclusion

The Port of Hueneme is well positioned and ready to lead in greening California's good movement industry. Key sustainability initiatives have been completed or are underway that can be built upon as California makes progress on Governor Brown's Executive Order B-32-15 and California's Sustainable Freight Action Plan.

Two emerging areas with great potential for environmental progress include electrifying drayage and heavy-duty trucks for Port-adjacent goods-movement activity along with transitioning off-port warehouses and facilities to local generation and electrification. This project has identified the potential impact as well as many of the key partners and funding sources that could move these initiatives forward.

The Port of Hueneme should work with partner organizations and companies that serve the Port to develop pilot projects focused on electrifying Port traffic and powering Port-related buildings and vehicles with renewable energy. The Port should then work to share the these pilot projects and lessons learned with the greater Port community and other ports across California and nationwide.

[24] CPUC. (May 31, 2018). Summary of Decision on Transportation Electrification Program Proposals from the Investor-Owned Utilities.

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